Generic Environmental Impact Statement on Animal Agriculture in Minnesota

Final Technical Working Paper

on

Topics D, E & F: Economic Structures, Profitability & External Costs

Submitted to the Minnesota Environmental Quality Board

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Revisions to the Economics TWP Based on Comments Made at the June 12, 2001
Meeting of the GEIS Citizens Advisory Committee

by William F. Lazarus

July 5, 2001

Question: How do you reconcile the comment made that dairy should remain strong in the Midwest, with recent declines in cow numbers in Minnesota?

Response: This is discussed on page III-13. The statement that dairy should remain strong is a prediction from the Purdue materials. Like all predictions, it may or may not prove accurate over time. A footnote was added acknowledging the recent declines, which do appear to be slowing compared to the mid-1990s.

Question: Do the FINBIN swine and dairy enterprise costs and returns discussed on pages V-1-105 to V-1-143 (Tables 25-39) include manure value?

Response: (The following paragraph was added to the discussion of Table 25) The FINBIN swine and other livestock enterprise data probably does not include much if any value for the manure. The issue of valuing manure has not been discussed to any great extent among the instructors and fieldmen, so there is no effort at present to encourage producers to value their manure. There is a place to enter "other income" in the computer program, and it is possible that some producers may enter manure values, but the averages for other income in 2000 ranged from one cent per hundredweight for farrow-to-finish to 19 cents per hundredweight for feeder pig finishing. Nineteen cents represents 0.6 percent of the total $32.40 gross return for that enterprise. If manure is currently under-valued (which we do not know for sure) and its true value were entered, it is unclear how the change would affect the conclusions made in this paper about risk-return tradeoffs and economies of size. A detailed study would be required to arrive at per-unit manure prices based on crop needs or sale possibilities. If an attempt were made to more accurately account for manure value, care would also be needed to accurately account for related manure handling costs.

Question: Explain the definition of the term "economic inefficiency" as it is used in the first paragraph and later in the "Externalities" section from the Encyclopedia of Economics, in the Appendix.

Response: The Encyclopedia of Economics does not include a definition of economic efficiency as a separate topic, but the reprinted "externalities" section does include several citations, including Coase's 1960 article, "The Problem of Social Cost" in the Journal of Law and Economics. Coase's complete explanation is too lengthy to include here, but the basic idea might become clearer by picturing a hypothetical, highly simplified situation where a widget-making firm is causing pollution which damages a neighbor's property. One scenario is that the firm ignores the damage it is causing the neighbor. Its marginal production costs per unit tend to increase if it expands production, so under perfect competition it will maximize its profit where its marginal cost per additional unit equals the price it receives from selling the product. Suppose this profit-maximizing production level is ten widgets/day. If the firm increases or decreases production, the amount of pollution increases or decreases as well.

This is compared to another scenario 2 where (ignoring measurement difficulties) we arrive at a set of dollar amounts that the neighbor is willing to accept in return for putting up with the damage resulting from different amounts of pollution. Suppose that producing eight widgets/day causes no pollution, but the ninth widget causes damage for which the neighbor is willing to accept a payment of $1/day. A production level of ten widgets causes more pollution, so the neighbor would demand an additional $3/day for the additional damage caused at a ten-widget level. Suppose also that the firm's profit is $2/widget on each of the ninth and tenth widgets produced/day. If required to pay $3, the firm will no longer find it profitable to produce the tenth widget/day, so it cuts production to nine/day, pays the neighbor $1/day, and still makes a $1 profit on the ninth widget.

So, in short, the ten-widget production level in scenario 1 is economically inefficient because the neighbor is willing to pay $3 to avoid the pollution of the tenth unit while the firm is only earning $2 in profit by producing it. A (mythical) social planner trying to maximize the sum of the firm's profit and the neighbor's well-being could improve that sum by implementing some sort of policy that reduces production to nine widgets, possibly by requiring the firm to pay as in scenario 2. If faced with the prospect of paying the $3 for damage, the firm is better off by cutting production and losing $2 in profit, while the neighbor is indifferent between receiving the $3 or avoiding the additional damage. Producing the ninth widget and paying $1 in damage is economically efficient from a social perspective, on the other hand, because again the $1 makes the neighbor indifferent to the damage while the firm makes $1 in profit.

Analysis of a real situation typically involves other issues that are beyond the scope of this brief explanation. One issue that Coase discusses is how the outcome would differ if 1) the firm is granted a "right to pollute" and has to be bribed by the neighbor to cut back, versus 2) where the neighbor is granted a "right to avoid pollution" and has to be bribed by the firm to accept the pollution. One source for further information is a book edited by Bruce A. Ackerman, Economic Foundations of Property Law. Boston: 1975, published by Little, Brown and Company. It contains a reprint of the Coase article and a number of related papers.

Question: Why wasn't government policy included in the list of four over-riding forces mentioned in the "Forces" section of the presentation: information technologies, globalization, tightly coordinated supply chains, and public skepticism? Promotional activities aimed at large farms was mentioned specifically.

Response: Government policy is very important, and is mentioned in the paper. It was not mentioned in the talk as one of the four over-riding forces partly because it was felt that the forces mentioned tend to influence the directions policies take, so that policy is in reaction to the other forces rather than being a separate, independent force. An example is, at least in Friedman's view, globalization increases the cost of protectionist trade policy and pushes governments toward more free-market policies. There are many points of view, of course, on what influences policy. The paper did explore state promotional activities in detail. They are probably important in certain circumstances, especially in the short run, but we would argue that they are less important to the long-run prosperity of the livestock industry than are the policies mentioned (environmental, industrial organization, trade and commodity price and income support policies).

Question: (There were a number of questions and comments about new technologies that may reduce the excess phosphorus quantities estimated in section IV. They did not seem to be questioning what is in the research itself, but rather calling for additional follow-up research. That follow-up research is beyond the scope of the current project, however.)

Question: Why are swine and dairy farms going out of business more rapidly than other farm types, while Table 18 (on page V-1-91) shows that these two farm types earned higher rates of return on equity than did the other types?

Response: (See added text on page V-1-90.) Consolidation is taking place in all farm types. Table 1 on page V-1-13 shows that the total number of farms in Minnesota declined from 86,000 in 1993 to 81,000 in 1999. Farms with milk cows and hogs are declining more rapidly than other types, however. The short answer to the question is, we don't know. Speculation is hazardous, but we can speculate about several reasons. The low returns that the hog farms experienced in 1998 were certainly one factor. We also know that many farm operators and household members hold off-farm jobs. The farms also serve as rural residences and provide value to the households that justify owning the farms even if rates of return are less than alternative investment opportunities would provide. The other farm types shown in Table 18 are beef and crop farms, which are more likely to be part-time operations because farm labor demands are less intense. Thus, operators of many of these crop and beef operations may put up with the lower returns because they have off-farm income and the farms have value as residences. Also, it was pointed out that the non-farm labor market has been tight in recent years. A farm operator considering whether or not to continue may tend to compare their returns not to other farm types but rather to what they can earn in an off-farm job. Perhaps dairy and hog farm operators have been more likely to obtain off-farm jobs because they are located closer to urban areas or because of skill differences. Finally, keep in mind that these rates of returns are from the farms that have remained in business. Rates of return of the farms that exited may have been lower than for the ones that have remained.

Question: How promising are alternative livestock production systems?

Response: In short, dairy grazing systems may have potential under proper management and at a size adequate to provide for family living expenses. Anecdotal evidence suggests that there are grazing dairies in Minnesota that are doing well, although on average the (self-identified) grazing dairies in the FINBIN record database achieved per-hour returns somewhat lower than other dairies. It was mentioned that there is a learning curve involved in switching from a conventional to a grazing dairy, and that performance of grazing dairies has improved in recent years, although the record database is inadequate to show that improvement at this time. Also, as the adage goes, "Not everything that counts can be counted," and there may be advantages to alternative systems in terms of flexibility, community cohesiveness, and sustainability that we can not measure with confidence at this time. The potential for alternative swine systems does not appear quite as promising as for grazing dairies at this time unless significant market premiums are possible.

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I. Executive Summary

Current Situation and Recent History: Geographic Distribution and Size of Enterprise in Minnesota Animal Agriculture

Farms are consolidating and changing the ways in which they acquire resources and manage risks. The total number of U.S farms peaked at 6.8 million farms in 1935. By 1997, only 1.9 million remained. Average acres per farm increased from 155 acres in 1935 to 487 acres in 1997. Most U.S. farms are organized as single proprietorships. Family and non-family corporations were 4 percent of the farms in 1997 but had 29 percent of the gross sales. Land leasing has changed from a way for beginning farmers to enter agriculture to a way of gaining access to additional assets. This allows farmers to avoid debt and risks associated with ownership, and to be able to respond more quickly to changing market conditions. Farmers have become more reliant on production and marketing contracts over the past 40 years. Eleven percent of U.S. farms had at least one marketing contract, but these farms accounted for 40 percent of the gross sales. Farm operator households typically receive income from several sources, and 88 percent of their household income came from off the farm in 1997. The relative importance of off-farm income varies widely among different farm types.

The major shifts in the Minnesota livestock industry in the 1990s are that cattle and sheep numbers are down while hogs, layers, and turkeys have shown growth. Consolidation of livestock production onto fewer farms is very evident in the hog and dairy farm numbers. The number of operations with hogs declined by 46 percent between 1993 and 1999, while dairy operations declined by 33 percent over that six-year period. The number of sheep operations was down 44 percent over the same time frame. Minnesota has been losing national market share in beef cow-calf and cattle feeding operations, while our pork industry share is increasing. Not much change is evident in the number of cow-calf operations, while the number with cattle on feed declined by eight percent from 1993 to 1998.

Forces Affecting Structural Change in the Minnesota Livestock Industry

Four over-riding forces that seem evident from this discussion are: 1) information technologies which increase the span of control of managers, making larger farms and other businesses feasible, and are also a major factor underlying globalization of finance and trade, 2) globalization, which presents new export opportunities for Minnesota farmers but also increases market volatility, 3) evolution of the food system into more tightly coordinated supply chains which challenge the historical leadership role and independence of farmers, and 4) public skepticism about science, technology and globalization, which may act as a counterweight that slows the industrialization of the food system, and at the same time may present market opportunities to astute producers who can tailor their production and marketing to their demands.

Driving forces differ among the dairy, hog/pork, beef, and poultry sectors. Dairy has historically been one of the more-protected agricultural sectors in many nations, so trade liberalization means that exports and imports could play an increasing role in domestic milk price movements. Food safety and quality concerns, constraints on western water supplies, and new on-farm technologies favor a shift toward a Midwestern dairy industry of larger operations that have closer vertical ties to the rest of the supply chain. The pork industry has largely already made that transition. It may face the widest array of policy challenges of any of the species, with environmental, animal well-being, worker safety, and concentration and control all being areas of policy concern. The beef industry faces unique challenges due to its more segmented and dispersed structure. Continued attempts to improve efficiency by better coordination of the entire beef production chain are expected. The poultry industry is affected by many of the same forces affecting the other species, but export markets may be more important in the case of poultry.

Policies that can at least potentially affect livestock industry structure are many and varied. Those policy areas most often mentioned in that regard include environmental policy, industrial organization policies, international trade, commodity price supports, access to farm credit, land use and urban sprawl, intellectual property protection, subsidies for research and education, tax policy, economic development, transportation, immigration, and energy policies.

Phosphorus Balance in Minnesota Feedlot Permitting

An analysis of 3,907 permitted feedlots in Minnesota over the years 1980-2000 shows that the larger a feedlot becomes, the less likely it is to have enough available land to make good use of all the P produced by animals on the farm. Further analysis of the data indicates that the problem is not having more animals *per se*. Rather, the problem is with the ratio of animal units per acre. For each increase in density of one animal unit per acre, surplus P increases by 78 pounds per acre. Larger farms, in general, tend to be more densely populated with animals and therefore have more surplus P.

At least half of Minnesota's permitted feedlots are building P levels in surrounding fields. Larger feedlots, on average, have much higher levels of P build-up than do smaller feedlots. Should the GEIS Citizens Advisory Committee determine this P build-up threatens water quality, some difficult decisions must be made. It is clear that if Minnesota wishes to avoid high P soils in areas that have high levels of animal production, it must devise a permitting process that lowers the animal density on many feedlots.

Literature Review Update

INDUSTRY STRUCTURE,COMPETITIVENESS, PROFITABILITY AND VIABILITY

This updated literature review combines the original literature review completed in 1999 with new literature that has become available since that time. It is organized in the same manner as the study questions laid out in the GEIS scoping document. Topic D covers the dimensions of the Minnesota livestock industry, including the numbers, locations, and nature of feedlots; the business structures used by livestock operations; the ownership and control of livestock operations; the present market situation; and the competitiveness of Minnesota livestock producers in national and international markets. Topic E covers the profitability and overall economic viability of both livestock farms and livestock processing firms including how they are affected by such factors as economies of scale, production methods, marketing arrangements, and government policies and programs. Livestock processing firms are discussed under question D4, so the discussion under topic E questions will focus on farms.

Thirty additional research publications, not available for the 1999 Literature Review, are included in this paper. The updates have been incorporated into the original document, so that users have access to a seamless body of text that has the entire set of material in one place. All of the tables of statistical data have been updated with the most recent data available as of early 2001. The most significant change in the statistical tables is that the 1998 swine and dairy farm business summary data (old Tables 19 and 27) has been replaced by four-year averages. These have only recently become feasible as a result of a new search engine for summarizing the MnSCU and farm business management association record data. Note particularly that the swine production economies of size picture looks somewhat different in the new four-year averages than it did in the old 1998 data, which was heavily influenced by the late 1998 hog market "crash". Also, there are now economies of size tables for four different swine enterprise types rather than just farrow-to-finish.

Several new studies are cited on the link between environmental regulations and enforcement, and livestock industry location. The authors of one study entertain the possibility that the relationship between environmental policy and livestock industry location is a two-way one - environmental policy developments may be a result of past livestock industry growth, as well as driving future growth, although their regression analysis is inadequate to establish which way the causality lies. That is, the observed regulatory differences may be in response to the growth of the large operations, rather than preceding and influencing their growth.

Relative to market access and choice of business organization - proposed federal regulation similar to Minnesota's "Agricultural Contracts" law is discussed. An interesting new analysis from USDA-ERS is cited relating to farm vs. non-farm terms of trade. The USDA Economic Research Service has also done some interesting analyses recently on terms of trade between agriculture and the rest of the economy. Their new material shows the diversity of agriculture more clearly than in the past.

REGIONAL ECONOMIC IMPACTS OF ANIMAL AGRICULTURE

1. None of the studies found provide estimates of the net impacts of changes in the size of the livestock industry, after considering potential offsetting effects. In very tight labor markets, reductions in the livestock industry will release labor which will be used in other industries. If those industries contribute more to the state's gross state product than livestock, the net impacts would be positive rather than negative. While we doubt this would be the case, none of the current research provides insights on this question.

2. Nearly all of the studies found, although labeled ••impact studies, were descriptive studies that traced the economic linkages between livestock and other sectors. While these studies can show the economic importance of the sector, the data they provide can not be used to estimate the net impacts of a change in the livestock industry.

3. Studies of the impacts of livestock or livestock processing that use a with/without approach, comparing changes between economic variables in a given community and in •any twin communities have to be very careful in selecting the twins. We found no studies that reported on the characteristics of the twins in sufficient detail that we could be confident that the livestock plants caused the changes noted.

4. The literature on whether small farmers buy more locally than large ones yields mixed results. An early study suggested that the percent of local purchases was lower for large farms but that the total amount was as high as for small farms. A more recent study shows that generally the small farms do buy more within their county but buy almost all of their inputs within the state.

5. The local employment and income impacts of larger pork farmers are higher than small ones when the survival rate is considered. If it were possible to keep all small farms in operation over time, they would contribute more to the local economies. The quality of jobs, in terms of wages per worker, was higher for large pork farms whether or not survival is considered.

6. Meatpacking plants provide benefits to local farmers but the wages paid are considerably lower than the average manufacturing wage. These wages have fallen greatly over the past decade as the meat packing plants have moved from urban unionized plants to rural non-unionized plants. However, the studies that use a before/after approach to examine the impacts of these plants are not methodologically correct. Given the changes in the structure of the industry, the studies would have needed to use a carefully designed with/without approach.

7. Presumably the labor in the meat packing plants are better off than their next best alternative employment or they will not stay. Many workers do not stay with turn over rates being high. However, if the plants are able to find employees, the current ones must be better off than they would be in their next best alternative. The impacts on the social aspects of the community are less clear but beyond this part of the report.

8. Meatpacking and poultry processing is moving to fewer big plants in remote rural areas. This reduces the odds that communities can use this as a development strategy. However, if the community is remote enough and other alternative jobs are scarce these plants can have a positive impact.

9. Wages appear to be competitive in the livestock production, after controlling for skills and regional differences. However, the research base for this conclusion is very thin.

10. The public sector fiscal impacts of livestock operations appear to be positive. Again, the research base for this is very preliminary and needs much greater attention. Further, this research does not tell us what would happen if the size of the livestock sector changed in a community or region.

11. Research on the impacts of farm size on poverty has used either the comparable area approach or a variation using multiple regression analysis. The most comprehensive study found rural poverty rates were influenced most by social relations and economic structure of the region and least by the size of farms.

12. In order to evaluate the trade-off between economic benefits and environmental or social costs of livestock production, changes have to be studied at the community or regional level. Studies done in other regions can not be extrapolated onto a local economy since the regions are likely to have different economic structures. Consequently, the same type and size of livestock operation will have very different impacts in different types of local economies. Similar differences are probably true on the environmental side. The value of this generic study is in guiding future research rather than in guiding public policy.

EXTERNAL COSTS AND BENEFITS

Like the 1999 Report, this update contains no numbers. Two years has not changed the basic fact that the available studies of externalities are limited and subtle, and taking individual numbers out of them, out of context, as if they were scientific constants, remains inappropriate. In the worst case, some of them would be used as if they were The Answer to some interesting quantitative question. The numbers from many of the papers mentioned here would be useful for informing optimal policy in Minnesota, but not without expert interpretation with specific questions in mind, something that is beyond the scope of this review. By the same token, in cases where specific titles do not stand out, a body of literature is summarized with general statements about the output of research in an area.

The concept of economic externalities remains an excellent way to structure thinking about agriculture policy in Minnesota. Quantification of those externalities is possible and has been done to some extent. Those results can be of great use in response to specific policy questions (though they are of little use in a free-form discussion). However, progress toward a grand generalizable set of quantifications is not likely to come in time to afford this decade's agriculture policy. Indeed, in many ways, increasing doubts about the narrowly-drawn cost-benefit approach among supporters of economic approaches (let alone opponents of such approaches) suggests that we may be moving further from technocratic analyses of complicated policies that affect material goods, aesthetic preferences, ethics, and social structures. Cherry picking seems to be the best policy strategy: take the useful structure, take what quantification there is available and strategically fill in a few gaps, and use the resulting tools and inputs without depending on filling all the gaps.

II. Current Situation and Recent History: Geographic Distribution and Size of Enterprise in Minnesota Animal Agriculture

Overview

Number of Farms, Farm Size, Tenure, Marketing, Farm Income

Farms are consolidating and changing the ways in which they acquire resources and manage risks. The total number of U.S farms peaked at 6.8 million farms in 1935. By 1997, only 1.9 million remained. Average acres per farm increased from 155 acres in 1935 to 487 acres in 1997. Most U.S. farms are organized as single proprietorships. Family and non-family corporations were 4 percent of the farms in 1997 but had 29 percent of the gross sales. Land leasing has changed from a way for beginning farmers to enter agriculture to a way of gaining access to additional assets. This allows farmers to avoid debt and risks associated with ownership, and to be able to respond more quickly to changing market conditions. Farmers have become more reliant on production and marketing contracts over the past 40 years. Eleven percent of U.S. farms had at least one marketing contract, but these farms accounted for 40 percent of the gross sales. Farm operator households typically receive income from several sources, and 88 percent of their household income came from off the farm in 1997. The relative importance of off-farm income varies widely among different farm types.

Terms of Trade

Terms of trade between agriculture and the rest of the economy are a longstanding policy issue. Past discussions of terms of trade have focused on price parity. Rates of return on assets or equity capital are a better measure of trade terms because rates of return capture technological change over time. Rates of return for Minnesota farms appear low compared to U.S. manufacturing corporations and food processors and retailers, because all manufacturing corporations averaged around 12 percent return on equity over the ten years, 1991-2000, while farms in the Southwestern Minnesota Farm Business Management Association averaged a return of around seven percent. Data for food processors and retailers were available only for 1990-96. Over that period, food processors averaged a 17 percent return while food retailers averaged 14 percent. On the other hand, a recent comparison of U.S. farm households versus households with non-farm businesses showed a different picture. Median rates of returns in 1997 for the farms were comparable with the returns of non-farm businesses, when farmland capital gains were considered. Large farms earned greater returns than did the non-farm businesses. The non-farm businesses also experienced more volatility in returns.

Livestock

The major shifts in the Minnesota livestock industry in the 1990s are that cattle and sheep numbers are down while hogs, layers, and turkeys have shown growth. Consolidation of livestock production onto fewer farms is very evident in the hog and dairy farm numbers. The number of operations with hogs declined by 46 percent between 1993 and 1999, while dairy operations declined by 33 percent over that six-year period. The number of sheep operations was down 44 percent over the same time frame. Minnesota has been losing national market share in beef cow-calf and cattle feeding operations, while our pork industry share is increasing. Not much change is evident in the number of cow-calf operations, while the number with cattle on feed declined by eight percent from 1993 to 1998.

Hogs

Competitiveness

Minnesota and the rest of the Upper Midwest appear to be strong world competitors in pork production. Studies show inconsistent results about the Upper Midwest's competitiveness versus the southeastern states. Recent cost and return estimates from the USDA Economic Research Service show an advantage for the Southern Seaboard region over the Heartland region in 1999, in contrast to other studies which showed the U.S. and Canadian plains states and regions as having the lowest costs. The Canadian prairie provinces, Argentina and Brazil are the main competitive threats that have been identified that could challenge the U.S. in world trade.

Consolidation

Nationally, consolidation of the pork industry is continuing. The changes are occurring primarily in the largest and smallest groups of producers. The largest operations are gaining the greatest market share and the very smallest are showing the greatest loss. There were 18 operations marketing 500,000 or more pigs per year in 1997, representing 24 percent of total U.S. slaughter. At the other extreme, five percent of U.S. hogs were marketed by approximately 80,000 farms selling fewer than 1,000 hogs annually.

The 7,500 Minnesota operations with hogs in December 1999 is down by almost half from the number with hogs in 1993. There were 17 percent more hogs and pigs on Minnesota farms in December 1999, compared to December 1992. The pig crop also increased since 1993, but both the pig crop and December inventory saw declines between 1998 and 1999.

Production Enterprise Types

An analysis of the swine enterprises participating in the Minnesota State College University Farm Business Management Program and the Southwestern and Southeastern Minnesota Farm Business Management Associations (MnSCU-FBMA) over the four years 1996-99 shows that swine production is moving rapidly away from farrow-to-finish toward systems where pigs are farrowed in a separate enterprise, in large, centralized sow units and often located outside of

Minnesota. In 1996, half of the hogs sold came from farrow-to-finish enterprises while only 25 percent were sold from that type of enterprise in 1999. The number sold from wean-to-finish enterprises tripled, from 4 percent to 12 percent, over the four years, while the number in production contract enterprises rose from 13 percent to 31 percent. Independent finishing of feeder pigs has held steady at about one-third of the total marketings, but these finishing enterprises have declined in number and increased in size. Inshipments of pigs into Minnesota were 23 percent of marketings in 1999. These inshipments were triple the 9 percent share of marketings in 1995, five years earlier.

Production Volume

Despite the decline in the number of farrow-to-finish enterprises, they are still providing about half of the total net returns generated by these swine enterprises. It is notable that more hogs were transferred from the contractee enterprises in 1999 than were sold from the farrow-to-finish enterprises, and nearly as many as from the feeder pig finishing enterprises. Despite the volume, the contractee enterprises contributed markedly less to the operations' net returns over the four years than did the other enterprises.

Financial Performance

Specialized Minnesota hog farms suffered significant financial losses in 1998 after two good years in 1996 and 1997. A modest level of profitability returned in 1999, but debt is still at higher levels than before the downturn. These financial stresses have accelerated the consolidation and production system changes that were already underway in the mid-1990s.

The decline in farrow-to-finish and independent feeder pig finishing enterprises and the increasing numbers of wean-to-finish and contractee enterprises may be at least partially explained by their relative financial performance. Wean-to-finish enterprises have been riskier but more profitable than contractee enterprises were over the four years, but both offered advantages over the more traditional farrow-to-finish and independent feeder pig finishing enterprises. Hourly earnings of the wean-to-finish enterprises averaged higher over the four years compared to the farrow-to-finish and independent feeder pig finishing enterprises, with lower risk as measured by the standard deviation of annual returns.

The contractee enterprises provided the lowest average hourly earnings, more than two dollars per hour less than for farrow-to-finish and independent feeder pig finishing, but did not experience the losses that the others suffered in 1998. Aside from the lower variability of annual returns, other explanations that have been put forth for the increasing popularity of contractee enterprises are the minimal skill required to manage finishing animals compared to a breeding herd, management assistance provided by contractors, and ease of financing due to the reduced income variability.

Independent feeder pig finishing is a high risk enterprise. In 1996 the largest size group averaged a return of $88 per hour, but lost money at a rate of $32 per hour in 1998.

Size

Average size has been increasing for all of the enterprise types, so that the total number of hogs sold or transferred from these farms is up 42 percent. Much of this increase was in contractee finishing with reduced per-unit labor requirements and returns, however. The combination of greater volumes but lower per-unit returns has left aggregate net returns for the group of farms about the same as it would have been if volume had stayed at 1996 levels but was all produced in farrow-to-finish enterprises. The number of independent feeder pig finishing farms in the largest size categories (2,501-5000 and over 5,000 marketed per year) increased over the four years 1996-1999, while the numbers in the smaller size groups declined.

The number of farms with wean-to-finish enterprises increased over the three-year period 1997-99 in all of the size categories for the wean-to-finish and contractee enterprises. For the farrow-to-finish enterprises, the number of farms increased only at the largest (over 1,000 litters) size even though the hourly returns were over $12 in the two smaller size groups.

Labor Efficiency

The difference in labor efficiency among the different swine enterprises is apparent. The labor requirement for the farrow-to-finish enterprises was more than twice as much as for finishing feeder pigs and for the wean-to-finish enterprises. This difference in labor is to be expected as the farrow-to-finish enterprises involve managing the sow herd, but the net returns have arguably not been adequate to compensate for the added labor. The added labor for wean-to-finish compared to finishing feeder pigs also makes sense in that wean-to-finish involves starting with younger animals.

The contractee enterprises appear markedly more labor efficient than the other enterprises, with less than half as much labor per pig compared to independent finishing of feeder pigs, although the largest feeder pig finishers were about as efficient as the contractees. Part of the reduction in contractee labor may be due to the fact that the contractors provide management functions such as marketing, acquisition of feed and other inputs, and general supervision. Still, the contractee-contractor system of swine production is around twice as labor efficient as with the other enterprise types. The flip side of this labor efficiency improvement of course is that the employment potential of the swine industry is declining.

Economies of Size

The presence of economies of size in pork production was evaluated by comparing the costs and returns across the size categories for the four major swine enterprises on the MnSCU-FBMA farms in 1996-99. The data was averaged across the four years in order to minimize the effects of year-to-year random variation and cycle effects, especially with regard to the unusual economic situation in late 1998 and early 1999. The MnSCU-FBMA swine operations are probably similar to the overall Minnesota and north central U.S. swine industry, except that the "mega" operations marketing 500,000 or more per year are not represented and operations marketing less than 1,000 per year are under-represented. Economies of size were not evident in the farrow-to-finish enterprises, perhaps because of recent disease problems in the largest operations. Economies were much more apparent in the other enterprise types.

For the enterprises other than farrow-to-finish, minimum enterprise sizes required to achieve earnings of $10 per hour appear to be 2,500 hogs marketed per year for independent feeder pig finishing and wean-to-finish, 2,500 pig spaces for contractees (around 7,000 finished per year), or 200 litters for farrow-to-finish. In independent feeder pig finishing, the "over 5,000 marketed per year" group was twice as labor efficient at 0.11 hours per head as was the "2,501-5,000" size category, and as a result averaged $37 per hour over the four years 1996-1999.

Dairy

Competitiveness

Minnesota’s share of the national milk market has declined from 8.3 percent in 1960 to 5.9 percent in 1998. Minnesota has dropped in ranking from third in 1960 to fifth in 1998. Nationally there has been a shift in where milk is produced. The greatest gains in market share have come in the western states. California has increased its market share by a factor of more than 2.5 since 1960 and is still growing. Pennsylvania, Michigan, and Vermont have tended to hold their market share, while the rest of the Northeast and Midwest has declined. States losing market share have been in the more traditional dairy areas - Wisconsin, Minnesota, Iowa, Illinois, Ohio, New York, Missouri, and Kentucky. These traditional areas tend to be made up of herds less homogenous in the way they are managed and operated with smaller herd sizes, and more diversified operations that grow a major portion of the feed supply that is marketed as milk.

The shifts in market share are at least partly explained by cost differences. The USDA regional production cost and return estimates for milk production for 1998 and 1999 show the Pacific region to be the low cost-of-production region. Total economic cost of producing milk in the Upper Midwest region, which includes Minnesota, was $0.45 per cwt. of milk above the national average in 1999. The major cost differences in the Upper Midwest region are feed costs that are $0.73 per cwt. lower than the national average, but higher capital costs, higher unpaid labor costs, and somewhat higher overhead, taxes and insurance. These estimates are limited in that they reflect averages for what they consider a single typical dairy for broad regions based on assumed average input costs and returns for the region.

Geographic Shifts in Milk Production Within Minnesota

Geographic shifts in milk production have also been occurring within the state. Minnesota's dairy belt has ranged from the southeastern counties of Houston and Fillmore, up through Winona, Goodhue, Wabasha, Rice, Carver, Wright, Stearns, Morrison, Todd, Ottertail and Becker

Counties. The top five milk producing counties are Stearns, Ottertail, Winona, Morrison, and Goodhue. Over time, the exodus from dairying has been more pronounced outside of this region resulting in a greater geographic consolidation.

Number of Dairy Farms and Cows

Minnesota reached a peak of 151,064 dairy farms in 1945. More than 80 percent of the farms sold milk at that time. As of 1999, 11 percent sell milk. Dairy herd numbers were at 9,100 or 12 percent of the farms in 1999. Cow numbers have dropped from a high in 1945 of 1,660,000 to 540,000 in 2000. Dairy cow numbers declined by eighteen percent between 1993 and 2000, but the rate of decline appears to be slowing. The dairy cow density on agricultural land has sharply decreased from one cow for every 19 acres in 1945 to one cow per 54 acres in 1998.

Herd Size

The structure of the Minnesota dairy industry has experienced dramatic changes in productivity, herd size growth, reduction in total cows and herds, and a dramatic reduction in the number of milk processing plants. Dairy farms are restructuring to larger, more specialized farms that are multi-person owned and operated, on a relatively smaller land base with greater vertical integration with the market and input sectors, and more diversity in size and production processes. Average herd size in Minnesota has increased from 11 to 58 cows per herd between 1945 and 1998. The number of small and medium herd size categories are decreasing most rapidly and the two largest herd size categories, above 200, cows are increasing in number in the 1990s. The average herd size nationally is 79 cows per herd. The number of dairy enterprises of less than 100 cows has been declining in Minnesota farm business summary programs. The enterprises in the 101-200 cow group and the 201-500 cow group increased over the four years 1996-1999.

Productivity

Productivity per cow has increased threefold between 1945 and 1998. Minnesota ranks sixteenth nationally in production per cow. Minnesota produces more than three times the amount of milk consumed in the state. Only about 15 to 18 percent of the total milk produced is consumed as fluid milk. The rest is processed into manufactured dairy products such as cheese, dry milk and butter and ice cream. In the 1970s and early 1980s, Minnesota was a national leader in butter, dry milk powder, and ice cream production. The industry has converted to cheese in response to changing consumer demands (Conlin 1995b), and almost 70 percent of Minnesota's milk was made into cheese in 1997.

Income

Milk sales are typically the largest generator of farm income in the state, ranging between 18 and 22 percent most years. Minnesota farm business summaries provide an indication of the degree of financial risk and economies of size in dairying and swine production over the four-year period 1996-99. For specialized dairy farms, the worst of the four years was 1997 when net farm income declined 25 percent from a year earlier, but net farm income averaged nearly the same over the four years as for the swine farms and was less variable. Non-farm income has remained nearly constant on the dairy farms, in contrast to the sharp increase on the swine farms.

Returns

Dairy farm returns on assets and on equity were higher on average in the late 1990s than for swine, and the dairy farms ended with a lower debt-to-asset ratio and better liquidity (higher current ratio and term debt coverage ratio). Net return per cow was positive in all size groups, and did not increase with size beyond the 51-100 cow size. There is a marked improvement in labor efficiency as size increases. Net returns per hour varied from $11.21 for the smallest 1-50 cow size to $24.20 for the largest 201-500 cow size.

Alternative Grazing System

The most popular alternative dairy system in Minnesota is one that relies on grazing to varying degrees as opposed to conventional systems that rely totally or mainly on mechanically harvested feeds. The grazing dairies had smaller herd sizes, averaging 48 cows. The majority fell in the 1-50 cow group with a few in the range of 51 to 100 cows. The grazing dairies produced less milk per cow, but also incurred lower feed costs and total expenses per cow. The grazing dairies earned less per hour than the overall averages, however. The grazing dairies' net return per cow was less than the average for all sizes and slightly less than for conventional dairies in the 1-50 cow size. The grazing dairies earned less per hour than the overall averages.

Beef, Sheep and Poultry

There were 15,800 Minnesota operations with beef cows and 2,700 with sheep in 1999. Operations with cattle on feed numbered 7,400 as of 1998. Structural change in the Minnesota beef, sheep, and poultry sectors has been relatively minor compared to what is occurring in swine and dairy. Numbers of sheep and lambs are down by almost a third since 1993, although the January 2000 inventory has started to rebound with a 6 percent increase. Cattle on feed have also rebounded a bit over the past two years, which would be expected given the low feed prices. Beef cow numbers seem to be on a fairly steady downward slide over the period.

Turkey production has grown since the early 1993, but appears to have leveled off in the past year at around 43 million birds raised annually. The number of laying hens is also up by 1.3 million. Nationally, contract broiler farms were in fair financial condition in 1995, with average net farm incomes of $15,969 which was less than half of the average $38,966 earned by other farms. While the broiler farms had lower incomes, they also had less invested in the business than did other farms, and worked fewer hours on the farm.

III. Forces Affecting Structural Change In the Minnesota Livestock Industry

by William F. Lazarus

EXECUTIVE SUMMARY

Four over-riding forces that seem evident from this discussion are: **1**) information technologies which increase the span of control of managers, making larger farms and other businesses feasible, and are also a major factor underlying globalization of finance and trade, **2**) globalization, which presents new export opportunities for Minnesota farmers but also increases market volatility, **3**) evolution of the food system into more tightly coordinated supply chains which challenge the historical leadership role and independence of farmers, and **4**) public skepticism about science, technology and globalization, which may act as a counterweight that slows the industrialization of the food system, and at the same time may present market opportunities to astute producers who can tailor their production and marketing to the demands.

Driving forces differ among the dairy, hog/pork, beef, and poultry sectors. Dairy has historically been one of the more-protected agricultural sectors in many nations, so trade liberalization means that exports and imports could play an increasing role in domestic milk price movements. Food safety and quality concerns, constraints on western water supplies, and new on-farm technologies favor a shift toward a Midwestern dairy industry of larger operations that are have closer vertical ties to the rest of the supply chain. The pork industry has largely already made that transition. It may face the widest array of policy challenges of any of the species, with environmental, animal well-being, worker safety, and concentration and control all being areas of policy concern. The beef industry faces unique challenges due to its more segmented and dispersed structure.

Continued attempts to improve efficiency by better coordination of the entire beef production chain are expected. The poultry industry is affected by many of the same forces affecting the other species, but export markets may be more important in the case of poultry. Policies that can at least potentially affect livestock industry structure are many and varied. Those policy areas most often mentioned in that regard include environmental policy, industrial organization policies, international trade, commodity price supports, access to farm credit, land use and urban sprawl, intellectual property protection, subsidies for research and education, tax policy, economic development, transportation, immigration, and energy policies.

The first four policy issues (environmental policy, industrial organization policies, international trade, and commodity price supports) are discussed in some detail in the paper because they interact in significant ways with technology, resources, and market conditions. State-level environmental policies appear to be a significant factor affecting where livestock expansion occurs. Most of the other major producing states appear to be catching up with Minnesota in regulatory stringency, however. Uniform federal regulations on the largest operations may lessen the importance of state differences in the future. Uniformity in environmental rules may increase

the importance of corporate farm and contracting legislation, unless proposed federal legislation is enacted in this area as well. Livestock production is modernizing around the world, so industry shifts across national boundaries could increase as a concern.

Industrial organization policy has long been a concern of the livestock industry. While livestock producers tend to focus their concerns on consolidation and performance at the packer level, the academic literature suggests that developments at the retail level may dictate the future of the overall food industry. National supermarket chains could develop, and food manufacturers' brands could lose ground to those of the retailers. There are calls for continued antitrust vigilence, but the empirical research tends to show that packer consolidation brings efficiency gains that largely offset the deleterious effects of increased market power. The spot market for hogs is shrinking and is expected to largely disappear in a couple more years, with a "market for contracts" taking its place. Legislation has been proposed at the federal level and in 16 states to protect contract growers and producers, along similar lines to Minnesota's "Agricultural Contracts" law but with the addition of language to prevent retaliation against producers who participate in producer organizations.

International trade and trade policies are important to the Minnesota livestock industry. The idea of "putting a fence" around the U.S. (or Minnesota) and restricting supplies to raise prices will be more costly than in the past, as Friedman's "Golden Straitjacket" imagery suggests. Import competition from low-wage countries may contribute to income inequality in the U.S. general economy. The root cause is probably a technological one with no easy answer other than helping affected workers to adjust and providing "income safety net" programs for those who find such adjustments difficult. A "household income safety net" alternative to the current farm price support program seems appealing in that regard, but would entail a dramatic redistribution of program benefits. It is not likely to be enacted without an acrimonious political debate. The report of the 21st Century Commission on Production Agriculture suggests that the income safety net provisions of the 2002 farm bill are more likely to include a three-part income safety net including a fixed baseline payment, a counter-cyclical supplemental payment, and a continuation of the marketing assistance loan program.

Global warming is receiving increased attention. Carbon sequestration policies as a response to global warming could have dramatic impacts on Minnesota agriculture. On the other hand, global warming is expected to have both positive as well as negative impacts on crop production. One benefit of worldwide trade liberalization is that it would facilitate shifts in cropping patterns in response to global warming.

III.1 FORCES AFFECTING STRUCTURAL CHANGE IN THE MINNESOTA LIVESTOCK INDUSTRY

by William F. Lazarus

INTRODUCTION

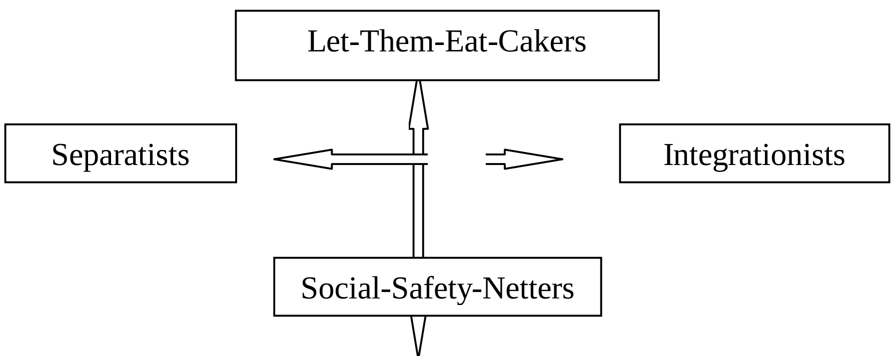
In The Lexus and the Olive Tree: Understanding Globalization, Thomas Friedman argues that trade liberalization since the end of the Cold War a decade ago is the root cause of recent changes in the global economy (Friedman 2000). The "Lexus" in the title refers to the luxury automobile, and symbolizes the new economic opportunities available to countries whose economies no longer must conform to security interests of one of the two great powers. This new openness along with the Internet have allowed investors (the "electronic herd") to buy and sell their investments anywhere in the world, more quickly than ever before. The result is increased pressure for economic policies that conform to the "golden straitjacket" of global investment norms. Countries, states or localities that are willing to put on the golden straitjacket of are rewarded with inflows of investment capital. The new investment capital results in industry modernization and increased productivity. At the same time, the new freedom ends the formerly protected status for local industries, which must also modernize or face extinction. These formerly protected local firms face competition not only from products of new competitors, but also for local capital that can now be invested in global financial markets. The downside is that the modernizing, streamlining, and privatization jeopardizes the sense of community and rootedness of belonging to a family, community, nation, or religion, symbolized by the "olive tree".

Friedman acknowledges the potential for varying degrees of backlash against globalization, in part because losses from globalization are often more visible than gains. When workers lose jobs when a factory closes due to foreign competition, for example, they are more likely to mobilize than the large numbers of consumers who benefit slightly from the low-priced imported goods. Also, he argues that people often don't understand that globalization is largely a technology-driven phenomenon, not a trade-driven one. He uses as an example a receptionist who lost her job to a computerized voice-mail system imported from Mexico. If imports from Mexico had been restricted, it is likely that a U.S. source would have soon supplied the voice-mail system anyway and the job loss would have still occurred.

Others have compared the current economic situation to surfing. A recent editorial about manufacturing layoffs seems equally applicable to agriculture:
"Surfers, like workers, do not make the waves. Waves form beyond the horizon and are nearly invisible until they reach the shore. Surfers just pick the best looking ones and ride them for all they are worth - using their skills, creativity and the best equipment available to them. When one wave ends - as they always do - surfers pound their way back past the breakers and wait for the next 'big one'. ... Knowledge, after all, is the single most important asset in a global economy. The recent layoffs, while painful, may provide affected workers with an opportunity to enhance their skills. In every surfer's career will

come the occasional wipeout. But so will the next wave." (Global Economy (Usually) Benefits Valley 2001)

Friedman presents a two-dimensional matrix to portray four basic political identities that people can choose from with respect to globalization. "Integrationists" shown on the right side of the diagram welcome globalization because they think it is good or inevitable, and want to see it promoted. "Separatists" see free trade and technological integration as neither good or inevitable because they widen income gaps, lead to jobs being sent abroad, and lead to life being controlled by distant, faceless market forces. The vertical line is the distribution axis. It represents what sort of policies one believes governments should adopt to go along with the golden straitjacket of globalization. "Social-safety-netters" believe that globalization will only be sustainable if it is democratized, in both the economic and political sense, by giving tools and resources to those left behind to help them compete. "Let-them-eat-cakers" believe that globalization is essentially "winner take all, loser take care of yourself." They want to shrink government, taxes, and safety nets, and let people truly reap the fruits of their own labor or pay the price of their own ineptitude (Friedman 2000), p. 438.



> Friedman's diagram illustrates some of the tensions that can arise as globalization proceeds. He does not go into specifics about how similar tensions play out in agricultural policy. Where would current U.S. domestic farm policy fall in the matrix? Where would Minnesota's corporate farm law fall?

Friedman sees globalization as "almost inevitable", and he argues that simply walling a local economy off from the global economy will be too costly and impractical. That does not imply that policymakers should sit idly by, however. He suggests a variety of policy measures to "democratize" or deal with the consequences of globalization, such as:

- tax breaks for severance pay and pilot projects for public employment for temporarily displaced workers,
- increased support and promotion of retraining programs and job-hunting assistance, and

- improved availability of investment capital to the most distressed, low-income communities where private financial markets fail.

THE PROCESS OF CHANGE AND DRIVING FORCES

The "structural change" currently occurring in agriculture includes changes in product characteristics, worldwide production and consumption, technology, size of operation, and geographic location (Boehlje 1999). Food retailing is increasingly more customer-responsive, service-focused, and global in ownership. Input supply and product processing are more consolidated and integrated. Boehlje calls for a refocusing of how industry structure is described. For addressing management questions, structure is often described in terms of size, financial characteristics, resource ownership, and technology (see, for example, the discussion under question D1 below). In order to better understand structural change, Boehlje argues that it is more useful to focus on changes in the ways of doing business. Two profound changes in how the agricultural sector carries out its economic and social functions are: development of supply or value chains, and adoption of biological engineering.

The process of change was described in the 1981 USDA report Structural Change in Agriculture: The Experience for Broilers, Fed Cattle, and Processing Vegetables, based on transformations that the broiler, fed cattle, and processing vegetable sectors went through in the 1950s and 1960s (Reimund et al. 1981). That transformation has been described as a four-step process. Forces outside farming trigger structural change, at first to exploit new conditions, and later to manage new risks. New technology, market conditions, and policies lead to **1)** technological adaptation, **2)** shift to new producing areas, **3)** growth and development, and **4)** adjustment to risk. For a brief chronology of U.S. agriculture from colonization through the technology boom, see (Hoag 1999).

Two lists of driving forces written sixteen years apart can be found in Reimund et al. and in a 1997 Purdue University study (referred to below as "the Purdue report") (Food System 21: Gearing Up for the New Millenium, EC-710 1997). Reimund et al. characterize the driving forces as falling into three general categories: technological developments, market forces and demand factors, and policy. Doering et al. refines these basic categories in several ways (Doering et al. 1997). They broaden "technological developments" to "resources and technology," which helps draw attention to the fact that new technologies change the efficiency of resource use. Some resources are relatively fixed in extent and exhaustible. In many cases, however, new technologies have turned "worthless" areas and materials into valuable resources as when drainage makes it possible to farm poorly drained soils. From an economist's perspective, it is useful to consider resources and technology together.

Friedman focused on the global communication capabilities of the Internet, but information technologies are also being used to expand the size of business that one manager can successfully oversee. This increased "span of control" arguably is the underlying force behind consolidation of agriculture into fewer, larger farms and the wave of mergers and acquisitions in the broader global economy. The role of information technologies in industry consolidation is illustrated in a recent Wall Street Journal article, "As Huge Companies Keep Growing, CEOs Struggle to Keep Pace: Technology and Delegating Help Tame the Barrage of Data, Deals, Decisions" (Murray 2001). Recent trends are summarized as follows:

"By 1999, the average annual revenue of the 50 largest public companies in the U.S., about $50.8 billion, was 70% higher than it had been just 15 years earlier, even taking inflation into account. More than 50 public companies currently employ more than 100,000 workers; in the mid-1980s, only 18 did."

The term "delegating" in the above headline also brings to mind the role of business management research and education in the increasing size of farms and businesses. When we bring young people from the farm to the university and train them in the business management techniques used by large farms and businesses, we shouldn't be surprised when they go back home and put their training to work expanding the size of their farming operations. Educational programs often contain the message that farm managers should focus on being "people managers" and delegate the day-to-day labor tasks to others when appropriate.

The Purdue report also focuses on the international trade component of Reimund's "Market forces and demand factors." The domestic market is also important, but they argue that the market has always gone beyond national borders. Strong trade has generally been associated with periods of prosperity for American agriculture, and weak trade has paralleled depressions or recessions in agriculture.

Both reports mention government policy as an important part of the agricultural landscape. In addition to the farm bills focused on prices and incomes, Doering mentions homesteading, conservation, transportation, and land use policy, as well as recent developments concerning market structure and concentration, and environmental and food safety regulations.

The Purdue report lists infrastructure development as a fourth major driving force. Infrastructure includes both physical and institutional developments. Transportation subsidies and water systems for irrigation are examples of U.S. government infrastructure investments that have benefited agriculture. The private sector has also invested in transportation, processing, and distribution facilities. The federal government's free land grants to set up educational institutions are perhaps the most notable institutional infrastructure investments. Of course, another aspect of infrastructure is the global financial system that Friedman argues is the main force driving globalization.

Cooperatives have been another important part of the infrastructure supporting U.S. agriculture. The Purdue report list of forces is then: resources and technology, international trade, infrastructure development, and government policy.

Boehlje uses the term "economic agents" to refer to entities such as business firms whose decisions affect the economy. Economic agents create or cause changes in the food system in response to opportunities offered by the forces described above. Boehlje argues that these (mainly private sector) economic agents are motivated by goals such as economies of size and scope, rent appropriation, strategic positioning, financial engineering, supply or value chain formation, risk management or mitigation, and market power/control exploitation. More specifically, supply chain development is motivated by expected better flow scheduling and resource utilization, increased ability to manage and control quality throughout the chain, reduce risks and especially the risk associated with food safety and contamination through traceback, and increased ability to respond quickly to changes in consumer demand for food attributes. Biological engineering (defined as adoption of process control technology and a manufacturing mentality, especially in production agriculture) is motivated by desires to eliminate the disconnect that has previously occurred at the farmgate in the assembly line from genetic material to the retail food store.

A similar discussion focusing on vertical coordination in food supply chains is (Tweeten and Flora 2001). They assert that in the future, tightly coordinated agriculture will be characterized by clusters with a hub, spoke, and wedge configuration. A livestock-processing plant will be at the hub of the cluster, in close proximity to livestock-feeding operations supplied by mills drawing grain and oilseed through transportation and communication spokes delineating crop production "wedges" covering large areas. The nation's landscape will include a relatively few clusters. Farms in the periphery (wedges) will require less and less labor and other local inputs and thus will provide diminishing social and economic support for their own local rural communities. All else being equal, industry-wide productivity gains decrease aggregate employment and other economic activities in rural communities. Production contracts have decreased farm labor in the aggregate, but have created opportunities for contractees in part because lenders are more willing to lend to producers with risk-reducing multiyear contracts.

While Tweeten and Flora do not go into detail on specific policy recommendations, they do suggest a number of principles which might help frame GEIS discussions on policies. Those suggestions are listed below (paraphrased in the interest of space):

- Allowing operators to choose whichever form of vertical coordination they find advantageous but relying on the public sector to establish and to enforce environmental standards raises real national income while holding down food and fiber costs to consumers.

- No universal formula: each community decides which development strategy to use, with state and federal governments establishing environmental ground rules and regulations and by providing information.

- Research and education to improve technology, information systems, risk management, and marketing tools to help family farmers and owners of small rural firms.

- Labeling backed by proper standards and enforcement to allow consumers to "vote" by purchasing labeled products with the attributes they desire.

- Local, state, and federal governments should build human capital for alternative opportunities locally or elsewhere through investment in schools, adult education, and skill building.

- Promote competiton at the federal level through antitrust and other measures.

- Promote market transparency, competition, and efficiency by releasing terms of contracts to the public.

The Purdue report suggests an extensive list of forces that are driving change in particular areas of the U.S. economy and the food system. For the general economy, an increasing market orientation and increasing international trade ("globalization") are key as is the stable monetary policy. International trade is discussed in more detail below, but has been influenced by lowered tariffs and trade barriers, dietary transitions in developing countries, and balance of payments constraints.

Another perspective on globalization that has so far not been widely discussed is that it could have the effect of reducing the degree of vertical integration in an industry, thus mitigating a issue of considerable concern in the livestock industry, at least in theory (McLaren 2000). The theory is more or less implicit in Friedman's anecdotes, but McLaren lays it out explicitly. The basic idea is that an input supplier selling to a downstream final goods producer could wait to negotiate the price of his product until after it is produced, but then risks being "held up" and not receiving a price high enough to recoup costs. Vertically integrating with the downstream stage eliminates that risk, but has its own disadvantages. If globalization results in opening up more overseas markets to the upstream supplier, his risk of being held up is less so there is less need to integrate.

What are the key aspects of consumer demand that might affect the species mix and production systems in the Minnesota livestock industry? Consumer demand is influenced by the aging population, increasing income and wealth, and changing preferences related to health concerns as well as ethnic shifts. Connor et al. find income is closely related to total food and beverage expenditures, with the richest one-fifth of U.S. households spending more than three times the amount spent by the poorest one-fifth (Connor et al. 1997). They also find that the dominance of electronic mass media has given an advantage to food processors with well-known brands, colorful packages, emotionally charged product images, and snappy slogans. They cite research findings that only about two percent of U.S. consumers are committed to natural/organic food at any price, but a significant segment of consumers would prefer to purchase foods raised without pesticides, antibiotics, and growth hormones. As many as half of all consumers place a value on sustainable agricultural practices. A recent study along these lines is Hurley and Kliebenstein, who compared societal perceptions of and acceptance levels for methods available for managing livestock odors and manure storage and application (Hurley and Kliebenstein). Air filtration, natural hog diet additives, and aboveground manure storage were more acceptable than microbial and enzyme manure additives, chemical diet additives, and soil injection of manure. Some of the results, such as preferences for surface manure application rather than injection, were counter to scientific experts' views. This study, like all ex ante "willingness-to-pay" experiments, is open to the criticism that consumers' later actual purchases may be different from what they said they would buy.

Connor et al. also review studies of consumer preference shifts, but find that the research results are often not consistent with food consumption data. The aging of the population was found to affect food choices, to the extent that "adult" versions of certain specific foods grew faster in the 1980s than did versions of the same foods aimed at children. Ethnic identity is a strong driving force for growth in the food industry, with growth rates of Hispanic and Asian foods higher than for other categories. This growth is partially stimulated by immigration and partially by a shift in preferences by the rest of the population. Mixed results were found for low-calorie or diet versions of foods and beverages, partially due to data problems. Foods with healthy or natural images have experienced 50 percent faster growth than foods with less healthy images, although research on such foods is complicated by changes in consumer perceptions over time. For example, in the late 19th century, breakfast cereals were regarded as the ultimate health food, while tomatoes were believed to be poisonous or aphrodisiacs.

Cotterill explains the vertical organization and performance of the food distribution industry in terms of the interactions among new technologies, capital markets, and market power (Cotterill 2001). Major technological advances in food processing equipment, biological sciences, chemistry, pharmaceuticals, computers, optical scanners, and marketing have lowered the cost of production, created new products, improved quality of older products, and created whole new industries and market channels. New industries and market channels include the data utilities, A. C. Neilsen and Information Resources, Inc., as well as the artificial insemination industry and the frozen and chilled food industries. The role of market power is discussed further below in the section, "Industrial Organization Policies."

Friedman uses the olive tree to symbolize the loss of community and rootedness than can result from modernization, streamlining, and privatization of the economy. This loss of community and rootedness along with public skepticism about science and technology has arguably been a factor in the growth of interest in organic and natural foods and the environmental movement. Johansson traces the origin of the U.S. environmental movement to the mid-19th century writings of Ralph Waldo Emerson, David Thoreau and John Muir. Public awareness and concern over environmental issues became galvanized in the 1960s due to well-publicized incidents such as the Cuyahoga River in Cleveland erupting in flame, and the publication of Rachel Carson's book Silent Spring (Johansson 2000; Carson 1962). E.F. Schumacher's 1973 book, Small is Beautiful: Economics as if People Mattered addressed the issue of whether happiness or a better way of life for those living in a mature industrial country depend on growing material wealth (Schumacher 1973).

The protests at recent World Trade Organization meetings and the new national organic standards just promulgated by USDA are indications of the continuing importance of this issue (USDA Agricultural Marketing Service, The National Organic Program 2001). This skepticism may act as a counterweight that slows the industrialization of the food system, and at the same time may present market opportunities to astute producers who can tailor their production and marketing to the demands.

Friedman also points out that just as technologies such as the Internet extend the reach of firms in the global marketplace, these technologies can also contribute to better global governance without the need for formal global government bodies which would probably be unworkable. The technologies can facilitate networking and publicity resulting in enforcement of global norms. Examples are when the Fair Labor Association pressured global apparel makers to restrict child labor, or when animal rights groups pressure a company like MacDonalds to set animal welfare standards for meat and poultry that it purchases.

FORCES SPECIFIC TO DIFFERENT LIVESTOCK SECTORS

The Purdue report elaborates on how the driving forces differ among the livestock species sectors: dairy, hog/pork, beef, and poultry. Key points from its analysis are discussed below along with insights from other sources:

Dairy

U.S. policy changes will have a significant on the dairy industry, and are discussed in more detail below. Dairy has historically been one of the more-protected agricultural sectors in many nations. Despite trade liberalization, exports and imports are expected to remain small compared to the domestic market but will play in increasing role in domestic milk price movements. The marketplace for dairy products is fiercely competitive, with introduction of many new products.

Food safety scares drive the industry toward increased vertical linkages and control systems. Dairy herds require substantial quantities of water, so increased urban demand for water in the western states could be a factor in gradually shifting the industry back to the Midwest1. Finally, new on-farm technologies such as ultrafiltration and reverse osmosis may allow milk to be concentrated prior to shipping, which could allow large dairies distant from population centers to be more competitive.

Dairy Competitiveness

An Ohio Extension publication, "Dairy Excel's 15 Measures of Dairy Farm Competitiveness," identifies ten areas of dairy farm competitiveness and the role of each in contributing to the success of the business. They point out that dairy producers that want to stay competitive must commit to continued improvement, modernization and change. They suggest a better than average dairy farm today must increase the number of dairy cows by 60 over in the next 10 years to maintain their standard of living to offset inflation (Polson et al. 1997).

Dairy farm management records suggest that many Midwest dairy businesses are highly profitable when compared to their competitors in the West, East, South, and elsewhere in the world. However, many others have the opportunity to be more competitive by: **1)** increasing cow and herd productivity, **2)** increasing the efficient use of capital, **3)** tightening their control of costs, and **4)** marketing more milk per worker. Family economics and lifestyle needs and hopes are critical on-farm forces of change. Dairy profit margins have become slimmer while family living costs have risen. Opportunities for quality family time and for breaks in day-to-day routines to get away are growing more important to many families. Success must ultimately be measured by the personal fulfillment and satisfaction of those having a vested interest in the business, although it will not survive long term without being profitable. (Conlin 1998) Historically Minnesota's dairy industry has flourished because of:

- Inexpensive high quality feeds
- Plentiful supply of water
- Land with limited alternative uses (forage production)
- Desirable climate (at least from a cow's perspective)
- Committed farm families
- Positive market reputation
- Strong support infrastructure, processors, and service and supply providers

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1It should be noted, however, that as of the 2000 year milk cow numbers were continuing to decline in Minnesota, although perhaps at a slower rate than in the mid-1990s. See Table 1 in section V-1. A shift back to the Midwest is not yet apparent in the Minnesota data.

There is wide heterogeneity in the economic vitality of Minnesota dairy farm businesses as shown by comparisons of high and low profit dairies in the state. (See Section E. of GEIS Report, Profitability and Vitality). Studies have shown that the high profit group are highly competitive nationally in being low cost producers of milk. Wisconsin researchers identified several factors contributing to the shift from the Upper Midwest and Northeast to the West and Southwest (Lawless et al. 1996):

- A large number of small farms that are unable to support an adequate level of family income
- Many dairy facilities and equipment are obsolete.
- Many operators are approaching retirement.
- Changes in government milk pricing policies.

⇒ Lower support prices beginning in 1981 based on anticipated purchase of surpluses and government costs that included an assessment to farmers to offset the cost.

⇒ A Federal milk marketing system that favored other regions at the expense of the upper Midwest.

- The Upper Midwest is no longer the lowest milk production cost region in the U.S..
- Many do not have access to capital needed to expand and or change their systems to be more cost efficient.

Swine

The rapidly industrializing pork industry could be affected by a number of resource and policy concerns. The main resource concern is labor. A job in a swine production unit is becoming more like an industrial job than like what has traditionally been thought of as farm work. Labor availability is an issue for the entire meat processing industry, including pork processing. Capital is another resource that can be a limiting factor, especially for smaller operations. Financial risk leads to pressure to reduce operating risk by means such as production and marketing contracts. While the entire livestock industry is affected by government policies and regulations, the pork industry may face the widest array of policy challenges - environmental, animal well-being, worker safety, and concentration and control all being areas of concern.

The role of economies of size as a factor in pork slaughtering industry consolidation and vertical linkages is evaluated by (Hayenga 1998). Fixed costs declined $3/head for double- versus single-shift plants, while capacity utilization rates can greatly affect variable cost per head and pricing behavior in the hog market. Government policies and regulations expected to shape the future of the hog/pork sector in particular fall into the following areas (Boehlje et al. 1997):

- policies regarding concentration, control, market access, and price discovery,
- environmental regulations,

- animal well-being, and
- worker safety

The first two of these policy areas are discussed in more detail below. Policies regarding animal well-being and worker safety are addressed in separate technical working papers.

"Industrialization" of the Swine Industry
The swine industry has been undergoing rapid changes in recent years along the lines of the earlier sectors discussed by Reimund et al., that some authors have termed "industrialization." New technologies and management strategies that are thought to be playing a major role include (Positioning Your Pork Operation for the 21st Century 1995):

- feeding programs that are closely geared to animal needs during specific growth phases, and that respond more quickly to changes in ingredient availability and cost,
- health-enhancing technologies such as all in-all out rearing and early weaning that may improve performance, reduce dependence on antibiotics, and/or maintain acceptable performance in larger facilities,
- breeding systems which utilize crosses of specialized sire and dam lines to achieve desirable traits, and artificial insemination and related technologies which allow elite lines to be utilized more widely,
- more careful facility design and better information systems to improve throughput of animals from a given investment in land and buildings, and
- networked (cooperative) selling and/or buying among groups of producers, and information sharing among producers and between producers and processors to capitalize on quantity- and quality-based premiums and discounts and identify areas that need improvement.

Implications for the future include:

- more site-specific micro production management,
- optimization of the supply chain from genetics to the end-user/consumer with better flow scheduling and resource utilization, better quality control, reduced food safety risks, and increased ability to respond to consumer demand for specific attributes,
- continued challenges related to environmental and odor problems which will affect size and location, unless technological fixes are developed,
- an increased role for producer associations that provide services to their members,
- trace-back systems from final product to genetics to quickly and easily identify sources of contamination,

- heightened risk from new sources such as shutdown of large plants or disruption of contracts, globalization, and more specialized production units.
- Decisions concerning new production, processing, and distribution centers will tend to be made in a more coordinated fashion than in the past when they were made relatively independently.
- Technological advances in production and processing could dramatically alter the labor requirements to manufacture pork.
- Pork's competitive position could improve relative to beef and possibly even relative to poultry. Finally, ownership of world pork production and processing could become more globalized with more firms investing across national boundaries.

Ginder characterizes the situation in terms of a bifurcated production channel, with one side being a producer-centered, commodity hog side dominated by independent producers and a few large production contractors, along with a specialty hog side dominated by the industrialized producers with packing and processing facilities (Ginder 1998).

The future role of cooperatives under a more industrialized agriculture is an issue which has received attention (Cook 1995; Fulton 1995). Fulton concludes that the changes in both technology and society's values (more individualism) are likely to make cooperation more difficult in the future. He argues that many cooperatives have been predicated on creating opportunities for farmers in a world of spot markets, and more direct marketing channels and reductions in output variability would diminish the opportunities for cooperatives. Cook sees a promising but challenging future for cooperatives that take a more offensive rather than defensive approach.

A number of factors are conducive to successful collective action in U.S. agriculture, such as where there is a new market in which existing preferences are unknown, where declining markets exist, where shared risk through relational contracts can be accomplished, or where producers recognize asset-specificity-driven opportunism in the early stages of technology adaptation.

Changes in farm profitability and food demand in recent years have led to a great deal of farmer interest in projects to add value to farm products. (Siebert et al. 1997) review some of the risks involved in post-harvest value added investment decisions, especially when the new market level being entered is not thoroughly understood. They suggest an alternative: investing in publicly traded equities (stocks) of investor-owned processing firms. For example, ConAgra, IBP, Hormel or Smithfield Foods might provide investment opportunities for livestock producers who are seeking to capture value added at the processing level. Siebert et al. suggest a formula for calculating the size of the investment needed to achieve a balance between the size of the farm's marketings and the diversification capacity of the value added investment. Olson points out that while many value-added agricultural ventures succeed, at least as many fail (Olson 2001).

Olson provides brief descriptions of 23 such ventures in the Midwest and how they have fared.

A number of Minnesota pork producers became involved in swine production networks in the mid-1990s. Twenty producers interviewed in late 1995 cited a number of specific reasons for joining networks (Koehler et al. 1996). Most of the producers were previously producing hogs in individually owned farrow-to-finish operations. In general, they were all looking for a way to access the technology and systems they saw as necessary to achieve low cost production of the product quality and volume necessary to be competitive in the future. Within that general theme, some people emphasized product quality while others focused on volume or labor simplification. The types of arrangements ranged from small-scale, informal farmer-to-farmer formula pricing arrangements to large-scale, jointly owned sow units directed by hired management consultants. Perceived advantages to network participation included:

- disciplined pig flow and larger pig group size that made all in-all out finishing work better, which in turn made it easier to achieve pig health goals
- the opportunity to utilize specialized facilities with modern technology and better working conditions
- the opportunity to utilize staff with specialized skills and expertise
- discounts on input purchases due to quantity purchasing

Perceived disadvantages included:

- the difficulty of arriving at an equitable sharing of profits among the producer-members of the network who might now be involved only in farrowing, only in finishing, or in other parts of the network rather than owning and being in control of the entire system as in a traditional farrow-to-finish operation
- more possible points of risk exposure because more people and facilities are involved in the larger networked system
- increased transportation requirements to move pigs from farrowing to the nursery, and then on to finishing facilities that are be located on different farms

Beef

The cow-calf sector of the beef industry utilizes large acreages of land. Land use conflicts with non-farm neighbors over issues such as grazing next to streams could have some effect on the industry. Government policies such as the Conservation Reserve Program and water and grazing rights could also influence where calves are produced and at what cost. The beef industry faces unique challenges due to its more segmented structure. The cow-calf industry remains dispersed compared to other sectors. Coordination of the four phases of brood cows, backgrounding, feeding, and processing is difficult. Firms in each phase tend to focus on their own welfare rather than that of the overall industry. Continued attempts to improve efficiency by better coordination of the entire beef production chain are expected. Domestic beef demand has been eroding, but exports are expected to grow. It remains to be seen how the current "mad cow disease" scare ultimately affects demand for U.S. beef.

Poultry

The poultry industry is affected by many of the same forces affecting the other species, but export markets may be more important in the case of poultry. Broiler exports approach 20 percent of domestic use, and turkey and egg exports are also increasing. Technology for poultry production is not geographically specific. It may be cheaper to move feed long distances than equivalent quantities of poultry even though the feed quantities are greater. Under that rationale, where to convert the feed to poultry products is a question, given that feed supplies are located in the U.S. while consumers are located overseas. So far, U.S. poultry companies remained in a strong competitive position by capitalizing on the benefits of large-scale operations, capital availability, relatively stable currency, and a stable political system. One factor benefiting U.S. producers is the difference in preferences for light and dark meat. The less preferred dark meat can be sold overseas where it is preferred, at prices that discourage foreign competitors.

ECONOMIC ANALYSES OF GOVERNMENT POLICY RELATING TO LIVESTOCK INDUSTRY STRUCTURAL CHANGE

Economic analyses of government policy relating to livestock industry structural change are selectively reviewed in this section. Policy issues are addressed here because, as described above, policy is an important driving force for structural change that interacts in significant ways with technology, resources, and market conditions. Some of the literature discussed here is also covered under topic C, "Role of Government," of the GEIS literature review (Hayes et al. 1999). That paper contains more detail about the specifics of laws and regulations, especially Minnesota state and local regulations relating to the environment and human health. The discussion here is confined to policies relating to structural change issues and economic implications of broad policy areas. Policies that can at least potentially affect livestock industry structure are many and varied. Those policy areas most often mentioned in that regard include:

- environmental policy,
- policies toward industry consolidation and market performance,
- farm credit,
- land use and urban sprawl,
- intellectual property protection,
- subsidies for research and education,
- international trade,
- commodity price and income support,
- tax policy,
- economic development (non-agricultural),
- transportation,
- immigration, and
- energy.

The first three areas (environmental policy, policies toward industry consolidation and market performance, and farm credit policy) were addressed in the GEIS "Structure/Profitability" section D/E of the literature review in response to specific questions raised in the scoping document. Land use and urban sprawl, intellectual property protection, and subsidies for research and education were addressed in the "Role of Government" section C of the literature review. The material from that publication is summarized and updated here. International trade and commodity price and income support policy is also addressed here in some detail because they are important forces not previously addressed. Brief comments about the other areas are also included.

The tradeoffs between environmental, price support, and international trade policies at the federal level are described in a background paper prepared for the 2002 farm bill debate, (Claasen et al. 2001). They point out that performance-based policies (paying producers who achieve good environmental performance or improved performance, or who use environmentally sound practices) have appealing aspects. Such policies would focus activity on practices that are effective in a given setting, and reduce producer participation costs by allowing them to select least-cost alternatives. The higher planning and enforcement costs for performance-based payments must be weighed against the inefficiencies of the older "one-size-fits-all" approaches, however. Also, payments for good environmental performance or good practices could provide unintended incentives to expand crop production onto previously uncropped land, unless sodbuster-type provisions are included.

Empirical studies comparing targeted versus nontargeted policies show mixed results. A simulation analysis of nitrogen fertilizer taxes to reduce groundwater nitrate concentrations in eastern Oregon found that the gains from a spatially-differentiated tax were modest compared to a uniform tax that ignores spatial differences (Fleming and Adams 1997). They considered it unlikely that the gains would be enough to cover the additional monitoring and other costs involved in the spatially-oriented tax. They also found that because of the inelasticity of yield response, the tax would have to be about four times the price of nitrogen fertilizer in order to bring about the necessary reductions in fertilizer usage. A tax of that magnitude seems unlikely to be implemented in the near future, from a political standpoint. On the other hand, a study of the impact of a hypothetical 40% reduction in phosphorus loading in the Le Sueur River in Minnesota found that a targeted approach would only reduce net farm income by five percent while a nontargeted approach would reduce it by almost 22% (Westra et al.).

Environmental Policy

A theoretical, spatial model of how livestock producers can be expected to make economic decisions under economies of size in waste handling is described in (Innes 2000). He uses the model to derive insights about design of regulations to reduce negative externalities from storage leaks and spills and from excessive land applications of manure.

Drabenstott argues that environmental regulations have recently been and will in the future be a major influence in the future location of the pork industry (Drabenstott 1998). This is a summary of statistical data from a variety of sources with interpretive comments about driving forces and possible future directions. Even if tighter regulations do not require existing livestock facilities to be modified, competitive pressures due to productivity improvements elsewhere in the industry may reduce the profitability of existing facilities. Producers will then be forced to expand, renovate or replace them (refer to the treadmill hypothesis mentioned under question E2a), at which point they become subject to increased regulatory scrutiny. See the discussion by Outlaw et al. for empirical results related to this point (Outlaw et al. 1993).

Drabenstott argues that the new pork supply chains with tens or hundreds of thousands of sows prefer large-scale units, and so have tended to locate their units in non-traditional pork producing states such as Utah and Oklahoma because of their less restrictive environmental regulations. He states,

> “What is clear is that firms in the pork industry are comparing regulatory climates across state lines and even county borders in search of places with fewer regulations. Analysts are divided on how important environmental regulations are in causing geographic shifts in production.” (p. 91)

The states are responding rapidly with tighter regulations, however. He also states that there is no comparison available on state-by-state variation in the overall costs of compliance with environmental regulation. Drabenstott claims that two environmental issues will be important in shaping pork industry location decisions:

- whether a national set of environmental standards is enacted, and
- differences in regulation across national borders.

The EPA has announced that it wants final action on national guidelines by December 2001. Drabenstott argues that standardized national standards would tend to push location decisions to the local level, where some communities are eager to embrace the industry while many others are not. He also argues that standardized national environmental regulations would highlight the role of corporate farming laws, which are addressed under question D1b. The issue of livestock production moving across national borders is illustrated by (Freese 2000), who found that eight of the 50 largest swine operations in North America in 2000 were located in Canada.

We could find few published empirical analyses of the cost of livestock operations' compliance with environmental regulations. One reason for the dearth of work on this area may be that the regulations are evolving so rapidly and vary so much across localities and farm types. It is difficult to arrive at a small number of representative farm situations that can be analyzed to provide results that are generalizable to the range of farm situations that are out there, and that will stay relevant into the future.

A recent PhD thesis at the University of Minnesota examined various ways that Minnesota regulators could meet federal regulations on phosphorus emissions into the Minnesota River, considering both point and nonpoint sources, and both agricultural runoff and wastewater treatment plants (Johansson 2000). Findings were that abatement costs varied widely across the various land units in the watershed and the point sources. A uniform reduction across all sources was the most costly approach. A 40 percent phosphorus abatement could be achieved at significantly less cost by using either tradable permits, effluent fees or quotas geared to the efficient reduction for each source.

Impact of State and Local Policies on Locational Shifts of the Livestock Industry
Metcalfe studied regulatory data for 19 states on ten different regulations imposed to control manure management on animal feeding operations, and found that the regulations became significantly more stringent between 1994 and 1998 (Metcalfe 2000). He ranked the regulations using an index based on 1) some regulation imposed at the local level, requirements for 2) facility and 3) waste system design approval, 4) geological testing, 5) requirements for public notice or hearings, 6) regulated setback distances, 7) nutrient management plans, 8) size restrictions more stringent than federal NPDES permit levels, 9) bonding requirements, and 10) moratoria on size of operation or on total production. Presence of cost-share programs was also considered. By his index, Minnesota's regulations were the most stringent in 1994.

By 1998, five other states had regulations on a par with Minnesota's (Arkansas, Georgia, Iowa, Kansas, and Mississippi, while Illinois, North Carolina, and South Dakota were only slightly less strict than Minnesota. Such broadbrush comparisons may miss important aspects of the regulatory process, however. A recent magazine article focused on the high cost of obtaining a feedlot permit (said to be $50,000 in one in Minnesota case and $70,000 in another), threats of legal action, and negative local attitudes which are causing livestock producers to consider relocating to locations outside the Upper Midwest (Sands 2001).

The significance of the state corporate farm laws and state and local environmental policies is difficult to evaluate reliably. One approach taken in several studies is to measure the policies' impacts by comparing livestock industry trends in states with more and less restrictive policies. The most recent study of this type is Park et al. (Park et al. 2000), a presented paper from the 2000 Western Agricultural Economics Association annual meeting. As a presented paper, it has not yet received the scrutiny that a peer-reviewed journal article would receive. Some parts of the paper are not explained very clearly2. Despite such flaws, the paper is cited here in addition to two older papers discussed below, because it contributes to the knowledge base in at least three ways. First, it relates the rather thin literature on livestock industry location to a more substantial literature on factors affecting location of manufacturing plants. The authors conclude from that literature that environmental policy differences generally have little effect on manufacturing plant location, although in some cases policy stringency is negatively correlated with plant location decisions. Second, they entertain the possibility that the relationship between environmental policy and livestock industry location is a two-way one - environmental policy developments may be a result of past livestock industry growth, as well as driving future growth, although their regression analysis is inadequate to establish which way the causality lies. Third, they break out the policy impacts between on small (less than 300 AU), medium (300 to 1,000 AU), and large (over 1,000 AU) operations, with all livestock species combined into one size measure with the inventory data converted into animal unit equivalents. They include data for all 48 contiguous states over a 30-year period, but their data on policies was taken from a 1998 survey so might not have accurately represented earlier policies.

Another study looked at trends in the swine industry in 13 major producing states over the period 1988-95 (Mo and Abdalla 1998b) (Mo and Abdalla 1998a). This was a linear regression analysis with the dependent variable being the annual percentage change in hog inventory by year, for the states IL, IN, IA, KS, KY, MI, MN, NE, NC, OH, PA, SD, and WI. Sixteen independent variables were included covering four categories: Natural Endowment, Economic Factors, Business Climate, and Regulation Factors. Of the four categories, economic factors were found

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2 For example, a table of annual percentage changes in livestock inventories by size of operation between 1970 and 1996. The source of the data is said to be the 1997 Census of Agriculture, but the data is given in two-year increments while the census is only conducted every five years so perhaps some sort of smoothing technique was used to interpolate to the intervening years, or the data was actually obtained from other National Agricultural Statistics Service publications.

to have the greatest influence on swine industry growth. These included the hog-corn ratio, percentage of farms with a hog inventory over 1,000 animals, and state slaughter capacity having positive impacts on growth. It is interesting that growth was more rapid in states with higher land values rather than lower ones. They had expected a lower land cost to stimulate expansion because it would reduce capital requirements. On the other hand, higher land values would provide collateral for facility loans, and that may be the influence that they picked up in the analysis. They included seven variables to measure the restrictiveness of state and local policies:

- Green index of general environmental regulations at the state level
- Lester classification of states' commitment to environmental protection activities and institutional capabilities
- Stringency of states' animal waste programs, based on rankings by three experts
- Staffing levels devoted to state animal waste control programs
- Average amount of fines imposed annually by state regulators
- Presence or absence of an anti-corporate farming law in the state
- Presence of absence of an agricultural exemption to local zoning

The impacts of the policy variables were as follows: The Green and Lester measures were found to have mixed influences on growth. The Lester measure placed more weight on enforcement capability, and was associated with lower growth (Mo-Abdalla do not provide details on the variables entering into the Lester and Green measures, but they cite other publications which describe them in detail). The measure of stringency of animal waste programs was insignificant, possibly because of the way it was measured. Fines tended to have a negative impact on growth. Higher staffing levels were also expected to suppress growth but had the opposite effect, possibly because the causality runs the other direction -- the industry grows, and then staff is increased in response. Growth was more rapid in states with agricultural exemptions to local zoning. Anti-corporate farming laws, on the other hand, did not slow growth. It should be noted that they did not attempt to measure how strict each state's anti-corporate farming law was.
Osei and Lakshminarayan performed a similar regression analysis of the U.S. dairy industry (Osei and Lakshminarayan 1996). They looked at the probability that a given county would experience an increase in dairy farm numbers between the two census years 1987 and 1992, as a function of milk price, feed costs, temperature and precipitation, land value, population density, surface water density, and four variables characterizing the stringency of environmental policy.

The economic variables of milk price, feed costs, and land values again had the expected effects, with higher milk prices encouraging farms to locate in the county while higher feed costs and land values discouraged location. Values for four environmental variables (air quality, groundwater policy, soil conservation, and an aggregate environmental policy index) were obtained from data provided by the Fund for Renewable Energy and the Environment as cited in (Lester and Lombard 1990). The four environmental policy variables all reduced the probability of location. When population density was introduced as a variable, the separate effects of the environmental policy variables were still negative but of lesser magnitudes. This was especially true for air quality policy. Their explanation is that:

> "The intuition behind this is clear when we realize that air policy issues arise in relation to odor and other air quality problems, which are most prominent when dairies are located in residential or densely populated areas. Thus, by locating away from densely populated areas, dairies avoid most of the regulatory pressures relating to odor and other air pollutants."

This issue is discussed in more detail in the section D/E updated literature review under Question E3, "How do government policies, regulations and programs affect the profitability and viability of livestock farms and firms in Minnesota? How do governmental policies in other states and countries differ from those in Minnesota with respect to their impacts on farm/firm profitability and viability in those places, and what can we learn from their experiences?" and Question D4, "What is the current market situation, how is the market changing and what are the implications for livestock producers with respect to the following factors: concentration of buyers, contractual buying and selling arrangements, price discovery and market fairness, access to markets, access to inputs, such as credit and genetics, terms of trade, and lending practices."

Cost of Compliance with Waste Management Regulations
One empirical analysis of dairy farms' cost of compliance with 1993 U.S. Environmental Protection Agency standards is (Outlaw et al. 1993). They did an analysis of budgets for a number of representative farms using their Farm Level Income and Policy Simulation Model (FLIPSIM). They looked at several dairy farm sizes in different regions of the U.S. They used the EPA Region VI standards as the basis for comparison, and adjusted them for climatic and soil conditions in the other states. The did not study Minnesota, but for Wisconsin they found that minimum capital investments for compliance ranged from $20,000 on a 50 cow farm to $40,000 on a 175 cow farm. Also:

"Moderate size dairies were found to be affected more adversely by being required to meet the specified Region VI EPA regulations than large size dairies. Dairies that were already in financial trouble could be put out of business by requirements to conform with the Region VI EPA standards. Many of these dairies, however, could go out of business regardless of the EPA requirements, albeit at a later date.

Large scale dairies that were not already in financial trouble appear to be able to amortize the extra capital investment costs associated with meeting the Region VI EPA requirements. This suggests that moderate size dairies faced with needing to make investments to meet the EPA standards may choose to expand the scope of their operations, if financially able. While such expansion would require an even larger investment, it also would hold the potential for making the dairy more efficient and competitive." (p. ii)

Efforts to Address Environmental Issues at an International Level

Many environmental issues cross national boundaries, and as a result are being addressed in various international negotiations. A total of 171 environmental treaties, protocols, and agreements on a diverse set of issues are registered with the United Nations (Peterson 2000). He suggests that an umbrella international environmental organization might achieve cost savings and more optimal levels of environmental protection compared to these piecemeal efforts, and discusses design considerations for such an organization. Such an organization could defend environmental principles in the same way that the World Trade Organization defends principles of liberal trade.

Friedman points out that making the leap from national institutions to formal global institutions bumps into at least two problems: 1) the reluctance of people to give up sovereignty to politicians and bureaucrats from the other side of the world over which they have not democratic control, and 2) the difficulty of enforcing regulations or behaviors in remote locations or cyberspace (Friedman 2000), p. 206. He feels that the Internet and related technologies are more likely to improve global governance and enforcement of global norms by means of networking and publicity, than would formal government institutions.

Industrial Organization Policies

One other issue that is driving change the livestock industry is that of policy toward industry consolidation and market performance. While livestock producers tend to focus their concerns on consolidation and performance at the packer level, the academic literature suggests that developments at the retail level may dictate the future of the overall food industry. Cotterill describes how newly unfettered global capital markets since 1980 have altered the food industry (Cotterill 2001). Leveraged buyouts, in particular, have allowed big investors to restructure firms in ways that tighten the firms' cash flows. When the issue of market power is left out of the analysis, such restructuring appears beneficial in offering shareholders more risk-return choices and assuring them that management is pushing relentlessly for profits. Bankruptcy becomes a more credible threat for the restructured firms, however, because of their tightened cash flows. When such firms possess market power, this bankruptcy threat puts them are in a much stronger position to force concessions from workers and force suppliers to lower prices. Such concessions then result in income transfers to the firms but do not necessarily improve economic efficiency of the overall food system.

Cottterill describes the neoclassical economic theory behind the common observation that farm-level price changes tend not to be fully transmitted into retail price changes. One counterintuitive result of this analysis is that vertical integration of food manufacturers with retailers can be a "win-win" situation for both themselves and consumers. An integrated manufacturer-retailer who is a monopolist will tend to both offer lower consumer prices and achieve higher profits than would food manufacturers and retailers who are monopolists in their stage but separate from the other stage. A related model is proposed by Giraud-Heraud et al. to explain instances in the French wine industry where large processers have restricted volumes to what could be sold as higher-quality brands, even though producers would have benefited from selling additional production in lower-quality segments of the market (Giraud-Heraud et al. 1999). Models such as this might provide a conceptual framework for exploring what market conditions would have to be present for Minnesota livestock producers to benefit from direct marketing (such as through a value-added cooperative).

Cotterill sees horizontal mergers among U.S. supermarket chains as a concern for food manufacturers and producers, however. He suggests plausible future mergers which could result in as few as six national supermarket chains who would control over fifty percent of all U.S. supermarket sales. With such volume, these chains would be able to institute their own retail brands which would be strong enough to diminish the positions and stock market values of the large U.S. food manufacturers. This development is presently further along in Europe than in the U.S. An interesting aside is that new VCR-like machines with hard disks are expected to make it easier for consumers to ignore television commercials. The diminuation of television advertising could make it more difficult for manufacturers to maintain their brand equity, placing them at a further disadvantage compared to retailers. This trend may have implications (not addressed by Cotterill) for livestock producer groups who add value by means of long-term marketing contracts under which premiums are paid in exchange for genetics and production practices that fit the packers' brands. If these packer brands lose ground to those of the retailers, the market environment faced by producers may change.

"Slotting fees" currently charged by retailers are an example of the use of market power to extract concessions from manufacturers which then must raise prices to maintain an acceptable return on investment, in effect forcing smaller customers to subsidize the large retail chains. Cotterill suggests that such results may lead to rejuvenated enforcement of the Robinson-Patman Act, which gives retailers (read smaller ones) legal recourse against manufacturers that grant discounts to other retailers (read larger ones) that are not cost-justified. The other main policy suggestion he makes is for monopsony/oligopsony merger guidelines that refocus attention on mergers' impacts on farmers and other suppliers, as opposed to the current focus on local retail market concentration and consumer prices.

The food marketing sector's market power can affect the welfare of consumers, producers, and overall economic efficiency. The food-marketing sector is made up of many different product segments with different degrees of market power. Sexton and Zhang present a theoretical economic model and use it to quantify the welfare effects of various degrees of this market power (Sexton and Zhang 2001). Their key result is that it is important to consider both buyer (oligopsony) and seller (oligopoly) power, and the potential impacts of successive market power at multiple stages of the market channel. The impacts can be under-estimated if only one stage is evaluated at a time. Compared to a competitive equilibrium where food marketers just cover their costs with no surplus, oligopsony and oligopoly would redistribute gains away from producers and consumers, toward the marketers3. Plausible levels of oligopsony and oligopoly would allow food marketers to capture the largest share of the surplus for themselves, leaving smaller shares for consumers and producers. The analysis leaves a number of policy-relevant questions unanswered, however, including 1) whether increasing concentration increases efficiency or breeds wasteful competition, 2) how important quality and variety are affected by concentration and market power, 3) whether producers can exercise countervailing power through cooperatives and bargaining, and 4) how effective antitrust regulations are in curtailing market power when it exists.

Concerns about market power at the farm level are addressed in Minnesota and many other states through regulations on legal organization choices (Hoppe 1996). In Minnesota, Statute 500.24 places limitations in the amount of farmland which a corporation can own. Corporations are prohibited from engaging in agriculture, except for family farm corporations and authorized farm corporations. Certain other exceptions to the prohibition also apply. Limited liability companies are prohibited from engaging in agriculture in Minnesota, and the regular business corporation laws apply to farming in the same way that they apply to other businesses. There are tax implications to the choice of legal organization. Harl includes a discussion of corporate farm laws in Minnesota and other states, as well as discussing the process of incorporation, what taxes apply, and other factors to consider (Harl 1996). The text of Minnesota’s corporate farm law is accessible on the World Wide Web (Minnesota State Legislature 1998).

The rationale for regulating legal organization choices in agriculture is given in subdivision 1 of 500.24: "The legislature finds that it is in the interests of the state to encourage and protect the family farm as a basic economic unit, to insure it as the most socially desirable mode of agricultural production, and to enhance and promote the stability and well-being of rural society in Minnesota and the nuclear family." For a related discussion, see Lazarus, and pages 137-39 of Lasley et al. (Lasley et al. 1995; Lazarus 1995). The choices of legal organization available to Minnesota farmers are addressed in more detail below under Question D1b, "To what degree are livestock producers allowed to operate agricultural systems interdependently as opposed to independently in Minnesota and in other states and what is the significance?"

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3 Welfare effects are measured in terms of "consumer surplus," which is the area under a demand curve or the difference between what they pay collectively for a product compared to what they would be willing to pay, and "producer surplus" showing what producers receive compared to what they would be willing to sell for.

Legislation has been proposed at the federal level and in 16 states to protect contract growers and producers, along similar lines to Minnesota's "Agricultural Contracts" law but with the addition of language to prevent retaliation against producers who participate in producer organizations. Arguments for and against the proposed federal legislation are given in (Boehlje et al. 2001) and (Harl et al. 2001). Boehlje et al. question whether the new rules would be sufficiently restrictive that the unintended consequence would be to not maintain a relatively independent agricultural structure, but instead to encourage vertical integration through ownership of production facilities by processors and packers. Harl et al. reply that all of the provisions have precedent in other areas of the law, such as consumer protection legislation or trade regulation, and that the provisions have not been shown to cause economic harm in those other contexts.

Boehlje et al. do not discuss how the presence of a corporate farm law would affect the likelihood of ownership integration. The authors of Boehlje et al. are employed at Purdue University, located in Indiana. The fact that Indiana does not have a corporate farm law may affect the perspective of their paper. Minnesota's law prohibits such ownership integration, so that concern may be less real in Minnesota (Hamilton and Andrews 1992). Contract hog production has increased in Minnesota in the 1990s to the extent that transfers from contractee enterprises in 1999 exceeded sales from independent farrow-to-finish enterprises, despite the fact that Minnesota's "Agricultural Contracts" law has been on the books since 1990 (see Tables 25 and 31 below). Boehlje et al. also caution that restrictive multi-state or federal regulation might cause a shift in production to Canada, Latin America, Asia or Australia.

Concentration, conduct, and performance of the meatpacking industry have been extensively studied (defining performance by measures such as the ability to charge monopoly prices). One recent study was organized by GIPSA in 1992 and published in 1996 (Concentration in the Red Meat Packing Industry 1996). One of the seven individual projects conducted as part of the study was a literature review of the economic history of the meatpacking industry, theory, and evidence (Azzam and Anderson 1996). (Azzam 1998) is an updated summary of the literature review. (Heffernan et al. 1999) documents the increasing concentration of agricultural production and processing in the hands of the top firms and the development of food chain clusters of firms combined in a variety of business relationships. Changes in concentration in U.S. commercial livestock slaughter between 1909 and 1994 are summarized in (Azzam and Anderson 1996), pages 22-30. The percentage of slaughter done by the top four firms has been rising since the mid-1980s, and was at 82 percent for steers and heifers, 73 percent for sheep, and 46 percent for hogs in 1994.

(Heffernan et al. 1999) and (Azzam 1998) present differing perspectives on the issue of increasing concentration. Heffernan et al. predict that four or five global clusters of food firms will emerge. Heffernan observes that other concentration studies have tended to focus on individual firms, and so miss important information by neglecting the relationships (e.g. joint ventures or strategic alliances) among firms within a cluster. They argue for government intervention on the grounds that the current highly concentrated structure allows a handful of firms to control the food system and capture higher-than-competitive profits at the expense of independent farmers and rural communities, and that the concentrated food system is too vulnerable to disruption. They do not attempt to measure differences in performance between more and less concentrated industry structures, but rather argue that the risk of poor performance is too great to delay action until empirical data becomes available.

Azzam reviews the studies that have attempted to measure the relationship between concentration and performance in the meatpacking industry. Some studies were done along the traditional lines of the Structure-Conduct-Performance (SCP) paradigm; others were based on more recent methods from what has become known as the New Empirical Industrial Organization (NEIO). Cross-industry studies in the 1960s focused on profitability as the measure of performance. They found that industry profitability increased with concentration, and these studies had an effect on antitrust policy of that era. These studies were criticized, however, over interpretation of their profitability-concentration correlations. An alternative interpretation was that firms become large because they are efficient due to greater managerial skills and innovativeness. Later studies shifted their focus from comparing profits across industries, to comparing prices across geographically separated markets within a single industry. Using price as the performance indicator instead of profit was thought to be a better way to measure market power because price would not pick up effects of efficiency differences that would affect the profitability measure. Most SCP studies of market power in the US meatpacking industry were of the price-concentration sort. NEIO models focus more directly than SCP models on what type of industry conduct is consistent with observed prices and quantities, and can test a variety of oligopoly theories.

Azzam (Azzam 1998) views the above empirical studies as one way of assessing competition - taking a snapshot of industry equilibria at a point in time. The studies offer little understanding of how the industry reached where it was at that point or whether, in fact, the economic data used in the studies represent equilibria. Azzam concludes that the evidence from both SCP and NEIO models on balance seems to indicate a (statistically) significant but small departure from competitive conduct. The implication is that both consumer and producer welfare could be increased by steering packer behavior toward closer conformity with the perfectly competitive benchmark. The question is whether one should target the structure or conduct of the industry. The question of whether the positive efficiency gains from industry consolidation outweigh the negative effects of greater market power remains an issue. Azzam cites two studies of beefpacking which attempted to find out whether the cost reductions achieved through economies of plant size or multi-plant operation offset allocative efficiency resulting from deteriorating packer market conduct, (Azzam and Schroeter 1995) and (Azzam 1997). Azzam and Schroeter found that the anticompetitive effects of a 50 percent increase in concentration were, at most, on the order of 2.4 percent. This was well below their estimate of actual cost savings of 4 percent which is likely to be generated by a 50 percent increase in the size of a representative plant in the industry. They concluded that the structural changes in beef packing in recent years have been welfare enhancing on balance. Azzam (1997) used a different approach but also found that the cost-efficiency effect outweighed the market-power effect. One more recent study just released by USDA is (Hahn et al. 1999). They studied monthly changes in U.S. farm-wholesale price spreads between 1979 and 1996. They did not find evidence that packers were exercising market power, although they caution that with concentration at 80 percent or higher, the potential for exercising market power in the industry does exist. Paul explored the market and cost structure of the U.S. beef industry using monthly cost and revenue data from a USDA Grain Inspection and Stockyards Administration survey of the forty-three largest U.S. beef packing plants in 1992-93 (Paul 2001). She found little market power exploitation in either the cattle input or beef output markets, and that any apparent evidence is counteracted by cost efficiencies such as utilization and scope economies.

Azzam argues that from a historical standpoint, the meatpacking industry has performed well in terms of innovation. It can be viewed as competitive in a dynamic sense of optimizing the allocation of resources between the present and the future. Profits are the returns to the innovative activity necessary to maintain a dynamically competitive process, and the appropriate type of competition to be concerned about is not static price competition, but competition in innovation. Innovations that have grown out of the industry structure range from ice rooms and refrigerated rail cars adopted a century ago to boxed beef technology today. Thus, it would be a mistake to surgically intervene to maintain an industry configuration consistent with the static notion of competition. The top meatpacking firms today such as IBP only recently reached dominant positions, while the top firms at the turn of the century disappeared long ago in what has been termed a "perennial gale of creative destruction." This would suggest that it is unlikely that a few firms will be able to maintain their positions for very long even without government intervention.

Azzam recommends that policy focus on industry conduct rather than structure (Azzam 1998). The aspect of conduct that policy should focus on is the degree to which competing firms may be able to coordinate their pricing without conspiring in the usual sense of the term - that is, without any overt or detectable acts of communication. The challenge is to develop creative measures, in the form of marketing institutions, to dissipate the rents from implicit collusion. Where acts of communication are overt and detectable, as in the recent ADM price-fixing case, antitrust remedies come into play. Mandatory price reporting as a policy response is discussed further below in the "State-Level Response" section.

A review of the literature of wholesale meat market concentration summarizes several studies which generally raise concerns about packers' and retailers' exercise of market power to the detriment of producers (Strange and Higby 1995). They describe motivations for the move toward formula pricing of slaughter animals and the problems presented by the reduction in the share of the market that is traded by negotiation. An analysis of randomly selected meat market reports shows how the selling of lower quality carcasses and cheaper cuts through channels that are reported, while higher quality ones are fabricated for their own retail customers or into specialty cuts that do not fit into reported standard commodity categories, may bias wholesale price reports downward. They provide a brief summary of the 1977 Illinois Brick Co. ruling by the U.S. Supreme Court, which held that only direct purchasers or sellers may sue a firm for damages due to the use of market power. This ruling presents an obstacle to farmers who might be in the position of being damaged by depressed wholesale prices that are passed on by packers or other intermediaries.

The USDA Advisory Committee on Agricultural Concentration reported to the Secretary of Agriculture with policy recommendations in 1996 (Concentration in Agriculture: A Report of the USDA Advisory Committee on Agricultural Concentration. 2001). Guiding principles they identified were to: promote competition; achieve, as close as possible, equal market information for buyers and sellers; and assure that markets exist for all comparable products under comparable terms, while being mindful of avoiding recommendations that proscribe market behavior in ways which could ultimately stunt opportunities for growth within the industry. A few key recommendations that seem germane to the GEIS scoping questions are:

- expand the private right to action to parties believing themselves to be damaged by violations of the Packers & Stockyards Act (P&SA), by providing a right to attorneys' fees,

- amend the PS&A to provide the same enforcement authority in poultry as in red meat, including growers who raise and care for poultry for another entity,

- permit price differentiation only with respect to differences in quality, verifiable differences in procurement costs (including differences in cost due to quantity), and time of delivery,

- research the reasons for and sources of economic difference in the value of market hogs,

- improve price reporting in a number of specific ways (this report was published before Congress enacted mandatory price reporting),

- make sure all parties in contracts or other alliances are well informed about their risks and rewards, set up rules to "level the playing field" with penalties for behavior deemed "a priori" to be exploitative or inappropriate, standardize terminology, and address pollution problems that might be a consequence of integration, and

- enable cooperatives and contract grower associations to bargain with processors without fear of recrimination, and require handlers to engage in good-faith negotiation with producer cooperatives and networks.

A minority report calls for stronger action, especially with regard to captive supplies and packer procurement practices.

Two federal government agencies responsible for policy regarding concentration of buyers of agricultural products are the Antitrust Division of the U.S. Department of Justice, and the U.S. Department of Agriculture's Grain Inspection, Packers and Stockyards Administration (GIPSA). An overview of the Antitrust Division's role is available on the Internet at (U.S. Department of Justice Antitrust Division Overview 99). Text of Congressional testimony about what the antitrust laws prohibit and Antitrust's recent activities related to the meat packing industry is available at (Turetsky 1996). The responsibilities of the Grain Inspection, Packers and Stockyards Administration are described at (USDA Grain Inspection, Packers and Stockyards Administration 99).

The meatpacking industry is comprised of multinational firms over which the Minnesota state government and local governments have very little influence. State and local policy options available to influence livestock processors would include whether to offer financial incentives to attract new slaughter plants, whether to allow the processors to produce their own animals, and how strict to be in environmental regulations on the plants. The entire scope of state and local policies affecting livestock production in the state is also likely to indirectly influence livestock processors, because shrinking production seems certain to ultimately result in slaughter plant closures while new plants will locate in areas that either currently have more production than can be slaughtered in nearby plants, or appear receptive to expansion.

One implication of marketing contracts for non-contracted producers is that the spot market becomes thinner and price discovery becomes less reliable. The term "captive supplies" is used to refer to the share of supply that does not go through the spot market, either because it is transferred through contractual arrangements or through vertical ownership integration of packers into the production stage or vice versa.

(Azzam and Anderson 1996) summarizes three studies of packer integration or captive supplies on fed beef cattle prices. Concern about packer feeding is not new, as the first study was conducted in 1966 (Aspelin and Engelman 1966). They found that packer feeding in the late 1950s and early 1960s varied from 4.6 to 7.4 percent of total marketings of fed cattle, with 151-215 packers involved in feeding cattle. They found that packer-feeder volume had a significant negative impact on terminal market cattle prices in the study area, which was one of the top ten terminal markets. A regression analysis found that a 100-head increase in packer-fed shipments to the plant, on average, lowered the local average price for Choice steers relative to other markets for the entire week by about $0.06 per hundredweight. A 1991 study found similar results (Schroeder et al. 1993). This study also found that price variability was not related to captive supplies. Another 1991 study found that captive supplies affected prices in Kansas but not in Colorado, Nebraska or Texas (Hayenga and O'Brien 1992).

In 1992, the USDA Packers and Stockyards Administration commissioned a major study to provide a more definitive answer to the captive supplies question (Ward et al. 1996). They found a:

> ".. relatively weak negative relationship between transaction prices for cash market cattle and either delivering cattle from an inventory of captive supplies or having an inventory of captive supplies from which to deliver at a later time. Results were not robust. Several versions of the models were estimated and estimations over sub-periods within the 1-year study period yielded inconsistent results. ... Price differences were found among procurement methods, but with the possible exception of price differences between forward contracts and cash market prices, observing such price differences in everyday transaction prices would be difficult." (pp. 81-82)

The USDA Grain Inspection, Packers and Stockyards Administration analyzed the hog procurement transactions during January 1996 by 4 firms and 12 plants in Iowa, southern Minnesota, eastern Nebraska, and the southeastern corner of South Dakota (Western Cornbelt Hog Procurement Investigation (GIPSA Backgrounder) 1998). The impact of procurement method on pricing was one of the issues studied. Results generally showed higher prices for marketing agreements and carcass merit pricing grade and yield versus spot live purchases. The spot market transactions tended to exhibit lower hog quality characteristics than the transactions under marketing agreements and forward contracts. Small sellers tended to sell on a spot market basis and received lower prices. The report of the study seems to leave unanswered the question of whether the price differential due to seller size was reasonable due to quality and transaction costs, or whether the smaller sellers were unfairly discriminated against.

A comparison of year-to-year hog production and price changes over the past three decades shows that prices have become more volatile (Tank). In the 1970s and 1980s, a one percent change in production resulted in a price change of around one and a half or two percent. During the late 1990s, the price response has been at least twice that great. It is unclear how much of the increased volatility is due to the increased prevalence of marketing contracts, and how much is due to other factors.

In response to the concerns described above, the Secretary of Agriculture announced a new rule on November 28, 2000 that requires large cattle, swine and lamb packers and importers to provide information about livestock marketing, including pricing, for public dissemination. The new reporting will provide information on 80-95 percent of all cattle, boxed beef, slaughter hog, sheep, lamb meat, and imported lamb meat transactions including purchases for future delivery, and packer-owned livestock, subject to certain confidentiality guidelines. The mandatory price reporting system was to go into effect on January 30, 2001, but has been delayed until April 2, 2001 to allow more time to test the electronic information collection system (USDA Agricultural Marketing Service, Mandatory Price Reporting 2001).

An emerging concern is being raised relative to the privatization of information and the potential social, economic, and environmental impacts that may result. Particular issues are that: 1) Institutional relations governing development, control and application of information in agriculture are changing at an accelerated pace, 2) Current and future processes through which knowledge is created and information applied in agricultural production systems will be developed through synthesis of political, economic, institutional, and technological considerations, and diminished public sector involvement and 3) Increased private sector responsibility for information development and dissemination in agriculture is significant (Wolf 1998).

Recent Developments in International Trade Policy

A major reason that U.S. agriculture has remained competitive internationally is due to its comparative agricultural productivity as measured by total factor productivity (TFP). Since TFP growth in U.S. agriculture is strongly associated with public R&D and infrastructure, the relative competitiveness of U.S. agriculture, in the long run, is likely to depend on its ability to sustain and increase growth in TFP. The livestock industry in central and eastern Europe and the former USSR has been hurt by the economic reform there, according to another USDA-ERS report, Transition Economies: International Agriculture and Trade Situation and Outlook Report. Potential accession of a number of eastern and central European countries into the European Union (EU) seems destined to lead to further reforms of the Common Agricultural Policy (CAP). The financial costs of absorbing these countries may be extreme. (from Agricultural Competitiveness: The Case of the United States and Major EU Countries, Transition Economies: International Agriculture and Trade Situation and Outlook Report, and Agriculture and European Union Enlargement at (USDA Economic Research Service Publications: International Agriculture 1999))

In this paper, the discussion of recent developments in international trade is framed in terms of the following questions:

- Is the U.S. holding its ground in terms of its international balance of trade?
- How important is international trade to Minnesota agriculture?
- What are the roles of regional trade agreements such as NAFTA and multilateral agreements such as the WTO?
- What are the implications for future Minnesota policy?

Is the U.S. holding its ground in terms of its international balance of trade?

Both U.S. exports and imports have increased substantially in the 1990s, as tariffs and other trade barriers have been lowered worldwide. Imports have increased more than have exports, however, leaving the U.S. trade balance worse off than a decade ago, both for all commodities and for agriculture (the agricultural numbers are shown in Table 1). U.S. agricultural trade accounts for 70 to 80 percent of total NAFTA exports and imports, and the bilateral trade between the U.S. and the other two countries accounts for about 98 percent of intra-NAFTA agricultural trade (Diao et al. 2001a). Canada and Mexico are among the most important trading partners of the U.S., and the trade balance numbers are shown for them as well as for the world overall.

Table 1. U.S. Agricultural and Overall Trade Balance, 1990-2000 (millions of constant 1996 dollars[1])

	1990	1996	1998	2000
Overall - Exports, Imports, and Net Exports				
NAFTA				
Exports	128,934	191,001	228,830	281,333
Imports	139,971	230,189	260,437	342,964
Net Exports	-11,038	-39,188	-31,606	-61,631
Canada				
Exports	*96,365*	*134,210*	*152,249*	*176,391*
Imports	*105,240*	*155,892*	*168,439*	*215,301*
Net Exports	*-8,875*	*-21,682*	*-16,190*	*-38,909*
Mexico				
Exports	*32,568*	*56,791*	*76,582*	*104,942*
Imports	*34,731*	*74,297*	*91,998*	*127,663*
Net Exports	*-2,163*	*-17,506*	*-15,416*	*-22,721*
Rest of the World				
Exports	324,357	659,774	678,205	722,234
Imports	430,465	729,160	808,857	1,007,859
Net Exports	-106,108	-69,386	-130,651	-285,626
World				
Exports	453,290	850,775	907,036	1,003,567
Imports	570,436	959,349	1,069,293	1,350,823
Net Exports	-117,146	-108,574	-162,257	-347,256
Agricultural - Net Exports				
NAFTA	$1,714	$1,787	$672	$317
Canada	*1,828*	*133*	*-759*	*-939*
Mexico	*-113*	*1,654*	*1,431*	*1,257*
Europe	6,021	4,835	589	-1,547
Asia	16,293	22,249	14,248	13,429
Rest of world	-4,114	-877	-1,163	-944
World	$19,915	$27,994	$14,346	$11,255

Source: Overall data from (U.S. Census Bureau, U.S. Trade Balances by Country). Agricultural data from (Scott 2001a), updated with year 2000 data from (USDA Foreign Agricultural Trade of the U.S.).

[1]Values deflated using GDP implicit price deflator.

The Importance of International Trade to Minnesota

The importance of international trade to Minnesota agriculture can be seen from the fact that export revenues accounted for 20 percent to 30 percent of U.S. farm income during the last 30 years. As described by Whitton and Jerardo, "Historically, the bulk commodities—wheat, rice, coarse grains, oilseeds, cotton, and tobacco—accounted for most U.S. agricultural exports. However, in the 1990's, as population and incomes worldwide rose, U.S. exports of high-value products (HVP)—meats, poultry, live animals, meals, oils, fruits, vegetables, and beverages—expanded steadily in response to demand for more food diversity. As of fiscal 1999, HVP exports accounted for a 64 percent share of total U.S. agricultural exports, while bulk exports accounted for 36 percent. U.S. agricultural exports have exceeded U.S. agricultural imports since the late 1950's, generating a surplus in U.S. agricultural trade. The U.S. agricultural export surplus narrowed in recent years from its peak in fiscal 1996. However, it is expected to expand as exports rise in response to the recovery from recent financial crises. Over the past 30 years, exports of oilseeds and all HVP groups grew faster than grain exports. But during the 1997-99 financial crises in Asia, Russia, and Latin America, growth in exports of oilseeds and of animal products declined due to reduced economic growth in Asia, Russia, and Latin America. The drop in the export value of grains, cotton, and oilseed products during the same period reflected low prices and strong export competition. U.S. imports have increased steadily since 1976, as demand for food diversification has expanded. U.S. consumers benefit from imports because they expand food variety, stabilize year-round supplies of fresh fruits and vegetables, and temper increases in food prices. Imports' share of total food domestic consumption was relatively low in 1975 and 1980. However, imports now account for a rising share of total food consumed in American homes. Spices and herbs, syrups, tree nuts, fruit juices, honey, sugar, and lamb are products for which a large share is imported. All U.S. agricultural imports grew throughout the 1990's, despite appreciation of the dollar versus currencies affected by the financial crises. Horticultural products are by far the largest U.S. agricultural imports, at 40 percent of the total. Animals and products are next in importance." (Whitton and Jerardo 2000)

Minnesota's shares of U.S. exports are shown in Tables 2 and 3 in order to further illustrate the importance of international trade to the Minnesota livestock industry. Wheat is the most-exported of the major Minnesota crops, with 40 to 50 percent of the crop exported over the past five years. About a third of the soybean crop is exported as raw beans. Significant shares of the processed soybean oil and meal is also exported. Corn exports run about 20 percent of the crop. Poultry exports amount to around 17 percent of production, while 8 percent of red meat and 2 to 4 percent of eggs are exported. Export values of meat animals and livestock products have amounted to 14 to 17 percent of farm cash receipts in recent years. Exports of poultry and egg exports varied from 8 to 12 percent, while dairy products were around 5 to 6 percent of farm cash receipts. The export values are based on the state's share of total U.S. production of that commodity. The export value percentages shown in the bottom panel are larger than the physical shares of the crops exported because the export values include processing and transport margins not included in farm cash receipts.

The livestock industry, international trade, and NAFTA are all important to Minnesota grain producers, as can be seen by comparing corn production and consumption changes between 1985 and 1999. In 1985, the corn crop was 724 million bushels. It had increased by more than a third by 1999, to 990 million bushels (Minnesota Agricultural Statistics 2000). Part of the increase was due to yield increases related mainly to favorable weather, and acreage was also up which may have been largely due to the elimination of commodity-specific acreage setasides in the 1996 FAIR Act. Feeding to swine and poultry increased by over 50 percent over the period, and processing into ethanol and sweeteners went from a negligible amount in 1985 to around 130 million bushels in 1999. Those increases in livestock feeding and processing were still less than the production increase, however, so exports increased as well over the period, with the largest outshipments going to the Asian market through the Pacific Northwest, and out of Duluth (Fruin and Tiffany). Mexico has become a significant market for Minnesota grain producers since NAFTA, more so for soybeans than for corn. Mexico received about seven percent of all Minnesota grain shipments between July 1999 and June 2000, leading to the conclusion that NAFTA has changed the general pattern of U.S. agricultural trade from an "east-west" direction to a "north-south" one. An implication for the GEIS is that if Minnesota policies are modified in ways that reduce the competitiveness of the Minnesota livestock industry, then at the same time attention could be given to the grain transportation system to make sure that it has the capacity to cost-effectively handle any increased exports that might result from declines in livestock production.

The international financial upheaval that began in Thailand in July 1997 and subsequently spread to other countries set back economic growth and trade worldwide. World economic growth slipped from 3.2 percent in 1997 to 1.6 percent in 1998. The value of U.S. agricultural exports declined by 23 percent in real terms from fiscal year 1997 to fiscal year 1999. This was less of a blow than the nearly 50-percent drop that occurred in the first half of the 1980s, however. The 1997-99 decline was mostly a price phenomenon due to oversupplies in major exporting countries and weakened demand from crisis-affected countries and other countries such as China (Langley 2000). The 1997-99 decline in agricultural exports attributed to Minnesota was 16 percent, or less of an impact than for the U.S. as a whole (see Table 2). One analyst has estimated that the increase in net imports from Canada and Mexico between 1993 and 1998 has cost Minnesota 6,345 jobs. Job loss for the U.S. overall was 440,172 (Scott 2001b).
A related question is, does trade with low-income countries imperil the wages of unskilled U.S. workers and widen the wage inequality in this country? Anderson reviews the literature on this issue (Anderson 2000). He cites data showing that for at least a decade before the mid-1970s, the gap between wages of college-educated workers and of those with only a high-school education had been narrowing. The trend turned in the late 1970s, however. Between 1979 and 1995, men in the bottom decile of full-time workers experienced a 21 percent decline in earnings while the top 10 percent enjoyed an eight percent earnings increase. In Europe, with more tightly regulated labor markets, wages did not change as much but job growth slowed. Economic theory dating from the 1940s hypothesized that trade with low-income countries would put downward price pressure on similar U.S. goods, and force U.S. workers in these industries to accept lower wages.

Empirical studies in the 1990s failed to find the price declines that were expected, however, and concluded that while such trade contributes to inequality, the primary explanation of recent wage trends is the profound and widespread change in technology that makes skilled workers more productive while leaving unskilled-worker productivity unchanged. If trade really were the cause of wage declines, U.S. plant managers would hire more unskilled workers, and fewer skilled workers, to reduce costs. Yet, the exact opposite has happened, with a trend to replace unskilled workers with more skilled ones. Anderson argues that limiting imports would be a bad idea in that it would create more losses for consumers than gains for workers. If technology is the culprit for the growing wage gap, effective policy will focus on workers rather than on imports. He cites a study noting that retraining of displaced workers is not particularly effective. Wage subsidies to make them more attractive to potential employers is a potentially more effective approach. Also, subsidies could be extended to workers whose wages are depressed due to trade-related competition, rather than being limited to those workers who lost their jobs.

Table 2. Shares of U.S. Production Exported, Selected Commodities

	Wheat	Corn	Soybeans	Soybean oil	Soybean meal
1996/97	44%	19%	34%	13%	20%
1997/98	42%	16%	31%	17%	24%
1998/99	41%	20%	27%	13%	19%
1999/00	47%	21%	32%	8%	19%
2000/01	49%	21%	32%	7%	18%
	Beef	Pork	Total red meat	Poultry	Eggs
1997	8%	6%	7%	17%	4%
1998	8%	6%	8%	17%	3%
1999	9%	7%	8%	16%	2%
2000	9%	7%	8%	17%	2%
2001	10%	7%	8%	17%	2%

Table 3. Minnesota agricultural exports and farm cash receipts: Estimated value by commodity group, FY 1995-98.

Year	Meat animals, and livestock products 1/	Dairy products	Poultry and eggs	Grains and oilseeds	Other 2/	Total
				(million dollars)		
Farm cash receipts						
1995	1,785	1,182	481	3,062	632	7,142
1996	2,089	1,362	671	3,864	823	8,809
1997	2,167	1,201	624	3,243	763	7,998
1998	1,762	1,426	567	3,066	859	7,680
Estimated export values						
1995	301	67	47	1,675	345	2,434
1996	305	62	54	2,257	334	3,012
1997	306	75	72	1,770	389	2,612
1998	305	76	68	1,526	384	2,359
Export values as a percent of farm cash receipts						
1995	17%	6%	10%	55%	55%	34%
1996	15%	5%	8%	58%	41%	34%
1997	14%	6%	12%	55%	51%	33%
1998	17%	5%	12%	50%	45%	31%

Sources: Estimated export values are from (Whitton et al. 2000). Farm cash receipts are from (Minnesota Agricultural Statistics 2000) and earlier issues.

1/ Cash receipts include honey and miscellaneous livestock and products. Exports include hides and skins, fats, oils, and greases.

2/ Cash receipts include vegetable crops, sugarbeets, dry beans, apples, floriculture, minor crops, fruits, and vegetables. Exports include feeds, fodders, vegetables, confectionery, nursery & greenhouse, essential oils, beverages, exc. juice, and other misc. animal & vegetable products.

On a related note, a Norwegian study recently considered the question of whether income inequality across countries is becoming more or less equal over time (Melchior et al. 2000). They conclude that international income inequality has decreased continuously from the last part of the 1960s until 1997, when differences in purchasing power are properly accounted for. They were unable to determine what role globalization has played in the observed changes, however.

What are the roles of agreements such as NAFTA, the WTO, and the Rio Summit on Climate Change?

One issue that has the potential to affect agricultural exports and the balance of trade is the rising number of regional trade agreements such as the North American Free Trade Association (NAFTA) and the Southern Common Market (MERCOSUR). A recent study concluded that RTAs appear to have contributed positively to the specialization and division of labor in agriculture among already trading nations, permitting more common and open trade policies (Diao et al. 2001a). The European Union, which is the only region for which a fully implemented trade agreement has been in effect for decades, has seen a diversion of agricultural imports to member countries since the E.U. was formed. European Union policies have not created agricultural trade opportunities for the rest of the world.

While NAFTA has come in for criticism in the U.S. for harming the balance of trade, two recent studies have found that domestic macroeconomic policies in the U.S. and Mexico have also had a major role in recent trade patterns (Diao et al. 2001a; Krueger 1999). Krueger argues that Mexican currency exchange rate policies in the late 1980s led to significant over-valuation of the peso by the early 1990s. The use of 1990 as a starting point for trade comparisons such as in Table 2 might therefore be misleading if the over-valuation depressed exports and stimulated imports at the start of the decade. Other factors which complicate any empirical analysis of NAFTA's effects are that trading relations from 1990 onward were affected to some degree by anticipation of the agreement, because President Bush and Mexican President Salinas signed an agreement in June 1990 that they would negotiate to enter into such an agreement. Also, not all tariffs between the three countries were removed when the agreement went into effect on January 1, 1994. For most commodities, there was a schedule phasing out the tariffs only over a ten or fifteen-year period, so trade flows in 1994 and afterward were not entirely free of duty. Mexico had also removed virtually all quantitative import restrictions by 1990 and had reduced tariffs, so Krueger argues that Mexico's share of the U.S. market after NAFTA would have increased to some extent even without the agreement. Diao, Roe and Somwaru also find that U.S. macroeconomic policies such as the early 1970s dollar depreciation had significant effects on trade with Canada and Mexico. They reached their conclusions based on statistical procedure which separated out trend and cyclical components of trade patterns among the members of NAFTA and other regional trading arrangements.

Agricultural trade barriers and producer subsidies inflict real costs, both on the countries that use these policies and on their trade partners, according to a recent USDA report (Burfisher et al. 2001). Trade barriers lower demand for trade partners' products, domestic subsidies can induce an oversupply of agricultural products which depresses world prices, and export subsidies create increased competition for producers in other countries. Eliminating global agricultural policy distortions would result in an annual world welfare gain of $56 billion. High protection for agricultural commodities in the form of tariffs continues to be the major factor restricting world trade.

The international community is addressing the challenges posed by global climate change through the United Nations Framework Convention on Climate Change (UNFCCC) agreed to at the Earth Summit in Rio de Janeiro in 1992, with 170 member countries. The U.S. ratified the UNFCCC, but has not ratified the 1997 Kyoto protocol, which set specific greenhouse gas emissions reduction targets. The Kyoto protocol would have committed the U.S. to reduce emissions of greenhouse gases to seven percent below their 1990 levels by the period 2008-2012 (House 2000). Another round of negotiations in November 2000 at the Hague ended without an agreement (Reiner 2001). Thus, future direction of climate policy is unclear at this time.
Given that international responses to climate change are moving slowly, adaptation to the

seemingly inevitable change will become increasingly important. Adaptation is likely to occur at the farm level (changing crop mix and farming practices), and at the national and international levels (shifts in cropping patterns, policies, and prices). Substantial cuts in agricultural tariffs and subsidies would facilitate economically efficient adjustments of the world food system to climate change, according to (Randhir and Hertel 2000). Their simulations suggest that the halfway trade liberalization implemented under the Uruguay Agreement on Agriculture may be making emissions worse, however, because it increases price transmission through tariffication of the old trade barriers but leaves price-distorting production subsidies in place. In particular, subsidized, high-cost production in the European Community would replace lower-cost production elsewhere in the world. If production subsidies are removed in future negotiations, production costs would be free to equalize across regions and aggregate welfare would increase. The relationship between U.S. farm policies and greenhouse gas emissions is discussed further in the next section.

Recent Developments in U.S. Commodity Price and Income Support Policy

On the policy front, direct U.S. government commodity price support policy and trade policy have been important forces driving change since at least as far back as the 1930s New Deal. The Federal Agricultural Improvement and Reform (FAIR) Act of 1996 was a dramatic departure from previous farm policies, with perhaps the most significant change being the decoupling of payments from crop-specific acreage limitations, which provided increased planting flexibility but eliminated the automatic countercyclical payment mechanism that deficiency payments had previously provided. The history of twentieth-century agricultural policy and the political maneuvering that let to the passage of the FAIR Act are reviewed in (Orden et al. 1999). They conclude that the two factors that were decisive in the radical policy change embodied in the FAIR Act were 1) the fact that control of Congress changed to the Republican Party in 1995, and 2) high commodity prices in late 1995 made the idea of decoupling palatable. They also conclude that a number of other circumstances had surprisingly little influence on passage of the FAIR Act, including the Uruguay Round international trade agreement, federal budget pressure, the cumulative structural modernization of agriculture, the diminished potency of the farm lobby, and the emergence of newly dominant ideas about the appropriate role of government in the farm sector. They do not attempt to make a single prediction of the prospects for further farm policy reform, but list six policy-driving factors that are likely to shape the next farm bill: 1) the continuing structural transformation of U.S. agriculture, 2) the condition and structure of international markets, 3) party control in Congress, 4) federal budget pressure, 5) the political feedback generated by earlier policy change, and possibly 6) the emergence of new policy ideas.

Orden, Paarlberg and Roe look to the report of the Commission on 21st Century Production Agriculture for a public statement about the extent to which reliance on markets and smaller government has become dominant within American agriculture. This commission was mandated as part of the FAIR Act to report on the changes that had taken place in U.S. agriculture, and to recommend specific legislation for future federal involvement in farm programs.

It identified four broad policy goals: 1) production of an abundant supply of high-quality agricultural products at reasonable prices, 2) maintenance of a prosperous and productive economic climate for the farmer producers, 3) maintenance of the family farm organization as a dominant part of the production system, and 4) realization of a high quality of life for all individuals living in rural areas (Commission on 21st Century Production Agriculture 2001). The commission recommends a three-part income safety net including a fixed baseline payment, a counter-cyclical supplemental payment, and a marketing assistance loan program. One issue that comes into play in price support policy is the international commitments that the U.S. has made certain commitments regarding maximum support expenditures. The supplemental income payment would be based on aggregate program crop gross income rather than on current prices and yields of any specific commodity and, as such, is believed to be exempt from those international commitments. In addition to the main report, one minority report recommends as an alternative, marketing loan rates based on a percentage of production cost, with voluntary acreage reductions in return for higher loan rates. Another minority report points to the diversity of the farm population and the fact that the average income of farm households in the 1990s often exceeded the average U.S. household income, and suggests that three defensible types of programs are safety nets only for catastrophic markets or weather situations; social or credit programs for farmers on the edge; and environmental stewardship programs.

Other key recommendations are for conservation reserve programs and conservation cost-sharing; improved crop insurance and tax preferred savings accounts for risk management; a unified approach to international trade negotiations, separate from negotiations on environmental and labor issues, and dairy policy that gives attention to federal marketing orders, extension of dairy compacts, federal price support, and international market opportunities and challenges. The wording of the goals identified by the commission is very similar to that in a recent farm policy proposal by Willard Cochrane, but his recommendations differ (Cochrane 1999). Dr. Cochrane's recommendations include an annual cash subsidy of $15,000 to $25,000 to family farms rather than commodity price supports, along with more emphasis on investigating monopolistic actions of large firms in the food systems.

Previous farm programs have linked payments to farms' production histories. The concept of a safety net oriented toward some minimum standard of living for farm households has generally been opposed by farm groups on the grounds that it seems too much like a welfare program, but is receiving increasing attention since Secretary of Agriculture Dan Glickman called 1999 the "Year of the Safety Net." A recent USDA Economic Research Service analysis looked at the cost to the government and the distribution of benefits across different farm sizes and regions if government assistance were based on: 1) income equal to that of the median non-farm household in the region, 2) income equal to 185 percent of the poverty line, 3) income equal to the average non-farm household's annual expenditures, or 4) income equal to the median hourly earnings of the non-farm self-employed ($10 per hour). The analysis was based on farm costs and returns data from the 1997 Agricultural Resource Management Survey. Lower-income farmers would benefit relatively more under the four scenarios, while farmers producing selected commodities benefit relatively more from current farm programs. Minnesota farmers overall would receive higher payments under the median household and median hourly wage scenarios than under current programs. They would receive less under the 185-percent-of-poverty-line and average household expenditures scenarios, except for northeastern Minnesota which would receive more.

The 185- percent-of-poverty-line scenario is considered the most likely, and would cost about the same as current programs. It was estimated that this scenario would have cost the government a total of $21 billion over the three years, 1998-2000 compared to the $19.5 billion actually spent (Gunderson et al. 2000; Offutt 2000).

A recent study by Diao, Somwaru and Roe estimates the effect on production, trade and well-being from the granting of market access, removing export subsidies, and eliminating trade-distorting forms of direct support to farmers in World Trade Organization member countries (Diao et al. 2001b). They find that,

> " ... removing trade barriers, subsidies, and support would cause aggregate world prices of agricultural commodities to rise by over 11 percent relative to an index of all other prices. Agricultural support and protection in the developed countries is found to be the major cause of low agricultural prices, and implicitly, a tax on net agricultural exporters in developing countries. Reform would increase world trade in agricultural commodities, but the level of total agricultural production is left almost unchanged." (page 1)

Prices of livestock and livestock products would rise by 22 percent, with oil and oilseeds rising 11 percent and grains other than rice and wheat rising 15 percent. Volume of livestock production would decline by 3 percent in the developed countries, with production of oilseeds and grains (other than rice and wheat) declining by 5 and 1 percent, respectively. From the standpoint of a Minnesota farm operator, a next question suggested by these numbers is, would the changes in market revenues implied by these price and output changes be sufficient to offset the loss in government payments? The question is probably moot in that complete, worldwide elimination of agricultural trade barriers and assistance programs is unlikely in the foreseeable future. Still, they serve as a reminder that government intrusion into the marketplace may have price and other secondary effects which negate the intended purpose of the policies.
Dairy policy in the United States includes both Federal and State programs. The two major federal dairy programs currently in place are the system of federal milk marketing orders and the milk price support program. A multi-State dairy policy organization, the Northeast Interstate Dairy Compact, operates under authority granted in the 1996 Farm Act. General government programs designed to assist international trade and provide domestic and international food aid also affect the dairy industry (USDA Economic Research Service Briefing Room: dairy: policy 2000).

Prior to 1981 the price of milk was supported at such levels to insure an adequate supply of milk, reflect changes in the cost of production, and assure a level of farm income to maintain productive capacity to meet future needs. Since October 1981 the support price has been established by Congress either at specific levels or by formula related to expected surplus levels rather than parity levels. To implement the price support program, the Commodity Credit Corporation offers to buy carlots of butter, cheese and nonfat dry milk at announced prices thus providing a floor for milk and dairy product prices. (Commodity Fact Sheet, 1996-97 Dairy price Support Program 1997) The purchase program was to have ended on December 31, 1999 but was twice extended for one year (to the end of 2000 and then 2001) at $9.90 per hundredweight of 3.67 percent butterfat milk (USDA Economic Research Service Briefing Room: dairy: policy 2000).

The 33 previously existing milk marketing orders were consolidated into 11 as of January 1, 2000, and new methods were put into place for determining class prices at that time. These reforms help insure American dairy farmers receive a fair price and that consumers enjoy an abundant affordable supply of milk. The federal order price system set minimum prices for milk used for alternative purposes. The new rules change the determinants of the Basic Formula Price, adopt a classified pricing structure for four classes of milk, and make some changes in the classification structure. Changes were made in the Class I price differentials with lower differentials in Southwest, West, Northwest, North East, and Appalachian areas. Class I differentials would rise in the Upper Midwest and Florida. Bailey points out that a direct change in class prices may not represent a direct change in farm gate prices. The Class III price (cheese and other hard products) in this rule will be lower than the current BFP (Basic Formula Price), and in the Upper Midwest processing plants have regularly bid pay prices above the minimum government prices. Further amendments were implemented on January 1, 2001, but were then halted by an injunction on February 2, 2001 (Bailey 2001).

The potential impacts of ending dairy price supports and milk marketing orders were recently analyzed by (Cox and Chavas 2001). Using 1995 dairy program as a base for comparison, their most significant finding (to Minnesota, at least) is that eliminating all classified price differentials under the federal and California milk marketing orders, plus eliminating the price support program, would increase the farm price of milk by $0.49/hundredweight in the Upper Midwest region (including Minnesota, Wisconsin, and North Dakota). The price would also increase in the California and Western regions, but would decrease in the other regions and would decrease by $0.25/cwt for the U.S. overall. Production in the Upper Midwest would increase by about one percent. They describe the January 1, 2001 policy changes described above as only a slight change from the 1995 program they used as a base for comparison, and state that most of their findings remain valid when compared to the current program.

The 104th U.S. Congress in 1996 gave conditional consent to the Northeast Interstate Dairy Compact (Section 147 of the Agricultural Market Transition Act, title 1 of Public Law 104-127; 7 U.S.C. 7256). This act provided consent for the states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont to regulate milk prices for their farmers. Milk pricing is the only agricultural commodity for which congress has given consent to the use of interstate compacts. The compact works with the federal order pricing system as a basis for its pricing mechanism. The higher farm level prices are passed to the consumers in the price they pay for fluid milk. A Compact Commission fixes a price that exceeds the federal order price for fluid milk, compact over order premium. The estimated impacts for a state belonging to the compact are as follows: increased farm marketings in response to a higher price, reduced consumer purchase of fluid milk due to a higher price, and an increase in portion of milk used for class 3 which impacts the price of class 3 milk. The estimated impacts on a non-compact state are: reduced milk marketing due to a price decline, a reduction in the federal order blend price, small increase in fluid milk consumption with a small decline in price, and a total market reduction in the revenues paid to farmers and collected from retail sales (Bailey 2000). Dairy compacts and Federal Milk Market Order Reform are two current milk-marketing issues under contentious regional debate. Upper Midwest representatives in Congress submitted H.R. 744 submitted a bill to rescind the Northeast Dairy Compact (Sensenbrenner et al. 1999).

"Green payments" linked to environmentally benign practices have been suggested as another alternative to current farm programs. One argument in favor of green payments linked to environmental practices is that non-farm taxpayers would be more comfortable with the expense if they feel that the environmental improvements are benefiting them. Green payments could be linked to international greenhouse gas commitments. The USDA Economic Research Service web page contains an extensive discussion of greenhouse gases and global warming at (Briefing Room: Global Climate Change). The main approaches being proposed in the U.S. for achieving a reduction are a tax on fossil fuels and increasing forest area (Paudel and Lohr). A fossil fuel tax would likely shift tillage practices in the direction of less conventional and more conservation tillage. U.S. cropland has the potential to sequester carbon equivalent to an estimated 24 percent of the required reduction, so practices such as converting from conventional to conservation tillage and adopting improved cropping systems would help meet the commitment. Paudel and Lohr develop a simulation model of tillage systems for producing cotton in Georgia, and conclude that conservation tillage offers economic and environmental benefits over conventional tillage in that situation.

The impact of a green payment scheme on Minnesota has not been estimated, but in Iowa conversion of corn-soybean rotations to no-till might result in producers receiving revenues potentially more than $100 million per year if the sequestered carbon were valued at $20 per ton. The Environmental Quality Incentives Program (EQIP) is a currently existing program which could be expanded to provide greater revenues to farmers and achieve environmental objectives while meeting pledges made by the U.S. in the General Agreement on Tariffs and Trade (GATT) to remove farm subsidies coupled to farm production (Batie 1999). Batie also observes that water-related environmental problems tend to be found close to large populations and the wetter eastern part of the U.S. while farm program payments have historically been concentrated in the Great Plains and the wheat growing areas of eastern Washington and Oregon, however, so green payments will not substitute well for traditional farm payments from a geographic standpoint. Complexity of the present EQIP program has hampered its implementation, however. Challenges include how to target payments to land with the most significant environmental problems and how to tailor assistance to farmers' needs.

Farm Credit Policy

USDA has a series of short, nontechnical reports on their web site which discuss federal government involvement in farm lending and ways in which federal action could improve efficiency (Maxwell 1998). They quote Department of Justice findings that 93 percent of rural banking markets are considered non-competitive in that banking business is concentrated among few banks. Suggested federal actions include:

- harmonizing charters and regulations for government-sponsored enterprises such as the Farm Credit System and the Federal Agricultural Mortgage Corporation to reduce market segmentation,
- regulatory reform for all lenders,
- encouraging entry into concentrated markets through nontraditional mechanisms including electronic funds transfers and telecommunications, and
- continued antitrust vigilance.

Federal estate tax changes are suggested to make it easier to transfer family farm businesses across generations, although they find that only about one-third of heirs in each generation choose to operate inherited family farms.

Another report in the USDA series addresses beginning farmers' credit needs. They suggest that traditional credit programs have limited potential to assist young low-equity farmers, because they are ill-equipped to deal with the increased risk that accompanies high leverage. They suggest tax initiatives such as lowering capital gains taxes on land sold to beginning farmers, tax-exempt or tax-deferred "aggie" savings accounts. Depending on how many of the potential land buyers are covered by such favorable tax treatment, the tax reductions could simply end up being bid into land prices so that the land would be no more affordable than it is at present.

They suggest that state statutes be changed to facilitate beginning farmers' access to equity capital. Limited partnerships, subchapter S corporations, and limited liability corporations are suggested as ownership forms that would make it easier for investors to purchase an ownership interest in the farm and limit their liability to the amount of the investment. It might be difficult, however, to identify a policy design which would provide sufficient capital access to help beginning farmers without giving non-farm investors so much access that family farmers would complain of unfair competition.

A more in-depth discussion of structural change in agriculture, how it is affecting lenders, and policy implications is presented in (Duncan and Stam 1998). They trace some of the history of the traditional farm lending industry, and past policy responses. They expect that the emergence of non-traditional credit sources and foreign lenders will compete with traditional ones. One area of concern is the possible impact that failure of large-scale integrated agricultural firms would have on the rest of the nation's food and fiber sector. There is currently no consensus on what if anything should be done to protect against such an eventuality.

The Minnesota and federal governments have instituted a number of programs that provide financing and technical and business planning assistance to Minnesota livestock producers beyond what is available from commercial lenders. Possible sources for new farm product processing and marketing ventures include (Sparby March 9, 2001):

- Minnesota Department of Agriculture's Rural Finance Authority and Cooperative Grant Program
- Agricultural Utilization Research Institute
- Minnesota Technology Institute
- Economic Development Centers
- Midwest Community Development Corporation
- Minnesota Business Finance Corporation
- Small Business Development Centers
- USDA Rural Business-Cooperative Service
- U.S. Small Business Administration

Both Friedman and the Purdue report discussed above emphasize that business managers must be able to adjust rapidly to marketplace changes. Access to credit and technical and business planning assistance facilitate such adjustments, so we second a recommendation made by Hayes, et al. for further research on the adequacy of these programs (Hayes et al. 1999), p. C-71. Implications for alternative forms of livestock production are that increased state funding for such programs would likely lead to more product differentiation and direct marketing; more jointly-owned value-added processing ventures; more rapid adoption of new production technologies; higher returns to labor and management; and substitution of capital for labor resulting in fewer total jobs in production agriculture which might be offset by additional jobs in processing and distribution. Commercial lenders are often said to pressure producers into signing production or marketing contracts in order to reduce operating risk. Thus, it seems possible that increased credit availability from programs such as those listed above would give producers more access to alternatives that leave them with more control and independence. If true, these programs may slow the trend toward increased vertical coordination and consolidation.

Other Policies That Can Affect Minnesota Agriculture

There are a number of other policy areas whose impacts on the livestock industry are less direct, but which will be listed here in the interest of completeness. One area is that of intellectual property protection, especially in the area of gene patenting. Recent controversy over biotechnology has drawn attention to these policies. Another policy area is subsidies for research and education in general, and in particular subsidies and regulations related to development and adoption of new technologies such as biotechnology precision agriculture, and information technologies. There is an extensive body of literature on the impact of research and education on economic development and competitiveness that will not be reviewed here. Funding for the University of Minnesota College of Agriculture, Food and Environmental Sciences; the United States Department of Agriculture; and USDA is described in (Hayes et al. 1999), pp. C-103 - C-120.

Tax policy can affect the competitiveness of states and localities. At the national level, estate taxes have been an issue recently. Minnesota policymakers have focused their attention on industry winners and losers that would result from changes in the system of property and sales taxes. Other policies directed at urban sprawl and non-agricultural economic development of rural areas will ultimately affect the livestock producers who live there.

Transportation policy could play a role in agricultural competitiveness and structural change. As Fruin and Tiffany have pointed out, NAFTA is tending to shift U.S. shipments of agricultural commodities from an "east-west" direction to "north-south," with increasing rail shipments of grain from Minnesota to Mexico in particular (Fruin and Tiffany). Any policy developments that affect livestock industry competitiveness and volume could at least potentially have implications for transportation patterns, and policy responses may be called for.

The increasing use of hired workers in agriculture means that worker protection regulations, including minimum wage and hour regulations and safety rules, can have an impact on agriculture. Also, it is obvious that the ethnic makeup of rural communities and the work forces in livestock operations and processors is changing, which suggests that immigration policies have played a role in changing the Minnesota livestock industry (Martin ; Amato ; Drew 2001). Finally, energy policy has not received much attention for a number of years, but spikes in oil and gas prices and West Coast electricity shortages have refocused the public's attention on energy issues. A research question that has been raised occasionally is, would higher energy prices favor pasture-based or low-capital livestock production systems vis-a-vis confinement systems that utilize capital and energy inputs to minimize labor requirements? A more specific question is, how would policies regarding ethanol blends in fuel affect the livestock industry. Minneapolis already requires that fuel be oxygenated, described as containing 2.7% oxygen which is achievable with a blend of 7.7% ethanol or 11% methyl tertyl butyl ether (MTBE) with conventional gasoline (Gallagher et al. 2000). With current exemptions from gasoline excise taxes, ethanol appears to have the dominant market share of the oxygenated fuel market in most Midwestern states. If the oxygenation requirement were extended to all of Nebraska, Minnesota, Iowa, Kansas, Missouri, Illinois, Wisconsin, North Dakota, and South Dakota, Gallagher et al. find that local economic benefits would be enough to offset the tax exemption and provide an overall \$399 million net welfare gain. While the overall effect is positive, Midwestern livestock producers would lose \$91 million from higher corn prices.

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IV. Phosphorus Balance in Minnesota Feedlot Permitting

by Joseph G. Schimmel, Richard A. Levins, and Dennis R. Keeney

Introduction

The Minnesota Pollution Control Agency began issuing feedlot permits in 1971. A primary goal of these permits was to ensure that livestock producers had enough land to apply manure at nitrogen based rates. To achieve this goal each permit incorporated a land application plan for manure produced on the farm that balances nitrogen (N) from manure with the N requirements of crops grown on land owned, or under contract, by the person requesting the permit. The permit process was revised in 1978 and most recently in 2000. The current focus is now to limit N on all acres to which manure is applied and to limit phosphorus (P) in certain sensitive situations.

When sufficient manure is added to cropland to satisfy N needs, the crop will usually not require all the P added in the manure. Therefore P can accumulate in the soils receiving manure at N fertilizer rates. Phosphorus as phosphate leaches only slowly compared to nitrate, and it presents unique problems. Too much P causes our lakes and streams to produce too much algae and weeds. As the algae and weeds die, oxygen is consumed causing odors and problems for fish and other aquatic animals. How much P is building up in fields that have been given feedlot permits? And, if the amount is judged too high, what should we do? These two questions are the subjects of this report.

This report was requested by the Environmental Quality Board as part of the Generic Environmental Impact Statement on Animal Agriculture. Other studies are underway that will attempt to define sites where the chances of P moving into the water are high, to recommend application rates under different circumstances, and to assess the consequences of P regulation. We will restrict ourselves to an analysis of how much surplus P (if any) is being applied to farm fields from feedlots that have been given permits in Minnesota.

Defining Surplus Phosphorus

For purposes of this study, we define surplus P as a situation where P is being applied as manure over a long period of time, at levels above those that can be removed by crops. We recognize that, depending on existing P levels in the soil, excessive P application rates in a given year may or may not contribute to water quality problems. No matter what the soil test levels are when the permit is granted, P levels will eventually become high if sufficient excess manure P is applied year after year.

THE DATA WE USED

We began with an MPCA database consisting of 5,483 feedlot permits issued by delegated county programs during the years 1980-2000. Each feedlot record in the database showed identification information including the owner, the date of issue, and the location of the feedlot. The database also showed how many acres were available for manure application. Finally, each record contained the species, type, and number of animals permitted for the feedlot. For example, one permit allowed 300 nursery pigs, 550 feeder pigs, 600 finishing pigs, 170 sows, and 10 boars. As a second example, a permit was issued for a feedlot having 21 beef cows and 18 calves.

Each permit record was carefully analyzed for completeness. In addition, we only accepted records for feedlots having at least 10 animal units, and no more than 1,000 animal units. Feedlots in this size range are most consistent with regulations in force during the time period covered. The final total of permits that met the criteria of complete data and proper size was 3,907. No other criteria were used to accept or reject permits for analysis; our goal was a comprehensive review of the permitted feedlots. While this is a large number, there are 16,000 feedlots permitted by MPCA and by MPCA regional offices that are not included in our study.

The 3,907 feedlot permits we analyzed included 766,050 animal units and 1,333,062 acres available for manure application.

HOW WE ANALYZED THE DATA

In most general terms, we needed to know two important numbers for each permitted farm. First, we needed to know how much P[4] was generated from manure. Second, we needed to know the P used by crops grown on the acres available for manure application. These numbers were not available directly from the database, so we had to estimate them from information that we had.

The Midwest Plan Service[2] gives the average amount of P produced by each animal type in our database for each day that animal is on the farm. For example, the manure produced in a day by a 1,400-pound dairy cow contains 0.24 pounds of P. We also needed to estimate how many days each animal would be on the farm. In consultation with Extension agricultural engineers, we determined a days on farm estimate for each animal type in the database. For example, breeding livestock were assumed to be on the farm for 365 days per year. Feeder cattle, however, were assumed to be on the farm for only 201 days per year. These numbers were then used to estimate total phosphorus produced by each animal type on the farm during the year, that is,

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[4] P_2O_5 was used as this is the form of P almost universally reported in agricultural literature. One pound of P is equal to 2.86 pounds of P_2O_5. We use the terms P and P_2O_5 interchangeably.

[2] Livestock Waste Facilities Handbook MWPS-18. Second edition, 1985.

P per day x days on farm x number of head = Total P produced

Next, we estimated P used by crops on the farm. Our overall procedure was to determine a typical acre for each county. To do this, we took the ten-year county average for acres harvested of crops to which manure is usually applied: corn, corn silage, alfalfa, grass hay, small grains, and soybeans. We also found the 10-year average yield[3] for each of these crops. Knowing the crops and yields allowed us to use Minnesota Department of Agriculture[4] data to determine phosphorus removal. For example, corn removes 36 pounds of P for every 100 bushels of grain harvested.

Now we could construct a typical acre and determine P removal for that acre in each county. For example, in Rock County, the typical acre looked like this:

Alfalfa	4	3.68 tons
Hay	*1*	*3.31 tons*
Corn	48	120.6 bu.
Corn Silage	*2*	*14.48 tons*
Oats	1	71.8 bu.
Soybeans	43	37.5 bu.

The typical acre for Rock County removed 38.18 pounds of P per year.

Total P removed by crops on each farm was found by multiplying the number of acres times the P removal for a typical acre in the county in which the farm was located. Having determined P produced from manure and P removed on each farm, we estimated the surplus or shortage of P by subtracting the second number from the first:

Surplus P = P from manure P removed by crops

Results for All Feedlots

The results of our analysis are shown in Figure 1. Each vertical bar in Figure 1 shows what percent of the total feedlots we analyzed had surplus P in certain ranges. (The totals are presented as pounds per acre, rather than total pounds, to facilitate later comparisons among different feedlots.) A negative surplus should be read as a shortage.

3 Acreage and yield data were from Minnesota Agricultural Statistics, various years.

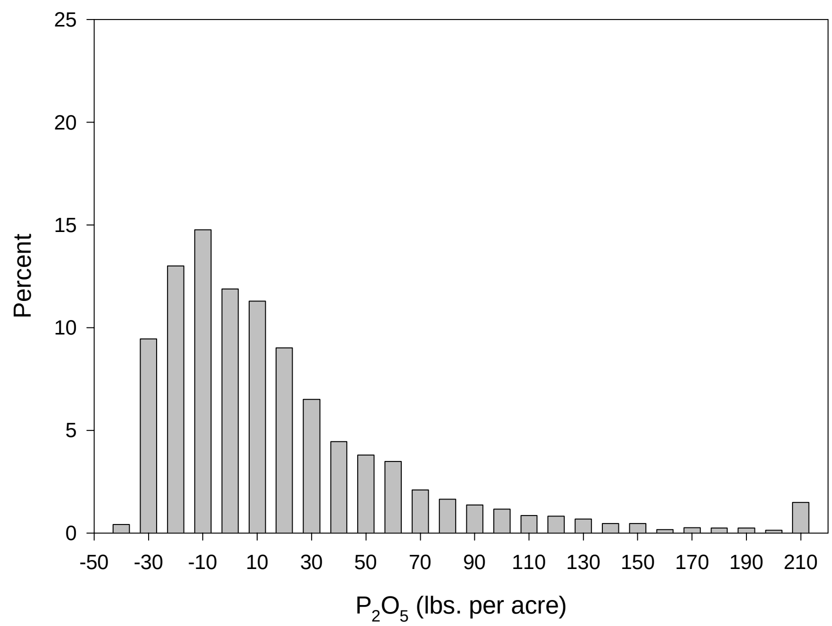
4 Minnesota Department of Agriculture. Useful Management Data, 1995.

The feedlots we analyzed were evenly split between those that had P shortages (negative numbers on the horizontal scale) and those that had P surpluses (positive numbers on the horizontal scale). However, seventy percent of the animal units were on feedlots that had surplus P. The median value of surplus P for all feedlots was 0.4 pounds per acre. In total, the amount of P available from manure on the feedlots was 54.2 million pounds. Crop use was estimated at 52.8 million pounds, so 1.4 million pounds of surplus P would be applied by the feedlots each year.

It is important to note that our surplus P estimates, in total and per feedlot, are conservative•most likely, the actual values are somewhat higher than what we show. The reason is that we are assuming that the manure is being spread to take best advantage of P. In fact, at many farms it is being spread to take best advantage of N. It is therefore entirely possible that a farm with an overall shortage of P is applying excess P from manure to at least some of its acres. It is also entirely possible that a farm with an overall surplus of P is supplementing at least some of its acres with additional P from non-manure sources. We have no way to assess this possibility without on-farm assessments.

We also recognize that the animal unit figures we used are those for animals permitted, not those actually on the farm. If, for some reason, a feedlot is operating below capacity, the numbers we used will overestimate surplus P for the feedlot. However, it must be recognized that the feedlot still had a permit to generate the amount of surplus P we estimated, regardless of whether it actually does so.

Figure 1. Feedlots Permits with Surplus P_2O_5



FURTHER ANALYSIS OF THE DATA

In Figures 2, 3, and 4, the results just presented are broken down into three size classes of permitted feedlots. Figure 2 is for feedlots permitted to have fewer than 100 animal units. Figure 3 is for feedlots with at least 100, but fewer than 300, animal units. The largest facilities in our study, those with more than 300 animal units, are presented in Figure 4. For simplicity, we will call these three groups - small, medium, and large feedlots, respectively.

There were 1,482 small feedlots in the study. These feedlots, on average, had 55 animal units and 220 acres of land. Small farms had a median P shortage of 17.3 pounds per acre. The medium feedlots, of which there were 1,620, averaged 172 animal units and 343 acres in size. This group of farms had a median P surplus of 4.5 pounds per acre. The largest feedlots averaged 503 animal units and 558 acres of land available for manure disposal. There were 805 feedlots in this group, and their median surplus P was 38.2 pounds for each acre of land to which manure was applied.

As is shown in Figures 2, 3, and 4, there is a large spread to the data. Some of the larger feedlots have a more desirable P balance than do some of the smaller feedlots. Farm size is therefore not the only variable influencing the P balance. Nonetheless, the figures show the center of the data bars moving steadily toward larger surpluses as feedlot size increases. The median surplus P for the large feedlots is 55.5 pounds per acre higher than that for the small feedlots.

The overall message is clear: the larger a feedlot becomes, the less likely it is to have enough available land to make good use of all the P produced by animals on the farm. Further analysis of the data indicates that the problem is not having more animals *per se*. Rather, the problem is with the ratio of animal units per acre. As is shown in Figure 5, for each increase in density of one animal unit per acre, surplus P increases by 78 pounds per acre. Larger farms, in general, tend to be more densely populated with animals and therefore have more surplus P.

Figure 2. Small Feedlots with Surplus P_2O_5

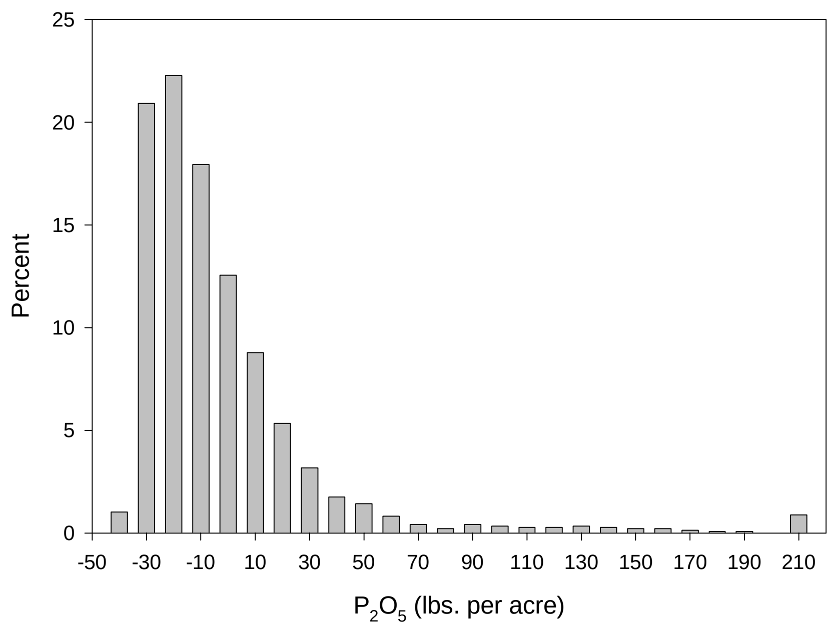


Figure 3. Medium Feedlots with Surplus P_2O_5

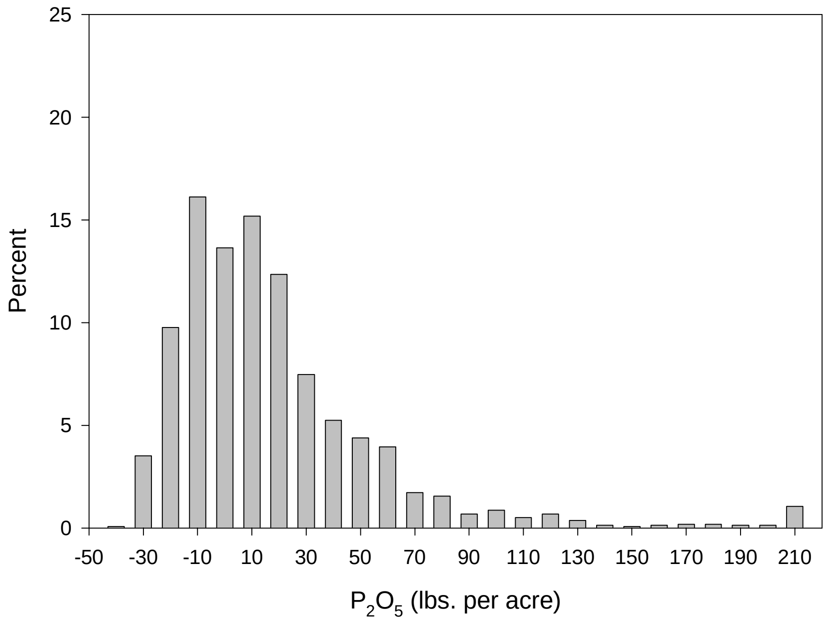


Figure 4. Large Feedlots with Surplus P_2O_5

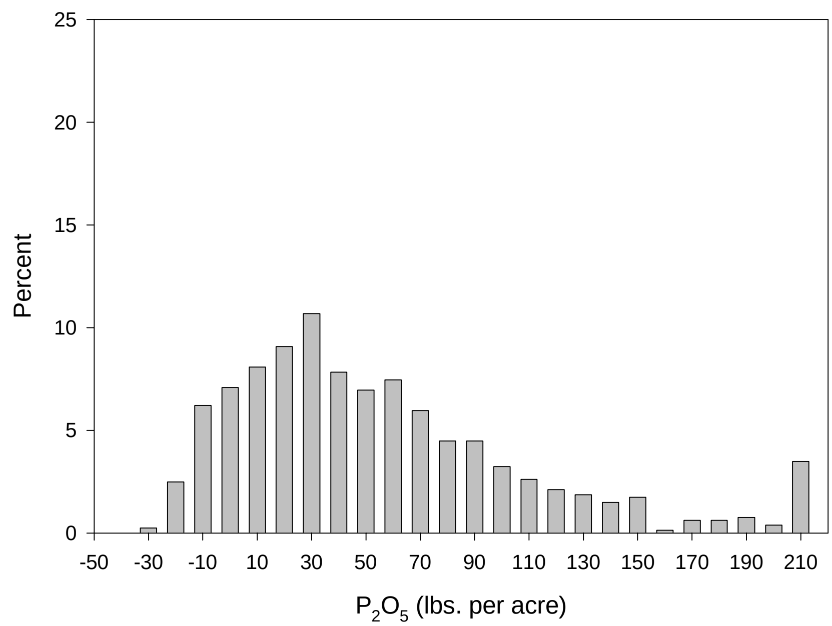
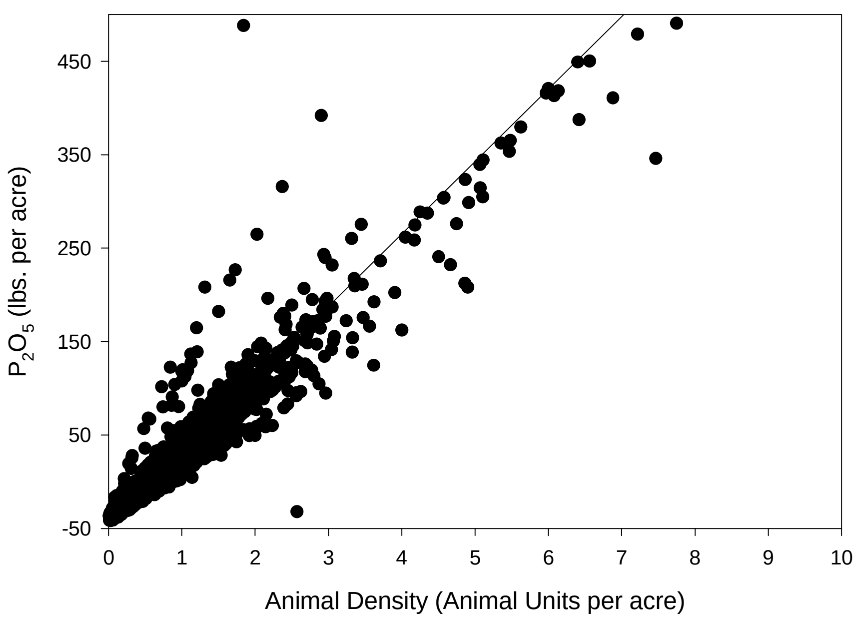


Figure 5. The Effect of Animal Density on Surplus P_2O_5



Some Directions for Policy and Planning

If it is judged that surplus P, as estimated in this study, is a threat to water quality, then a sticky problem for policy arises. The main cause of P surpluses is a high ratio of animal units to acres available for spreading manure. If old permits are to be reviewed and revised to reduce these surplus numbers, there are two obvious paths: reduce the number of animal units or increase the number of acres available for spreading manure. Both are difficult. Reducing animal units may lead to inefficient, and therefore more costly, use of existing buildings and other facilities used in raising livestock. Increasing acres may not be possible in all cases because surrounding land may not be available for spreading manure. Furthermore, manure application costs will rise as hauling distance increases.

New rules might be developed to better account for P as well as N balances. We acknowledge the protective measures in the recently revised rules to prohibit the long term build up of P near waters, to require set backs, and to require a P strategy for large facilities with high P soils. Feedlots permitted with new standards (N and P balance) would face difficulties of more expensive land application, but should at least be able to properly size buildings and facilities. Perhaps a new permitting program could be combined with special incentives to encourage smaller feedlots. These are, for the most part, those that can most easily meet new environmental performance guidelines. At the same time, they may have more difficulty competing from an economic standpoint, and would therefore benefit from the financial incentives a new program might offer.

Finally, a compromise might be considered for feedlots with a previously issued permit. The land application plans for these feedlots have presumably been designed with only N in mind. The plans could be reviewed for each feedlot with an eye toward relaxing N limits and tightening P limits. This would not be easily done, nor would it be popular with those who might see it as somehow backing off on nitrogen standards. At the same time, some gains might be made without incurring the cost of changing permitted animal unit and acreage levels.

As part of this latter suggestion, or as a stand-alone program, it might also make sense to review P applications from commercial sources. The reason for this is simple enough: the more P we allow from commercial sources, the less P from manure will be in demand by crop farmers. Manure separation systems that can allow P-containing components of manure to be hauled greater distances at lower cost might also be investigated. Other potential solutions may be associated with selling manure and changing animal diets to reduce P in manure.

All of the preceding section is intended only to guide discussion. The justification for further consideration of any of these ideas depends on the extent to which the GEIS Citizens Advisory Committee determines that surplus P results indicate a serious threat to the environment.

Conclusion

At least half of Minnesota•s permitted feedlots are building P levels in surrounding fields. Larger feedlots, on average, have much higher levels of P build-up than do smaller feedlots. Should the GEIS Citizens Advisory Committee determine this P build-up threatens water quality, some difficult decisions must be made. It is clear that if Minnesota wishes to avoid high P soils in areas that have high levels of animal production, it must devise a permitting process that lowers the animal density on many feedlots. Further study is needed regarding why the P levels vary as they do, and the best ways to achieve any desired reductions in light of the economic pressures faced by the livestock industry today.

V-1. Literature Review Update: Industry Structure and Competitiveness, and Profitability and Economic Viability

by William F. Lazarus

List of Tables

INTRODUCTION

This updated literature review combines the original literature review completed in 1999 with new literature that has become available since that time. It is organized in the same manner as the study questions laid out in the GEIS scoping document. Topic D covers the dimensions of the Minnesota livestock industry, including the numbers, locations, and nature of feedlots; the business structures used by livestock operations; the ownership and control of livestock operations; the present market situation; and the competitiveness of Minnesota livestock producers in national and international markets.

Topic E covers the profitability and overall economic viability of both livestock farms and livestock processing firms including how they are affected by such factors as economies of scale, production methods, marketing arrangements, and government policies and programs. Livestock processing firms are discussed under question D4, so the discussion under topic E questions will focus on farms.

Some of the study questions under topic E are closely related to questions under topic D, such as E3 on effects of government policies and D1 on choices of business organization. Several questions within each topic are also closely related. After conferring with Environmental Quality Board staff, we have rearranged the order of such questions in order to improve the flow of the presentation.

Business, production, processing, and distribution systems in the food chain are in a period of rapid change. These changes are in response to a host of dynamic economic and social forces such as global economic competitiveness, monetary policy, government regulations, consumer preferences, environmental stewardship, and food safety and new technologies, to the social and economic needs of farm families and rural communities. Business decisions on how to structure and operate the businesses to position themselves to survive and compete are increasingly influenced by external global forces. These decisions are typically subjective decisions based on specific situations and are continually being revised in response to a rapidly changing climate. Therefore, the nature of firms within the industry is a collage of various types of business organizations and the way they operate. There are no two firms alike in the way they operate. Availability of research based information to address several of the questions on business structure and competitiveness is limited due to the dynamics of the industry and the historic nature of research based information. Therefore these authors have supplemented verifiable research based information available with industry facts, statistics, and knowledgeable experts interpretations of the assessments to more fully answer the questions posed with current thinking and ideas. The authors used care to be objective in selecting these references for which there appears to be general agreement.

Readers must also be aware that the livestock industry is composed of species subsectors that are very different from each other. They compete at the retail level. The poultry industry, broilers, turkeys, and eggs is quite integrated and concentrated. The beef cow calf industry is very dispersed, with many small producers on more marginal land, but beef feedlots that are more concentrated and integrated. The swine industry has been evolving in recent years toward greater concentration and integration. The dairy industry has been moving more slowly than swine in this direction. Because of these differences and differences in the input resources, readers are cautioned about making general conclusions that apply universally to a non-homogenous livestock industry.

Changing linkages between producers and those firms that provide inputs to producers and buy their products, are key elements of the structural change occurring in food distribution and distribution. The NE-165 Regional Research Project, •Private Strategies, Public Policies, and Food System Performance,• includes researchers from U.S. land grant universities and government agencies. This group held a conference in 1995 on •Vertical Coordination in the Food System.• Updated versions of the conference papers were recently published in a book which focuses on the changing nature of linkages in the food chain (Royer and Rogers 1998). The book covers a wide range of topics including: how to measure the degree of vertical coordination among industry segments involved in manufacture of a particular product (e.g. ice cream or animal feeds); effect of ownership on contract structure in the beet sugar industry; and alternative models for the future of pork production.

There is one publication that deserves special mention as a source of data: (Food System 21: Gearing Up for the New Millenium, EC-710 1997). We recognize that it contains expert opinion-based predictions about the future of the food system. These predictions are believed to be reliable, but they are also by nature unverifiable. The report also contains occasional statements that some readers may view as value judgements. The primary objective of the book is to present a fifty-member Purdue University faculty task force's best sense of what the food and agricultural system will look like in the first part of the 21st century. They expect that the analysis will be useful for at least three different levels of decision making:

1) specific sectors such as particular types of livestock operations,

2) linkages and interdependencies between and among the various stages of the food system, and

3) implications for input supply firms.

They focus on four categories of drivers of change:

1) demand/consumption/demographics, such as changing export markets, international competition and actions of competitors, changing age and work habits of U.S. families and consumers, and changing attitudes about food safety and quality,

2) productivity and technology, such as the status of intellectual property rights,

3) government regulation and policy, such as antitrust and international trade policy, and

4) resources such as capital, human resources, and information and industry infrastructure as well as the environment.

Two USDA reports provide overviews of vertical coordination in the pork and broiler industries. The first reviews the trend data on pork packer coordinating arrangements and describes a procedure they used to estimate the impact of improved quality and lower acquisition costs on retail prices and consumer welfare (Martinez 1997). The second finds that recent changes in the structure of the U.S. pork industry reflect, in many ways, changes in the broiler industry (Martinez 1999). Vertical integration and production contracts in broiler production facilitated rapid adoption of new technology, improved quality control, assured market outlets for broilers, and provided a steady flow of broilers for processing. Incentives for contracting and vertical integration in the pork industry may yield comparable results. If so, these arrangements might lead to larger supplies of higher quality pork products at economical prices. The report provides historical background on vertical integration in the broiler and pork industries; explores the motives for vertical integration and contracting; examines the relationship between vertical integration and the price and quality of pork and chicken products; and explores the public policy implications of vertical integration in the pork industry. Increased contracting, integration and consolidation also result in concerns about market power and barriers to entry. Independent producers' production and marketing decisions may be distorted due to reductions in the amount and accuracy of publicly available market information.

SUMMARY OF NEW LITERATURE ADDED

Thirty additional research publications, not available for the 1999 Literature Review, are included in this paper. The updates have been incorporated into the original document, so that users have access to a seamless body of text that has the entire set of material in one place. The updates are also described briefly below.

The Procite computerized bibliographic database has been reconfigured to enter publication titles rather than "Anonymous" in the in-text citations for publications without credited authors, which will hopefully improve readability.

All of the tables of statistical data have been updated with the most recent data available as of early 2001. The most significant change in the statistical tables is that the 1998 swine and dairy farm business summary data (old Tables 19 and 27) has been replaced by four-year averages. These have only recently become feasible as a result of a new search engine for summarizing the MnSCU and farm business management association record data.

Note particularly that the swine production economies of size picture looks somewhat different in the new four-year averages than it did in the old 1998 data, which was heavily influenced by the late 1998 hog market "crash". Also, there are now economies of size tables for four different swine enterprise types rather than just farrow-to-finish.

A few subheadings have been added and revised to better delineate sections.

Question D2 on the current situation in the Minnesota livestock industry, changes taking place, why are the changes occurring, and what are their implications, is unchanged except for the addition of (Gunderson et al. 2000), (Short 2000), (Cash Hog Prices Likely to be Gone in Two Years 2001), (Production Costs Changed Little in 1999, but Lower Commodity Prices Cut Most Returns 2000), and (Freese 2000).

Question D1b on interdependence and corporate farm laws is unchanged except for the addition of citations on proposed federal contracting legislation - (Boehlje et al. 2001) and (Harl et al. 2001).

Question E3 on impact of government policies, regulations and programs on the profitability and viability of livestock farms is enhanced with an MDA report on the cost of the revised feedlot rules is cited - (Wilcox 2001). There is a new article comparing regulations in 19 states - (Metcalfe 2000). There is also a new study on the impacts of state corporate farm laws and state and local environmental policies on the dairy industry shifts, (Park et al. 2000), that complements one cited originally on the swine industry. A recent theoretical article on manure regulation, (Innes 2000), was added along with non-technical discussions in (Innes 1999) and (Lovell and Kuch 1999).

The section on "International Policy Developments" is smaller because much of the material was moved to a separate publication prepared under Task 3, "Forces Driving Change In The Dairy, Swine And Poultry Sectors Of Minnesota Agriculture."

Question D3 on livestock farm - non-farm differences and similarities is unchanged.

Under question D4 on changes in the market situation, (Senauer 2001) was added on differentiation in food demand. A number of publications were added under "Concentration in the Meatpacking Industry," including (Concentration in Agriculture: A Report of the USDA Advisory Committee on Agricultural Concentration. 2001), several relating to the lysine price-fixing case that support the concerns raised in the original Heffernan paper ((Connor 1997), (Lieber 2000), and (Levins 2001)). Several journal articles including (Hayenga 1998) were added on the role of economies of size as a factor in pork slaughtering industry consolidation and vertical linkages and (Anderson et al. 1998) on beef packing plant closures, and (Muth and Wohlgenant 1999) and (Paul 2001) on market power and economies of size in beef packing firms.

(MacDonald and Ollinger 2000) also recently examined the extent of scale economies in hog slaughter.

The information on Minnesota's approach to mandatory price reporting has been updated (Minnesota Department of Agriculture, Minnesota Daily Livestock Market Price Report 2001). The new federal mandatory pricing system is discussed in (USDA Agricultural Marketing Service, Mandatory Price Reporting 2001). (Schroeder and Ward 2000) was added to the section on "Price discovery". (Ward and Stevens 2000) look at the effects of industry structural change on price transmission and its effects on producers. A related analysis of broiler price asymmetry is (Bernard and Willet 1996). The section on dairy policy was updated with the latest material from the USDA Economic Research Service, (USDA Economic Research Service Briefing Room: dairy: policy 2000) and extension economists (Bailey 2001).

The USDA Economic Research Service has also done some interesting analyses recently on terms of trade between agriculture and the rest of the economy. Their new material shows the diversity of agriculture more clearly than in the past. Their data shows that median returns of farm businesses were comparable to non-farm businesses (Hopkins and Morehart 2000).

Several new citations were added on impacts of lending practices. A citation was added on the impact of bank mergers and acquisitions on agricultural lending, (Ahrendsen et al. 1999). (Sparby March 9, 2001) describes financing and technical and business planning assistance to Minnesota livestock producers. (Boehlje and Ray 1999) finds that at least in the case of a typical hog finishing contract, contract production can provide producers with a higher rate of return on equity and less risk then independent production if the contract makes additional financing available.

Question D5 on ownership and control, and D6 on starting and exiting, are unchanged, except for the addition of (Freese 2000).

Question E1 on economies of size is updated with new statistical information. The revised statistical tables 20 through 29 for swine, and 37 through 39 for dairy, include new information related economies of size and different production arrangements. They show costs and returns by size for the most common enterprises, and compare contractee swine finishing and grazing dairy enterprises to the other enterprise types.

Question E2 on economic viability is unchanged.

The "List of Major Relevant Ongoing Work" has been updated.

Two items were added to "Recommendations for Additional Future Research", which were suggested by the discussion in the "Forces Affecting Structural Change in the Minnesota Livestock Industry" paper. One deals with the adequacy of policy measures to deal with the consequences of globalization. The other is to evaluate the adequacy of financing, technical and business planning assistance available to producers to facilitate rapid adjustments to marketplace changes.

New publications added since the original literature review

Cash Hog Prices Likely to be Gone in Two Years. 2001 Mar 8. Feedstuffs.

Concentration in Agriculture: A Report of the USDA Advisory Committee on Agricultural Concentration. Located at: http://www.ams.usda.gov:80/concentration/home.htm. Accessed 2/14/2001.

Minnesota Department of Agriculture, Minnesota Daily Livestock Market Price Report. Located at: http://www.mda.state.mn.us/livestock/Start.asp. Accessed 2/14/2001.

Production Costs Changed Little in 1999, but Lower Commodity Prices Cut Most Returns. Agricultural Income and Finance. Washington, D.C. USDA Economic Research Service, 2000, AIS-75, pp. 25-28, 50-55

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CRITICAL REVIEW OF INFORMATION SOURCES (Original Plus Updates)

Topic D covers the dimensions of the Minnesota livestock industry, including the numbers, locations, and nature of feedlots; the business structures used by livestock operations; the ownership and control of livestock operations; the present market situation; and the competitiveness of Minnesota livestock producers in national and international markets.

Topic E covers the profitability and overall economic viability of both livestock farms and livestock processing firms including how they are affected by such factors as economies of scale, production methods, marketing arrangements, and government policies and programs. Livestock processing firms are discussed above under question D4, so the discussion under topic E questions will focus on farms.

QUESTION D2. WITH RESPECT TO THE FOLLOWING FACTORS, WHAT IS THE CURRENT SITUATION IN THE MINNESOTA LIVESTOCK INDUSTRY, WHAT ARE THE CHANGES TAKING PLACE, WHY ARE THE CHANGES OCCURRING, AND WHAT ARE THEIR IMPLICATIONS:

a. Geographic distribution, and size of enterprise

General Livestock Industry Trends

Farm structure discussions frequently cover aspects such as (Quiroga 1991; Gunderson et al. 2000; U.S. Census of Agriculture 1998):

- Number and size of farms: Total number of U.S farms peaked at 6.8 million farms in 1935, and has declined to 1.9 million in 1997. Average acres per farm increased from 155 acres in 1935 to 487 acres in 1997.

- Concentration: Seventy-four percent of the farms were non-commercial (sales less than $50,0000) in 1997 and accounted for 7 percent of the production. Farms with sales of $1 million or more made up 1.4 percent of the farms but accounted for 42 percent of the gross sales. Four percent of farms produced half of the gross sales. Eight percent produced 72% of the gross sales. Seventeen percent of the farms produced half of the gross sales in 1900 compared to 4 percent in 1997.

- Tenure: Most operations were full owners in 1997, but part owners and tenants had larger farms. Tenure differs by sales class, with commercial farms less likely to be full owners. Land leasing has changed from a way for beginning farmers to enter agriculture to a way of gaining access to additional assets. This allows farmers to avoid debt and risks associated with ownership, and to be able to respond more quickly to changing market conditions.

- Legal Organization: Most U.S. farms are organized as single proprietorships, but partnerships and family corporations tend to be much larger. Partnerships made up only 9 percent of the U.S. farms in 1997 but accounted for 18% of the gross sales. Family and non-family corporations were 4 percent of the farms but had 29% of the gross sales.

- Contracting: Farmers have become more reliant on production and marketing contracts over the past 40 years. Eleven percent of U.S. farms had at least one marketing contract, but these farms accounted for 40 percent of the gross sales.

- Operator Characteristics: Full time commercial farms made up 21 percent of all farms, but accounted for 76 percent of the value of gross sales. Forty five percent of all farm operators reported farm or ranch as their major occupation in 1993, operated 73 percent of the land and had 82% of the gross sales. Retired operator accounted for a substantial proportion of all farms but produced relatively little.

- Operator households: Farm operator households typically receive income from several sources, and 88% of their household income came from off the farm in 1997. The relative importance of off-farm income varies widely among different farm types.

Recent trends in the Minnesota livestock industry are shown in Table 2. There were 15,800 Minnesota operations with beef cows and 2,700 with sheep in 1999. Opeations with cattle on feed numbered 7,400 as of 1998. Cattle and sheep numbers are down in the state. Numbers of sheep and lambs are down by almost a third since 1993, although the January 2000 inventory has started to rebound with a 6 percent increase. Cattle on feed has also rebounded a bit over the past two years, which would be expected given the low feed prices. Beef cow numbers seem to be on a fairly steady downward slide over the period. Dairy cow numbers declined by eighteen percent between 1993 and 2000, but he rate of decline appears to be slowing.

The sectors that have shown growth since the early 1990s are hogs, layers, and turkeys. Perhaps the big story is hogs -- there were 17 percent more hogs and pigs on Minnesota farms in December 1999, compared to December 1992. The pig crop also increased since 1993, but both the pig crop and December inventory saw declines between 1998 and 1999.

Turkey production has grown since the early 1993, but appears to have leveled off in the past year. The number of laying hens is also up by 1.3 million. The Golden Oval operation in Renville County is at around two million hens, so it would appear that the rest of the egg industry is pretty static.

Consolidation of livestock production onto fewer farms is very evident in the hog and dairy farm numbers. The number of operations with hogs declined by 46 percent between 1993 and 1999. Dairy operations are also down, by 28 percent. Not much change is evident in the number of cow-calf operations, while the number with cattle on feed is down eight percent. The number of sheep operations was down substantially as of a year ago.

The 1997 Census of Agriculture reports that there were 819 Minnesota operations with 50 percent or more of their sales from poultry and eggs. Of those, 219 had 50 percent or more of sales from chicken eggs, 168 from broilers, and 257 from turkeys.

Table 4. Changes in the Minnesota Livestock Industry, 1993-99

Species	1993	1998	1999	2000	1998-99	1999-2000	1993-99	1993-2000
	number of animals (000)				percent			
Inventories and Production:								
All sheep & lambs, 1/1 inventory	245	165	175	165	6%	-6%	-29%	-33%
All cattle, 1/1 inventory	2,849	2,500	2,500	2,550	0%	2%	-12%	-10%
Cattle on feed, 1/1 inventory[a]	330	265	270	285	2%	6%	-18%	-14%
Beef cows, 1/1 inventory	410	395	385	400	-3%	4%	-6%	-2%
Milk cows, 1/1 inventory	660	555	545	540	-2%	-1%	-17%	-18%
All hogs and pigs, prev. 12/1 inv.	4,700	5,700	5,700	5,500	0%	-4%	21%	17%
Pig crop, annual	8,618	9,612	9,289			-3%	8%	
Turkeys raised, annual	42,000	44,500	43,500			-2%	4%	
Laying hens, annual average	10,731	12,032	12,310			2%	15%	
Broilers raised, annual	46,600							

	1993	1997	1998	1999	1997-98	1998-99	1993-99
Operations with:	Number operations				percent change		
Hogs	14,000	9,000	8,500	7,500	-6%	-12%	-46%
All cattle and calves	38,000	33,000	31,000	30,000	-6%	-3%	-21%
Milk cows	13,500	10,500	9,700	9,100	-8%	-6%	-33%
Beef cows	16,000	16,000	15,800	15,800	-1%	0%	-1%
Cattle on feed	8,000	7,500	7,400		-1%		
Sheep	4,800	2,900	2,600	2,700	-10%	4%	-44%
All farms[b]	86,000	81,000	80,000	81,000	-1%	1%	-6%

Source: (Minnesota Agricultural Statistics 2000)

[a]Cattle on feed are animals for slaughter market being fed a ration of grain or other concentrates and are expected to produce a carcass that will grade select or better.

[b]A farm is any establishment from which $1,000 or more of agricultural products were sold or would normally be sold during the year.

More Details on Trends in the Dairy Industry

The structure of the Minnesota dairy industry has experienced dramatic changes in productivity, herd size growth, reduction in total cows and herds, and a dramatic reduction in the number of milk processing plants. Milk sales are typically the largest generator of farm income in the state, ranging between 18 and 22 percent most years. Nationally there has been a shift in the regional market share where milk is produced (Table 3). Minnesota's share of the national milk market has declined from 8.3 percent in 1960 to 5.9 percent in 1998. (Conlin 1995b; Milk Production 1999) Minnesota has dropped in ranking from third in 1960 to fifth in 1998.

Table 5. Shifts in Percent of U.S. Milk Production

	1998	1993	1991	1987	1984	1973	1960
California	17.5	15.2	14.5	12.5	11.3	8.7	6.6
Wisconsin	14.5	15.2	16.2	17.4	17.4	16.3	14.4
New York	7.5	7.6	7.5	8	8.4	8.5	8.4
Pennsylvania	6.9	6.8	6.8	7.1	7	5.8	5.6
Minnesota	5.9	6.4	6.6	7.3	7.6	8	8.3
Idaho	3.7	2.1	2	1.7	1.6	1.4	1.3
Texas	3.6	3.9	3.6	3	2.8	2.8	2.4
Michigan	3.4	3.6	3.5	3.7	3.9	4.1	4.2
Washington	3.4	3.3	3	2.6	2.6	2	1.7
New Mexico	2.8	1.8	1.3	0.7	0.7	0.3	--
Ohio	2.8	3.1	3.2	3.4	3.4	3.8	4.2
Iowa	2.4	2.7	2.8	2.5	2.8	3.5	4.8
Arizona	1.7	1.2	1.2	1	0.9	0.6	--
Vermont	1.7	1.7	1.6	1.7	1.6	1.7	1.6
Florida	1.5	1.7	1.7	1.6	1.4	1.6	1.1
Missouri	1.5	1.9	1.9	2	2	2.6	3
Indiana	1.4	1.5	1.5	1.6	1.7	2	--
Illinois	1.3	1.7	1.9	1.9	1.9	2.4	3.4
Virginia	1.2	1.3	1.4	2.6	1.5	1.5	1.6
Colorado	1.1	1	0.9	0.8	0.7	0.7	--
Kentucky	1.1	1.4	1.5	1.6	1.6	2.1	2.6
Kansas	1	0.7	0.8	0.9	0.9	1.3	1.5
Oregon	1	1.1	1.1	1	1	0.9	--

Sources: USDA Economic Research Service, Dairy Situation, March 1985-92.
USDA Agricultural Marketing Service, Dairy Market News, Vol. 55, Rep. 10, 1988.
USDA Economic Research Service, Dairy Outlook, February 23, 1988.

Adapted from: USDA, NASS, http://usda.mannlib.cornell.edu/re…ssr/dairy/pmp-bb/1999/mkpr0299.txt

The greatest gains in market share have come in the western states of California, Washington, Arizona, New Mexico, and Idaho. California has increased its market share by a factor of more than 2.5 since 1960 and is still growing. Pennsylvania, Michigan, and Vermont have tended to hold their market share, while the rest of the Northeast and Midwest has declined. States losing market share have been in the more traditional dairy areas - Wisconsin, Minnesota, Iowa, Illinois, Ohio, New York, Missouri, and Kentucky. The reasons for these shifts are not well documented in the literature but there is evidence of differences in the average cost of production (Table 11 below), productivity (Milk Production various issues), herd size (Table 4), use of technology, level of specialization, and mode of operation. These traditional areas tend to be made up of herds less homogenous in the way they are managed with smaller herd sizes, and more diversified operations that grow a major portion of the feed supply that is marketed as milk.

Minnesota reached a peak of 151,064 dairy farm in 1945. More than 80% of the farms sold milk at that time. Dairy herd numbers were at 9,100 or 12% of the farms in 1999. Cow numbers have dropped from a high in 1945 of 1,660,000 to 540,000 in 2000. The dairy cow density on agricultural land has sharply decreased from 19 acres per cow in 1945 to 54 acres per cow in 1998. Herd size in Minnesota has increased from 11 to 58 cows per herd between 1945 and 1998. The number of small and medium herd size categories are decreasing most rapidly and the two largest herd size categories, above 200, cows are increasing in number in the 1990s. The average herd size nationally is 79 cows per herd. Table 3 documents the herd size profile of Minnesota dairies with other major milk producing states and state that have been increasing their market share.

Table 6. Herd Size Profile Percent Inventory by Size Groups for Selected States -- 1998

	1-29	30-49	50-99	100-199	200-499	500+
			Percent of total cows			
California	--	--	--	3	18	78
Wisconsin	5	21	43	18	10	3
New York	3	11	34	26	15	12
Pennsylvania	5	25	37	22	10	2
Minnesota	6	22	40	16	12	4
Michigan	5	11	25	32	18	10
Idaho	1	2	6	12	19	61
Washington	--	1	4	16	32	47
New Mexico	--	--	--	1	3	96

Productivity per cow has increased three fold between 1945 and 1998. Production per cow averaged 17,192 pounds nationally in 1998 compared to 16,833 pounds per cow in Minnesota. Minnesota ranks sixteenth nationally in production per cow. Washington ranks number one in productivity at 21,476 pounds milk per cow annually (Milk Production various issues). Minnesota DHIA reports that more than 1,325 herds in the state are producing more than 20,000 lbs. per cow. (Minnesota Dairy Herd Improvement Association Annual Summary 1998 1999). Total milk produced in the state peaked at 10.8 billion lbs. in 1985 and dropped to 9.2 billion lbs. in 1998.

Minnesota produces more than 2,000 pounds of milk per person in the state or 3-1/2 times the average consumption (Table 5). Only about 15 to 18% of the total milk produced is consumed as fluid milk. The rest is processed into manufactured dairy products such as cheese, dry milk and butter and ice cream. Almost 70% of Minnesota's milk was made into cheese in 1997 with a rapid rise in Italian cheese production since 1993. This is in contrast to Minnesota's national leadership in butter, dry milk powder, and ice cream production in the 1970's and early 1980's. This required an industry conversion to cheese in response to changing consumer demands (Minnesota Agricultural Statistics 1998; Conlin 1995c; Conlin 1995b). Minnesota ranked fourth nationally in cheese production and fifth in butter processing in 1998 (Minnesota Agricultural Statistics various issues).

Table 7. Minnesota's Changing Dairy Landscape

Year	Dairy Farms (thousands)	% Farms Marketing Milk	% Grade A	Dairy Cows (thousands)	Cows/ Herd	Ag land per cow (acres)	Milk lb/Cow
1945	151	80	--	1,660	11	19	5,186
1955	116	70	4	1,378	12	23	6,410
1965	67	47	8	1,232	18	25	8,550
1975	33	28	26	884	26	36	10,119
1985	22	23	47	915	41	34	11,800
1993	13	15	72	648	49	46	15,000
1998	9.5	12	92	551	58	54	16,833

Geographic shifts in milk production have also been occurring within the state. Minnesota's dairy belt has ranged from the Southeast: Houston and Fillmore counties, up through Winona, Goodhue, Wabasha, Rice, Carver, Wright, Stearns, Morrison, Todd, Ottertail and Becker Counties. The top five milk producing counties are Stearns, Ottertail, Winona, Morrison, and Goodhue. Over time, the exodus from dairying has been more pronounced outside of this region resulting in a greater geographic consolidation. (Conlin 1995b)

The structure and performance of specialized dairy farm businesses in the U.S. are described in (Short 2000). "Specialized dairy farm businesses" were those that had at least $50,000 in dairy-related sales. Data from the 1993-95 USDA Farm Costs and Returns Surveys and the 1996 Agricultural Resource Management Study showed that milk producers are struggling to adjust to markets that are more dependent on the forces of supply and demand. In general, they did a fairly good job of meeting short-term debt, generating returns, and meeting long-term debt from 1993 to 1996. Those in the Upper Midwest region of Minnesota, Wisconsin and Michigan earned rates of return on equity of 2 to 3 percent (considering only current income, not capital gains) over the four-year period. These rates of return were similar to the national averages, except for 1993 when wet weather affected the region. Herd size was the most significant factor contributing to variation in net farm income, accounting for 90% of the variation. Production, financial, and marketing strategies were compared across regions and farm sizes. One notable result was that the larger farms used marketing strategies extensively. Almost half of the Upper Midwest farms with $500,000 in sales contracted the sales of their product as a marketing strategy. Hedging, on the other hand, was not used very much.

Professor Joe Conlin, a University of Minnesota extension dairy scientist working with the dairy industry since 1968, characterized some of the changes taking place in the Minnesota dairy industry over time. See Table 6, based on agricultural statistics available from the Minnesota Department of Agriculture. (Conlin 1995b)

He identified ten major trends that are underway in the dairy industry (Conlin 1995b):

1) Dairy farms are restructuring to larger, more specialized farms that are multi-person owned and operated, on a relatively smaller land base with greater vertical integration with the market and input sectors, and more diversity in size and production processes.

2) Higher priority given to management goals: efficiency, profitability and life quality with higher productivity per unit of labor, feed, and asset, more emphasis on effective management of people, adoption of cost effective technologies, use of outside expertise and greater systemization, routinization and specialization of production tasks.

a) Implementation of quality management concepts such as management information systems, strategic and tactical business plans and action protocols, team work, and monitoring and control systems.

b) Increased business networking and collaboration through joint ownership, creative financing and risk sharing, leasing arrangements, closer linkages between production and consumption, more outsourcing operational phases, and greater use of external advisors.

3) Greater price volatility with less government involvement in regulating prices of feed and milk, and expanding potential for export pressures and greater use of price risk tools such as futures, options, and contracts.

4) Stronger consumer driven markets with more emphasis on quality defined in human health/safety risks, consumer tastes, packaging and product preferences, with growing competitive opportunities in international markets and niche markets and product differentiation.

5) Restructuring of the dairy industry business/service sector with mergers, and consolidations having fewer processing plants, greater privatization of information, globalization of technology and services, with a feed industry becoming more price driven with greater use of commodities, and separation of consulting services from product sales.

6) Changing public policy with markets being more driven by supply/demand and quality, less regulation of pricing policies, broader public input on agricultural policy, particularly issues related to the environment, food safety, and animal care. The dairy business will be more sensitive to broad government policies related to taxes, interest rate, environment, health, trade, crop programs, etc.

7) Stricter environmental protection policies related to protection of ground water and air quality that will bring greater integration of manure application with the cropping and land characteristics.

8) Cow numbers will shift to regions that have dairy friendly communities with plentiful supplies, cost competitive feed and services, with a desirable climate, infrastructure of dairy support services and markets, and where there is access to capital.

Table 8. Dairying's Contribution To Farm Income					
Year	Gross Farm Milk Income ($ thousands)	% Total Farm Income Dairying	Average Price $/cwt	State Total Milk lb. (billions)	No. Minnesota Butter & Cheese Plants
1945	184	20	2.70	8.6	845
1955	247	19	3.12	8.8	625
1965	348	22	3.34	10.7	327
1975	687	15	7.68	8.9	86
1985	1,026	21	12.05	10.8	44
1993	1,229	18	12.67	9.7	27
1998	1,362	16	13.19	9.2	20

More Details on Trends in Other Livestock and Poultry

Table 7 shows percentage shifts in market share for the top ten states and Minnesota (if not one of the top ten) for selected years since 1970. Minnesota has been losing market share in beef cow-calf and cattle feeding operations, while our pork industry share is increasing. While the state's sheep numbers in absolute terms are down (see Table 1), so are national inventories so that in percentage terms our market share is fairly stable. Our poultry market share has also been stable in the 1990s. One question that has been raised is whether there are any examples of states where livestock production was declining in terms of market share vs. other states, and had turned around and is growing today. Missouri and Oklahoma's increases in hog inventories since 1991 are two example turnarounds that stand out. Wyoming's market share in sheep inventories also increased in 1998, but they actually lost inventories in absolute terms, just not to the extent that other states did.

Table 9. Shifts in State Market Shares of U.S. Livestock and Poultry Production

Beef cows, 1/1 inventory

	1998	**1995**	**1992**	**1990**	**1985**	**1980**	**1975**	**1970**
TX	16.4	17.1	16.2	15.7	15.8	15.1	15.2	15.3
MO	5.9	6.0	6.1	5.9	5.7	6.1	6.1	5.2
OK	5.8	5.6	5.7	5.7	5.6	5.8	6.0	5.8
NE	5.7	5.4	5.2	5.3	5.1	5.3	5.2	5.0
SD	4.6	4.7	4.5	4.5	4.6	4.1	4.7	4.6
MT	4.6	4.4	4.3	4.0	4.3	3.8	3.7	4.3
KS	4.3	4.3	4.0	4.2	4.3	4.6	4.3	4.9
KY	3.4	3.3	3.3	3.1	2.9	3.0	3.1	2.9
FL	3.0	3.2	3.2	3.3	3.3	3.2	3.2	2.4
IA	2.9	3.0	3.4	3.4	3.7	4.7	4.0	3.9
MN	1.2	1.2	1.1	1.1	1.2	1.5	1.6	1.4
other	42.2	43.0	44.3	44.9	44.7	44.3	44.4	45.7

Cattle on feed, 1/1 inventory

	1998	**1996**	**1993**	**1991**	**1986**	**1981**	**1976**	**1971**
TX	21.0	20.6	19.4	18.3	18.7	15.8	14.6	11.6
KS	17.4	17.3	15.1	13.8	12.5	9.5	10.4	7.2
NE	16.9	15.9	16.8	18.2	16.6	14.1	10.8	11.1
CO	8.4	8.4	7.9	7.9	8.2	7.3	7.2	6.8
IA	7.3	5.7	7.0	8.2	5.9	11.8	11.8	15.6
OK	3.2	3.2	2.7	2.6	2.8	2.8	2.2	1.9
CA	2.9	2.7	3.5	3.5	4.0	5.8	7.4	7.8
SD	2.3	2.6	2.7	2.5	3.1	3.1	2.8	2.7
ID	2.2	2.1	2.2	2.0	1.8	2.1	1.6	1.7
MN	2.0	2.6	2.6	2.7	2.6	3.2	3.3	4.3
other	16.3	18.9	20.2	20.3	23.8	24.5	27.9	29.3

Hogs and pigs, 12/1 inventory

	1997	**1994**	**1991**	**1989**	**1984**	**1979**	**1974**	**1969**
IA	23.4	24.2	26.0	25.1	26.3	24.1	24.3	24.6
NC	16.2	11.7	6.3	4.8	4.3	3.9	3.4	2.8
MN	9.0	8.1	8.5	8.3	8.0	7.3	6.7	5.5
IL	7.9	8.9	10.2	10.6	10.0	10.3	11.8	11.6
NE	5.9	7.3	7.8	7.8	6.8	6.2	5.5	5.0
MO	5.8	5.8	4.7	5.0	6.4	6.9	7.1	7.4
OK	2.7	1.0	0.3	0.4	0.4	0.5	0.6	0.7
OH	2.7	3.0	3.3	3.9	3.6	3.1	3.5	4.5
KS	2.4	2.2	2.5	2.7	3.0	3.1	3.2	2.9
SD	2.1	2.9	3.4	3.2	3.0	3.0	3.1	3.0
other	21.8	25.0	26.9	28.3	28.4	31.6	30.7	32.0

Table 6 (continued)

Breeding sheep and lambs, 1/1 inventory

	1998	1995	1993	1990	1985	1980	1975	1970
TX	21.1	21.0	21.9	19.7	18.9	20.3	20.0	19.6
WY	9.2	8.4	8.6	7.3	8.4	8.7	9.6	9.8
CA	7.9	8.4	7.7	8.1	9.8	9.0	7.3	6.8
MT	7.0	7.0	6.3	6.7	5.3	5.1	5.0	6.2
SD	6.0	6.3	6.0	5.6	6.4	6.5	5.8	5.8
UT	5.7	5.6	5.4	5.1	5.5	5.4	5.3	5.6
CO	4.3	3.9	4.5	4.7	4.2	4.6	4.4	4.7
ID	4.2	3.7	2.8	2.8	3.3	4.1	4.5	3.6
NM	3.9	4.1	4.6	4.9	5.5	5.4	4.4	4.5
OR	3.2	3.8	3.9	3.6	3.9	3.5	2.9	2.6
MN	2.0	2.2	2.2	2.2	2.1	2.0	2.4	2.4
other	25.5	25.8	26.1	29.4	26.6	25.5	28.3	28.2

Turkeys raised, annual

	1996	1994	1992	1990	1985	1980	1975	1970
NC	20.3	20.6	20.9	19.2	16.1	12.9	10.6	8.1
MN	13.2	12.8	12.8	14.1	14.2	13.7	16.2	16.9
MO	8.1	7.2	6.8	6.0	6.6	7.4	6.7	7.3
AR	7.3	7.7	8.2	7.5	8.0	8.5	5.9	6.5
CA	6.9	6.8	7.9	12.0	11.5	13.5	13.2	13.9
VA	6.6	6.2	5.7	5.2	6.6	5.5	4.4	3.5
IN	4.9	5.1	5.5	4.8	3.5	3.7	3.7	4.3
SC	3.6	2.6	3.1	2.8	2.2	2.8	2.7	2.7
PA	3.4	3.1	2.8	2.8	3.6	3.0	2.4	2.0
OH	3.2	2.7	2.3	2.2	1.9	1.6	2.4	3.4
other	22.5	25.2	24.1	23.5	25.8	27.4	31.8	31.4

Broilers raised, annual

	1996	1993	1991	1989	1984	1979	1974	1969
AR	15.5	15.1	15.5	16.1	16.2	16.2	15.3	14.0
GA	15.5	14.4	14.0	14.9	14.6	13.7	14.0	15.4
AL	11.5	13.0	13.8	13.1	17.6	12.1	12.7	12.3
NC	9.7	10.2	9.8	10.2	10.5	9.9	10.1	10.3
MS	8.5	7.9	7.2	6.8	7.2	7.0	7.4	7.7
TX	5.2	5.3	5.5	5.2	4.7	5.7	5.8	5.9
DE	3.9	4.2	4.4	4.7	5.1	4.9	5.2	5.2
MD	3.8	4.4	4.3	4.6	6.4	6.5	6.7	6.8
VA	3.4	3.7	3.6	3.3	3.6	3.1	2.5	2.2
CA	3.2	3.6	4.2	4.4	4.6	3.9	3.4	2.9
MN	0.7	0.8	0.8	0.8	0.7	0.5	0.4	0.5
other	19.1	17.4	16.6	15.8	8.8	16.6	16.5	16.8

Source: (Minnesota Agricultural Statistics 1998)

Information on the size distribution of swine operations is available from several sources. The USDA National Agricultural Statistics Service publishes data on the number of swine operations and percent of inventory by size in the December 1 Hogs and Pigs reports each year. This is usually the most current source of information, and is based on surveys which appear to be reasonably sound from a statistical standpoint. One drawback of the Hogs and Pigs Report data is that it does not provide much detail on the largest sized operations, since the largest size category is "over 5,000 pigs" in inventory. Another source with more detail is the Census of Agriculture. This includes size breakdowns by number in inventory, number sold per year, and number of litters farrowed per year. The census is probably the most accurate data available, since all farms are enumerated rather than only a sample as with the Hogs and Pigs report. A drawback of the census is that it is only done every five years, so the data is not always as current as with Hogs and Pigs. It also is somewhat lacking in detail about the largest size categories, with the largest size categories being "5,000 or more pigs inventory", "7,500 or more pigs sold per year", and "1,000 or more litters farrowed per year."

These three different size measures can be confusing for the casual reader, so care must be taken when comparing different sources to assure consistency of comparisons. For most intensively managed swine operations, the number of pigs sold per year will be greater than the number in inventory at any point in time, since it only takes about six months for a pig to reach market weight. Also, roughly 7 - 10 pigs are typically sold per litter farrowed, depending on the age at sale, death losses, and other factors, so the number sold will be greater than the number of litters farrowed. The numbers are further complicated by the fact that some operations both farrow and finish the pigs to market weight, while increasingly operations only farrow the pigs and sell or transfer them to others for finishing.

A third source with more detail on the largest operations is a series of annual surveys conducted by researchers at Iowa State University and the University of Missouri. The latest report from this activity is (Lawrence et al. undated). The sampling frame is based mainly on the list of subscribers to a swine trade magazine, with complete enumeration of the largest operations. As such, its statistics may not be quite as reliable as the other two sources but is often used because of its additional detail. The size distribution by number marketed (sold) per year is shown in Table 8. It shows that there were 18 operations marketing 500,000 or more pigs per year in 1997, representing 24 percent of total U.S. slaughter.

Their summary of the most recent size trends was:

> "Consolidation of the pork industry is continuing. However, the changes are occurring primarily in the largest and smallest groups of producers. The largest operations are gaining the greatest market share and the very smallest are showing the

greatest loss. In 1997, 145 firms marketing 50,000 hogs or more a year marketed approximately 33.1 million head (37% of U.S. produced) of hogs in 1997 (Table 7). This figure compares with 16 million head from 66 firms in that size class in 1994, the last such study completed (Grimes and Rhodes, 1995). This is a dramatic increase in only three years. Another 51.7 million hogs (56%) were marketed by an estimated 23,400 operations selling 1,000-49,999 head a year. The remaining 5% of the U.S. hogs were marketed by approximately 80,000 farms selling fewer than 1,000 hogs annually based on USDA estimate of the number of farms with hogs, December 1997, Hogs and Pigs." (p. 2)

Table 10. Estimated Number of U.S. Swine Operations and Share of U.S. Slaughter 1997, by Size Category.

Annual Marketings (1000 Head)	Number of Operations (Number)	Market Share (%)
<1	80,000	5.4
1-2	11,708	12.1
2-3	4,996	9.7
3-5	3,438	9.9
5-10	1,978	9.9
10-50	1,318	16.2
50-500	127	13.1
500+	18	23.8

Source: (Lawrence et al. undated)

In the hard copy and PDF versions, four maps from MN Ag Stats will be inserted here showing which MN counties have concentrations of different livestock species

c. Type of business organization and degree of vertical integration or coordination

One source of information on type of business organization is the Census of Agriculture, which gives a breakdown of the number of sole proprietorships, partnerships, and corporations (U.S. Census of Agriculture 1998). All farms are lumped together in the statistics, rather than having a separate breakdown just for livestock livestock operations. Corporations with more than ten shareholders made up only 0.3 percent of Minnesota farms in 1997, and accounted for 4.2 percent of the market value of products sold.

Extent of Marketing and Production Contracts in the Swine Industry

It would be possible to measure vertical integration or coordination by measures such as packer control of production through ownership of production facilities, marketing contracts, or production contracts. Feed or genetics suppliers may exercise a certain degree of control of production through ownership or contracts. Veterinarians and other information providers may be involved in production decisions to some degree.

According to a February 1999 survey of nine the largest twelve pork packers, 64 percent of the slaughter hog purchases during January 1999 were priced under some contractual method other than the spot market (Hog Marketing Contract Study, University of Missouri and National Pork Producers Council 1999). This was an increase from 57 percent in 1997. Formula price contracts tied to the spot market amounted to 44 percent of sales, so that the spot market determined prices for 80 percent of the hogs which is down only slightly from the 82.5 percent found in the 1997 survey. About 18 percent of the hogs were purchased under some system that supposedly reduces price risk to producers, but the amount of the risk reduction is unclear because many of the contracts involve ledger balances which may have to be repaid later in the life of the contract. When the authors state that the spot market determined prices of hogs sold under formula prices, we believe that they are speaking of daily price movements over the short run. As one reviewer points out, over the longer run, increased use of marketing contracts may cause thinning of the spot market. As the spot market thins, the hogs sold on the spot market may become less representative which could frustrate price discovery. A more recent report found that spot market sales of hogs were down to 17 percent of all hogs in January 2001, which was an eight percent decline from a year earlier. If this rate of decline continues, the cash market could disappear within two years (Cash Hog Prices Likely to be Gone in Two Years 2001). This topic is discussed further under section D4f, "price discovery and market fairness."

Production contracting may not initially be thought of as falling under "contractual buying and selling arrangements," but it does involve buying and selling the farm operation's labor, facility and other services, so will be mentioned here. The latest figures on the level of production contracting in the swine industry is from the 1998 Industry Structure Study by Glenn Grimes, University of Missouri and John Lawrence, Iowa State University (Miller 1998). They found that 17 percent of 1997 slaughter hogs were farrowed under contract, and 30 percent were finished under contract. They also looked at when currently held contracts were signed. The largest signup was in 1997. Most contracts are set to expire at a fairly even rate between now and the year 2007. Production contracting is the norm in the poultry industry, with 85 percent of broilers grown under contract in 1995. Most of the remaining chickens are grown on farms owned and operated by the integrator (Perry et al. 1999).

The most recent USDA estimates of hog production costs and returns include information on the use of contracts. They found that for the United States overall, 41 percent of all hogs were produced under contract in 1999. Regions ranged from 7 percent in the Mississippi Portal region to 87 percent in the Southern Seaboard. In the Heartland region (southern Minnesota down to Missouri and east to Ohio), 29 percent were produced under contract (Production Costs Changed Little in 1999, but Lower Commodity Prices Cut Most Returns 2000).

Milk Marketing Contracts

No research-based studies were found on milk marketing contracts. Most milk is marketed through farmer cooperatives with informal marketing arrangements that producers can change processors at relatively short notice. Upper Midwest milk processors are currently in highly competitive with each other to secure producer milk to maintain plant-processing efficiency in the face of a declining supply. The authors are aware of several incentives processors are using to compete for producer milk such as quality premiums, discounts on hauling charges, management services, volume premiums, and various forms of formal milk contracts. The extent to which milk contracts are used is not available. Little is known about the terms of these contracts in that they are proprietary and are confidential between the producer and processor.

Quantifying Vertical Coordination and Vertical Integration

Vertical coordination has been described as a continuum of vertical governance structures, variable in the extent to which one party of a vertical exchange prescribes the behavioral pattern of another (Henderson and Frank 1998). Henderson and Frank review the literature on quantifying vertical coordination and vertical integration, and discuss the measurement difficulties involved. They show upstream vertical coordination indices for 38 different U.S. food-manufacturing industries for 1982. They find that, for example, ice cream and frozen desserts have an index of 0.999, while animal fats and oils are at 0.009. Some other industries of relevance to the GEIS are processed egg products, 0.771; fluid milk, 0.543, and fresh meats, 0.528.

Related comments including a discussion of the USDA Packers and Stockyards study of packer concentration and vertical coordination in the swine industry is included under question D4 below.

The Top Fifty Milk Cooperatives in the U.S.

Hoards Dairyman compiles an annual summary of milk volume and membership of the top fifty milk cooperatives in the U.S (Mowrey 1998). In 1998, the top fifty milk cooperatives in the U.S. ranked on volume of milk accounted for 120 billion pounds of the national production of 157 billion pounds in 1998. They claimed 70,820 member dairy farmers. The ranking of the largest cooperatives has had some major shifts in the most recent years because of mergers. These shifts are expected to continue with very recent mergers and merger discussions in progress. The ten milk cooperatives with largest milk volume accounted for half of total 1998 U.S. milk production:

Dairy Cooperative	**Member Milk (bil. pounds)**	**Number Members**
Dairy Farmers of America, Springfield, MO	31,500	18,453
Land O Lakes Inc, St Paul, MN	7,988	6,400
California Milk Producers, Artesia, CA	6,750	336
Foremost Farms USA, Barb, WI	5,400	5,850
Family Dairies, Madison, WI	5,256	7,625
Darigold Farms, Seattle, WA	5,050	878
Dairylea Cooperative Inc., Syracuse, N.Y.	4,886	2,369
North Central AMPI, New Ulm, MN	4,400	5,000
Dairymans Cooperative Creamery Assn, Tulare, CA	4,212	245
Manitowoc Milk Producers Cooperative, Manitowoc, WI	3,540	3,230

The second-ranked cooperative, Land O Lakes, has merged with ninth-ranked Dairymans Cooperative Creamery Association since these 1998 figures were compiled.

"Industrialization" of the Swine Industry

The swine industry has been undergoing rapid changes in recent years along the lines of the earlier sectors discussed by Reimund et al., that some authors have termed "industrialization." An overview of recent trends and driving forces is included in a chapter of Purdue University's Food System 21 report (Boehlje et al. 1997). The types of vertical linkages and transaction methods in Canada, the Netherlands, and the U.S. are compared by (Srivastava et al. 1998), who conclude that industrialization, globalization, and changes in consumer demand and preferences are resulting in massive structural and operational changes in the international pork industry. More detail on specific technologies and their potential to improve profitability is provided in (Positioning Your Pork Operation for the 21st Century 1995). New technologies and management strategies that are thought to be playing a major role include:

- feeding programs that are closely geared to animal needs during specific growth phases, and that respond more quickly to changes in ingredient availability and cost,
- health-enhancing technologies such as all in-all out rearing and early weaning that may reduce improve performance, dependence on antibiotics, and/or maintain acceptable performance in larger facilities,

- breeding systems which utilize crosses of specialized sire and dam lines to achieve desirable traits, and artificial insemination and related technologies which allow elite lines to be utilized more widely,
- more careful facility design and better information systems to improve throughput of animals from a given investment in land and buildings, and
- networked (cooperative) selling and/or buying among groups of producers, and information sharing among producers and between producers and processors to capitalize on quantity- and quality-based premiums and discounts and identify areas that need improvement.

Government policies and regulations that Boehlje et al. expect to shape the future of the hog/pork industry fall into the areas of:

- environmental regulations,
- animal well-being,
- worker safety, and
- policies regarding concentration, control, market access, and price discovery.

Implications they see for the future include:

- more site-specific micro production management,
- optimization of the supply chain from genetics to the end-user/consumer with better flow scheduling and resource utilization, better quality control, reduced food safety risks, and increased ability to respond to consumer demand for specific attributes,
- continued challenges related to environmental and odor problems which will affect size and location, unless technological fixes are developed,
- an increased role for producer associations that provide services to their members,
- trace-back systems from final product to genetics to quickly and easily indentify sources of contamination,
- heightened risk from new sources such as shutdown of large plants or disruption of contracts, globalization, and more specialized production units.
- Decisions concerning new production, processing, and distribution centers will tend to be made in a more coordinated fashion than in the past when they were made relatively independently.
- Technological advances in production and processing could dramatically alter the labor requirements to manufacture pork.

- Pork's competitive position could improve relative to beef and possibly even relative to poultry. Finally, ownership of world pork production and processing could become more globalized with more firms investing across national boundaries.

Another analysis of industrialization of the pork sector is presented by several authors in (Royer and Rogers 1998). The chapter by Rhodes in that book includes a number of suggestions for research on ways to:

- reduce social costs of the changes,
- help smaller operations to remain competitive,
- manage the risks involved in the new industry structure,
- assure legal protections for growers that make sense in terms of efficiency considerations, market and political realities, and mainstream ethics, and
- evaluate the tradeoffs for various current and potential production areas, and develop institutional rules that could greatly reduce social costs.

The chapter by Ginder in the same book characterizes the situation in terms of a bifurcated production channel, with one side being a producer-centered, commodity hog side dominated by independent producers and a few large production contractors, along with a specialty hog side diminated by the industrialized producers with packing and processing facilities.

The future role of cooperatives under a more industrialized agriculture is an issue which has received attention from a number of researchers. (Fulton 1995) and (Cook 1995) discussed the outlook for cooperatives. Fulton concludes that the changes in both technology and society's values (more individualism) are likely to make cooperation more difficult in the future. He argues that many cooperatives have been predicated on creating opportunities for farmers in a world of spot markets, and more direct marketing channels and reductions in output variability would diminish the opportunities for cooperatives. Cook sees a promising but challenging future for cooperatives that take a more offensive rather than defensive approach, and a number of factors conducive to successful collective action in U.S. agriculture, such as where there is a new market in which existing preferences are unknown, where declining markets exist, where shared risk through relational contracts can be accomplished, or where producers recognize asset-specificity-driven opportunism in the early stages of technology adaptation.

Changes in farm profitability and food demand in recent years have led to a great deal of farmer interest in projects to add value to farm products. (Siebert et al. 1997) review some of the risks involved in post-harvest value added investment decisions, especially when the new market level being entered is not thoroughly understood. They suggest an alternative: investing in publicly traded equities (stocks) of investor-owned processing firms. For example, ConAgra, IBP, Hormel or Smithfield Foods might provide investment opportunities for livestock producers who are seeking to capture value added at the processing level. Siebert et al. suggest a formula for calculating the size of the investment needed to achieve a balance between the size of the farm's marketings and the diversification capacity of the value added investment.

Production Networks as a Minnesota Response to Swine Industry Industrialization

A number of Minnesota pork producers became involved in swine production networks in the mid-1990s. Twenty producers interviewed in late 1995 cited a number of specific reasons for joining networks (Koehler et al. 1996). Most of the producers were previously producing hogs in individually-owned farrow-to-finish operations. In general, they were all looking for a way to access the technology and systems they saw as necessary to achieve low cost production of the product quality and volume necessary to be competitive in the future. Within that general theme, some people emphasized product quality while others focused on volume or labor simplification. The types of arrangements ranged from small-scale, informal farmer-to-farmer formula pricing arrangements to large-scale, jointly owned sow units directed by hired management consultants. Perceived advantages to network participation included:

- disciplined pig flow and larger pig group size that made all in-all out finishing work better, which in turn made it easier to achieve pig health goals
- the opportunity to utilize specialized facilities with modern technology and better working conditions
- the opportunity to utilize staff with specialized skills and expertise
- discounts on input purchases due to quantity purchasing

Perceived disadvantages included:

- the difficulty of arriving at an equitable sharing of profits among the producer-members of the network who might now be involved only in farrowing, only in finishing, or in other parts of the network rather than owning and being in control of the entire system as in a traditional farrow-to-finish operation
- more possible points of risk exposure because more people and facilities are involved in the larger networked system
- increased transportation requirements to move pigs from farrowing to the nursery, and then on to finishing facilities that are be located on different farms

d. Competitiveness in national and international markets

Competitiveness can be evaluated by comparing US numbers against selected major competing livestock-producing countries, comparing Minnesota against selected other states, and comparing counties or multi-county regions within the state.

Pork Competitiveness

Benchmarking is a method for identifying and measuring important performance measures and best management practices for performance improvement. Benchmarking is being used extensively in many industries and service sectors from autos to education for quality and performance improvement. Management not only compares their performance with previous time periods but also with other similar actors in the business or service sector. Quality management research provides evidence that benchmarking is an effective approach to continuos improvement. Comparison of performance overtime provides measures of improvement. Comparison with the best performing businesses helps to identify competitive opportunities for improvement. A successful benchmarking program requires collective agreement on the performance measure to be used, and a system for collection and distribution of the benchmarking information. There are many references in the business literature by various authors about benchmarking in various business and service sectors, such as (Keehley and McBride 1997) and (Bogan and English 1994).

The swine industry is evolving so rapidly that it is difficult for producers and others to determine benchmarks that can indicate what is required to remain competitive in the future. The one-time, in-depth studies described below can be helpful in this regard, and the Minnesota farm business management record summaries discussed later in the "economies of size" section are other sources of benchmarking data. Another source which may become available in the future is a national database which the National Pork Producers Council is developing (Pork Leader 1999). This database, as proposed, will be made up of standardized production and financial information submitted by producers and summarized using standardized formulas.

(Drabenstott 1998) addresses the question of whether the US pork industry could lose market share to other major pork producing countries or regions. He summarizes a cost analysis (Martin et al. 1998) which shows that the Canadian prairie provinces have the lowest pork production costs of the regions studied, and have a cost advantage over the US western corn belt including Minnesota (Table 9). The analysis is based on a set of budgets originally developed at Purdue University, with input expenses adjusted for price differences across regions. (Drabenstott 1998) also shows that pork production in Manitoba has doubled in the past 12 years (since 1984), a period over which production in Minnesota increased by 12 percent (Minnesota Agricultural Statistics various issues). (McEwan 1999) attributes the Manitoba expansion to the fact that the Manitoba pork industry is highly concentrated in the hands of a few decision-makers who have responded rapidly to low feed prices brought about by the reduction in Canadian grain transportation subsidies. Roughly one-third of the Manitoba pork production is by two feed companies, while one-third is fed by a small number of Hutterite colonies and the remaining one-third is by independent pork producers. The growth in the Canadian industry is confirmed by (Freese 2000), who finds that in 2000, eight of the 50 largest swine operations in North America are located in Canada.

Table 11. Hog Production Costs by Region

Region	Size of operation 1200 sow	 3000 sow
	(cost per 100 kg in Canadian dollars)	
U.S. West Corn Belt	88.67	84.44
U.S. East Corn Belt	89.99	85.27
U.S. South East	98.36	93.78
U.S. Mountain	104.15	99.24
Maritime Provinces	104.26	100.08
Quebec	101.22	96.82
Ontario	87.23	81.93
Eastern Prairie Provinces	74.06	69.78
Western Prairie Provinces	84.08	79.30
Argentina	104.64	101.55
Chile	107.96	105.10
Netherlands	143.24	137.16
Denmark	142.95	136.37

Source: (Martin et al. 1998), George Morris Centre at University of Guelph

(Drabenstott 1998) also argues that Argentina and Brazil could expand pork production substantially in the future. Argentina's pork production costs appear to be much higher than in the US and Canada, due mainly to an unusually high cost of capital. Two-thirds of its cost disadvantage is due to higher interest rates alone. If they are able to reduce inflation and interest rates, Argentine costs could be much more competitive. Brazil was not included in the cost analysis but has many similarities to Argentina. Brazil has nearly doubled its pork production since 1980, according to USDA estimates cited by Drabenstott.

(Brewer et al. 1998) compares pork production costs in five U.S. states (Iowa, Illinois, Nebraska, Kansas, and Missouri, but not Minnesota) with two Canadian provinces (Alberta and Ontario), the Netherlands and Denmark (Table 10). They based their comparison more heavily on averages from farm business record programs and less on budgets than did (Martin et al. 1998), but arrived at the same ranking of the U.S. versus international competitors: Alberta's costs are a little less than in the U.S., while Ontario's are a little more. The Netherlands and Denmark have costs almost twice as high as in the U.S. In a companion paper, Hayenga discusses the structures of the swine industries in each of the countries compared (Hayenga 1998a). He concludes that North America has a competitive advantage in export of pork products to many parts of the world where relative transportation costs are not prohibitive.

Table 12. Comparison of Pork Production Costs (U.S. $/cwt)

Item	Average U.S. MW	Large U.S. MW	Alberta	Ontario	Netherlands	Denmark
Variable cost:						
Feed cost	25.47	22.75	20.12	27.03	34.00	34.77
Labor cost	4.42	3.45	4.40	3.98	10.63	10.40
Interest	1.54	1.39	0.92	1.14	2.88	3.58
Other variable costs	5.63	5.94	5.41	6.21	14.47	11.81
Sub-total	37.06	33.53	30.85	38.36	61.98	60.56
Fixed cost:						
Housing costs	6.22	5.50	8.12	8.61	12.60	17.03
Total costs	43.28	39.03	38.97	46.97	74.58	77.59

Source: (Brewer et al. 1998)

Recent U.S. regional cost and return estimates from the USDA Economic Research Service show an advantage for the Southern Seaboard region (Virginia down through the Carolinas and west to eastern Louisiana) over the Heartland region (southern Minnesota down through Missouri and east to Ohio) in 1999, in contrast to the studies by Martin and others which showed the U.S. and Canadian plains states and regions as having the lowest costs (Table 11). The USDA estimates are based on a 1998 survey of 1,600 producers with 25 hogs or more in 21 states, weighted to represent 95 percent of the hog inventory. One explanation for the difference in results between this and the Martin study may be that there may be more variation between the low and high-cost farms in the Midwest than in the southern region. The USDA numbers represent the average farm while the Martin numbers may be attempting to represent what is possible with good management and facilities.

Table 13. Hog production costs and returns per hundredweight gain, 1999

Item	U.S.	Heart-land	N. Crescent	N. Great Plains	Prairie Gateway	Eastern Upland	S. Sea-board	Miss. Portal
	Dollars per cwt gain 1/							
Gross value of production								
Market hogs	29.21	29.61	28.12	31.14	28.33	24.68	29.29	26.16
Feeder pigs	9.72	7.82	3.99	8.01	2.17	15.17	18.64	9.59
Cull stock	0.93	0.85	1.81	0.72	1.90	1.79	0.46	1.48
Breeding stock	0.65	0.33	0.29	0.08	3.25	2.96	0.43	0.48
Inventory change	-0.17	-0.89	-0.98	0.64	1.46	-0.66	1.45	-1.02
Other income 2/	1.32	1.47	1.74	0.95	0.93	1.14	0.96	1.26
Total, gross value of production	41.66	39.19	34.97	41.54	38.04	45.08	51.23	37.95
Operating costs:								
Feed --								
Grain	5.07	6.46	7.27	3.10	4.90	4.70	0.70	10.27
Protein sources	4.21	5.62	5.60	1.95	3.73	2.04	0.38	4.68
Complete mixes	9.79	7.54	4.12	12.60	8.58	11.88	17.75	4.12
Other feed items 3/	0.17	0.20	0.20	0.02	0.12	0.77	0.01	0.09
Total feed cost	19.24	19.82	17.19	17.67	17.33	19.39	18.84	19.16
Other --								
Feeder pigs	11.13	9.59	7.78	17.06	11.06	7.39	16.53	6.32
Veterinary and medicine	1.04	1.14	0.93	0.81	0.83	1.18	0.86	1.47
Bedding and litter	0.03	0.04	0.02	0.02	0.03	0.03	0.00	0.01
Marketing	0.97	0.62	0.52	0.54	0.64	1.51	2.18	0.77
Custom services	0.37	0.29	0.27	0.04	0.09	0.14	0.73	0.33
Fuel, lube, and electricity	1.12	1.21	1.15	0.94	0.90	1.59	0.81	2.20
Repairs	0.76	0.86	0.81	0.47	0.69	1.00	0.44	1.06
Other operating costs 4/	0.03	0.03	0.03	0.05	0.05	0.07	0.03	0.00
Interest on operating capital	0.82	0.79	0.68	0.88	0.74	0.76	0.95	0.74
Total, operating costs	35.51	34.39	29.38	38.48	32.36	33.06	41.37	32.06
Allocated overhead:								
Hired labor	2.22	2.30	2.25	0.97	2.77	2.37	1.72	2.80
Opportunity cost of unpaid labor	5.17	5.97	6.82	4.81	3.97	9.30	2.16	25.60
Capital recovery of machinery and equip.	10.09	10.45	10.98	8.64	10.31	12.47	8.27	24.70
Opportunity cost of land (rental rate)	0.05	0.05	0.07	0.02	0.06	0.08	0.04	0.85
Taxes and insurance	0.45	0.48	0.44	0.85	0.52	0.78	0.26	0.77
General farm overhead	0.94	0.98	0.95	1.30	1.17	1.07	0.61	2.97
Total, allocated overhead	18.92	20.23	21.51	16.59	18.80	26.07	13.06	57.69
Total costs listed	54.43	54.62	50.89	55.07	51.16	59.13	54.43	89.75
Value of production less total costs listed	-12.77	-15.43	-15.92	-13.53	-13.12	-14.05	-3.20	-51.80
Value of production less operating costs	6.15	4.80	5.59	3.06	5.68	12.02	9.86	5.89
Supporting information:								
Production arrangement (percent of production) 5/								
Independent	59	71	73	47	84	40	13	93
Under contract	41	29	27	53	16	60	87	7
Size of operation (head sold/removed) 5/								
Market hogs	1,726	1,522	1,032	1,776	2,012	873	5,074	367
Feeder pigs	1,224	845	214	664	593	1,464	6,652	253

Source: (Production Costs Changed Little in 1999, but Lower Commodity Prices Cut Most Returns 2000)
1/ Cwt gain = (cwt sold - cwt purchased) + cwt inventory change. 2/ Value of manure production.
3/ Milk replacer, milk, milk by-products, antibiotics, and other medicated additives.
4/ Costs for odor control and fees, permits, licenses, and other regulatory costs.

5/ Developed from survey base year, 1998.

Dairy Competitiveness

An Ohio Extension publication identified ten areas of dairy farm competitiveness and the role of each in contributing to the success of the business. They point out that dairy producers that want to stay competitive must commit to continued improvement, modernization and change. They suggest a better than average dairy farm today must increase the number of dairy cows by 60 over in the next 10 years to maintain their standard of living to offset inflation (Polson et al. 1997).

They identified the measures listed below as guidelines for competitive performance levels.

1. Rate of production measured by pounds of milk sold per worker (For large breeds, >600,000 to 1,000,000 pounds)

2. Cost control as measured by
   - Total feed cost per 100 pounds of milk sold (<$6.00)
   - Milking herd feed cost per 100 pounds of milk sold (<$4.00)
   - Operating expense ratio (<70%)

3. Capital Efficiency as measured by
   - Dairy investment per cow (<$6,000)
   - Asset turn over Rate (>.50)

4. Profitability as measured by
   - Net farm income (>$75,000 per owner operator)
   - Rate of return on assets (>11.0%)

5. Liquidity as measured by current ratio (>1.3)

6. Debt repayment schedule measured by scheduled annual debt payment as a percent of gross receipts (<20%)

7. Solvency as measure by
   - Debt to asset ratio (<40%)
   - debt per cow (<$2,000 if not expanding, $,3,000 if expanding)

8. Mission Statement on which the management team agrees to why they are in business (Written statement)

9. Maintain family's standard of living as measured over time (Expand herd 60% every 10 years)

10. Motivated labor force (well trained, enthusiastic, empowered family and employees who share commitment to the mission and goals of the business)

Dairy farm management records suggest that many Midwest dairy businesses are highly profitable when compared to their competitors in the West, East, South, and elsewhere in the world. However, many others have the opportunity to be more competitive by: 1. increasing cow and herd productivity, 2. increasing the efficient use of capital, 3. tightening their control of costs, and 4. marketing more milk per worker. Family economics and lifestyle needs and hopes are critical on-farm forces of change. Dairy profit margins have become slimmer while family living costs have risen. Opportunities for quality family time and for breaks in day-to-day routines to get away are growing more important to many families. Success must ultimately be measured by the personal fulfillment and satisfaction of those having a vested interest in the business; it will not survive long term without being profitable. (Conlin 1998)

The Minnesota Dairy Industry's Competitive Strengths

Historically Minnesota's dairy industry has flourished because of:

- Inexpensive high quality feeds
- Plentiful supply of water
- Land with limited alternative uses (forage production)
- Desirable climate
- Committed farm families
- Positive market reputation
- Strong support infrastructure, processors, and service and supply providers

There is wide heterogeneity in the economic vitality of Minnesota dairy farm businesses as shown by comparisons of high and low profit dairies in the state. (See Section E. of GEIS Report, Profitability and Vitality). Studies have shown that the high profit group are highly competitive nationally in being low cost producers of milk.

Wisconsin researchers identified several factors contributing to the shift from the Upper Midwest and Northeast to the West and Southwest. (Lawless et al. 1996)

- A large number of small farms that are unable to support an adequate level of family income

- Many dairy facilities and equipment are obsolete.

- Many operators are approaching retirement.

- Changes in government milk pricing policies.

  ⇒ Lower support prices beginning in 1981 based on anticipated purchase of surpluses and government costs that included an assessment to farmers to offset the cost.

  ⇒ Federal Milk Marketing system that favored other regions at the expense of the upper Midwest.

- The Upper Midwest is no longer the lowest milk production cost region in the U.S..

- Many do not have access to capital needed to expand and or change their systems to be more cost efficient.

The USDA Economic Research Service reports estimated production cost and returns for milk production by region of the U.S. The most recent estimates for 1998 and 1999 (Table 12) are consistent with a time trend that shows the Pacific region to be the low cost-of-production region. Total economic cost of producing milk in the Upper Midwest region, which includes Minnesota, was $0.45 per cwt. of milk above the national average in 1999. The major cost differences in the Upper Midwest region are feed costs that are $0.73 per cwt. lower than the national average, but higher capital costs, higher unpaid labor costs, and somewhat higher overhead, taxes and insurance. These estimates are limited in that they reflect averages for what they consider a single typical dairy for broad regions based on assumed average input costs and returns for the region. These estimates do not capture the heterogeneity in performance efficiencies within the region particularly in the more traditional dairy areas that are in a period of rapid change. The most sustainable dairies in the long run will be among the lowest cost producers.

Table 14. Milk production economic costs and returns, per cwt sold, 1998-99

Item	United States		Corn Belt		Northeast		Pacific		Southeast		Southern Plains		Uppe
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	
Gross value of production:													
Milk	15.51	14.40	15.39	14.29	15.63	15.14	15.07	13.78	17.63	16.76	15.70	15.00	15.48	14.00
Cattle	0.83	0.90	1.04	1.12	0.73	0.80	0.61	0.64	0.92	0.98	0.84	0.92	0.94	1.03
Other income 1/	0.55	0.54	0.47	0.46	0.43	0.41	0.56	0.55	0.51	0.50	0.36	0.35	0.68	0.66
Total, gross value of production	16.89	15.84	16.90	15.87	16.79	16.35	16.24	14.97	19.06	18.24	16.90	16.27	17.10	15.69
Economic (full ownership) costs:													
Feed costs (inc. in variable cash expenses)	*7.51*	*6.79*	*8.00*	*7.47*	*7.80*	*7.65*	*6.87*	*6.53*	*8.26*	*7.33*	*8.49*	*7.40*	*7.33*	*6.06*
Variable cash expenses	11.54	10.85	12.12	11.61	12.84	12.68	9.61	9.40	13.28	12.31	11.42	10.40	11.57	10.29
General farm overhead	0.62	0.60	0.66	0.64	0.61	0.60	0.39	0.38	0.74	0.72	0.53	0.51	0.75	0.73
Taxes and insurance	0.36	0.31	0.33	0.28	0.48	0.41	0.14	0.12	0.40	0.34	0.18	0.16	0.46	0.39
Capital replacement	2.10	2.17	2.21	2.25	2.07	2.12	1.34	1.44	2.51	2.66	1.99	2.13	2.53	2.57
Operating capital	0.10	0.09	0.10	0.09	0.11	0.10	0.08	0.07	0.11	0.09	0.10	0.08	0.10	0.08
Other nonland capital	0.87	0.85	0.87	0.84	0.82	0.80	0.56	0.57	1.47	1.49	0.79	0.81	1.03	0.99
Land	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01
Unpaid labor	1.65	1.59	2.68	2.54	2.38	2.23	0.43	0.43	0.31	0.29	0.83	0.77	1.95	1.86
Total, economic costs	17.25	16.47	18.98	18.26	19.31	18.94	12.56	12.42	18.83	17.91	15.84	14.86	18.40	16.92
Residual returns to management and risk	-0.36	-0.63	-2.08	-2.39	-2.52	-2.59	3.68	2.55	0.23	0.33	1.06	1.41	-1.30	-1.23

1/ Includes the dairy's share of receipts from cooperative patronage dividends, assessment refunds, renting or leasing of dairy animals, the estimated value of manure as a fertilizer, and insurance

Source: (Milk Costs and Returns: 1998-99 Costs of Production from the Agricultural Resource Management Study 2000)

Another source of data on national and international competitiveness that might be useful for future in-depth research is the Farm Level Income and Policy Simulation Model (FLIPSIM) modeling activity at the Agricultural and Food Policy Center at Texas A&M University (Texas A&M University Agricultural and Food Policy Center 99). That group of researchers maintains contact with a panel of representative farms across the U.S. They contact the farm operators periodically, and collect financial data which is used to develop a set of 80 farm budgets each of which represents a size and type of farm in 27 states. These budgets are used in a computer simulation model to analyze policy alternatives and make economic projections. The number of farms is too limited to permit state-level analysis, however. For example, they have no panel farms in Minnesota. Dairy is fairly well represented with farm budgets for the north central states of WI, MI and MO, northeastern states of NY and VT, western states CA, ID and WA, and southern states of NM, TX, GA and FL. The only hog farm budgets are for IL, IN, MO, and NC. Beef is represented by budgets for MT, WY, and CO. They have a number of publications listed on the web site which contain the results of analyses done using the model. One publication that contains a description of the panel farms is Policy Working Paper 98-1, REPRESENTATIVE FARMS ECONOMIC OUTLOOK FOR THE JANUARY 1998 FAPRI/AFPC BASELINE. They have also started to develop some representative farm budgets for a few other countries as well. Dairy farm budgets have been completed for Mexico and Kenya, and work has started on dairy budgets for Canada and Germany. They have not done any budgets for other types of livestock operations outside the U.S.

QUESTION D1. WHAT CHOICES OF BUSINESS ORGANIZATION ARE AVAILABLE TO LIVESTOCK PRODUCERS IN MINNESOTA AND IN OTHER STATES? TO WHAT DEGREE ARE LIVESTOCK PRODUCERS ALLOWED TO OPERATE AGRICULTURAL SYSTEMS INTERDEPENDENTLY AS OPPOSED TO INDEPENDENTLY IN MINNESOTA AND IN OTHER STATES AND WHAT IS THE SIGNIFICANCE?

D1a. What choices of business organization are available to livestock producers in Minnesota and in other states?

(Boehlje and Lins 1998) describes the basic business organization choices, which are summarized in Table 13. Choices of legal organization include sole proprietorship; partnership (general, limited, and in Minnesota limited liability); corporation (regular and subchapter S); limited liability company (not allowed in Minnesota); land trust; and cooperative. It is worth noting that, increasingly, farms may utilize more than one type of legal organization. For example, the farmland is owned by individual family members as sole proprietors, some of whom also own livestock buildings as general partners, and are also shareholders in an operating corporation which owns the livestock and equipment. There are also different business arrangements such as production contracts, joint ventures, and strategic alliances, as well as leasing options and sources of equity and debt capital.

Summaries of the status of forms of business organization utilized in Minnesota are provided in (Lazarus 99) and (Prim et al. undated)

Most Minnesota livestock operations are organized as single-family, sole proprietorships where the farmer and/or the farm family that owns the production or owns, or leases, the productive assets provide day-to-day labor and management.

Single-family sole proprietorships, while they are common and have a rich heritage, are not the only way to organize the capital, land, labor, and management decision making required for agricultural production. There are other options, as well. The range of options for organizing and financing a business has expanded considerably in recent years due in part to innovations in financial markets. Some livestock producers are utilizing these various options in order to finance the capital needs of larger facilities while sharing control, returns and risks among multiple owners, employees, and other stakeholders.

The choices and options include legal organization, business arrangement, leasing options, and sources of both equity and debt capital. Legal organization options in addition to sole proprietorships are partnerships (general and limited), regular and Subchapter S corporations, limited liability companies, land trusts and cooperatives. The limited liability partnership is a relatively new legal option available to Minnesota farmers. Business arrangement options in addition to the traditional independent production include production and marketing contracts, joint ventures, and strategic alliances (Boehlje and Lins 1998).

Table 15. The Organizational/ Financial Structure of the Agribusiness Firm: The Choices and Options

Legal Organization	Business Arrangement	Leasing Options	Equity	Debt
▪ Sole Proprietorship ▪ Partnership - General - Limited ▪ Corporation - Regular - Subchapter S ▪ Limited Liability Company ▪ Land Trust ▪ Cooperative	▪ Independent Producer ▪ Contract Producer ▪ Subcontractor ▪ Joint Venture ▪ Strategic Alliance ▪ Franchise Agreement ▪ Licensing	▪ Real Estate Lease - Cash lease - Share lease - Flexible cash lease - Shared appreciation lease ▪ Facility/ Equipment Operating Lease ▪ Capital/ Financial Lease ▪ Leveraged Lease ▪ Leasebacks	▪ Sources - Initial capital contributions - Retained earnings - Stock * Common stock * Preferred stock - "External" equity - Warrants or options - Venture capital ▪ Business Practices - Payout (dividend or withdrawal) policy - Intrafamily transfers - ESOPs and stock options - "Buyout" policies	▪ Loans - Maturity - Interest rate - Amortization arrangement - Prepayment features - Security/ collateral - Conversion of terms - Shared appreciation mortgages - Reverse mortgages - Interest rate strips, futures, options, swaps ▪ Bonds - Convertible bonds - Callable bonds - "Zero coupon" or deep discount bonds

SOURCE: NCR-568, *Planning the Financial/Organizational Structure of Farm and Agribusiness Firms: What Are the Options?*, August 1998.

Legal organization choices are regulated in Minnesota and many other states (Hoppe 1996). In Minnesota, Statute 500.24 places limitations in the amount of farmland which a corporation can own. Corporations are prohibited from engaging in agriculture, except for family farm corporations and authorized farm corporations. Certain other exceptions to the prohibition also apply. Limited liability companies are prohibited from engaging in agriculture in Minnesota, and the regular business corporation laws apply to farming in the same way that they apply to other businesses. There are tax implications to the choice of legal organization. Harl includes a discussion of corporate farm laws in Minnesota and other state, as well as discussing the process of incorporation, what taxes apply, and other factors to consider (Harl 1996). The text of Minnesota's corporate farm law is accessible on the World Wide Web at the address listed in the reference list.

The rationale for regulating legal organization choices in agriculture is given in subdivision 1 of 500.24: "The legislature finds that it is in the interests of the state to encourage and protect the family farm as a basic economic unit, to insure it as the most socially desirable mode of agricultural production, and to enhance and promote the stability and well-being of rural society in Minnesota and the nuclear family." For a related discussion, see pages 137-39 of Lasley et al., and Lazarus (Lasley et al. 1995; Lazarus 1995).

Production networks are a type of business arrangement popular in the Minnesota swine industry. A recent University of Minnesota report lists things to consider when joining a network (Koehler, et al.) It includes a financial analysis of a typical arrangement, and includes a spreadsheet template for analyzing specific situations.

Boehlje and Lins (Boehlje and Lins 1998) have described a comprehensive range of options for organizing and financing farm business firms, and explain circumstances in which various options are likely to be most useful (see Table 14). These options have expanded in recent years as innovations in financial markets have created new alternatives to meet varied needs. Historically, financing focused on internally-generated equity, with debt used if internal resources of equity were not adequate to finance the growth of the business. Sole proprietorship has been the dominant organizational structure, with limited forward or backward linkage (i.e., contracts or ownership of successive stages of production). Current options are much broader in terms of 1) business and legal arrangements, 2) asset control strategies, and 3) financing instruments/options.

Boehlje and Lins point out the need for strategic planning to capture the best financial and organizational structure for the business. They outline the criteria for making these choices.

- **Control:** The fundamental objective for independent control and individual decision making may be a dominant factor in preponderance of sole proprietorships in the farm business sector.

- **Returns:** This objective focuses on which option will allow access to resources and funds at the lowest cost and emphasizes the set of economic activities that maximizes profit. The tax treatment and resulting tax burden of alternative are important, as are the various ways of sourcing funds.

- **Risk:** This element involves four issues:

  *Claim of various parties on income or revenue*s: Because of legal structure, contract agreement, or financial arrangements, various parties have different claims on the business. Characteristics of these claims, including amount, certainty, and priority, will determine impact on risk.

  Claim on assets: Legal and financial arrangements carry specific claims on the assets of the business. These claims are frequently conditional in nature and contingent on specific financial performance, which will determine the impact on risk.

  Bankruptcy/legal liability: The risk of financial loss from bankruptcy and legal liability depends heavily on financial and organizational structure. The use of multiple legal entities may help protect assets of entity from liability. The organization and financial structure can significantly affect potential liability exposure.

  Failure: Success or failure is influenced in part by the financial and organizational structure. Failure may result in losses in value or other consequences for related business ventures, as well as self-esteem and respectability of the owners.

- **Maturity/Permanence/Liquidity:** The longevity or permanence of the arrangement is reason for choosing an option. Some business arrangements are difficult or costly to dissolve once they are set up while others are more flexible and have a shorter-term maturity.

LEGAL ORGANIZATIONS

Part of the strategic plan for organizing and financing a business is how to combine the legal/business arrangements to satisfy the specific goals. More than one legal arrangement is frequently used in successful business ventures.

Harl compares various forms of farm business organizations and state restrictions on corporations in the North Central Region (Harl 1996). There are three basic forms of business organizations: sole proprietorship, partnerships, and corporations. Variations of these are limited partnerships, and the tax option corporation. These forms are described as follows:

Sole Proprietorship is when one person operation owns, runs and manages the business. There may be many hired employees.

Partnership is an aggregation of co-owners to carry on the business for profit. Two or more persons contribute assets and share management and responsibility for profits and losses. Each partner is liable for the actions of all partners within the scope of partnership activities.

Limited partnership is a special form of partnership where liability for debts and obligations is limited to the investment of the limited partners. Limited partners are just investors. A limited partnership must have a general partner who handles management of the business and is fully liable for all partnership debts and obligations.

Corporation is a separate business entity distinct from its owners. The corporation draws a sharp line of distinction between the business and the owners, the shareholders. The corporation is a separate legal person as well as a separate taxpayer. The limited liability feature of a corporation is important. Shareholder risk is usually limited to the amount of their investment. An employee, officer, or director may be personally liable for negligent actions even though the corporation is also liable. Corporation assets are not liable for personal obligations. The life of the corporation does not depend on the life of the people, and the continuity of the business is not affected by the death of a shareholder or the transfer of stock. Therefore the corporation offers a method of maintaining the farm business as a going concern, avoids the interruptions that result upon death, and provides for managers to do the long-range planning necessary to keep pace with technical advances. Minority shareholders may be disadvantaged by being locked into the rule of the majority and have no power to compel directors to pay dividends on the stock. A corporation may be dissolved by a majority vote, or the state can revoke a charter if the corporation fails to comply with state laws. Lenders may have less fear that death or incapacitation of a single individual might cause termination of the business. Lenders are likely to be more liberal in extending credit if there is evidence of management succession and business continuity. Ownership is easily divided into shares of stock. New investment may be made by the purchase of stock or by lending money to the corporation. Shareholders receive a share of the profits after the salaries have been paid. Lenders incur less risk by receiving a fixed rate of interest. There are limitations on loans from federal and federally related agencies. Shareholders can be employed and be eligible for employee benefits such as retirement plans and tax-free medical benefits. Employee benefit plans can not discriminate in favor of shareholder-employees and against others. Shares of stock provide a simple and convenient way to transfer property. Shares of stock may be sold, given away, or transferred by will or under state inheritance laws at death. Shares of stock provide a means for gradual transfer and progressive shift in ownership in the business. A minor may own stock.

Some characteristics of corporations are often considered to be a disadvantage: all wages and salaries are subject to FICA including children under 18 years of age; some states may require all employees to be covered by worker compensation insurance, whereas not for partners or sole proprietors; shareholders must meet at least annually for a shareholders meeting, and corporations are required to file and annual report and pay an annual fee (Harl 1996).

Tax option corporation (sometimes called a subchapter S corporation) is a creation of the federal tax law. It is a corporation in all respects except that it generally pays no income tax because each shareholder-owner reports a share of corporate income tax.

Limited Liability Company (LLC) is a hybrid that allows the limited liability of a corporation and tax treatment of a partnership. LLCs are more informal in organization and in operation than a corporation. LLCs offer the owners limited liability like a corporation without facing the double tax on business income like a regular corporation, and does not restrict the number of owners and other limitations of an S-corporation. Under some circumstances a LLC could fail to be classified as a pass through tax status entity and become classified as a corporation. Laws permitting LLCs vary from state to state, but most states now allow this form of legal business entity. Added information on LLCs can be found in (Minnesota State Legislature 1998).

Limited Liability Partnership is also a hybrid with general partnership features but has some aspects of limited liability associated with corporations. Liability of a partner is eliminated for negligence, wrongful acts, and misconduct of other partners and partnership employees, agents and representatives. Each partner remains personally liable for their own conduct and for those under their direct supervision. Each partner remains personally liable for any commercial obligations of the partnership such as loans, leases, taxes and wages. Creditors have recourse against partnership assets including the investments of individual partners. Many states have also enacted legislation providing authority for limited liability partnerships.

Harl has compared the characteristics of the farm business organizations (Table 13):

Table 16. Comparison of Sole Proprietorship, Corporation, Partnership and Limited Liability Company Forms of Organization

Issue	Sole Proprietorship	C Corporation	General/ Limited Liability Partnership	Limited Partnership	Limited Liability Company	S Corporation
Nature of Entity	Legal person same as the owner	Legal person separate from shareholder-owners	Aggregate of two or more persons	Aggregate of two or more persons	Aggregate of two or more persons	Legal person separate from shareholder-owners
Life of Business	Fixed term; ends when owner dies	Perpetual or fixed term of years	Agreed term; terminates at death of partner; LLP must register annually	Agreed term; terminates at death of partner	Agreed term; terminates at death of partner	Perpetual or fixed term of years
Management Decision	Sole proprietor	Elected directors and officers selected by directors	Usually agreement of partners	Usually general partner	Usually manager is elected	Elected directors and officers selected by directors
Formation of Entity	Very simple	Relatively simple	Relatively complex; LLP must register	Relatively complex	Relatively simple	Relatively simple
Flexibility in Capitalization	N/A	Very flexible	Very flexible	Very flexible	Very flexible	Somewhat inflexible
Limited Liability	None	Yes	No; LLP partner exempt from co-partner's torts	No for GP / Yes for LP	Yes	Yes
Flexibility in Conducting Business Affairs	Inflexible	Flexible	Flexible	Relatively flexible	Relatively flexible	Somewhat inflexible
Flexibility in Taxable Year	None	Yes	No	No	No	Little
Allocation of Income, Losses, Deductions, and Credits	N/A	Somewhat inflexible	Very flexible	Very flexible	Very flexible	Generally inflexible
Tax Effect Upon Liquidation	No double tax	Difficult to avoid double tax	No double tax	No double tax	No double tax	Generally no double tax (Section 1374)
Convertibility to Another Entity Tax-Free	Yes	Some restrictions	Yes	Yes	Yes	Some restrictions
Line of Business	Very flexible	Few restrictions	Flexible; LLP some restrictions	Very flexible	Few restrictions	Few restrictions
Self-employment Income from Entity	Yes	No	Yes	Yes - GP / No - LP	Usually; see proposed Regs § 1.1402(a)-18	To extent of salary and bonus
Effect of Passive Loss Limitation Rules	N/A	Applies at corp. level; generally avoidable for larger corps.	Partners may or may not materially participate	Ltd. partners deemed not to materially participate	Members may or may not materially participate	Shareholders may or may not materially participate
Availability of Entity Losses to Owners	N/A	No	Flow through of losses to owners	Flow through of losses to owners	Flow through of losses to owners	Flow through of losses to owners
Fringe Benefits	Limited compared to C Corporation	Widest available	Limited compared to C Corporation	Limited compared to C Corporation	Limited compared to C Corporation	Limited compared to C Corporation
Estate Planning Opportunities	Fair	Very good	Good	Very good	Very good	Fair
Accumulated Earnings and PHC Tax	N/A	Section 531 and Section 541 applicable	No	No	No	No
State Taxes	Same as individual	Generally uniform and deductible	Generally uniform	Generally uniform	States vary	States vary
Dividend Received Deduction	N/A	Allowed	Not allowed	Not allowed	Not allowed	Not allowed
Effect of Bus. Liabilities on Owner's Basis	Full effect	No effect	Proportionate share	Limited partners share in non-recourse	Proportionate share	Only shareholder's own loans
Alternative Minimum Tax	Subject to AMT	Subject to corporate AMT	Preference items flow to each partner	Preference items flow to each member	Preference items flow to each member	Preference items flow to each shareholder
Method of Accounting	Cash method	Depends on size and ownership	Generally may use cash method	Generally may use cash method	Generally may use cash method unless farming syndicate	Generally may use cash method

SOURCE: McEowen, Roger and Harl, Neil E., *Principles of Agricultural Law*, Agricultural Law Press, 1997.

Boehlje and Lins have summarized the general characteristics of some additional business organizations in Table 15 (Boehlje and Lins 1998).

Table 17. Comparison of Sole Proprietor, Partnership, Corporation and Land Trust Forms of Organization §

	Sole Proprietor	Partnership	Corporation	Land Trust
Nature of Entity	Single individual	Aggregate of two or more individuals	Legal person separate from shareholders	Separate from beneficiaries and trustees
Life of Business	Terminates on death	Agreed term; terminates at death of partner	Perpetual or fixed term of years	Fixed term of years with extensions thereafter
Liability	Personally liable	Each partner liable for all partnership obligations	Shareholders not liable for corporate obligations	Beneficial interests subject to attachment, not land
Source of Capital	Personal investment; loans	Partners' contributions; loans	Contributions of shareholders for stock; sale of stock; bonds and other loans	Settlor
Management Decisions	Proprietor	Agreement of partners	Shareholders elect directors who manage business along with officers elected by directors	Beneficiaries and trustee by trust and management agreements
Limits on Business Activity	Proprietor's discretion	Partnership agreement	Articles of incorporation (by-laws) and state corporation laws	Trust and management agreements
Transfer of Interest	Terminates proprietorship	Dissolves partnership; new partnership may be formed if all agree	Transfer of stock does not affect continuity of business. Stock may be transferred to outsiders if there are no restrictions.	Assignment of beneficial agreements
Effect of Death	Liquidation	Liquidation or sale to surviving partners	No effect on corporation. Stock passes by will or inheritance.	Trust agreement and trust code interests are personal property by will or laws of decent
Income Taxes	Income taxed to individual	Partnership files an information return but pays no tax. Each partner reports share of income or loss, capital gains and losses as an individual.	*Regular Corporation:* Corporation files a tax return and pays tax on income; salaries to shareholder-employees are deductible. Capital gains are offset by capital losses. Rates, July 1, 1987: 1st $50,000, 15%; next $25,000, 25%; over $75,000, 34%.‡ *Tax-Option Corporation:* Corporation files an information return but pays no tax. Each shareholder reports share of income, operating loss, and long-term capital gain.	Income, depreciation, and expenses pass to beneficiaries in proportion to the beneficial interest held

§ Table taken in part from NCR-11, *The Farm Corporation*. Land trust added by G. Harrison.

‡ An additional 5% tax (maximum amount of $11,250) is imposed on a corporation's taxable income above $100,000. This provision phases out the benefit of the 15% and 25% rates for corporations with taxable incomes of more than $335,000.

SOURCE: NCR-568, *Planning the Financial/Organizational Structure of Farm and Agribusiness Firms: What Are the Options?*, August 1998.

Boehlje and Lins have described two additional legal forms of business organization that are less common but coming into greater use.

Land Trust is a legal entity that allows a land owner to transfer property to a trustee. The powers of ownership are governed by a trust agreement which places the possession and management powers in the hands of the beneficiaries. The primary benefits are the avoidance of probate upon death, insulation of land from legal judgements, avoidance of problems of multiple ownership, and privacy of ownership. The main problems are management, limited duration (typically 20 years), termination of trust, and loss of homestead exemption. Additional information on land trusts can be found in (Harl 1996).

Cooperatives: Increasingly farmers are using the cooperative structure to jointly acquire and provide machinery and equipment services, breeding stock, marketing and selling services, advisory and consulting services, and other assets and services. A cooperative is an incorporated business capitalized by its member patron/owners and remits margin to its patron/owners in proportion to their patronage business. A cooperative is taxed on income at corporate rates but patronage refunds are tax deductible to the cooperative if specific rules are met (Harl 1996). Wisconsin workers describe New Generation Cooperative (NGC) that differ from most traditional marketing cooperatives in that it is market driven, closed with limited members, tradable membership shares, allocate rights to deliver units of the farms raw products, but shares spread up-front capitalization responsibility equitably among its members. Wisconsin workers report that the number of new generation cooperatives in the upper Midwest expanded from two in 1989 to over fifty in 1996. They point out these cooperatives involve cooperation among farm families, provide a means of benefiting from economies of scale, and are usually value added enterprises adding value to grain and forage through the end livestock product. (Lawless et al. 1996)

BUSINESS ARRANGEMENTS

Farmers have a wide choice of business arrangements they can use in addition to the legal form of the business. The alternatives include: independent production, contract production, subcontractor, joint ventures, strategic alliances, franchise agreements, and licensing.

Independent producer is the most common method of conducting business. The firm is free to buy inputs from whomever and where ever it pleases and whatever market channels it chooses. The independence of the operator’s decisions is the key advantage of this business arrangement. In some commodities, however, economic forces are making it less feasible for independent producers to compete effectively in an increasing integrated market.

Contract Production is increasing in popularity in livestock and crop production. Contracts have become commonplace in the production of various vegetable and specialty crops, broilers, turkeys, and increasingly in hog and milk. The contract agreement is between the producer and an input supplier or processor. Contract agreements are highly variable in scope but likely to take on one of the following forms:

Product specification contracts include detailed product specifications relative to quality characteristics and sizable discounts occur if quality standards are not met.

Resource Providing specify the contractor will supply specific services.

Price-or risk sharing contracts specify a guaranteed price for products with specific quality attributes, specify a minimum profit margin above a calculated cost of production, and sharing the margin above a calculated cost or some combination.

Market Access guarantees access by the producer to the processing facility. It is usually a flow scheduling device to use processing facilities more efficiently

Subcontracting or Contract for Services: These arrangements can take many different forms but essentially involve the payment for services provided. It usually involves fewer services or functions than contract production. It may involve payments for feed processing, labor services, custom feeding of hogs or cattle, custom harvesting, manure spreading, or chemical application. Producers may participate on either side of these contracts.

Joint Ventures: A separate business entity or subsidiary is formed by two or more firms to jointly carry out specific business activity. It may be done in an informal fashion to jointly own machinery or equipment, feed or breed livestock, market products or buy inputs. Agribusiness firms have used joint venture arrangements for purchasing, distribution, or merchandising activities often as part of a large scale national or international market.

Strategic Alliance : Strategic alliances may be formal or informal to work jointly to achieve a desired end result, goals or procedures. They can work in many different ways, be quite flexible, and are often of limited duration. Each firm has a vested interest in the success of the other firm but do not share ownership of assets. An example would be a packer forming an alliance with a group of producers and a feed company to be assured an even flow of quality pork.

Franchise Agreements: These arrangements are most common in the food distribution chain. The benefits come from name recognition, efficiency of promotion, and standardization of product and service functions.

Licensing: This arrangement is not common in production agriculture but is more common in the input supply and/or product processing industries. It is a way a firm that possesses a certain technology but lacks the resources to exploit it completely can license it to another firm for a fee. For example biotechnologies that require large investments to develop, may be licensed to other firms to more fully exploit its use.

Leasing: Leasing allows one to acquire control of an asset for a fee without the requirement of ownership. Some view leasing as an alternative form of financing. And is a common method of financing an asset used in agriculture. It is more frequently used for real estate and buildings that for machinery and equipment. There are various forms of leases.

Cash lease typically involves a cash payment for the annual right to farm or graze a parcel of real estate. Payments are a function of productivity, local supply/demand, but typically fixed with full or partial payment in advance. About 64 percent of farmland leases were cash leases in 1992.

Share Lease: Both tenant and landlord share some part of the expenses and income. Common share leases in the US are 50-50 share with tenant and landlord sharing equally. A share lease may involve livestock production and is typically more complex than crop share leases. About 30 percent of farmland leases in 1992 were share leases.

Flexible cash lease: Annual lease payment may be dependent on yields or price. These arrangements are usually combine with a fixed base to guarantee a minimum lease payment. This has the feature to transfer some of the risk from the tenant to the landlord.

Shared Appreciation Lease: This is a farmland lease that allows tenant to pay a higher than normal rent in exchange for some share of future capital gains. This allows the tenant to improve the property and share in the value of the increase, and provides for acquiring an equity interest in property without borrowing money. This method has been suggested for institutional owners of farmland but is largely untested in practice. More information on this arrangement can be found (Lins 1990)

Facility/Equipment Operating Lease: Operating leases are typically seasonal or annual with renewals in length, with no ownership rights or responsibilities to the lessor. They usually involve a piece of equipment, warehouse space, etc. for a period of time.

Capital/Financial Leases: These leases are longer term, usually a function of the life of the asset to allow the lessee to recover the purchase price of the asset. They are treated much like debt-financed asset purchase from an accounting perspective, and are included on the balance sheet. Qualified capital leases receive unique tax treatment, fully deductible, which may be a major advantage. They are more popular in agribusiness than at the farm level, and are used for major equipment items. In many cases, the option to buy at the end of the lease is structured to encourage purchase or replacement with another leased asset.

Leverage Lease: These leases involve three parties, a lessor, a lessee, and a lender. The lender makes a loan to the lessor that enables him/her to purchase the asset. The lessor then leases the asset to the lessee. These are common in the transportation industry and could be used more in agriculture. These arrangements allow advantageous use of the tax and financial position of the lessor and lessee.

Leasebacks: This arrangement is commonly used to restructure financially-stressed businesses. The business sells the asset to another with a lease back provision. This provides the lessee use of the property. These leases can be effective to improve asset liquidity, and operating flexibility of the business.

EQUITY AND DEBT CAPITAL

An owned business has two fundamental sources of funds, debt and equity. There are a number of alternative forms of debt and equity to make apparent simple decisions complex. (Boehlje and Lins 1998) have described various forms of equity and debt capital. These forms are listed below:

Equity Capital
- Initial Capital contributions
- Retained Earnings
- Stock
- External Equity
- Warrants or Options
- Venture Capital

Debt Capital
- Loans
  - Interest Rates
  - Amortization arrangements
  - Prepayment Features
  - Security/collateral
  - Conversion terms
  - Shared appreciation mortgage
  - Reverse Mortgage
  - Index rate strips, future, and options
- Bonds
  - Convertible Bonds
  - Callable Bonds
  - Zero Coupon or deep discount bonds

D1b. To what degree are livestock producers allowed to operate agricultural systems interdependently as opposed to independently in Minnesota and in other states and what is the significance?

General Comments

It is beyond the scope of this project to do the legal research needed to describe the corporate farming laws and other laws related to business arrangements in every state in enough detail to assure complete accuracy and currency. It is apparent these laws are in a state of continuing change. (Dahl 1991) provided a fairly comprehensive review in 1991 in which he identified nine states of the fifty states (North Dakota, South Dakota, Minnesota, Wisconsin, Iowa, Illinois, Kansas, Missouri, and Oklahoma), as having major restrictions on corporate farms. He refers to a U.S. Supreme Court case which concluded that state corporate farming restrictions do not violate the U.S. Constitution or the fourteenth amendment because property law is chiefly a state matter. He includes a map of the US showing states with major or minor restrictions on farm corporations. One significant change since Dahl wrote his report is that Illinois no longer has major restrictions on corporate farms. That state repealed its Agricultural Land Ownership Act in 1996. Also, Nebraska is listed by Dahl as having only minor restrictions, although that state is often viewed as having one of the tightest restrictions in the nation (see reviewer comment). Another source of information on corporate farm laws in every state as of December 1992 is (Aiken 1993).

Neil Hamilton and Greg Andrews of Drake University Law School provided a review of state regulation of contract feeding and packer integration in the swine industry in 1992 (Hamilton and Andrews 1992). They identified nine Midwestern states that have enacted corporate farming laws. These were the same states identified by Dahl except that Illinois was not on his list, and Nebraska was. Hamilton and Andrews conclude that the language of each law differs but that many arguably prohibit contract production of livestock either directly or indirectly. They indicate that contract feeding and packer integration were controversial and coming under scrutiny in several states. Their conclusions were that:

1. It is within the states' power to either place restrictions, prohibit or establish guidelines for how contracting may be done,

2. Minnesota's legislation is the most ambitious example of state regulation of contract feeding,

3. If a state is determined to regulate contract feeding, then efforts should be made to deal with the identified problems associated with it and the likely concerns if its use should spread,

4. Legislation concerning contract feeding does not necessarily have to prohibit or restrict its use but rather can establish guidelines to protect financial interests of producers and insure fairness of contracting methods,

5. One claimed risk of contract feeding legislation is that it will drive contract production to other states,

6. Anti-corporate farming laws can be interpreted as prohibiting both contract feeding and packer integration by restricted business entities,

7. If contract production increases, states may need to consider legislation to protect producer rights to organize and bargain for fair marketing practices.

Legislation has been proposed at the federal level and in 16 states to protect contract growers and producers, along similar lines to Minnesota's "Agricultural Contracts" law but with the addition of language to prevent retaliation against producers who participate in producer organizations. Arguments for and against the proposed federal legislation are given in (Boehlje et al. 2001) and (Harl et al. 2001). Boehlje et al. question whether the new rules would be sufficiently restrictive that the unintended consequence would be to not maintain a relatively independent agricultural structure, but instead to encourage vertical integration through ownership of production facilities by processors and packers. Harl et al. reply that all of the provisions have precedent in other areas of the law, such as consumer protection legislation or trade regulation, and that the provisions have not been shown to cause economic harm in those other contexts. Boehlje et al. do not discuss how the presence of a corporate farm law would affect the likelihood of ownership integration. The authors of Boehlje et al. are employed at Purdue University, located in Indiana. The fact that Indiana does not have a corporate farm law may affect the perspective of their paper. Minnesota's law prohibits such ownership integration, so that concern may be less real in Minnesota (Hamilton and Andrews 1992). Contract hog production has increased in Minnesota in the 1990s to the extent that transfers from contractee enterprises in 1999 exceeded sales from independent farrow-to-finish enterprises, despite the fact that Minnesota's "Agricultural Contracts" law has been on the books since 1990 (see Tables 25 and 31 below). Boehlje et al. also caution that restrictive multi-state or federal regulation might cause a shift in production to Canada, Latin America, Asia or Australia.

Neil Harl provided a review of business structure alternatives to assist farmers in determining their best options in 1995. This publication focused on twelve North Central states and provides a review of state laws in these states at that time. Harl discusses the advantages and disadvantages of various forms of business structures, how they operate, what taxes apply, and the process of incorporation and dissolving the business (Harl 1996).

Mark Edelman at Iowa State is leading a project of the National Extension Public Policy Committee, which compared regulations by state. A preliminary report is available at (Edelman and et al. 1999). Edelman's results were based on voluntary survey responses from Extension Public Policy faculty in each state. Of the 35 states responding only five states indicated their state government prohibited corporations or other entities from owning farmland or engaging in confined livestock operations. These states included Iowa, Kansas, Minnesota, Nebraska, and South Dakota.

Minnesota's Corporate Farm Law was first enacted in 1973. A brief history of Minnesota's law is available in (Dahl 1991). Producers are allowed wider latitude to operate interdependently in other livestock activities in Minnesota, compared to dairy, where only family farm corporations, and authorized farm corporations with five or fewer shareholders are allowed. Minnesota does not allow the legal form known as a limited liability company (or LLC) to be utilized in agriculture. LLCs are allowed in most other states.   A summary of Minnesota's restrictions on forms of legal organization allowed in agriculture are shown in Table 16.

Mark Hanson points out that that livestock operations are expanding in the Midwest to take advantage of competitively priced feeds and scale efficiencies possible in larger more modern operations (Hanson). As the size of this venture increase, substantial capital must be employed to construct, develop, and implement viable production and marketing entities. These significant capital requirements demand participation by investors, both on farm and off farm, which prudently will require corporate liability protection. The business structure allowed in a given state becomes a central issue to livestock venture formation. Corporate farming laws tend to severely restrict the type of business entity and venture that may be entered into. Security laws in some states have a significant impact on raising equity for a project.

Comments on Individual States' Restrictions

Minnesota: The Minnesota statute 500.24 Corporate and Partnership Farming can be accessed at http://www.revisor.leg.state.MN.us/stats/5000/24.html.

Minnesota generally only allows family farm, family farm corporations, authorized farm corporations, authorized livestock farm corporations (except for dairy cattle), family farm partnerships, and authorized farm partnerships to engage in farming or acquire any interest in agricultural land. "Family" requires that a majority of the shareholders be related to each other within the third degree of kindred and a least one of the related persons is residing on or actively operating the farm. (Hanson)

Minnesota repealed a 5,000 limitation on land that could be owned by a farm corporation in 1973. They enacted a detailed statute requiring farm corporations to file an annual report, and limited expansion of corporate farming operations except for family corporations and authorized farm corporations (Harl 1996). The law was amended in 1975 to further restrict who can operate an authorized corporation: shareholders cannot exceed 5 and are natural persons or an estate; the corporation has only one class of stock; revenues from rents, royalties, dividends, interest, and annuities cannot exceed 20 percent of gross receipts; shareholders holding 51 percent or more of the stock must reside on the farm and be actively engaged in farming; the corporation cannot own more than 1,500 acres of land used for farming; and a shareholder of an authorized corporation cannot be shareholder in another corporation that owns more than 1,500 acres of farmland. (Harl 1996), (Hanson).

In 1994, the limits were relaxed for corporations formed for production of livestock other than dairy cattle by natural persons or family farm corporations that provide 75 percent or more of the capital investment; 75 percent or more of the control and financial investment must be held by farmers residing in Minnesota; and at least 51 percent of the required farmers must be actively engaged in livestock production. Previous other limitations to authorize corporations apply to the new category of livestock production corporations. Dairy cattle production continues to be an exception to the other types of livestock production and is restricted from an authorized corporation as a legal form of business in Minnesota (Harl 1996). A Limited Liability Company is not a legal business option for agricultural producers in Minnesota.

Hanson identifies an exception to corporations or limited liability companies for a breeding stock farm that owns land for the purpose of raising breeding stock including embryos for resale to farmers. A breeding stock farm that is organized to raise livestock other than dairy cattle must sell castrated animals to be fed out or finished to farming operations that are neither directly nor indirectly owned by the entity operating the breeding stock operation. Neither general partnerships nor limited liability partnerships are covered by the corporate farming restriction, but partners must be exempt themselves from the corporate farm laws for these entities to be used.

Hanson summarizes by concluding that Minnesota restrictions make structuring animal agriculture other than poultry with liability protection difficult. Authorize livestock corporations may be used other than dairy but they restrict investments from non-exempt entities.

For dairy, generally only a limited liability partnership may be used. He suggests the possibility of joint ventures in which the buildings and animals are owned by a non-exempt entity and exempt entities conduct the farming and production activities.

Table 18. Summary of Legal Agricultural Business Organizations in Minnesota

Entity type	Eligible shareholders	Ineligible shareholders	Number of shareholders	Limited liability	Pass-through taxation	Dairy and row crop eligible
General Partnerships	Natural persons, partnerships, other entities certified under the corporate farm law	Entities that are not certifiable under the corporate farm law, i.e. partnership of non-qualifying corporations	Unlimited	No; joint and several liability exits for each partner	Yes	Yes
Limited Partnerships						
A. Family Farm Limited Partnerships	Natural persons, partnerships, limited partnerships, limited liability partnerships	Corporations, limited liability companies	Unlimited, but the majority of the shareholders must be related within the 3rd degree of kindred	Yes, for limited partners. However, there must be at least one general partner that retains liability.	Yes	Yes
B. Authorized Farm Limited Partnerships	Natural persons	All non-natural persons such as partnerships and corporations	Up to 5; no relation required	Yes, for limited partners. However, there must be at least one general partner that retains liability.	Yes	Yes
Corporations						
A. Family Farm Corporations	Natural persons, partnerships, limited partnerships, limited liability partnerships	Corporations, limited liability companies	Unlimited, but the majority of the shareholders must be related within the 3rd degree of kindred	Yes	Depends on whether the corporation is a Subchapter C or Subchapter S	Yes
B. Authorized Farm Corporations	Natural persons	All non-natural persons such as partnerships and corporations	Up to 5; no relation required	Yes	Depends on whether the corporation is a Subchapter C or Subchapter S	Yes
C. Authorized Livestock Farm Corporation	Natural persons and family farm corporations	All non-natural persons other than family farm corporations	Unlimited, but 75% must be farmers, and 51% of the 75% must be livestock farmers	Yes	Depends on whether the corporation is a Subchapter C or Subchapter S	No; only eligible for corporations engaged in livestock production other than dairy cattle
Limited Liability Partnerships	Natural persons, partnerships, other entities certified under the corporate farm law	Entities that are not certifiable under the corporate farm law, i.e. partnership of non-qualifying corporations	Unlimited	Yes; the partners may elect to have some of the partners have less than joint and several liability	Yes	Yes
Cooperatives	Treated the same as corporations					
Business Trusts	Treated the same as corporations					
Limited Liability Companies	Prohibited; no exceptions					

Source (Prim et al. undated) MN Department of Agriculture

A brief description will be provided for other neighboring Midwestern states taken from Hanson (Hanson) and Harl (Harl 1996), except for the South Dakota information which is taken from South Dakota Statute 47-9A (South Dakota Legislative Research Council 99).

Wisconsin: Wisconsin will permit corporations to own land and carry on farming providing there are no more than 15 shareholders, no more than two classes of stock, and all shareholders are natural persons. However Wisconsin law prohibits corporations from engaging in the production of dairy, and hogs. Wisconsin also has a breeding stock exemption. Wisconsin corporate farm law does not prohibit poultry and egg production.

Iowa: Corporate ownership of agricultural land is prohibited. Processor ownership of beef and pork feedlots is restricted. If an entity other than a sole proprietorship or general partnership desires to own land in Iowa, it must fit into one of the following forms of ownership: a chapter 501 cooperative, a family farm corporation, an authorized farm corporation, a family farm limited liability company, a networking farmers corporation, a networking limited liability company, a farmers cooperative association, or a farmers cooperative limited liability company. The ownership structure depends on the makeup of the entity owners.

To qualify as a family farm entity, a family farm corporation or family farm limited liability company, the majority of members or stockholders must be related to each other as spouse, parent, grandparent, or lineal descendents of their grandparents or their spouses. All stockholders or members of an authorized farm corporation or limited liability company must be natural persons and number no more than 25.

The networking farmer entities - networking farmers corporation or networking limited liability company - may hold interest in up to 640 acres of agricultural land if at least 75% of the entity's gross receipts are from the sale of livestock or livestock products. Natural persons actively engaged in farming, or a general partnership in which all partners are natural persons engaged in farming must own 51% of the issued shares and qualified persons must own at least 70% of all issued shares. A qualified farmer is a natural person actively engaged in farming, a general partnership in which all partners are natural persons actively engaged in farming, or a farm estate. Qualified persons are qualified farmers, a family farm entity, or a qualified commodity share landlord. Networking entities can be formed with non farm entities so long as the percentage ownership requisite is met.

Authorized Farmer Cooperative, (FCA) farmer cooperative associations and (FCLLC) farmers cooperative limited liability companies, may hold interest in up to 640 acres of agricultural land if it does not produce forage or grain. They may enter agreement with a person to produce forage or grain so long as the grain is not received as payment for the lease. Qualified farmers must own at least 51% of the equity interest and qualified persons must own 70% of the equity.

FCLLC cooperatives must own 100% of all membership interests, and FCAs must own 70% of the interests. These business forms also permit joint ventures with non-farm cooperatives so long as the 70% ownership requisite is met by FCAs.

Chapter 501 Cooperative may acquire, lease, or otherwise obtain up to 640 acres of agricultural land if authorized farming entities own 60% of the stock and are eligible to cast 60% of the votes at member meeting. An authorized farming entity is a natural person who regularly participates in the physical labor on the farm or one of the permitted corporate forms of ownership. Natural persons or partnerships must own at least 75% of the stock and be eligible to cast 75% of the voted are member meetings.

Processing entities that control the manufacturing, processing, and preparation for sale of beef or pork products are restricted from owning, controlling, or operating hog or cattle feedlot if their annual wholesale sales is greater than 10 million dollars. They may participate in the breeding and farrowing of swine but cannot directly or indirectly control the finishing portion of the operation or provide feed and care for the animals for more than ten days. They can contract for purchase of swine and cattle for slaughter.(Hanson).

North Dakota; North Dakota generally allows only limited liability companies or corporations with less than sixteen members or shareholders related to each other to own real estate or engage in the business of farming. Officers or members must be actively engaged in farming and at least one must live on the farm. Excepted from this restriction are cooperative corporations where seventy-five percent of its members or shareholders are actual farmers residing on farms or depending principally on farming for their livelihood.

South Dakota: The family farm act of 1998 provides restrictions on corporations or limited liability companies from forming or being licensed for the purpose of owning, leasing, holding, or otherwise controlling agricultural land to be used in the business of agriculture, including facilities for the breeding, farrowing, and raising of swine. Family farm corporations with at least one shareholder residing on the farm or actively farming, and authorized small farm corporations with 10 or fewer shareholders, are exempt. There are other restrictions to this rule. For example, facilities for the purpose of feeding poultry for meat and egg production, and facilities for feeding livestock are exempt.

Nebraska: The Nebraska constitution allows only family partnership, family farm corporation, and family ranch corporations to acquire any interest in real estate used for farming and engaged in farming or ranching. Related individuals must hold a majority of the stock and at least one of them must reside or be actively engaged in the day to day labor and management of the farming operation. This prohibition includes non-stock cooperatives. There are exceptions to this corporate farming restriction; for example, agricultural land used for poultry production is excepted.

Kansas: Statewide, Kansas restricts agricultural land ownership to authorized farm corporations, family farm corporations, limited liability agricultural companies, family farm limited liability agricultural companies, and limited agricultural partnerships. There are some qualifying limitations and exceptions. Agricultural land may be held or leased by a corporation or limited liability company for use as a feedlot, poultry confinement facility, or rabbit confinement facility. There are some special county approval restrictions on corporate or limited liability company use of agricultural land for swine or dairy production.

Illinois: The Agricultural Land Ownership Act was repealed effective August 14, 1996. The Illinois statutes, administrative rules, and case law neither restrict nor expressly permit corporate ownership for profit of an agricultural pursuit.

Summary Comments

There is wide diversity in the limitations placed on business structure and arrangements among the fifty states. Most states do not prohibit corporations or other entities from owning farmland or engaging in confined livestock operations. Midwestern states tend to be more restrictive in the business structures allowed for agricultural use (Edelman and et al. 1999), (Dahl 1991). From the above review of Midwest State limitations, there is inconsistency in the language of the laws and how the laws apply to types of livestock production, poultry, swine, dairy, or beef. The rationales for these differences are unclear. It is evident that many states have provisions for exceptions, and that interpretation of laws in place has changed over time. There is wide diversity in the environment regulations among states(Edelman and et al. 1999). Hanson points out that environmental and zoning laws strongly impact location decisions (Hanson 1998).

There is very little documentation on who owns and controls livestock or other farm assets in Minnesota, as discussed below in section D5 on ownership and control. Anecdotal information suggests that there are farm families who working together in multi-family operations using the various legal forms and business arrangements mentioned above to achieve desired control, return and risk objectives. To the extent that the previous statement is true, multi-family operations are a research topic that relates to question D1b on interdependent vs. independent operation. One study on multi-family operations is (Lawless et al. 1996). This Wisconsin study points out that the single greatest factor affecting multi-family operations are outside economic and demographic forces to which families can only react. Their discussion focused on dairy farms but the principles apply to other livestock classes. They discuss five rationales motivating farm multi-family businesses:

Farm viability: This rationale assumes the best way to survive is to expand their operation. Some families do not have the capital and cannot acquire the financing to do it alone so are attempting to do it with others. Some see the advantage of scale efficiencies and combining capital, labor, and management expertise as a means of improving efficiency, and reducing unit production costs.

Quality of Life: By involving more families in larger operations, the workload and management can be parceled so that no one individual is overly burdened. Some do not want to commit to the 365 day responsibilities of operating a single family operation and their descendant are less likely to want to make this commitment.

Value added: Some farm families are looking to add value to their farms grain and forage production through a mutual investment in a commonly owned livestock enterprise and enjoy the gain of addition value added income.

Return on Investment: This rationale is to achieve a fair return on their capital investment in the business.

Community Economic Development: Non-farm community interests in generating jobs, markets, and economic vitality in the community.

QUESTION E3. HOW DO GOVERNMENT POLICIES, REGULATIONS AND PROGRAMS AFFECT THE PROFITABILITY AND VIABILITY OF LIVESTOCK FARMS AND FIRMS IN MINNESOTA? HOW DO GOVERNMENTAL POLICIES IN OTHER STATES AND COUNTRIES DIFFER FROM THOSE IN MINNESOTA WITH RESPECT TO THEIR IMPACTS ON FARM/FIRM PROFITABILITY AND VIABILITY IN THOSE PLACES, AND WHAT CAN WE LEARN FROM THEIR EXPERIENCES?

Spatial Models to Analyze the Economics of Livestock Waste and Its Regulation

Several economists have developed spatial models of livestock producers' economic decisions under alternative approaches to regulation, most recently (Innes 2000), who also cites earlier work by (Roka 1993) and (Schnitkey and Miranda 1993). Key features of Innes' model are assumptions about economies of size in the waste storage and spreading process, and in livestock production apart from its waste aspects. Producers faced with these economies and a competitive marketplace decide how large their livestock facilities will be and how many of these facilities there will be in a given region. The waste storage structures are assumed to have some probabilities of leaking and of overflowing. The waste is transported to fields of different distances from storage, with the objective to minimize the sum of fertilizer purchases plus transport costs. Innes assumes that a large manure spill or leak is more damaging to the environment than the same quantity spilling or leaking from multiple smaller sites, and concludes that storage standards should be stricter for larger structures. He takes for granted that it is impractical to monitor or regulate manure-spreading itself, and considers a) limits on animal density/acre or on size of facility, and b) taxes on chemical fertilizer as alternatives.

The general conclusion that Innes draws from the model is that because of the negative externalities from livestock production, too much (i.e. a higher-than-socially-optimal) production will tend to take place in the absence of regulation. See (Innes 1999) for a non-mathematical discussion of the model, and compare with (Lovell and Kuch 1999) on the question of how practical the direct regulation of manure spreading is. While this insight is useful, a considerable amount of additional work would be required to fit the model to data and solve it for empirical results relevant to specific locations. Such quantification would be necessary to evaluate how much smaller a "socially-optimal" livestock facility would be compared to current sizes that have evolved in the absence of size limitations, for example. Even if the model could be quantified and solved, its usefulness for policy-making might still be limited because of some of the ways it abstracts from reality. It ignores heterogeneity of livestock facilities, for example, ignoring the fact that smaller facilities tend to be older and designed to less stringent environmental standards. It also ignores significant aspects of Minnesota's regulatory policies, such as monitoring phosphorus buildup through soil testing.

Cost of Compliance with Minnesota's Revised 7020 Feedlot Rules Adopted in 2000

Minnesota's feedlot permitting rules were revised in 2000. One requirement of the new law was a mandate that the state must arrive at an estimate of the financial assistance that producers would need in order to bring their operations up to the requirements of the new rules. The new rules stated that the Pollution Control Agency may not require a feedlot operator to spend more than $3,000 to upgrade an existing feedlot with less than 300 animal units unless cost-share money is available to the feedlot operator for 75 percent of the cost of the upgrade, or to spend more than $10,000 to upgrade an existing feedlot with between 300 and 500 animal units, unless cost-share money is available to the feedlot operator for 75 percent of the cost of the upgrade or $50,000, whichever is less. The feedlots are required to come into compliance over a ten-year period. A Minnesota Department of Agriculture work group recently estimated the total ten-year cost for implementing the new rule at $238 million. Of that total, $163 million is for structural upgrades falling under the above language. The remaining $75 million is for engineering assistance, manure management plans, and handling equipment required by the rules but not covered by the cost-sharing language, and $2 million for feedlots with over 500 animal units that would not be eligible for cost sharing because of their size. Cost-share funding to cover the structural upgrade portion of that cost would come to $122 million. Current cost-share funding already available is around $50 million, so $73 million in additional public funds would be needed to meet the requirements of the statute (Wilcox 2001).

Impact of State and Local Policies on Locational Shifts of the Swine Industry

Metcalfe studied regulatory data for 19 states on ten different regulations imposed to control manure management on animal feeding operations, and found that the regulations became significantly more stringent between 1994 and 1998 (Metcalfe 2000). He ranked the regulations using an index based on 1) some regulation imposed at the local level, requirements for 2) facility and 3) waste system design approval, 4) geological testing, 5) requirements for public notice or hearings, 6) regulated setback distances, 7) nutrient management plans, 8) size restrictions more stringent than federal NPDES permit levels, 9) bonding requirements, and 10) moratoria on size of operation or on total production. Presence of cost-share programs was also considered. By his index, Minnesota's regulations were the most stringent in 1994. By 1998, five other states had regulations on a par with Minnesota's (Arkansas, Georgia, Iowa, Kansas, and Mississippi, while Illinois, North Carolina, and South Dakota were only slightly less strict than Minnesota.

The significance of the state corporate farm laws and state and local environmental policies is difficult to evaluate reliably. One approach taken in several studies is to measure the policies' impacts by comparing livestock industry trends in states with more and less restrictive policies. The most recent study of this type is Park et al. (Park et al. 2000), a presented paper from the 2000 Western Agricultural Economics Association annual meeting. As a presented paper, it has not yet received the scrutiny that a peer-reviewed journal article would receive. Some parts of the paper are not explained very clearly5. Despite such flaws, the paper is cited here in addition to two older papers discussed below, because it contributes to the knowledge base in at least three ways. First, it relates the rather thin literature on livestock industry location to a more substantial literature on factors affecting location of manufacturing plants. The authors conclude from that literature that environmental policy differences generally have little effect on manufacturing plant location, but also that cases exist where policy stringency is negatively correlated with plant location decisions. Second, they entertain the possibility that the relationship between environmental policy and livestock industry location is a two-way one - environmental policy developments may be a result of past livestock industry growth, as well as driving future growth, although their regression analysis is inadequate to establish which way the causality lies. Third, they break out the policy impacts between on small (less than 300 AU), medium (300 to 1,000 AU), and large (over 1,000 AU) operations, with all livestock species combined into one size measure with the inventory data converted into animal unit equivalents. They include livestock data for all 48 contiguous states over a 30-year period, but their data on policies was taken from a 1998 survey so might not have accurately represented earlier policies. One finding consistent with their expectations was that presence of a corporate farm law had a negative effect on the number of animal units on large operations, while affecting the small and medium size groups and total size positively. Some of their other findings were counterintuitive. For example, they found that agricultural zoning was negatively correlated with volume on large operations while written stringency of environmental regulations and amount of fines levied were positively correlated with large operation volume. They argue that these counterintuitive findings may be due to a reversed direction of cause-and-effect. That is, the observed regulatory differences may be in response to the growth of the large operations, rather than preceding and influencing their growth.

Another study looked at trends in the swine industry in 13 major producing states over the period 1988-95 (Mo and Abdalla 1998b) (Mo and Abdalla 1998a). This was a linear regression analysis with the dependent variable being the annual percentage change in hog inventory by year, for the states IL, IN, IA, KS, KY, MI, MN, NE, NC, OH, PA, SD,

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5 For example, a table of annual percentage changes in livestock inventories by size of operation between 1970 and 1996. The source of the data is said to be the 1997 Census of Agriculture, but the data is given in two-year increments while the census is only conducted every five years so perhaps some sort of smoothing technique was used to interpolate to the intervening years, or the data was actually obtained from other National Agricultural Statistics Service publications.

and WI. Sixteen independent variables were included covering four categories: Natural Endowment, Economic Factors, Business Climate, and Regulation Factors. Of the four categories, economic factors were found to have the greatest influence on swine industry growth. These included the hog-corn ratio, percentage of farms with a hog inventory over 1,000 animals, and state slaughter capacity having positive impacts on growth. It is interesting that growth was more rapid in states with higher land values rather than lower ones. They had expected a lower land cost to stimulate expansion because it would reduce capital requirements. On the other hand, higher land values would provide collateral for facility loans, and that may be the influence that they picked up in the analysis. They included seven variables to measure the restrictiveness of state and local policies:

- Green index of general environmental regulations at the state level
- Lester classification of states' commitment to environmental protection activities and institutional capabilities
- Stringency of states' animal waste programs, based on rankings by three experts
- Staffing levels devoted to state animal waste control programs
- Average amount of fines imposed annually by state regulators
- Presence or absence of an anti-corporate farming law in the state
- Presence of absence of an agricultural exemption to local zoning

The impacts of the policy variables were as follows: The Green and Lester measures were found to have mixed influences on growth. The Lester measure placed more weight on enforcement capability, and was associated with lower growth (Mo-Abdalla do not provide details on the variables entering into the Lester and Green measures, but they cite other publications which describe them in detail). The measure of stringency of animal waste programs was insignificant, possibly because of the way it was measured. Fines tended to have a negative impact on growth. Higher staffing levels were also expected to suppress growth but had the opposite effect, possibly because the causality runs the other direction -- the industry grows, and then staff is increased in response. Growth was more rapid in states with agricultural exemptions to local zoning. Anti-corporate farming laws, on the other hand, did not slow growth. It should be noted that they did not attempt to measure how strict each state's anti-corporate farming law was.

Osei and Lakshminarayan performed a similar regression analysis of the U.S. dairy industry (Osei and Lakshminarayan 1996). They looked at the probability that a given county would experience an increase in dairy farm numbers between 1987 and 1992, as a function of milk price, feed costs, temperature and precipitation, land value, population density, surface water density, and four variables characterizing the stringency of environmental policy. The economic variables of milk price, feed costs, and land values again had the expected effects, with higher milk prices encouraging farms to locate in the county while higher feed costs and land values discouraged location. Values for four environmental variables (air quality, groundwater policy, soil conservation, and an aggregate environmental policy index) were obtained from data provided by the Fund for Renewable Energy and the Environment as cited in (Lester and Lombard 1990). The four environmental policy variables all reduced the probability of location. When population density was introduced as a variable, the separate effects of the environmental policy variables were still negative but of lesser magnitudes. This was especially true for air quality policy. Their explanation is that:

> "The intuition behind this is clear when we realize that air policy issues arise in relation to odor and other air quality problems, which are most prominent when dairies are located in residential or densely populated areas. Thus, by locating away from densely populated areas, dairies avoid most of the regulatory pressures relating to odor and other air pollutants."

(Drabenstott 1998) argues that environmental regulations have recently been and will in the future be a major influence in the future location of the pork industry. This is a summary of statistical data from a variety of sources with interpretive comments about driving forces and possible future directions. He does not quantify the impact of the regulations on profitability of existing farms. Even if tighter regulations do not require existing livestock facilities to be modified, competitive pressures due to productivity improvements elsewhere in the industry may reduce the profitability of existing facilities. Producers will then be forced to expand, renovate or replace them (refer to the treadmill hypothesis mentioned under question E2a), at which point they become subject to increased regulatory scrutiny. See discussion of Outlaw et al. for empirical results related to this point (Outlaw et al. 1993).

Drabenstott argues that the new pork supply chains with tens or hundreds of thousands of sows prefer large-scale units, and so have tended to locate their units in non-traditional pork producing states such as Utah and Oklahoma because of their less restrictive environmental regulations. He states,

> “What is clear is that firms in the pork industry are comparing regulatory climates across state lines and even county borders in search of places with fewer regulations. Analysts are divided on how important environmental regulations are in causing geographic shifts in production.” (p. 91)

The states are responding rapidly with tighter regulations, however. He also states that there is no comparison available on state-by-state variation in the overall costs of compliance with environmental regulation. It seems clear that if precise quantitative estimates of compliance costs are desired for the GEIS, new research will be needed to derive them.

Drabenstott claims that two environmental issues will be important in shaping pork industry location decisions:

- whether a national set of environmental standards is enacted, and
- differences in regulation across national borders.

The EPA has announced that it wants final action on national guidelines by December 2001. Drabenstott argues that standardized national standards would tend to push location decisions to the local level, where some communities are eager to embrace the industry while many others are not. He also argues that standardized national environmental regulations would highlight the role of corporate farming laws, which are addressed under question D1b.

Cost of Compliance with Dairy Waste Management Regulations

We could find few published empirical analyses of the cost of livestock operations' compliance with environmental regulations. One reason for the dearth of work on this area may be that the regulations are evolving so rapidly and vary so much across localities and farm types. It is difficult to arrive at a small number of representative farm situations that can be analyzed to provide results that are generalizable to the range of farm situations that are out there, and that will stay relevant into the future.

One empirical analysis of dairy farms' cost of compliance with 1993 U.S. Environmental Protection Agency standards is (Outlaw et al. 1993). They did an analysis of budgets for a number of representative farms using their Farm Level Income and Policy Simulation Model (FLIPSIM). They looked at several dairy farm sizes in different regions of the U.S. They used the EPA Region VI standards as the basis for comparison, and adjusted them for climatic and soil conditions in the other states. The did not study Minnesota, but for Wisconsin they found that minimum capital investments for compliance ranged from $20,000 on a 50 cow farm to $40,000 on a 175 cow farm. Also:

"Moderate size dairies were found to be affected more adversely by being required to meet the specified Region VI EPA regulations than large size dairies. Dairies that were already in financial trouble could be put out of business by requirements to conform with the Region VI EPA standards. Many of these dairies, however, could go out of business regardless of the EPA requirements, albeit at a later date.

Large scale dairies that were not already in financial trouble appear to be able to amortize the extra capital investment costs associated with meeting the Region VI EPA requirements. This suggests that moderate size dairies faced with needing to make investments to meet the EPA standards may choose to expand the scope of their operations, if financially able. While such expansion would require an even larger investment, it also would hold the potential for making the dairy more efficient and competitive." (p. ii)

International Policy Developments

Federal and international agricultural policy is a very broad topic with a voluminous literature. The question was raised in a meeting of the GEIS Citizens' Advisory Committee as to the extent to which this response should address national-level policies in the U.S. and other countries, and how they might enter into the eventual GEIS policy recommendations. The sense of the group seemed to be that the response should focus on describing recent national-level policy developments and economic trends which might most directly affect the outcomes of Minnesota's policy alternatives. More on international policy is included in a separate publication, "Forces Affecting Change in the Minnesota Livestock Industry."

QUESTION D3. HOW ARE LIVESTOCK BUSINESSES DIFFERENT FROM AND SIMILAR TO NON-AGRICULTURAL BUSINESSES WITH RESPECT TO THE FOLLOWING FACTORS, AND WHAT ARE THE IMPLICATIONS OF THESE DIFFERENCES:

There are a tremendous number of ways in which livestock businesses and non-ag businesses are different and similar. This question as stated is much too broad to be researchable. Environmental Quality Board staff indicated that this question grew out of concerns such as: "Does agriculture receive special treatment in terms of public policy and public sentiment, and should it receive such special treatment?" and urged us to address the question from that perspective. From a practical standpoint, one way to narrow this question to a manageable scope would be to state a few specific policy issues which call for such a comparison. If that were done, we would be better able to start to focus on the similarities and differences that are most likely to be important to addressing those policy issues. For example, one policy issue might be: "Should the state give livestock facilities and other agricultural property preferential property tax rates compared to other businesses and residential property?" One way in which studies have addressed this question is to compare costs of public services to tax revenues. One such study is (Senf 1994), which found that farmland in Farmington, Lake Elmo, and Independence required less than $1 of expenditures per $1 of revenues, and a lower ratio of expenditures than did residential or commercial/industrial land. At least two studies of the cost of urban sprawl are currently underway, one by the Twin Cities Metropolitan Council and another by the Minnesota Department of Agriculture (Taff 1999). Additional studies are cited in a paper by the Lincoln Institute of Land Policy (see Taff for source). They caution that:

> "Fiscal impact studies must be carefully evaluated, since the choices of methodology and assumptions greatly influence the findings. It has been noted, for example, that 'the results of most fiscal impact analyses conform with the policy inclinations of the governments or organizations that sponsored them.' (Altshuler et al. 1993, page 92). Burchell and Listokin (1992) also note that few fiscal impact analyses are tested for reliability by comparing actual costs and revenues after development with pre-development projections. Finally, since specific circumstances vary

> considerably from community to community, generalizations should be made with caution."

Comments on the individual factors:

a. location

One approach to this would be to compare how dependent different county or metropolitan economies are on agriculture, versus other industries. A map of farming-dependent counties is available on the USDA web site, along with similar maps showing dependence on other industries (Nonmetro Farming-Dependent Counties, 1989 99). The criterion for the farming dependence map is that at least 20 percent of labor and proprietors' income is from farming. Roughly half of the counties in southwestern and west-central Minnesota, along with most of the Red River Valley region and a few counties in the southeastern part of the state, are dependent on agriculture by this measure. Minnesota appears to be less dependent on agriculture than the region further west, including most of the Dakotas, Nebraska, western Kansas and eastern Colorado, and down into northern Texas.

A larger question might be how diversified county economies are, versus how dependent on any one industry, whether agriculture, mining, forestry, steel, or whatever. On the other hand, if the policy question of the moment is whether to enact some policy which affects the economic viability of agriculture, then knowing how dependent one's economy is on agriculture would help one predict the impact of the policy.

Various web sites are available which allow searching for government economic statistics such as jobs, income, and number of firms by industry and by state, county, or municipality. One is the U of MN Humphrey Institute of Public Affairs' Economic Development web site (Welcome to the State and Local Policy Program's ECONOMIC DEVELOPMENT WEB SITE 99). We could compile some summary information from these databases, but most of that work might be better left until some specific policy questions are identified.

A recent analysis of U.S. Bureau of Labor Statistics payroll data shows that most rural Minnesota counties are gaining manufacturing jobs, although the author cautions against complacency about the future. Most gained manufacturing payroll between 1988 and 1996 by more than the national average increase of 28.3 percent (Beal 1999). By this measure, at least, the economy of the state's rural counties may depend less on the livestock industry than it once did. The complete study is available in (Zimmerman 1998). A comparison of Minnesota counties bordering other states against counties in the other states bordering Minnesota shows that the other states are doing better (see Zimmerman's Table III-4, not duplicated here). Jobs in the other state counties increased by 32 percent from 1988 to 1995, while the Minnesota border counties increased by 20 percent. Furthermore, most of Minnesota's border growth came in one county, Dakota. Minnesota border counties other than Dakota only increased by an average of 8 percent. The recent decision by Anderson Windows to locate a new factory in Menomonie, Wisconsin rather than in Woodbury, Minnesota reinforces this concern (Hughlett 1999).

Another recent USDA study found that manufacturers in rural and metropolitan locations are remarkably similar in their adoption of new technologies, worker skill requirements, use of government programs and technical assistance, exports, and sources of financing, based on a national survey (Gale et al. 1999). The most widespread concern was with quality of labor.

Study question 3 asks how livestock businesses are different or similar to non-agricultural businesses. Most industry comparison statistics lump all farms into one industry category, so it is easier to compare all agriculture with non-ag than to compare just livestock businesses. Employment, for example, is not split out separately for livestock versus crop enterprises. Most farm operators raise both livestock and crops, and the share of time spent on livestock varies widely. One can estimate the share of employment involved in producing a particular species of livestock by such means as multiplying typical labor requirements per animal times animal inventories, but such estimates would not be very accurate.

b. technology employed

At a very aggregate level, "technology" implies a mix of capital, labor, and land which differ across different types of businesses. We were unable to locate any publications that compare technology in livestock businesses with non-agricultural businesses, other than personal computer use. In 1995, 15 percent of U.S. farms (including both livestock and crop farms) reported using computers for bookkeeping and financial analysis, 6 percent for production decisions, 2 percent to aid chemical application or field operations, and 0.8 percent reported use of global positioning systems (Sommer et al. 1998). In a June 1997 nationwide survey, 43 percent of Minnesota farms reported having access to computers, 32 percent owned or leased a computer, 22 percent used computers in the farm business, and 11 percent had Internet access (Farm Computer Usage and Ownership 1997). The Minnesota numbers were not split out for livestock operations versus crop, but the data for the north central region was split out. North central livestock operations' computer usage was very similar to that for all Minnesota farms. Minnesota farms' usage was a little higher than that of all U.S. farms except for the category of Internet use, where 13 percent of all U.S. farms reported having Internet access compared to 11 percent of Minnesota farms.

Computer use by workers in non-metropolitan areas is at 36 percent and increasing rapidly, but still lags behind use by metro workers whose rate is 49 percent based on data from the Current Population Surveys for 1984, 1989 and 1993 (Kusmin 1997). The differences are attributed to differences in the mix of occupations. (Gale 1997) discusses a wider range of manufacturing technologies and differing rates of use by manufacturing plants in metro and non-metro locations, but does not include farms.

c. business concentration

This topic has been widely studied for at least some industries. In agriculture, most work has focused on the meatpacking industry. Most work that has analyzed business concentration has done so from the standpoint of how concentration might affect business conduct and performance (such as ability to charge monopoly prices). The production agriculture sector, including livestock businesses, has been regarded as not concentrated enough to raise performance concerns, so to our knowledge has not been studied much.

d. use of land as a resource

We have been able to locate few studies that directly compare use of land as a resource by livestock businesses and non-agricultural businesses. There are databases that describe land use by agriculture. For example, the U.S. Census of Agriculture contains data on land in farms and in various crops on a nationwide basis and by state and county (U.S. Census of Agriculture 1998). The Minnesota farm business summaries contain data on crop acres owned and rented by farms with different types of livestock (Olson et al. 1999), (Minnesota Farm Business Management Program, Statewide Annual Reports, 1996 undated). We are aware of databases of land use data that are focused mainly on conservation issues, and databases exist that contain land use statistics for non-agricultural industry categories such as timber by type of ownership (Statistical Abstract of the United States 1998). We have not delved very far into this topic due to uncertainty about what the real questions are and the criteria for comparison that are of interest. Further focusing of the question is needed to improve researchability.

One possible way to narrow this question to a more manageable scope would be to consider only those aspects of land use that affect the amount of water pollution originating from land used by livestock businesses and other businesses. One study in that vein is a 1991 survey of Twin Cities residents on the use of lawn care chemicals, including fertilizers and pesticides (Creason and Runge 1992). They found that average levels of fertilizer application appeared to fall below recommended levels, and that pesticide application rates were similar to non-urban agricultural use. They stressed the need for follow-up studies to obtain better information.

e. patterns of ownership and control

(Strasser 1989) is one source that discusses ownership and control in retailing, which has parallels with what is happening in the livestock industry. For example, during the 1880's and 1890's, local retailers protested the rise of department stores and mail-order houses (page 215). Legislation passed in 1912 that authorized parcel post shipments was controversial, since it benefited Sears and Montgomery Wards and was a severe blow to retail merchants (page 81). Of course, the current controversies over WalMart taking business away from rural main street retailers illustrates that the retail industry continues to evolve. Further comments are included under question D5a below.

f. government regulation and assistance

Government is involved in all sectors of the economy in a myriad of ways. It would be easier to compare livestock businesses with the rest of the economy if some sort of index such as dollar cost could be assigned to each government program and totaled up for each industry. To arrive at such an index would necessitate comparing against a hypothetical case of no government involvement, however. As (Browne et al. 1992) point out,

> "A market system totally free from government involvement is a misnomer. Market systems require ownership of resources and the right to collect returns from those resources. So government has to be involved from the outset to establish some public agreement on protecting the ownership rights of individual entrepreneurs. The way these rights are established has definite repercussions for market performance (in other words, for the allocation of resources to their most valuable and best use) and for the distribution of wealth in a society." p. 129

Lacking a way to sum up the overall effect of all types of government involvement, we can still identify publications which merely describe the major types of regulation and assistance. One recent summary of federal programs affecting rural businesses in general is (Bowers 1998). They list targeted tax cuts, disaster aid, transportation programs, housing assistance, welfare-to-work programs, and regulatory changes including telecommunications, electric power, air and water pollution, public land management, banking, and finance. Many of the federal programs affecting agriculture are included in farm bills, which in recent years have been passed roughly every five years. Most provisions of the Federal Agriculture Improvement and Reform Act of 1996 are well known, but for a summary see (Young and Westcott 1996).

g. public perceptions

Is this question intended to evaluate the often-heard perception that agriculture is viewed more favorably by the public than are other industries, and deserves special treatment in government policies? There are several rationales for this perception, such as: 1) a moral or Jeffersonian argument that farmers are more deserving than other people just because they work the land and produce a product, food, which is more essential than many other products; 2) a regional economics-based argument that at least some rural communities have few other industries to depend on for tax revenues and trade; and 3) a social argument that owner-operators are more likely to be stable and involved in the local community than are people who work for others, and that owner-operators make up a larger share of the agriculturally-based population than for other industries.

Farmers' values were compared to those of the general population with respect to morality, political ideology, work ethic, and outlook, in (Drury and Tweeten 1997). Using data from the General Social Surveys of the National Opinion Research Center at the University of Chicago, they found that:

> "Compared with the general population, the farm family is more stable, the typical farmer is more religious, politically more conservative, and happier and more satisfied with some aspects of life. "In many aspects, particularly those concerning work ethic and outlook, farmers are not different from others. Nonetheless, as a group, farmers are among the better-adjusted members of society. They are optimistic and have a healthy outlook on life in terms of interpersonal relationships and general viewpoint." (p. 68)

They conclude that farmers' unique attributes can translate into positive externality benefits which the public can weigh against the costs of government interventions to save family farms. Offutt et al. took Drury and Tweeten to task, arguing that the basic question of preference in policy for farmers is a matter of equity -- of societal and political preference for redistribution among favored and less favored groups -- not one of (economic) efficiency. They also questioned the definition of morality used (Offutt et al. 1998), (Drury and Tweeten 1998).

A earlier nationwide mail survey by Tweeten found that the public was much concerned about farm problems and committed to preserve the family farm. The public was generally supportive of government efforts to help farmers but tended to be undecided regarding specific measures (Jordan and Tweeten 1987).

There are perhaps over one hundred publications that relate to public perceptions of a wide range of specific issues more or less related to agriculture. They do not appear to be relevant to the ag versus non-ag comparison question posed here, so will not be cited individually, but some of the issues addressed in different studies are:

- biotechnology (the most widely researched issue, by far)
- food hazards
- transmissible spongiform encephalopathies (mad-cow disease)
- food irradiation
- agrichemicals or pesticides
- feed additives such as growth promotants and antibiotics
- how farmers treat the soil
- agricultural research
- regulatory changes

- natural resources management or wilderness management
- river management and storm water management
- fish farming in general, and shrimp farming in particular
- fee hunting
- the pulp and paper industry

A 1995 BRE (Business Retention and Enhancement Program) in Becker and Ottertail counties surveyed dairy producers on their perception of how they thought dairy farmers were perceived in the community. The responses for negative or indifferent attitudes toward dairy farmers were: Farmers (not dairy producers) 42%, Main Street Businesses 47%, Local Government Officials 51%, Rural non-farm residents 64%, and City residents 73%. Of the 131 respondents 73% indicated that it was highly likely they would continue to produce milk through the next three years, with larger herds indicating they planned to continue dairying. (Morse et al. 1995) A similar study in Stearns county in 1997 ranked the top five characteristics dairy farmers valued about dairy farm life: 1) Good place to raise a family 2. Opportunity to make own decisions 3. Time to be used with family 4. Economic rewards from farming and 5. Opportunity to work outdoors. Of the ninety two percent of the respondents in this survey that plan to continue farming over the next three years, 41% said they were likely or very likely to expand their dairy operation. (Love and Lazarus 1997)

The Iowa Farm and Rural Life Poll is conducted annually by Iowa State University to address major farm and rural issues (Lasley and Larson 1998). The 1998 report presents farmers' opinions about economic development directions that have been pursued or suggested for Iowa. Improving rural infrastructure, maintaining a world class educational system, and diversifying agriculture were supported more strongly in 1998 than ten years earlier. There was also strong support for local processing, placing more emphasis on agricultural exports, and funding biotechnology research, but support for these was down slightly from 1988. A majority thought their quality of life had improved in the past five years. They were mainly optimistic about continued improvement in their own family's quality of life, but less optimistic about their communities. There was an increase in concerns about odor and noise from livestock operations.

QUESTION D4. WHAT IS THE CURRENT MARKET SITUATION, HOW IS THE MARKET CHANGING AND WHAT ARE THE IMPLICATIONS FOR LIVESTOCK PRODUCERS WITH RESPECT TO THE FOLLOWING FACTORS:

a. consumer demand (including brand loyalty)

We found a large body of literature related to Question D4 on the changing market situation. We have cited some refereed journal articles on consumer demand, but we concluded that many of the changes in food distribution and retailing that may potentially affect producers are better described in various USDA reports and trade magazines. The USDA Economic Research Service monitors trends in food consumption. The latest numbers by commodity, and a discussion of the methodology used to measure consumption, are presented in (Putnam and Allshouse 1999). Food consumption is generally measured indirectly, by subtracting non-food use from supply numbers.

When economists refer to consumer demand, they are generally referring to a concept that is somewhat broader than simply per capita consumption at a point in time:

> "Demand is a schedule of different quantities of a commodity that buyers will purchase at different prices at a given time and place." (Kohls 1967), p. 131.

Two consumer demand research issues that have received considerable attention by academic researchers over the past decade or so are:

- How has the relationship between quantity demanded, on one hand, and price, socioeconomic and other observable variables changed over time, and

- What is the impact of advertising, especially generic versus brand advertising?

The first question is especially important for price forecasting. For example, researchers have studied how consumers' preferences have evolved as a result of a growing awareness of the health hazard of high fat intake. (Moschini and Meilke 1992), (Green and Alston 1990), (Eales and Unnevehr 1988), (Eales and Unnevehr 1993), and (Eales and Unnevehr 1994) are all studies that looked at structural change in U.S. meat demand and approaches to estimating demand elasticities.

Interest in the second question has been motivated at least in part by the desire to evaluate the effectiveness of producer check-off-funded generic advertising for milk, meat, and eggs. (Brester and Schroeder 1995) studied the effects of meat advertising expenditures on beef, pork, and poultry demand. Studies of milk advertising include (Lenz et al. 1998), (Kaiser and Liu 1998), (Pritchett et al. 1998), (Kaiser et al. 1992), (Suzuki and Kaiser 1997). (Schmit et al. 1997) looked at the impact of generic advertising on egg demand.

Generic advertising has raised fluid milk sales an estimated 18.1 billion pounds (6.0%) and cheese sales by 6.8 billion pounds in the period September 1984 and September 1997. The impact on sales of butter and frozen products was unaffected. These researchers estimated milk prices were 2.3 percent higher than they would have been in the absence of the program. They estimated the gross return for each dollar of the 15 cents per hundredweight assessment to return $3.44 from the generic advertising. (Blisard et al. 1999)

In 1993, a random sample of 515 consumers in the metropolitan Minneapolis-St. Paul, Minnesota area were surveyed to learn more about consumer preferences for meat characteristics (Kinsey et al. 1993). Some key findings were that only four percent of households had increased beef consumption over the past year while 37 percent had decreased beef consumption. Seven percent of the households did not eat meat at all. Concerns about diet and health cut across age and educational groups, and these concerns were correlated with a decrease in beef consumption. There were a number of other findings having to do with eggs, poultry, fish, income levels, and fat substitutes. They identified nine market niches such as "low fat," "safety," and "price conscious" households. Over half were willing to pay more for beef that is free of antibiotics and growth hormones, but less than one-fourth were concerned about humane treatment of animals for meat and only 16 percent worried about their environmental impact. Many did not know what to think about these issues.

Trend data on where food is purchased might be important to producers who are considering direct marketing or other alternatives to the mainstream food distribution system. Tables 103 and 104 in (Putnam and Allshouse 1999), not duplicated here, provide data on where food is purchased in the U.S. For example, the percentage purchased directly from farmers, manufacturers and wholesalers has been flat in the 1990s at around two percent. A more in-depth analysis of direct marketing as a rural development tool is provided by (Gale 1997). Gale cites growing interest in direct marketing by both consumers and producers, but also cautions that direct selling is still relatively small and limited to communities close to urban areas. His analysis is based on data from the 1992 Census of Agriculture. The 1997 Census of Agriculture has become available since that article was published, and might provide more recent data on direct marketing income potential (U.S. Census of Agriculture 1998).

Producers who plan to continue to market through mainstream channels may be interested in the rapid change taking place in the food distribution and retailing sector. The changes appear to be driven partly by consumer demographics and partly by opportunities presented by new information systems. Numerous changes have been occurring in the food wholesaling, food store retailing, and foodservice industries that compose the consumer food distribution channels (Connor et al. 1997). Increasing levels of concentration in wholesaling and at the food store level, and a shift away from merchant wholesalers toward more direct negotiation between food store chains and manufacturers are some of the trends cited. One new initiative that promises to lower costs and improve efficiency is Efficient Consumer Response, which is a cooperative effort between processors, wholesalers, and retailers to improve distribution efficiency and customer service. Connor et al. also speculate about whether the so-called "British Model" of grocery retailing might catch on in the U.S. That model entails fewer retail chains - five retail chains account for more than 80 percent of the UK market. They would carry fewer manufacturers' brands and more private-label brands, with retail employees playing a greater role in new product development. The UK retailers earn two to four times the profit rate of their American cousins. The UK model may be starting to influence U.S. retailers, as evidenced by Sainsbury's recent acquisition of two large retail grocery chains in the northeastern U.S. They appear to be making over these acquisitions in the Sainsbury image.

Producers and others can also get a general sense of retailers' perspectives on what is changing and why by reading trade magazine articles such as (Tosh 1999). For example, according to Tosh one challenge that full-line meat distributors such as Supervalu face is the large number of individual items which distribution centers must handle. In its larger divisions such as the northern region, the number of items can reach 1,700. The variety of retailers supplied by the wholesaler is part of the problem, such as the Byerly's stores in Minneapolis handle exclusively prime beef while many other stores do not stock the product. Improved packaging is allowing retailers to increase volumes of case-ready products. Category management is a management technique that Supervalu and others are adopting to improve profitability, in marketing areas where sales and demographic data are available. Another article in the same magazine describes how the distributor and retailer attempt to determine the optimal mix of national brands and private brands for the store.

What are the implications of these food distribution changes for producers? Tosh provides a general understanding of the changing marketplace. It does not include the level of detail that would be required to quantitatively analyze specific farm-level production and marketing alternatives. Cash register scanner data, for example, might be useful for some types of analysis but is not generally available to academic researchers. It is our impression that some farm operators with sufficient resources and entrepreneurial savvy are establishing relationships with processors and distribution firms which give them access to such information. The potential for such coordination may be a significant incentive for farmers to increase their operation size or to work together with other farms.

Demand for food in the aggregate is not very responsive to price changes because there is little opportunity to substitute non-food items in the consumers budget (Putman 1997; Senauer 2001). However demand for individual foods is responsive to prices as consumers demand more convenience and quality. Rising income increases expenditures for more expensive food items. Consumer purchases represent a vote in the market place that provides feedback through the system about their preferences. Changes in the makeup of the population, lifestyles, incomes, attitudes on food safety and health, and convenience have drastically affected conditions for producers and marketers of food products.

There have been some major shifts in the eating habits between 1970 and 1996 (Agriculture Fact Book 1998):

Coffee	-35%
Eggs	-28%
Beverage Milk	-22%
Red Meat	-15%
Alcoholic Beverages	17%
Fats and Oils	21%
Fruits and vegetables	23%
Caloric sweeteners	24%
Fish	26%
Flour/Cereal Products	46%
Poultry	90%
All Carbonated soft drinks	114%
Cheese	143%

U.S. food and beverage expenditures as a share of total personal consumption expenditures have fallen from 32.1 percent in 1947 to 16 percent in 1996. The 1996 number includes 9.6 percent for consumption at home and 5.4 percent consumed away from home (Connor et al. 1997). They also discuss the implications of changing consumer preferences on growth potential for different types of food products. For example, they use supermarket sales data to document rapid growth in:

- highly convenient foods,
- Asian, Hispanic and Mediterranean foods,
- low-calorie foods,
- packaging that preserves freshness,
- snacks, and
- perceived healthy or natural foods.

USDA researchers studied the potential adjustment in agricultural production as the U.S. diet moves toward the dietary recommendations specified in the Food Guide Pyramid. Their results shown in Table 17 project an increase in animal products of milk, yogurt, and cheese, and of meat, poultry, fish, dry beans, eggs, and nuts. The major reductions are projected in sugars, fats and oils, and starchy vegetables. (Young and Kantor 1998)

Table 19. 1995 food supply servings compared with Food Guide Pyramid recommendations.

Food group	Food Guide Pyramid recommendation for a 2,200-calorie diet[1]	1995 food supply servings	Change needed to meet Pyramid recommendation
	Servings	Servings	Percent
Grains	9.0	9.4	--
Vegetables	4.0	3.7	8
Dark green leafy and deep yellow vegetables	1.3	0.3	333
Dry beans, peas, and lentils[2]	0.6	0.2	200
White potatoes and other starchy vegetables	0.8	1.3	-38
Other vegetables	1.3	1.9	-32
Fruit	3.0	1.3	131
Citrus, melons, berries	1.5	.6	150
Other fruit	1.5	.7	114
Milk, yogurt, and cheese[3]	2.2	1.8	22
	Ounces	Ounces	
Meat, poultry, fish, dry beans, eggs, and nuts[4]	6.0	5.7	5
	Grams	Grams	
Added fats and oils[5]	38	59	-36
Added sugars[6]	12	32	-63

[1] USDA, CNPP, 1996; Cronin et al., 1987.
[2] Dry beans, peas, and lentils can be counted in either the vegetable or meat groups. Counting these foods toward "vegetable group" servings is consistent with other dietary assessment studies.
[3] Recommendation based on a weighted average of recommended servings for different age groups of the U.S. population.
[4] Food supply servings reflect both the lean and fat portion of meat and poultry.
[5] The Food Guide Pyramid does not make a recommendation for added fats and oils. The upper limit reported here is based on the assumption that added fats and oils contribute the same 52 percent of total fat in the food supply as in 1994, and that total fat is no more than 73 grams of 30 percent of total calories for a 2,200-calorie diet.
[6] The recommendation for added sugars is a suggested upper limit based on caloric intake.

Source: (Young and Kantor 1998)

Farm retail spreads have increased every year for the past 30 years. The average payment for farm raw products in 1997 was 23 percent of retail cost. The farm- retail spread varies greatly by product (Agriculture Fact Book 1998).

b. concentration of buyers

Concentration in the Meatpacking Industry

The USDA Advisory Committee on Agricultural Concentration reported to the Secretary of Agriculture with policy recommendations in 1996 (Concentration in Agriculture: A Report of the USDA Advisory Committee on Agricultural Concentration. 2001). Guiding principles they identified were to: promote competition; achieve, as close as possible, equal market information for buyers and sellers; and assure that markets exist for all comparable products under comparable terms, while being mindful of avoiding recommendations that proscribe market behavior in ways which could ultimately stunt opportunities for growth within the industry. A few key recommendations that seem germane to the GEIS scoping questions are:

- expand the private right to action to parties believing themselves to be damaged by violations of the Packers & Stockyards Act (P&SA), by providing a right to attorneys' fees,
- amend the PS&A to provide the same enforcement authority in poultry as in red meat, including growers who raise and care for poultry for another entity,
- permit price differentiation only with respect to differences in quality, verifiable differences in procurement costs (including differences in cost due to quantity), and time of delivery,

- research the reasons for and sources of economic difference in the value of market hogs,

- improve price reporting in a number of specific ways (this report was published before Congress enacted mandatory price reporting),

- make sure all parties in contracts or other alliances are well informed about their risks and rewards, set up rules to "level the playing field" with penalties for behavior deemed "a priori" to be exploitative or inappropriate, standardize terminology, and address pollution problems that might be a consequence of integration,

- enable cooperatives and contract grower associations to bargain with processors without fear of recrimination, and require handlers to engage in good-faith negotiation with producer cooperatives and networks.

A minority report calls for stronger action, especially with regard to captive supplies and packer procurement practices.

Changes in concentration in U.S. commercial livestock slaughter between 1909 and 1994 are summarized in (Azzam and Anderson 1996), pages 22-30. The percentage of slaughter done by the top four firms has been rising since the mid-1980s, and was at 82 percent for steers and heifers, 73 percent for sheep, and 46 percent for hogs in 1994.

Concentration, conduct, and performance of the meatpacking industry have been extensively studied (defining performance by measures such as the ability to charge monopoly prices). One recent study was organized by GIPSA in 1992 and published in 1996 (Concentration in the Red Meat Packing Industry 1996). One of the seven individual projects conducted as part of the study was a literature review of the economic history of the meatpacking industry, theory, and evidence (Azzam and Anderson 1996). (Azzam 1998) is an updated summary of the literature review. (Heffernan et al. 1999) documents the increasing concentration of agricultural production and processing in the hands of the top firms and the development of food chain clusters of firms combined in a variety of business relationships.

(Heffernan et al. 1999) and (Azzam 1998) present differing perspectives on the issue of increasing concentration. Heffernan et al. predict that four or five global clusters of food firms will emerge. One interesting observation made in the Heffernan paper is that other concentration studies may tend to focus too much on individual firms, and so may miss important information by neglecting the relationships (e.g. joint ventures or strategic alliances) among firms within a cluster. They argue for government intervention on the grounds that the current highly concentrated structure allows a handful of firms to control the food system and capture higher-than-competitive profits at the expense of independent farmers and rural communities, and that the concentrated food system is too vulnerable to disruption. They do not attempt to measure differences in performance between more and less concentrated industry structures, but rather argue that the risk of poor performance is too great to delay action until empirical data becomes available. One well-documented example of where price-fixing practices of a group of multinational firms resulted in felony convictions was the 1992-95 global price-fixing conspiracy, documented in (Connor 1997), (Lieber 2000), and (Levins 2001).

Azzam reviews the studies that have attempted to measure the relationship between concentration and performance in the meatpacking industry. Some studies were done along the traditional lines of the Structure-Conduct-Performance (SCP) paradigm; others were based on more recent methods from what has become known as the New Empirical Industrial Organization (NEIO). Cross-industry studies in the 1960s focused on profitability as the measure of performance. They found that industry profitability increased with concentration, and these studies had an effect on antitrust policy of that era. These studies were criticized, however, over interpretation of profitability-concentration correlations. An alternative interpretation was that firms become large because they are efficient due to greater managerial skills and innovativeness. Later studies shifted their focus from comparing profits across industries, to comparing prices across geographically separated markets within a single industry. Using price as the performance indicator instead of profit was thought to be a better way to measure market power because price would not pick up effects of efficiency differences that would affect the profitability measure. Most SCP studies of market power in the US meatpacking industry were of the price-concentration sort. NEIO models focus more directly than SCP models on what type of industry conduct is consistent with observed prices and quantities, and can test a variety of oligopoly theories.

Azzam (Azzam 1998) views the above empirical studies as one way of assessing competition - taking a snapshot of industry equilibria at a point in time. The studies offer little understanding of how the industry reached where it was at that point or whether, in fact, the economic data used in the studies represent equilibria. Azzam concludes that the evidence from both SCP and NEIO models on balance seems to indicate a (statistically) significant but small departure from competitive conduct. The implication is that both consumer and producer welfare could be increased by steering packer behavior toward closer conformity with the perfectly competitive benchmark. The question is whether one should target the structure or conduct of the industry.

The question of whether the positive efficiency gains from industry consolidation outweigh the negative effects of greater market power remains an issue. Azzam cites two studies of beefpacking which attempted to find out whether the cost reductions achieved through economies of plant size or multi-plant operation offset allocative efficiency resulting from deteriorating packer market conduct, (Azzam and Schroeter 1995) and (Azzam 1997). Azzam and Schroeter found that the anti-competitive effects of a 50 percent increase in concentration were, at most, on the order of 2.4 percent. This was well below their estimate of actual cost savings of 4 percent which is likely to be generated by a 50 percent increase in the size of a representative plant in the industry. They concluded that the structural changes in beef packing in recent years have been welfare enhancing on balance. Azzam (1997) used a different approach but also found that the cost-efficiency effect outweighed the market-power effect. The role of economies of size as a factor in pork slaughtering industry consolidation and vertical linkages is evaluated by (Hayenga 1998b). Fixed costs declined $3/head for double- versus single-shift plants, while capacity utilization rates can greatly affect variable cost per head and pricing behavior in the hog market.

Packing plant closures have often raised concerns about industry concentration and market access. A recent analysis of cattle slaughtering plant closures found that plant-level factors such as age and capacity were the most important determinants of plant exit (Anderson et al. 1998). Small plants in already-concentrated markets were more likely to exit than those in less-concentrated markets. The reason for the difference may be that in already-concentrated markets, larger plants may utilize exclusive forward-contracting relationships with feedlots that reduce open-market supplies to the smaller plants. The authors conclude that technical inefficiencies are stronger determinants of exit than are market structure factors. They concur with the conclusions of Azzam and Schroeter above, that any government action aimed at reducing concentration of the beef packing industry must consider the trade-off between market power and improvement in technological efficiency.

Azzam argues that from a historical standpoint, the meatpacking industry has performed well in terms of innovation. It can be viewed as competitive in a dynamic sense of optimizing the allocation of resources between the present and the future. Profits are the returns to the innovative activity necessary to maintain a dynamically competitive process, and the appropriate type of competition to be concerned about is not static price competition, but competition in innovation. Innovations that have grown out of the industry structure range from ice rooms and refrigerated rail cars adopted a century ago to boxed beef technology today. Thus, it would be a mistake to surgically intervene to maintain an industry configuration consistent with the static notion of competition. The top meatpacking firms today such as IBP only recently reached dominant positions, while the top firms at the turn of the century disappeared long ago in what has been termed a "perennial gale of creative destruction." This would suggest that it is unlikely that a few firms will be able to maintain their positions for very long even without government intervention.

To sum up the Azzam's message, he recommends that policy focus on industry conduct rather than structure (Azzam 1998). The aspect of conduct that policy should focus on is the degree to which competing firms may be able to coordinate their pricing without conspiring in the usual sense of the term - that is, without any overt or detectable acts of communication. The challenge is to develop creative measures, in the form of marketing institutions, to dissipate the rents from implicit collusion. Where acts of communication are overt and detectable, as was the case in the beef cartel at the close of the last century, antitrust remedies come into play. Mandatory price reporting as a policy response is discussed further below in the "State-Level Response" section.

Muth and Wohlgenant show that seemingly minor specification differences in a regression model can change the results as to whether beef packing firms are exercising market power in their buying and selling practices (Muth and Wohlgenant 1999). When the model coefficients are held constant over time, results showed the presence of market power (marginal revenue or marginal cost not equal to average price). But, when the coefficients were allowed to vary over time as a function of prices and concentration, the indications of market power were no longer statistically significant.

Hahn and others at USDA studied monthly changes in U.S. farm-wholesale price spreads between 1979 and 1996 (Hahn et al. 1999). They did not find evidence that packers were exercising market power, although they caution that with concentration at 80 percent or higher, the potential for exercising market power in the industry does exist. Paul explored the market and cost structure of the U.S. beef industry using monthly cost and revenue data from a USDA Grain Inspection and Stockyards Administration survey of the forty-three largest U.S. beef packing plants in 1992-93 (Paul 2001). She found little market power exploitation in either the cattle input or beef output markets, and that any apparent evidence is counteracted by cost efficiencies such as utilization and scope economies. MacDonald and Ollinger also recently examined the extent of scale economies in hog slaughter (MacDonald and Ollinger 2000). They found that the industry's largest plants can deliver pork products to buyers at costs per pound that are 2-3% lower than plants half their size, and assert that this rather modest cost difference is enough to have important effects on industry structure. They argue that the rapid exit of the smaller plants in the 1980s and 1990s is an indication that pork price competition was strong over the period. Those plants would have remained in operation if prices had been above their costs.

Dairy Marketing

Restructuring has been characteristic of the dairy industry at all levels in the last 50 years. Technological developments have changed the way things are done on the farm, in assembly, in processing, and in distribution. At every level economies of scale have led to fewer and larger operations. The kinds of firms have change drastically in response to cost pressure and investment pressures. Cooperatives handled 86 percent of the milk sold to plants and dealers in 1994 compared to 73 percent in 1973. For much of the century eight large specialized dairy companies dominated the marketing of fluid milk and manufactured dairy products and shaped the structure of the industry into the 1970’s. Since then competition with mergers, corporate restructuring and divestitures have taken many of them out of the business. Foreign owned companies have become more involved in U.S. dairy markets in recent years. The number of fluid milk plants fell from 10,000 in

1940 to 478 in 1995. Market power has shifted to retailers and those who service retail outlets. Cooperatives dominate the butter and ingredients markets and private firms the frozen products markets. The natural cheese markets is shared, 43 percent cooperative and 57 percent private proprietary firms in 1992. Manchester suggests that cooperatives could face significant change as public dairy programs are eliminated. And members expect them to reduce price volatility, set production quotas, better manage inventories, and expand market sales. (Manchester and Blayney 1997)

Food Marketing

An assessment of the growth, conduct, performance, and structure of food marketing institutions - food processors, wholesalers, retailers, and foodservice firms - is provided in (Gallo 1998). He found that:

> "New food product introductions fell sharply in 1996. The number of new plants, consumer advertising expenditures, and common stock prices reached new highs in 1996, as did the number of mergers in the foodservice industry. Profitability from food manufacturing and retailing was higher due to strong sales, wage and producer price stability, and streamlining of operations."

Food industry mergers and acquisitions have continued at a rapid pace, setting a record in 1998 (Smith 1999).

A review of the relationship between food retailing concentration and consumer prices, power and profits yielded mixed results, especially with regard to price (Kinsey 1998). That review of the consumer impact of food retailing concentration notes that U.S. food expenditures are falling relative to household income, which calls into question the importance of concentration as a societal concern. One cited study found that greater concentration at the wholesale level was associated with lower retail food prices, probably due to economies of scale being passed on to consumers. Overall conclusions were that increased retail level concentration has been associated with both increases in prices in some food categories and decreases in others. Profits uniformly increased with concentration, but the reason was unclear. Part of the increase was attributed to lowering costs through the use of information technology and vertical coordination.

> "Casual observation implies that retail food firms engage in fierce competition and where prices are high, it is usually due to adding value and services for which consumers are willing to pay." (p. 24)

A review of the literature of wholesale meat market concentration summarizes several studies which generally raise concerns about packers' and retailers' exercise of market power to the detriment of producers (Strange and Higby 1995). They describe motivations for the move toward formula pricing of slaughter animals and the problems presented by the reduction in the share of the market that is traded by negotiation. An analysis of randomly selected meat market reports shows how the selling of lower quality carcasses and cheaper cuts through channels that are reported, while higher quality ones are fabricated for their own retail customers or into specialty cuts that do not fit into reported standard commodity categories, may bias wholesale price reports downward. They provide a brief summary of the 1977 Illinois Brick Co. ruling by the U.S. Supreme Court, which held that only direct purchasers or sellers may sue a firm for damages due to the use of market power. This ruling presents an obstacle to farmers who might be in the position of being damaged by depressed wholesale prices that are passed on by packers or other intermediaries.

Another interesting aspect of food industry policy is that of "vertical restraints," a term that refers to complex contractual arrangements between manufacturers and retailers such as franchise fees, exclusive territories, and forcing the retailer to carry the full line of the manufacturer's products. Theory is ambiguous about the social effects of such restraints. U.S. and U.K. policy toward such restraints in the food system is compared in (McCorriston and Sheldon 1997).

Federal Agencies with Jurisdiction over Antitrust Issues

Two federal government agencies responsible for policy regarding concentration of buyers of agricultural products are the Antitrust Division of the U.S. Department of Justice, and the U.S. Department of Agriculture's Grain Inspection, Packers and Stockyards Administration (GIPSA). An overview of the Antitrust Division's role is available on the Internet at (U.S. Department of Justice Antitrust Division Overview 99). Text of Congressional testimony about what the antitrust laws prohibit and what Antitrust's recent activities related to the meat packing industry have been, is available at (Turetsky 1996). The responsibilities of the Grain Inspection, Packers and Stockyards Administration are described at (USDA Grain Inspection, Packers and Stockyards Administration 99).

State-Level Response

The meatpacking industry is comprised of multinational firms over which the Minnesota state government and local governments have very little influence. One way in which Minnesota has attempted to influence over the meatpacking industry has been to require mandatory price reporting on animals purchased from Minnesota producers (Minnesota Department of Agriculture, Minnesota Daily Livestock Market Price Report 2001). This state-level system, which has been operating since September 1999, was superseded by the national system implemented by the USDA Agricultural Marketing Service on April 2, 2001. The USDA system is discussed in more detail below.

Other state and local policy options available to influence livestock processors would include whether to offer financial incentives to attract new slaughter plants, and environmental regulations on slaughter plants. The entire scope of state and local policies affecting livestock production in the state is also likely to indirectly influence livestock processors, because shrinking production seems certain to ultimately result in slaughter plant closures while new plants will locate in areas that either currently have more production than can be slaughtered in nearby plants, or appear receptive to expansion.

c. contractual buying and selling arrangements, and

f. price discovery and market fairness

Livestock Markets

"Price discovery" is the process by which buyers and sellers arrive at a price for a particular transaction (Schroeder and Ward 2000). One implication of marketing contracts for non-contracted producers is that the spot market becomes thinner and price discovery becomes less reliable, as discussed below. The term "captive supplies" is used to refer to the share of supply that does not go through the spot market, either because it is transferred through contractual arrangements or through vertical ownership integration of packers into the production stage or vice versa.

Concern about packer feeding is not new, as the first study was conducted in 1966 (Aspelin and Engelman 1966). In 1992, the USDA Packers and Stockyards Administration commissioned a major study to provide a more definitive answer to the captive supplies question (Ward et al. 1996). They found a:

> ".. relatively weak negative relationship between transaction prices for cash market cattle and either delivering cattle from an inventory of captive supplies or having an inventory of captive supplies from which to deliver at a later time. Results were not robust. Several versions of the models were estimated and estimations over sub-periods within the 1-year study period yielded inconsistent results. ... Price differences were found among procurement methods, but with the possible exception of price differences between forward contracts and cash market prices, observing such price differences in everyday transaction prices would be difficult." (pp. 81-82)

Azzam and Anderson report that packer feeding in the late 1950s and early 1960s varied from 4.6 to 7.4 percent of total marketings of fed cattle, with 151-215 packers involved in feeding cattle (Azzam and Anderson 1996). They found that packer-feeder volume had a significant negative impact on terminal market cattle prices in the study area, which was one of the top ten terminal markets. summarize three studies of packer integration or captive supplies on fed beef cattle prices. Their regression analysis found that a 100-head increase in packer-fed shipments to the plant, on average, lowered the local average price for Choice steers relative to other markets for the entire week by about $0.06 per hundredweight. A 1991 study found similar results (Schroeder et al. 1993). This study also found that price variability was not related to captive supplies. Another 1991 study found that captive supplies affected prices in Kansas but not in Colorado, Nebraska or Texas (Hayenga and O'Brien 1992). In a different approach, Schroeder and Ward report on market simulations which showed that cash market transaction prices tended to be more variable when sizeable proportions of the fed cattle market were under marketing contracts (Schroeder and Ward 2000). Schroeder and Ward also describe the economic incentives for and drawbacks of formula pricing, which can lead to pricing of large volumes of production being based on a cash price in a single geographic market for a specific within-day trading period on a specific day, which can be susceptible to price manipulation.

The USDA Grain Inspection, Packers and Stockyards Administration analyzed the hog procurement transactions during January 1996 by 4 firms and 12 plants in Iowa, southern Minnesota, eastern Nebraska, and the southeastern corner of South Dakota (Western Cornbelt Hog Procurement Investigation (GIPSA Backgrounder) 1998). The impact of procurement method on pricing was one of the issues studied. Results generally showed higher prices for marketing agreements and carcass merit pricing grade and yield versus spot live purchases. The spot market transactions tended to exhibit lower hog quality characteristics than the transactions under marketing agreements and forward contracts. Small sellers tended to sell on a spot market basis and received lower prices. The report of the study seems to leave unanswered the question of whether the price differential due to seller size was reasonable due to quality and transaction costs, or whether the smaller sellers were unfairly discriminated against.

An analysis of packer kill sheets provided by 300 Iowa pork producers showed that price increased with size of operation, at a declining rate (Lawrence 1996). A producer marketing 9,000 to 10,000 head per year would receive about $0.85/hundredweight more than a producer marketing only 100 head per year. Prices to producers marketing over 5,000 head per year leveled off, and the analysis showed that the price advantage peaks out at about 9,000 to 10,000 head. Backfat thickness, yield, and sort loss were included in order to adjust for quality differences.

A comparison of year-to-year hog production and price changes over the past three decades shows that prices have become more volatile (Tank 1999). In the 1970s and 1980s, a one percent change in production resulted in a price change of around one and a half or two percent. During the late 1990s, the price response has been at least twice that great. It is unclear how much of the increased volatility is due to the increased prevalence of marketing contracts, and how much is due to other factors.

In response to the concerns described above, the Secretary of Agriculture announced a new rule on November 28,2000 that requires large cattle, swine and lamb packers and importers to provide information about livestock marketing, including pricing, for public dissemination. The new reporting will provide information on 80-95 percent of all cattle, boxed beef, slaughter hog, sheep, lamb meat, and imported lamb meat transactions including purchases for future delivery, and packer-owned livestock, subject to certain confidentiality guidelines. The mandatory price reporting system was to go into effect on January 30, 2001, but has been delayed until April 2, 2001 to allow more time to test the electronic information collection system (USDA Agricultural Marketing Service, Mandatory Price Reporting 2001).

Ward and Stevens analyze structural change in the beef market by comparing price transmission patterns over time from live steer prices to boxed, wholesale, and retail prices. They measure pricing attributes such as the percentage of a price change at one stage that is transmitted to the next stage within a month or two. Looking at the period 1974-98, they find a decline in wholesale-to-retail price response, indicating that the relationship between retail chains and their purveyors has changed over that period. On the other hand, despite the consolidation that has occurred at the packer level, there has been little change in the price linkage between producers (slaughter steer prices) and the first handler (boxed beef prices) (Ward and Stevens 2000).

Retail pork prices did not decline very much in late 1998 and 1999 when farm-level hog prices plummeted, and the lack of response was widely criticized. "Price transmission asymmetry" is the term used to describe a situation where retail-price response to farm-price declines is less than response to increases. Azzam uses a theoretical model to demonstrate how such asymmetry can arise when spatially competitive retailers compete with each other over time, with the asymmetry depending on the shapes of their demand functions (Azzam 1999). He shows that vigorous competition among retailers may not necessarily result in the larger retail-price declines farmers expect during periods of declining farm prices. Repricing costs explain why retail prices tend to be rigid in the face of both upward and downward movements in the farm price.

A related analysis of broiler price asymmetry is (Bernard and Willet 1996). They found that concentration and power of integrators have allowed the wholesale price to become the center, causal price in the market. Asymmetric price transmissions are limited, however. Downward movements in the wholesale price are passed on more fully to growers than are price increases. On the consumer side, only consumers in the North Central region of the U.S. share a larger portion of wholesalers' price increases than price decreases.

Dairy Policy

Dairy policy in the United States includes both Federal and State programs. The two major federal dairy programs currently in place are the system of federal milk marketing orders and the milk price support program. A multi-State dairy policy organization, the Northeast Interstate Dairy Compact, operates under authority granted in the 1996 Farm Act. General government programs designed to assist international trade and provide domestic and international food aid also affect the dairy industry (USDA Economic Research Service Briefing Room: dairy: policy 2000).

Prior to 1981, the price of milk was supported at such levels to insure an adequate supply of milk, reflect changes in the cost of production, and assure a level of farm income to maintain productive capacity to meet future needs. Since October 1981 the support price has been established by Congress either at specific levels or by formula related to expected surplus levels rather than parity levels. To implement the price support program, the Commodity Credit Corporation offers to buy carlots of butter, cheese and nonfat dry milk at announced prices thus provides a floor for milk and dairy product prices.

(Commodity Fact Sheet, 1996-97 Dairy price Support Program 1997) The purchase program was to have ended on December 31, 1999 but was twice extended for one year (to the end of 2000 and then 2001) at $9.90 per hundredweight of milk containing 3.67 percent butterfat (USDA Economic Research Service Briefing Room: dairy: policy 2000).

The 33 previously existing milk marketing orders were consolidated into 11 as of January 1, 2000, and new methods were put into place for determining class prices at that time. These reforms help insure American dairy farmers receive a fair price and that consumers enjoy an abundant affordable supply of milk. The federal order price system set minimum prices for milk used for alternative purposes. The new rules change the determinants of the Basic Formula Price, adopt a classified pricing structure for four classes of milk, and make some changes in the classification structure. Changes were made in the Class I price differentials with lower differentials in Southwest, West, Northwest, North East, and Appalachian areas. Class I differentials would rise in the Upper Midwest and Florida. Bailey points out that a direct change in class prices may not represent a direct change in farm gate prices. The Class III price (cheese and other hard products) in this rule will be lower than the current BFP (Basic Formula Price), and in the Upper Midwest processing plants have regularly bid pay prices above the minimum government prices. Further amendments were implemented on January 1, 2001, but were then halted by an injunction on February 2, 2001 (Bailey 2001).

USDA began tracking the mail box price milk producers receive within Federal Milk Market Order areas. Mailbox prices account for all payment for milk, amount and quality premiums, performance bonuses, fat and or protein premiums, as well as deductions for promotion, hauling, capital retains, and coop dues. The average mailbox prices received by producers were significantly higher in these orders: Upper Midwest $1.72, Chicago Regional $1.53, Iowa $.99, Florida $.68, Nebraska-Western Iowa $.57, and Southwest Idaho-Eastern Oregon $.55. The higher price over minimum blend prices in these areas in 1998 were a result of competition for milk by cooperatives and other buyers.(Hoards Dairyman Staff 1999)

The 104th U.S. Congress in 1996 gave conditional consent to the Northeast Interstate Dairy Compact (Section 147 of the Agricultural Market Transition Act, title 1 of Public Law 104-127; 7 U.S.C. 7256). This act provided consent for the states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont to regulate milk prices for their farmers. Milk pricing is the only agricultural commodity for which congress has given consent to the use of interstate compacts. The compact works with the federal order pricing system as a basis for its pricing mechanism. The higher farm level prices are passed to the consumers in the price they pay for fluid milk. A Compact Commission fixes a price that exceeds the federal order price for fluid milk, compact over order premium. The estimated impacts for a state belonging to the compact are as follows: increased farm marketings in response to a higher price, reduced consumer purchase of fluid milk due to a higher price, and an increase in portion of milk used for class 3 which impacts the price of class 3 milk. The estimated impacts on a non-compact state are: reduced milk marketing due to a price decline, a reduction in the federal order blend price, small increase in fluid milk consumption with a small decline in price, and a total market reduction in the revenues paid to farmers and collected from retail sales (Bailey 2000). Dairy compacts and Federal Milk Market Order Reform are two current milk marketing issues under contentious regional debate. Upper Midwest representatives in Congress submitted H.R. 744 submitted a bill to rescind the Northeast Dairy Compact (Sensenbrenner et al. 1999).

d. access to markets, and

g. access to inputs, such as credit and genetics

Small, independent producers' access to markets for both farm products and inputs is a concern that is often expressed in the farm press and elsewhere. Market access is mentioned in some academic publications by way of justification for research on more specific issues such as what affects hog prices (Lawrence 1996) or simulating the welfare effects of vertical integration (Pritchett and Liu). A number of studies have been done on the impacts of international trade agreements on access to foreign markets for various industries. One such study dealing with agriculture is (The Future of the U.S. Dairy Industry: A Domestic and International Perspective 1997). None of these studies seem be very closely related to the issues being addressed in the GEIS, so the others will not be cited here. There appears to be little academic research specifically on market access as it relates to the livestock industry.

Exports have been a relatively minor market for U.S. dairy products. U.S. milk prices have historically been well above the World market price. thus the price of the major export products, butter and dried skim milk, have not been competitive. (Historical Perspective on World Dairy Prices 1979-1998, http://www.fas.usda.gov/dlp/circular/1998/98-12Dairy/prd&tr-html). Europe is the largest dairy exporter with 45- 50 percent of the markets. The strong European presence in dairy exports is more related to the government subsidization of dairy products in the World market rather than low cost of production. The U.S. has only 10 percent, New Zealand 22 percent and Australia 9 percent. Dobson states that the U.S., New Zealand and Australia will move to displace Europe in the world trade of dairy products in the next 10 years as European subsidies decline. The European Union agreed to reduce export subsidies for cheese, butter and nonfat milk in the Uruguay GATT agreements. They will reduce subsidized cheese exports by up to 25 percent by the year 2000. These changes are expected to bring export competition at more fair prices reflecting world supply and demand. Dobson points put that U.S has fewer constraints for expansion but will face substantial competition particularly in Asia. He points out that the New Zealand Dairy Board is a monopoly that provides product differentiation, vertical integration and early movement into new markets. (Dobson 1996)

An emerging concern is being raised relative to the privatization of information and the potential social, economic, and environmental impacts that may result. Various authors suggest this to be an important issue that deserves attention by analysts, advocates, policy makers, and those with a direct economic stake in agriculture. These concerns were the focus of a 1995 workshop, Privatization of Information and Technology Transfer in U.S. Agriculture. This workshop was organized to stimulate research and debate on the restructuring of agricultural information systems and the implications of the changes taking place. Three principal themes came from this workshop; 1) Institutional relations governing development, control and application of information in agriculture are changing at an accelerated pace, 2) Current and future processes through which knowledge is created and information applied in agricultural production systems will be developed through synthesis of political, economic, institutional, and technological considerations, and diminished public sector involvement and 3) Increased private sector responsibility for information development and dissemination in agriculture is significant. An excellent discussion of these issue can be found in the workshop proceedings (Wolf 1998).

e. terms of trade

The terms of trade between agriculture and the rest of the economy has been a long-standing issue, often referred to under the heading of "parity." The parity price formula was written into the Agricultural Adjustment Act of 1933 (Brandow 1977). Price parity ratios are calculated by the USDA National Agricultural Statistics Service and published in the monthly Agricultural Prices publication under the authority of the Agricultural Adjustment Act of 1938, as amended (Agricultural Prices various issues), page A-25. The overall parity ratio for U.S. farmers for January 1999 stood at 41 (1910-41 = 100). A parity ratio less than 100 means that the average per unit purchasing power of all farm products is less than half that during the 1910-41 period (page B-2). A major difficulty in interpreting the parity ratio is how to account for improvements in productivity. The annual average increase in productivity from 1948 to 1994 was 1.94. The January 1999 parity ratio, adjusted based on productivity trend for the prior 15 years, stands at 1041. This suggests that farm inputs are 25 times as productive as in 1910-14, indicating that the ratio of prices received to prices paid is around ten times as high now as in 1910-14 after considering the increase in productivity. The procedure used by USDA to measure agricultural productivity trends is explained in (Ahearn et al. 1998).

A description of the agricultural economics profession's response to the parity issue through 1971 is provided in (Brandow 1977). Full parity prices were foreseen in a 1947 report as leading to unmarketable surpluses that would in turn require production controls and subsidies, to which many economists were opposed. The controversy over free markets versus government programs spilled over into discussions of quantifying an equity norm for agriculture. During the 1950s and 1960s farm policy literature contained the idea that a suitable policy goal was rates of return on labor and investment on efficient farms that were equal to rates earned on comparable resources outside of agriculture.

Measurement of rates of returns on land and other investments and their use for policy purposes can cause circularity problems, however. In the 1980s, USDA was required to calculate costs-of-production indicators that the Secretary of Agriculture could use to set support prices for major crops. (Harrington 1983) explains the difficulties encountered with the procedures used at that time.

> "In general, the return to an input should equal the return it would earn in its next best use - its opportunity cost. However, what is the next best use of a specialized input, such as agricultural land? Economic theory also says that costs of specialized inputs cannot be determined independently of the demand for the product. The opportunity cost concept is difficult to apply to all specialized inputs, including those specialized to agriculture. ... If the difficulties inherent in the imputation lead to cost estimates that are too high or too low and if these estimates influence target prices, artificially induced price spirals may result." (p. 1)

Bearing in mind the circularity issue, a rough comparison of rates of return can be made by comparing the rates of return on equity (market value) experienced by farms in the Southwestern Minnesota Farm Business Management Association (SW FBMA) (Olson et al. 1999) and reports for earlier years, with the ratio of profits after income taxes (annual rate) to stockholders' equity experienced by all U.S. manufacturing corporations over the past ten years (Council of Economic Advisers 2000), (Table 18). The farms' rate of return on equity at market value was averaged five percentage points less than that of manufacturing firms for the six years for which comparable data was available. As another comparison, (Gallo 1998) provides after-tax profits as a percentage of stockholders' equity for food processors and retailers for the period 1986-96. Processors' returns ranged from 13.5% in 1993 to 20.9% in 1988, and were generally flat over the period. Retailers' returns generally rose over the period, ranging from 5.3% in 1989 to 18.5% in 1994. It should be noted that the farm rates of return are on an accrual-adjusted basis considering beginning and end-of-year market value balance sheet net worth changes, so to that extent include both operating income and unrealized capital gains on land and other assets. Part of the increase in the SW FBMA rate of return for 2000 was due to a change in the depreciation method used in the calculation from a tax-based method to a management-based method.

One caveat that applies to this comparison and later discussions is that the SW FBMA farms are not representative of all farms in their area, although their data is often used because it is the best data available. They tend to be larger, a higher proportion of their land is rented, and they tend to be more efficient than the population of all farms (Andersson and Olson 1996).

Table 20. Rates of Return on Equity on Southwestern Minnesota Farm Business Association Farms Compared to All Manufacturing Corporations, Food Processors, and Food Retailers, 1991-2000.

	SW FBMA	All Manufacturing Corporations	Food Processors	Food Retailers
1991	3%	6.2%	17.6%	14.5%
1992	6	2.1	15.7	9.0
1993	3.5	8.0	13.5	11.3
1994	4.4	15.8	17.7	18.5
1995	9.1	16.0	18.5	17.2
1996	9.5	16.7	19.4	17.4
1991-1996 average	5.9	10.8	17.1	14.6
1997	9.7	16.7	a	a
1998	1.6	15.8	a	a
1999	6.3	17.1[b]	a	a
2000	11.3[c]	a	a	a

[a]Food processor and retailer data was not available for 1997 through 1999. Manufacturing corporation data was not available for 2000.

[b]Average for first three quarters of 1999.

[c]Part of the increase in the SW FBMA rate of return for 2000 was due to a change in the depreciation method used in the calculation from a tax-based method to a management-based method.

Table 19 shows rates of return on equity experienced by the association farms broken out by farm type for the period 1991-2000. The farm type rates are only published for cost basis balance sheet data, rather than on a market value basis as in Table 17, so the numbers are not directly comparable between the two tables. The 1996-2000 average rate of return across all farms is seven percent when calculated on a cost basis compared to eight percent when calculated on a market value basis, which would indicate that about one percentage point of the Table 17 rates is due to capital gains from asset appreciation. Also, cost-basis asset values on the balance sheets are likely to be less than market values when some degree of inflation is present, which would tend to make the cost-basis rates of return higher than market-based rates for the same income levels. Part of the increase in the rates of return for 2000 was due to a change in the depreciation method used in the calculation from a tax-based method to a management-based method.

The "All SW FMBA Farms," "Hog", "Crop," "Crop-Hog," and "Crop-Beef" columns are for the southwestern association. The "SE FBMA Dairy" column is from the southeastern association, which has more dairy farm members than does the southwestern association.

The farm types are based on having 70 percent or more of gross sales from that category. The number of farms included varies from year to year. In 1999, there were 216 total farms in the All "SW FBMA Farms" average, including 12 hog farms, 62 crop farms, 34 crop-hog farms, 18 crop-beef farms, and 75 other farms. There were 16 dairy farms in the SE FBMA average. It is apparent that the hog, crop and beef farms experienced relatively good years in 1995 and 1996, while 1997 through 1999 have been much less profitable. The financial performance of the dairy farms was more favorable in 1998 and 1999.

It is interesting to note that swine and dairy farms going out of business more rapidly than other farm types, while Table 18 shows that these two farm types earned higher rates of return on equity than did the other types. Consolidation is taking place in all farm types. Table 1 on page V-1-13 shows that the total number of farms in Minnesota declined from 86,000 in 1993 to 81,000 in 1999. Farms with milk cows and hogs are declining more rapidly than other types, however, despite the higher average returns. We don't know for sure why that is. Speculation is hazardous, but we can speculate about several reasons. The low returns that the hog farms experienced in 1998 were certainly one factor. We also know that many farm operators and household members hold off-farm jobs. The farms also serve as rural residences and provide value to the households that justify owning the farms even if rates of return are less than alternative investment opportunities would provide. The other farm types shown in Table 18 are beef and crop farms, which are more likely to be part-time operations because farm labor demands are less intense. Thus, operators of many of these crop and beef operations may put up with the lower returns because they have off-farm income and the farms have value as residences. Also, it was pointed out that the non-farm labor market has been tight in recent years. A farm operator considering whether or not to continue may tend to compare their returns not to other farm types but rather to what they can earn in an off-farm job. Perhaps dairy and hog farm operators have been more likely to obtain off-farm jobs because they are located closer to urban areas or because of skill differences. Finally, keep in mind that these rates of returns are from the farms that have remained in business. Rates of return of the farms that exited may have been lower than for the ones that have remained.

Table 21. Rates of Return on Equity (Cost Basis) on Southwestern and Southeastern Minnesota Farm Business Management Association Farms by Farm Type, 1989-99

	All SW FBMA Farms	Hog	Crop	Crop-Hog	Crop-Beef	SE FBMA Dairy
1991	3%	4%	2%	5%	4%	8%
1992	6	7	3	8	3	7
1993	2	11	1	1	-1	3
1994	3	-3	7	5	1	7
1995	13	22	14	18	8	5
1996	12	22	11	16	11	6
1997	5	11	3	3	8	3
1998	-6	-36	0	-17	-11	14
1999	7	2	1	4	8	12
2000[c]	19	45	15	20	15	16
1991-2000 average	6%	9%	6%	6%	5%	8%
1996-2000 average	7%	9%	6%	5%	6%	10%

Source: Annual reports of the Minnesota Farm Business Management Associations, such as (Olson et al. 1999).

[c]Part of the increase in the rates of return for 2000 was due to a change in the depreciation method used in the calculation from a tax-based method to a management-based method.

While the above comparison shows rates of return for Minnesota farms that appear low compared to U.S. manufacturing corporations and food processors and retailers, a recent USDA Economic Research Service study showed that median returns of farm businesses were comparable to non-farm businesses (Hopkins and Morehart 2000). This paper compares U.S. farm rates of return on assets against those of 245 households with non-farm businesses in 1997. The farm data is from USDA's Agricultural Resource Management Surveys. USDA has changed their analysis procedures in recent years so that they can do a better job of showing how diverse farms are and how much variability there is in costs and rates of returns from one farm to another. Median farm returns on assets were the same as for the non-farm businesses when capital gains on farmland were considered, and that large farms ($250,000 plus in sales) earned greater rates of return than for the non-farm businesses. They also found that the effect of direct government payments was slight. Volatility of returns was greater for non-farm businesses than for the farms.

h. lending practices

It is assumed that the main interest here is how lending practices might differ to different types and sizes of livestock operations, how any such differences might affect industry structure, whether any such differences are fair and economically justified, and how government policy might be changed to better address societal goals such as economic efficiency and equity.

Agricultural finance has been a major part of the discipline of agricultural economics since its inception, and there is a considerable body of agricultural literature. One source of refereed literature on agricultural finance is (Ladue), but other articles are found in the American Journal of Agricultural Economics and other journals. Various articles address different aspects of the lending decision such as the relative degree of risk involved in different types of farms, and ways of assessing risk such as credit scoring models (Novak and LaDue 1997).

One source of basic descriptive information is a recent report from the US Small Business Administration that rated the “small farm friendliness” of all commercial banks and bank holding companies. They defined small farm loans as loans under $250,000, and assigned a decile (10 percent) ranking based on 1) the ratio of small farm loans to total bank assets, 2) ratio of small farm loans to total farm loans, 3) total dollar amount of small farm lending, and 4) total number of small farm loans. The ranking was based on data from the banks’ June 1998 “call reports” to banking regulators. The study found that the smallest banks had the largest share of small farm loan dollars, and raised concerns that recent bank consolidations are reducing the number of small banks so that there are fewer small banks remaining to lend to small farms. They found that the stock of small farm loans had increased in the past year while the number of such loans declining, so that either the average loan size is increasing or many small loans have been repaid.

Passage of the Riegle-Neal Interstate Banking and Branching Act of 1994 and its implementation in 1997 is expected to increase the rate of bank mergers and acquisitions over the next few years (Ahrendsen et al. 1999). Ahrendsen et al. evaluate whether such mergers are likely to decrease agricultural lending, since larger banks tend to have lower agricultural loan-to-asset ratios than do smaller banks. They found mixed results for independent banks that acquired other banks between 1988 and 1997. The consolidated banks tended to adjust their agricultural loan-to-asset ratios to be like that of the acquiring bank. That is, if the acquiring bank's ratio was low, the consolidated bank tend to reduce its ratio as well to near the acquiring bank's ratio. If the acquiring bank had its assets concentrated in agriculture, on the other hand, the acquisition tended to have a positive impact on the agricultural lending of the acquired bank. Most acquiring banks had smaller agricultural loan ratios than the acquired ones, however, so the results suggest that the agricultural lending of commercial banks will decrease in most instances. The authors do not see this result as necessarily implying a gap in agricultural lending, however, because other lenders may step in and fill the gap.

One paper in 1993 indicates that the larger scale of the newer swine operations has attracted the interest of investors and lenders from around the world, such as Rabobank in Holland (Braaksma 1993).

A source of information on agricultural credit conditions and analysis of current economic issues is the set of Economic Review publications published by the regional Federal Reserve Banks, which is available in hard copy and on the Internet. The Kansas City bank in particular publishes a great deal of information on agricultural issues (Federal Reserve Bank of Kansas City.).

USDA has a series of short, non-technical reports on their web site which discuss federal government involvement in farm lending and ways in which federal action could improve efficiency (Maxwell 1998). They quote Department of Justice findings that 93 percent of rural banking markets are considered non-competitive in that banking business is concentrated among few banks. Suggested federal actions include:

- harmonizing charters and regulations for government-sponsored enterprises such as the Farm Credit System and the Federal Agricultural Mortgage Corporation to reduce market segmentation,
- regulatory reform for all lenders,
- encouraging entry into concentrated markets through nontraditional mechanisms including electronic funds transfers and telecommunications, and
- continued antitrust vigilance.

Federal estate tax changes are suggested to make it easier to transfer family farm businesses across generations, although they find that only about one-third of heirs in each generation choose to operate inherited family farms.

Another report in the USDA series addresses beginning farmers' credit needs. They suggest that traditional credit programs have limited potential to assist young low-equity farmers, because they are ill-equipped to deal with the increased risk that accompanies high leverage. They suggest tax initiatives such as lowering capital gains taxes on land sold to beginning farmers, tax-exempt or tax-deferred "aggie" savings accounts. They suggest that state statutes be changed to facilitate beginning farmers' access to equity capital as a substitute for debt. Limited partnerships, subchapter S corporations, and limited liability corporations are suggested as ownership forms that would make it easier for investors to purchase an ownership interest in the farm and limit their liability to the amount of the investment. This is the flip side of the often-heard argument that the non-farm investors would unfairly compete with family farmers.

A more in-depth discussion of structural change in agriculture, how it is affecting lenders, and policy implications is presented in (Duncan and Stam 1998). They trace some of the history of the traditional farm lending industry, past policy responses. They expect that the emergence of non-traditional credit sources and foreign lenders will compete with traditional ones. One area of concern is the possible impact that failure of large-scale integrated agricultural firms would have on the rest of the nation's food and fiber sector. There is currently no consensus on what if anything should be done to protect against such an eventuality.

The Minnesota and federal governments have instituted a number of programs that provide financing and technical and business planning assistance to Minnesota livestock producers beyond what is available from commercial lenders. Possible sources for new farm product processing and marketing ventures include (Sparby March 9, 2001):

- Minnesota Department of Agriculture's Rural Finance Authority and Cooperative Grant Program
- Agricultural Utilization Research Institute
- Minnesota Technology Institute
- Economic Development Centers
- Midwest Community Development Corporation
- Minnesota Business Finance Corporation
- Small Business Development Centers
- USDA Rural Business-Cooperative Service
- U.S. Small Business Administration

Both Friedman and the Purdue report discussed above emphasize that business managers must be able to adjust rapidly to marketplace changes. Access to credit and technical and business planning assistance facilitate such adjustments, so we second a recommendation made by Hayes, et al. for further research on the adequacy of these programs (Hayes et al. 1999), p. C-71. Implications for alternative forms of livestock production are that increased state funding for such programs would likely lead to more product differentiation and direct marketing; more jointly-owned value-added processing ventures; more rapid adoption of new production technologies; higher returns to labor and management; and substitution of capital for labor resulting in fewer total jobs in production agriculture which might be offset by additional jobs in processing and distribution.

Financial risk is said to lead to pressure on producers from commercial lenders to reduce operating risk by means such as production and marketing contracts. Thus, it seems possible (but unlikely) that increased credit availability would slow the trend toward increased vertical coordination and consolidation. A different perspective is that at least in the case of a typical hog finishing contract, contract production can provide producers with a higher rate of return on equity and less risk then independent production if the contract makes additional financing available (Boehlje and Ray 1999). If so, then economic opportunity may be driving the increased use of contracts rather than lack of financing alternatives. Another conclusion of this study, however, is that lenders may be under-estimating the financial risk of some contracts. (See tables 25 - 29 below for recent financial performance of independent and contractee hog enterprises in Minnesota.)

QUESTION D5. WHAT IS THE CURRENT SITUATION AND WHAT ARE THE CHANGES TAKING PLACE IN THE OWNERSHIP AND CONTROL OF LIVESTOCK IN MINNESOTA:

D5a. who owns the livestock and livestock facilities and what is the significance?,

D5b. what are the current trends in type of ownership by animal species, facility size and regional location?

also D3e. How are livestock businesses different from and similar to non-agricultural businesses with respect to the following factors, and what are the implications of these differences: patterns of ownership and control

It is not clear what classification of owners is of interest to these questions. A measure was debated and almost passed in the Minnesota House of Representatives this session to allow different feedlot regulations for farms where the owners resided, compared to farms where the owners did not reside (Journal of the Minnesota House of Representatives 99). That debate suggests that classifying owners by local community of residence might be of interest. On the other hand, the Minnesota Corporate Farming Law differentiates between Minnesota farmers and others, suggesting that a classification based on state of residence and principal occupation might be of interest. Unfortunately, our investigations to date have not turned up any publications that classify either livestock businesses or non-agricultural businesses according to local community or state of residence, or principal occupation of the owners, except for (Freese 1998) and (Freese 2000). That report, published annually, describes the 50 largest U.S. pork producers and lists the states in which they operate. According to their 2000 data, four of the 50 largest producers are headquartered in Minnesota: Cargill (6), Christensen Farms (8), Land O'Lakes (11), Pipestone System (15), New Fashion Pork (25), Wakefield Pork (26), Holden Farms (30), and Schwartz Farms (42). In addition, Bell Farms/Hormel Foods (17), Consolidated Nutrition (19), and Pork Technologies (32) operate partially in Minnesota. The report does not go into detail on the ownership and control of these operations. Pipestone is reportedly organized as a number of separate corporations whose management is coordinated by a veterinary clinic. Each corporation operates a sow unit jointly owned by producer-shareholders who receive early-weaned pigs and finish them in their individual operations. The other large operations in Minnesota are believed to be held under a variety of different ownership arrangements, but detailed information was not available on them.

Two classifications that are available are: 1) type of legal organization (proprietorships, partnerships, and corporations), and 2) ownership by foreign persons versus U.S. citizens. USDA monitors foreign ownership of agricultural land, but does not monitor ownership of livestock businesses as distinct from other farms. As of December 1995, foreign persons owned slightly more than one percent of all privately held agricultural land in the U.S. (Krupa 1996)

There are dramatic differences in types of legal organization used by farms versus non-farm businesses. In 1997 corporations made up 18.8 percent of all non-farm businesses but generated 90 percent of all non-farm business receipts (Statistical Abstract of the United States 1998). Corporations with more than ten shareholders made up only 0.3 percent of Minnesota farms in 1997, and accounted for 4.2 percent of the market value of products sold (U.S. Census of Agriculture 1998). (Allen and Lueck 1998) use a theoretical model based on a trade-off between moral hazard incentives and gains from specialization to explain why farming has generally not converted from small, family-based firms into large, factory-style corporate firms. They compare their model to empirical evidence that family-controlled farm production has narrowed to those stages that include the most biologically based aspects of farming. Changes in livestock technology, which largely eliminated nature, have allowed factory-corporate production to dominate in feedlot cattle, hogs, and poultry.

Another study that mentions farm ownership is (Wilson et al. 1993). They studied the risk perceptions and management responses of managers of large Arizona dairy farms. They found that firm size, ownership structure, and age were consistently important in determining the likelihood of selecting a wide range of important perceptions and management responses.

Broadening the Control Question

It might be useful to broaden the discussion of control from control of livestock in Minnesota to control of the food system generally. Boehlje and Schrader argue that a fundamental issue in any negotiation-based coordinated system is the point (or points) and source of power or control. Who dictates, or has the most control, over the performance of the system, of the sharing or risk and rewards? And what is the source of that power or control? They argue that there are two fundamental points of control and one fundamental source of power in a negotiation-based coordinated food production and distribution system. The first point of control is the end user or consumer and those firms that have intimate contact with the consumer. The second point of power is the raw material suppliers, especially suppliers of inputs with the fewest substitutes - the genetic material in plant and animal production, the seed and breeding stock. In both cases, the source of this power is knowledge. They also argue that the food system is at an early stage in the process of shifting to contract/ownership coordination, and there may be an opportunity for organizations such as very large producers or producers' cooperatives to assert control and offset the perceived advantage of firms at the consumer or raw material end points of the system.

D5c. what legal and business structures are used?

One of the concerns about livestock operations operated as corporations or other liability-limiting forms of business organization appears to be that the limitation on liability allows owners and managers to take more risks with environmental and other practices than they would take as sole proprietors. It is probably not practical to sort out the impact of this liability issue from the impact of firm size per se in an empirical study – at least it has not been done to date. Discussions of when and how the corporate form of business organization was first written into law, and the concerns that were expressed then about corporations abusing their economic power, can be found in chapter 4 of (Korten 1995) and on pages 25-26 of (Strasser 1989). This concern is not limited to agriculture and probably would have to be addressed at an economy-wide and national if not international level.

D5d. who makes the decisions over the practices of livestock operations of different kinds in Minnesota (owners vs. renters)?

We were not sure how to address the "owners vs. renters" dichotomy in this question. In the late 1970s, several studies addressed the question of whether rented cropland was being as well protected from soil erosion as owner-operated cropland was. A quick search did not turn up any publications on this question more recent than about 1985, so it appears that interest in this topic appears to have declined. None of the publications seemed to focus specifically on livestock operations, in any case, so we will not cite them here. The "renters" category seems less relevant to livestock issues than it does to crop issues. In livestock production, it would seem that a more relevant dichotomy might be something like:

- independent producers vs.
- producers with production contracts (own facilities but not the animals) and their contractors vs.
- owners of larger operations, managers, and their employees who do not have an investment in the operation.

The decisions of interest also seem unclear. In the 1970s studies, the focus seemed to be on decisions that affected soil erosion and conservation. Conservation issues might also be of interest for livestock operations, especially with regard to manure management practices. Other areas of interest might be animal welfare and food safety.

One publication that seems to relate most closely to this question is a report on management decisions made by U.S. farmers which was based on data from USDA's Farm Costs and Returns Survey(Perry and Johnson 1996). They include graphs showing the percentage of farms where the decisions were made by: 1) the operator, 2) the spouse, 3) both, and 4) someone else, with the decisions classified as:

- Buy/sell land,

- Buy/sell equipment,
- Scheduling,
- Marketing,
- Off-farm job, and
- Taking up a new practice or new crop/livestock.

That report also contains graphs showing the percentage of farms and of value of production with:

- partnerships or family corporations,
- share rent landlords,
- production contracts,
- both landlords and contracts, and
- non-family corporations and cooperatives.

They found that about 73% of farms and 26% of production was from single-family farms with none of these other arrangements, and that the prevalence of the other arrangements decreased in the order listed above. The report did not, however, provide results for livestock operations only, or discuss how differences in decision-making affected performance. Our search of the economics literature to date has not turned up any other publications very directly related to these issues.

QUESTION D6. WHAT MOTIVATES LIVESTOCK PRODUCERS AND PROCESSORS TO START, CONTINUE, EXPAND, AND QUIT BUSINESS? WHAT ARE THE CHARACTERISTICS OF THOSE STARTING, CONTINUING, EXPANDING, AND QUITTING?

D6a. What motivates livestock producers and processors to start, continue, expand, and quit business? and

D6b. What are the characteristics of those starting, continuing, expanding, and quitting?

Minnesota workers studied dairy herds that made significant increases in the total milk marketed from the farm in the period 1989 to 1993. (Stahl et al. 1999) About 80% of the increase was achieved from increasing cow numbers and the remainder from improved productivity. The herds chosen for this study were from the top 100 DHIA herds making the largest increase in milk sold. The fifty herds in the study had an average increase in milk marketed of 90% and increased herd size by 51 cows. Fifty percent of these farms were partnerships and the balance was single family farms. These farms made major changes such as animal housing, milking systems, feed storage, manure handling, hired labor, record keeping, feeding program, use of outside expertise, etc. The primary reasons these farms made these changes were: increase income, improvement in lifestyle, efficiency of operation, modernize facilities, and desire for a management challenge. Eighty four percent indicated they had met their goals. They reported the areas of greatest difficulty in this transition period were in rank order: uncertain economic times, limited access to capital, employees difficult to find, expert opinions differed, environmental regulation, and development of financial plans for financial institutions.

Fundamentally, the motivation of producers to raise livestock probably has not changed since colonial times – to add value or provide a market for their crops. (Lawrence 1997) describes characteristics and motivations of Iowa producers who quit pork production between 1992 and 1996. They averaged 48 years old, had average annual marketings of 745 head, and had relatively little money invested in facilities. Economic reasons (low returns or high cost) ranked above other reasons such as access to markets or pressure from neighbors as reasons for stopping production. Half of the producers indicated that they had experienced health problems while raising hogs.

There is a line of reasoning that the commodity programs of the past few decades, by stabilizing crop prices, may have reduced the risk associated with specialized crop and specialized livestock operations, compared to diversified crop-livestock operations. The stabilizing effects of the commodity programs were cited as forces driving the development of specialized broiler operations and beef feedlots in the 1960s and 1970s (Reimund et al. 1981). The rationale is explained in (Lazarus 1995):

> "The rationale is that the effective price that is being supported (what the crop producer gets) is the sum of the market price for the grain plus the deficiency payment. But the livestock producer only pays the market price. If the market price is less than it would be without the program, the crop producer is not hurt as long as the deficiency payment makes up the difference. The other main feature of the feed grain program - cropland setaside - restricts supply so that deficiency payments are minimized. Still, deficiency payments have been substantial in some years. A major input risk for livestock producers has been reduced to the extent that feed prices have stabilized. Without such stability, it might have been more difficult for large, specialized livestock operations to develop."

The 1996 farm bill converted the deficiency payment feature to a fixed transition payment no longer linked to current market prices, so that there is less of a stabilizing effect on crop producers' income. There is also less importance placed on commodity loans for keeping crops off the market and stabilizing prices, so livestock producers are facing more volatile feed prices than previously.

Our impression is that many of the new swine finishing enterprises that were set up in Minnesota in the 1990's were undertaken by formerly specialized grain producers in response to low grain prices. That was the case in one specific operation's situation, as discussed in (Watson 1993). At more of an aggregate level, there are the discussions of the motivations for the development of integrated food supply chains in Mike Boehlje's materials, the Heffernan paper, and elsewhere.

There is a considerable body of literature on motivation for the development of tighter vertical integration or contractual coordination linkages in the economy generally and in the livestock industry specifically. The question is unclear about the extent to which " ... start, continue, expand, and quit business ..." includes the issue of packers integrating into production, large producers building their own packing plants, etc. One publication which provides a brief review of the theory and empirical evidence from a survey of large hog producers and processors is (Lawrence et al. 1997).

QUESTION E1. WHAT ARE THE ECONOMIES OF SCALE (INCLUDING DISECONOMIES) RELATED TO LIVESTOCK RAISING, AND WHAT ARE THE IMPLICATIONS FOR SIZE AND TYPE OF PRODUCTION SYSTEM?

A clarification of terminology - Economies of size and scale are often used interchangeably, but they are somewhat different concepts. *Economies of size* relate to the reduction in average total cost associated with varying levels of output, where the proportional relationship between production resources is not held constant. In other words, as farms get bigger, the relative proportions of land, labor, and capital typically change. *Economies of scale* relate to proportionate increases in all production resources as output increases. For most farm situations, "economies of size" is a more commonly used concept, in that resource ratios typically change as farms become larger. (Harsh et al. 1981), page 57 and (Hallam 1991). We will assume that economies of size are what is of interest to the GEIS.

One point which needs to be kept prominent in the discussion is the fact that increasingly, livestock businesses operate with *multiple locations* under *one business entity* or firm which controls the multiple locations through direct ownership, contracts or other business arrangements. In a multi-location livestock operation, size can be calculated based on the number of livestock at the same location or the number controlled by the same firm. For some environmental issues such as volume of a potential manure spill, the location size seems most relevant. For other issues such as market power, the firm size is probably what matters.

The agricultural economics profession has focused a great deal of attention on the theoretical and empirical aspects of economies of size and scale for many years. Two collections of papers were published in 1984 (Center for Agricultural and Rural Development 1984), and 1993 (Hallam 1993). Empirical studies of economies of size in agriculture have generally found the cost curve to be "L"-shaped. Changes in the structure of agriculture over time are not necessarily consistent with this cost structure.

These differences can be reconciled by appeal to external, non-size factors, and to difficulties in correctly measuring size economies (Hallam 1991).

Hallam lists three reasons to be interested in economies of size:

1) International competitiveness and terms of trade – economies of size in one country may be exploited to maximize domestic welfare, while economies of size in another country may be stifled and an industry protected to attain other social goals.

2) The normative issue of the desirability of the family farm – if research shows that there are no economies of size for firms larger than the "typical" family farm, then policies that protect this entity are more palatable to those who argue for economic efficiency as a primary objective.

3) Understanding economies of size may help policy makers, firms and consumers to predict the changing structure of U.S. agriculture.

In summarizing studies relating to economies of size and scale in agriculture, Hallam draws two general conclusions: 1) there do not seem to be significant economies of size for mixed crop farms, the most common farm type; and 2) the cost curve does fall, but remains rather flat over acreage compatible with the "average" family farm. Cost curves for livestock producers fall more sharply and over a larger range of output levels. This evidence would imply that firm size should be fairly constant. This is not in accordance with the dramatic decrease in farm numbers and increase in farm size over the past forty years. The difference between changes in industry structure and those predicted by the "size economies" theory need to be reconciled.

There are many reasons for these differences:

- pecuniary economies (quantity premiums for selling in larger quantities, and quantity discounts in purchasing inputs,

- economies realized as the industry as a whole expands and specializes,

- technical change that continually moves the entire cost structure in favor of larger firms (the cost structure is "L"-shaped but moves lower and to the right each period due to technical change),

- improvement in managerial technique and information use such that relatively minor technical economies are parlayed into significant operational economies, and

- opportunity costs outside the agricultural sector – if wage levels outside of agriculture are on the rise, then farmers may tend to leave the sector until wages equalize. This can result in farm size increases, especially if equipment efficiency increases at the same time.

He points out that differences in farmers' values and goals may have a major impact on agricultural structure. If the cost curve is only mildly downward sloping, then producers who value the farming lifestyle will accept a slightly lower return to labor and management and thus make small firms with higher economic costs fully compatible with large firms that have lower costs. The inaccuracies in measuring size economies and the relative flatness of most measured curves do not allow the distinguishing of these possibilities.

A number of potential problems in measuring economies of size were also identified, which are categorized into those which relate to cross-sectional studies, those which relate to normative studies, and one which relates to any study where commodities or firms are aggregated:

- Cross-sectional studies (such as farm record summary data sorted by size, and USDA Farm Costs and Returns Surveys) may encounter problems due to lack of homogenous technologies across sizes, and firms may not be fully exploiting their technology at a given point in time. As firms learn, costs drop and the curve shifts. Also, all firms may be producing at the point of minimum average cost so that there are no observations in the upward sloping portion of the cost curve, masking any size economies of diseconomies that are present.

- Normative studies (economic-engineering, budget or mathematical programming models) can only represent technologies that are specified available by the researcher. There may be mis-specification of the technologies, if some are left out. If data from cross-sectional surveys are used to obtain technical coefficients and construct technologies, firms with the lowest cost of production may be considered outlyers and left out.

- Most empirical models involve aggregation over commodities or firms, often in ad hoc ways. The results may be biased if such aggregation masks economies of scope and jointness.

One additional concern which a reviewer pointed out is not very well articulated by Hallam - how the farm operator's labor and management is represented. It is often argued that an important motivation for farms getting bigger today is to generate greater income or net return to the operator's labor and management. For increased size to generate greater income implies that labor may have been under-utilized previously, and/or that labor efficiency is being improved through increased mechanization, automation, or more effective management. This phenomenon may or may not be captured in the study depending on how labor and management data is represented.

Economic efficiency, as measured by per unit cost of production, is one component of the income revenue generated by the farm business to support the family income and life quality goals. Conlin used the following equation to illustrate the principles:

Profit = (Price-Cost) * no of units marketed.

Decisions for managing improved profitability of the farm business consist of increasing price received, reducing cost of production , and or increasing units marketed. These components are interdependent in that cost may be reduced by increasing number of units produced, which leads to economies of size as described by the L-shaped curve discussed above. There also may be some improved market price advantage by marketing more units. Obviously, marketing more units where the cost per unit is more than the price received will result in larger revenue losses. Diseconomies of size would suggest the cost of production increases at certain size levels, or there are diminishing returns with increases in size. In spite of diminishing returns on a per unit of production, total profit will increase with more units marketed up to the point where the cost of the next unit is equal to the revenue generated by that unit. This is the concept of marginal returns. Maximum profitability of the business is where marginal returns equal marginal cost. Therefore the lowest cost of production is not necessarily the most profitable for the business.

Readers must also be cautioned that concept of an L-shaped curve relates to aggregated data from large numbers of farms or perceived representative farm situations, but that for any individual farm the points on the curve will vary as a result of many individual farm and human factors. Farm business managers continually apply new technology and make changes to improve their businesses and survive in a competitive environment. These changes impact the cost of production and potential economies of size and scale.

Empirical Studies Relevant to Minnesota

Aggregate Analysis

(Peterson 1997) analyzed economies and diseconomies of size at a very aggregate level across all farms in ten Corn Belt states, using data from the 1987 Census of Agriculture. He points out that scale economies must be a temporary, disequilibrium phenomenon since payments to factors will exceed output. Obviously, this situation cannot persist indefinitely. He performed a regression analysis with the dependent variable being out-of-pocket expenses per dollar of sales, using nine size classes from $2,500 sales and less, to $500,000 sales and over. He found that economies of size were evident in the data when using only farm sales as the output variable. When 1) an implicit rental value is placed on the farm dwelling and added to sales, 2) differences in corn yields across farm size classes were netted out, and 3) days of off-farm work were factored in, diseconomies of size became evident. The result is interesting, although we are not sure how useful the result is to livestock industry issues given that he aggregated all farm types together. We are also not sure how valid his assumption is that corn yield differences are due to differences in soil type rather than management. Also, while days of off-farm work helped explain differences in the expense ratio, he did not have data on off-farm earnings, which might have been a better indication of family well-being. This publication was cited in the January 1998 report from the USDA National Commission on Small Farms to justify their call for greater support for small farms.

Hog Farm Profitability

For the pork industry, possible sources of information on economies of size relevant to Minnesota include:

- farm business record summary programs,
- surveys by the USDA National Agricultural Statistics Service, and
- 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 relevant farm business record summary programs are the Southeastern and Southwestern Minnesota Farm Business Management Associations and the Minnesota State College University Farm Management Program, both of which are accessible through the new FINBIN software available through the University of Minnesota Center for Farm Financial Management's web site, http://www.cffm.umn.edu/.

None of the current published annual reports from any of these three record summaries include swine enterprise averages by size of operation, which would be needed to analyze economies of size. It would probably be possible to obtain averages by size from any or all of the three programs if a small amount of funding were provided to pay for the staff time to do the necessary computer runs. There is another problem, however. The most rapid growth in the swine 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. We assume that what the GEIS is most interested in is how profitability of these megas compares to the more traditional, small- to mid-sized, diversified, crop-hog operations. The problem is that the megas do not generally participate in university farm business summary programs and are not represented in the averages.

Another source of economies of size data is the Farm Costs and Returns Survey conducted by the USDA National Agricultural Statistics Service and the USDA Economic Research Service. The most recent report with a size analysis is (McBride 1995), based on the 1992 survey. The farrow-to-finish hog operations are analyzed in four size categories: fewer than 500 head sold or removed under contract, 500-999 head, 1,000-2,999 head, and 3,000 head or more. The largest size breakpoint thus represents only around 150 sows, so the data is not useful in comparing the megas with the traditional mid-sized operations.

The only source 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 useable 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 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. Readers are cautioned not to rely too heavily on this data, because as one reviewer points out, there are many factors that influence whether a producer "stays in."

"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 20). 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 22. 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 (Positioning Your Pork Operation for the 21st Century 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, or record summaries may be more reliable indicators of overall industry conditions when available.

Table 19 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 19 is not adequate to test such hypotheses.

Financial Performance and Structural Change in the Swine Industry, 1996-2000: Evidence from Minnesota Farm Business Management Records

An analysis of hog farms and swine enterprises in the Minnesota State College University System's Farm Business Management Program and the Southeastern and Southwestern Minnesota Farm Business Management Associations (MnSCU-FBMA) shows some dramatic structural changes in the industry and some clues about how financial performance and economies of size are driving those changes.

Pork producers must make a deliberate decision to participate in the MnSCU and FBMA programs. The database is used in this analysis thus is not a statistically reliable estimator of the total population of farms, but it is used because it includes detailed financial information not available elsewhere. The MnSCU-FBMA enterprises included farrow-to-finish, finishing feeder pigs, and wean-to-finish enterprises. Contractee enterprises were not included, but some of those marketings may be included by operators with the other enterprises who contracted out some of their finishing to others. The MnSCU-FBMA farrow-to-finish enterprises are summarized by number of litters rather than by marketings, so the size breakpoints are approximate. Multiplying litters by average head sold per litter gave breakpoints of less than 867, 867 to 4,403, and greater than 4,403 marked. Table 21 shows the 1999 market shares by size category compared to 1997 market shares for all U.S. operations from (Lawrence et al. undated). The MnSCU-FBMA operations are probably similar to the overall population of medium- to large-sized swine operations in Minnesota and the Midwest, but do not include any of the "mega" operations that produced 24 percent of the nation's hogs in 1997.

Table 23. Estimated Market Shares of MnSCU-FBMA Participants Compared to All U.S. Swine Operations, by Size Category.

Annual Marketings 1000 Head	MnSCU-FBMA Swine Enterprises, 1999[a]	All U.S. Swine Operations, 1997
<1	2%	5%
1-5	38%	32%
5-500	60%	39%
500+	0%	24%
Total	100%	100%

[a]Farrow-to-finish, independent finishing of feeder pigs, and wean-to-finish enterprises.

Table 22 shows whole-farm financial results for hog farms in the database over the period 1996-2000. "Hog farms" are defined as those farms with over 70 percent of their sales from hogs. Hog prices were disastrously low in 1998. Specialized hog farms suffered significant financial losses in 1998 after two good years in 1996 and 1997. The 2000 year was a profitable one, and reduced debt to the level present before the downturn. It is becoming more difficult to interpret quoted hog prices because of a shift to carcass-weight rather than live-weight pricing, quality differences, and marketing contract variations. The average of USDA weekly live weight prices for 47-49 percent lean hogs in 1998 was $31.93/hundredweight (Buhr 1999). The price received by the MnSCU farms was higher, averaging $38.45/hundredweight for the year. This is still about 20 percent lower than what would be considered normal levels, and dipping to under $10/hundredweight by year end. The low prices resulted in the farms averaging a net farm income of $-32,021 in 1998. Income and returns to equity returned to positive levels in 1999 and 2000. Net non-farm income also increased sharply in 1999 but fell back in 2000.

Table 24. MnSCU-FBMA Hog Farm Financial Performance, 1996-2000.

	1996	1997	1998	1999	2000	Average
Number of Swine Farms	135	142	95	94	105	114
Liquidity:						
Current Ratio (Ending)	2.17	1.85	1.19	1.49	1.90	1.72
Term Debt Coverage % (accrual)	267%	183%	24%	166%	256%	179%
Solvency:						
Farm Debt to Asset Ratio (ending, mkt)	48%	54%	65%	61%	54%	56%
Profitability:						
Return on Assets %	12.5%	9.3%	-2.7%	8.0%	15.30%	8.48%
Return on Equity %	18.9%	11.8%	-25.1%	8.9%	26.50%	8.20%
Operating Profit Margin %	23.5%	20.7%	-8.1%	19.5%	29.7%	17.06%
Net Farm Income	$75,301	$61,154	$-32,021	$55,273	$127,389	$57,419
Efficiency:						
Asset Turnover rate (cost)	53.3%	45.2%	32.8%	41.1%	51.5%	44.78%
Operating Expense Ratio	76.1%	78.6%	90.2%	79.5%	76.3%	80.14%
Depreciation Expense Ratio	5.2%	4.9%	8.2%	6.4%	4.3%	5.80%
Interest Expense Ratio	4.7%	5.1%	7.3%	6.4%	4.8%	5.66%
Net Farm Income Ratio	14.0%	11.4%	-5.8%	7.6%	14.6%	8.36%
Family Income:						
Total Non Farm Income	$12,819	$13,496	$15,615	$26,360	$17,073	$17,073

Just under five percent of the farms in the MnSCU-FBMA database were classified as hog farms in 1996. By 2000, hog farms had declined to 4.1 percent of the group. This is a greater decline than that reported by the Minnesota Agricultural Statistics Service for all farms having one or more hogs on hand during the year (Minnesota Agricultural Statistics 2000). By their definition, the number of hog farms declined by 20 percent, from 9,500 in 1996 to 7,500 in 1999. Part of the reason for the greater decline in numbers based on income is that average hog prices dropped from $55.44 per hundredweight in 1996 to $44.19 in 2000. This price decline may have reduced hog income enough to shift some farms out of the "hog farm" category even though they were still producing the same number of animals as before.

Is a swine enterprise still a suitable one for inclusion in a diversified farm business, or does modern swine production technology require a greater degree of specialization than in the past? One way to address this question is to look at how much of total hog sales reported by the MnSCU-FBMA farms is from these specialized hog farms, and how much came from farms with less than that degree of specialization. Table 23 shows that the percentage of all hog sales coming from specialized hog farms increased in 2000 after relative stability over the earlier years.

The MnSCU-FBMA data reflects the shift away from farrow-to-finish enterprises toward more specialized systems of production in recent years. Two-thirds of the hog income came from farrow-to-finish enterprises in 1996. That category has fallen to 39 percent as of 2000. These enterprise categories are chosen based on management and accounting needs rather than physical location of the animals, so the hogs in the farrow-to-finish enterprises may not all have been farrowed and finished at the same location although that was the traditional system and most probably still are raised that way. Some, however, may be moved for finishing and some may be finished under contract by other operators who are included in the "contractee" category.

The enterprises classified as "finish feeder pigs" in the MnSCU-FBMA database are referred to in this text as "independent finishing of feeder pigs" to distinguish them from the "contractee" enterprises, which are believed to be mainly finishing but could include some other types such as nurseries. In a contractee finishing enterprise, the producer whose information is included in the database normally provides the facility and labor but does not own the animals or provide the feed. A contractee producer thus is protected from price risk in the hog and feed markets, but is vulnerable to the relationship risk that the contractor may default, not renew the production contract, or reduce payment rates. While the independent feeder pig finishers own the animals, it is likely that many of them now purchase pigs under long-term contracts rather than buying lots individually from sources such as sale barns.

A wean-to-finish enterprise begins with a newly weaned pig rather than an older pig coming out of a nursery, and incorporates the nursery phase of production as well as the finishing phase. The enterprises classified as wean-to-finish in the database have their accounting records for the nursery and finisher combined. This accounting classification is not to be confused with the swine industry's use of the term "wean-to-finish" to refer to buildings where the pigs are placed at weaning and remain through finishing. The wean-to-finish enterprises may involve separate nurseries and finishing buildings, or may use wean-to-finish buildings. Wean-to-finish enterprises are likely to be purchasing early-weaned pigs which are expected to have fewer health problems than those moved after the nursery phase or weaned later, because the early-weaned pigs still have antibodies to certain diseases. To manage the younger pigs, the wean-to-finish producer needs more skill than the feeder pig finisher typically needs.

Wean-to-finish enterprises have emerged as a significant category, with sales going from under three percent of total hog sales to 16 percent in four years. A number of farrow-to-weaning sow units have gone into production in Minnesota and elsewhere in recent years. Sales of weaned pigs from these enterprises have been increasing and were up to 2.2 percent of all hog sales in 2000.

Table 25. Hog Farms as a Percentage of All MnSCU-FBMA Farms, 1996-2000.

	1996	1997	1998	1999	2000
		(number)			
Total farms	2,730	2,703	2,577	2,721	2,582
Hog farms[a]	135	142	95	94	105
Hog farms as a percentage of all farms	4.9%	5.3%	3.7%	3.5%	4.1%
		(millions)			
Hog sales on all farms	$116	$122	$100	$103	$120
Hog sales on hog farms	$58	$65	$47	$56	$74
Hog farm share of all hog sales	50%	53%	47%	54%	62%
Enterprise share of gross hog income:					
Farrow-to-finish	65.1%	48.8%	43.5%	40.0%	38.4%
Feeder pig production	2.2%	3.0%	4.8%	3.4%	1.4%
Finish feeder pigs	27.1%	30.7%	33.9%	36.5%	25.6%
Contractee[b]	0.6%	1.2%	1.9%	1.2%	1.1%
Farrow-to-weaning	0.9%	1.7%	1.4%	2.5%	2.2%
Weaning-to-feeder	1.1%	0.2%	3.0%	0.2%	0.1%
Wean-to-finish	2.6%	13.8%	11.2%	16.0%	30.8%
Contractor	0.3%	0.6%	0.5%	0.1%	0.3%
Hogs, total	100.0%	100.0%	100.0%	100.0%	100.0%

[a]"Hog farms" are defined as farms with 70 percent or more of their gross sales from hogs.
[b]The contractee share appears relatively insignificant in this comparison of gross income, but represents only the contract payments, which are normally only small in relation to the other enterprises' gross income because contractee does not incur costs for the pigs, feed and other inputs which are supplied by the contractor. See the average numbers of hogs sold per year in the next table for a comparison of the relative physical sizes of the enterprises.

The rest of this discussion will focus on four of the above hog enterprise types that produce mainly market animals for slaughter: farrow-to-finish, finish feeder pigs, contractee, and wean-to-finish. Trends in the number of swine enterprises of these types along with their relative sizes are shown in 23. This data is taken from the livestock enterprise section of the database rather than the whole farm section which was the source for Tables 21 and 22. Feeder pig production, weaning to feeder, and contractor enterprises are fewer in number and so were omitted. The number of farrow-to-finish enterprises has dropped by more than half in five years, while the number of independent feeder pig finishing enterprises is down by 25 percent. Increases occurred in the number of wean-to-finish and contractee enterprises, but from a much smaller 1996 base. The total number of hog enterprises is down by 25 percent since 1996. Average size has been increasing for all of the enterprise types, however, so that the total number of hogs sold or transferred from these farms is up 42 percent, to almost 1.2 million per year. The bottom panel of Table 24 shows the fairly striking result is that only a quarter of the animals are now finished in the same farrow-to-finish operations where they were farrowed, while 75 percent are brought in from somewhere else.

The MnSCU-FBMA farms sold or transferred ten percent of all hogs marketed in Minnesota in 1999, as reported by the Minnesota Agricultural Statistics Service (Table 25). Total marketings in the state rose by 30 percent between 1996 and 1999, a lesser increase than for the MnSCU-FBMA farms.

Table 26. Types of Swine Enterprises Present on MnSCU-FBMA Farms, 1996-99.

	1996	1997	1998	1999	2000
	Number of enterprises				
Farrow-to-finish	249	205	148	112	75
Finish feeder pigs	212	190	170	158	114
Wean-to-finish	17	28	31	37	41
Contractee	38	41	49	67	62
Total hog enterprises	516	464	398	374	292
	Number sold or transferred/year/farm				
Farrow-finish	1,635	1,734	2,000	2,647	3,543
Finish feeder pigs	1,336	1,527	2,001	2,408	2,490
Wean-to-finish	1,879	3,573	3,335	3,747	5,469
Contractee	2,152	3,206	4,195	4,386	5,352
	Total number sold/transferred, all farms				
Farrow-finish	407,028	355,481	296,038	296,458	265,698
Finish feeder pigs	283,232	290,130	340,170	380,464	283,860
Wean-to-finish	31,943	100,044	103,385	138,639	224,229
Contractee	81,776	131,446	205,555	293,862	331,824
Total hog enterprises	803,979	877,101	945,148	1,109,423	1,105,611
	Share of total animals sold or transferred				
Farrow-to-finish	51%	41%	31%	27%	24%
Finish feeder pigs	35%	33%	36%	34%	26%
Wean-to-finish	4%	11%	11%	12%	20%
Contractee	10%	15%	22%	26%	30%
Total hog enterprises	100%	100%	100%	100%	100%

Table 27. Minnesota Pig Crop, Inshipments, and Marketings, 1995-99.

	Annual Pig Crop	Inshipments	Marketings
	(thousands)		
1995	8,632	770	8,895
1996	8,138	1,130	8,966
1997	8,873	1,470	9,041
1998	9,612	2,010	11,150
1999	9,289	2,650	11,653

Source: (Minnesota Agricultural Statistics 2000), page 76.

A comparison of the costs and returns across the size categories for the four major swine enterprises gives an indication of the presence of economies of size in pork production. The FINBIN software allows tabulations by size of enterprise, but comparisons across the different swine enterprises is complicated by differences in the size measures. The economies of size comparisons were done by averaging across the five years of available data in order to minimize the effects of year-to-year random variation and cycle effects, especially with regard to the unusual economic situation in late 1998 and early 1999. FINBIN allows users to generate a size comparison across multiple years by simply averaging across all farm records in each size group regardless of which years a particular farm participated. Such an approach can bias the results, however, if different sized farms are over- or under-represented in different years of better or worse profitability. To avoid such potential bias, summaries were generated for each year. A simple average of the individual year costs and returns per unit was then calculated. The approach used implicitly assumes that the farms in each size category in each year fairly represents all farms of that size, ignoring the differences in numbers of farms across groups.

The FINBIN swine and other livestock enterprise data probably does not include much if any value for the manure. The issue of valuing manure has not been discussed to any great extent among the instructors and fieldmen, so there is no effort at present to encourage producers to value their manure. There is a place to enter "other income" in the computer program, and it is possible that some producers may enter manure values, but the averages for other income in 2000 ranged from one cent per hundredweight for farrow-to-finish to 19 cents per hundredweight for feeder pig finishing. Nineteen cents represents 0.6 percent of the total $32.40 gross return for that enterprise. If manure is currently under-valued (which we do not know for sure) and its true value were entered, it is unclear how the change would affect the conclusions made in this paper about risk-return tradeoffs and economies of size. A detailed study would be required to arrive at per-unit manure prices based on crop needs or sale possibilities. If an attempt were made to more accurately account for manure value, care would also be needed to accurately account for related manure handling costs.

Table 26 shows key summary numbers for the farrow-to-finish enterprises, which are grouped by litters farrowed per year. The litter breakpoints are multiplied by average number marketed per litter in each size group in order to convert the breakpoints to marketings per year. Average price received for raised hogs" is shown, but the net return numbers are based instead on the "gross return" numbers which also consider inventory changes, purchases and sales of breeding stock, and transfers. The largest-sized operations (over 1,000 litters) had slightly higher total per-unit expenses, so their net returns were less than for the two smaller-sized groups. Hired labor, custom hiring, interest, and lease expenses are all somewhat higher for the large size group. One explanation for the apparent diseconomy at the largest size may be herd health problems, and in particular the pseudorabies outbreak in southern Minnesota in 1998-99. In the last two years, the largest size group had a higher average for pigs born per litter but fewer sold per litter than did the next largest size. Aside from the pseudorabies outbreak, it is not known how many of the largest farrow-to-finish operations might have expanded recently and might be suffering from the stress of managing a larger facility. Expanding a farrow-to-finish enterprise is probably more difficult than expanding a finishing-only site because of the greater complexity of the operation.

Note that as discussed above, a limitation of the FINBIN data is that even the largest operations are quite small in relation to the largest swine operations in the U.S. For example, the "over 1,000 litters" group of farrow-to-finish enterprises shown in Table 25 averaged 12,285 head sold in 2000, while Table 23 shows that 24 percent of U.S. marketings in 1997 were from operations selling over 500,000 head. Smithfield Foods alone managed 695,000 sows in 2000, which translates into around 1.4 million litters farrowed or 14 million head marketed! (Freese 2000).

Tables 25 through 28 show several calculations related to labor efficiency, the operator's labor and management opportunity cost that operators specify that their time would be worth in other activities, and what their labor and management time is actually earning in the swine enterprises. The "net return" line is the difference between the gross returns and total listed expenses. "Total listed expenses" include the expense items charged directly to the swine enterprise in the farm's accounting records plus allocated shares of overhead expenses. Allocated overhead expenses include machinery and building depreciation, interest on term debt, and a number of other items. It is notable that there is no attempt to allocate the farm business' equity capital among enterprises.

"Estimated labor hours" are shown next in tables 25 through 28. These labor estimates are generally regarded as not being very precise because producers do not usually keep records on how much time is spent on different enterprises. The labor estimates are nevertheless used in the tables because their use make it possible to standardize the returns numbers to an hourly basis that the general public can relate to non-farm employment. "Labor & mgmt charge" is the share of the operator's labor and management opportunity cost that is allocated to the enterprise. That number is added to the hired labor expense to arrive at a total labor and management charge. The total labor and management charge is then divided by labor hours to arrive at an hourly "hired and operator labor & mgmt charge per hour" which represents the hourly rates that the operators felt their time was worth plus what they paid to hired labor. If the enterprise earned more than this amount, then the "est. return over labor & mgmt charge" line is positive. A negative indicates that the enterprise was not able to return what the operator's time was worth.

The next-to-bottom line adds the hired labor expense and operator labor and management charge back in to arrive at a net return without considering any labor cost. The bottom line then divides that net return by estimated labor hours to arrive at what the enterprise earned per hour of labor.

To illustrate, the farrow-to-finish enterprise shows a positive net return at all sizes except for the 1-100 litter size. The hired and operator labor and management charge varied from $9.72 per hour for that size, up to $13.49 per hour at the 501-1,000 litter size. Net returns earned per hour varied from $-3.36 to $14.96 per hour.

The independent feeder pig finishing, wean-to-finish, and contractee enterprises all display increased per-unit net returns as size increases. If $10 per hour is arbitrarily chosen as a minimum required hourly return, required enterprise size would be 1,000 animals marketed per year for independent feeder pig finishing, 2,500 animals for wean-to-finish, or 2,500 pig spaces for a contractee enterprise, which would translate into around 7,000 head finished under contract per year. Hourly earnings were estimated considering both hired and unpaid labor, by adding hired labor expenses back into net return and then dividing by estimated labor hours per unit.

The number of farms included for each year is shown in each table by size category. For the farrow-to-finish enterprises, the number of farms increased at the largest (over 1,000 litters) size even though the hourly returns were also over $12 in the 201-500 litter group. There are several possible reasons why the hourly returns may be inflated as measures of labor earnings. First, as mentioned above, the format used for the enterprise analysis does not consider the equity capital invested in the enterprise because of the difficulty of allocating equity among enterprises. The opportunity cost of this equity is thus not included in total expenses. So, part of the hourly earnings represent a return to equity capital. If this equity portion could be estimated and subtracted from the hourly returns, the remaining return to labor and management might be reduced significantly. The number of finishers in the largest (over 5,000 marketed) size group declined from 20 to 12 in 2000. The number of farms in the comparable-sized wean-to-finish group increased, so some of the finishers may have remained in business but switched from finishing feeder pigs to finishing weaned pigs so they now appear under the wean-to-finish category.

Another factor explaining the drop in farm numbers might be that the depreciation numbers used in the analysis are based mainly on tax depreciation and may under-estimate the funds needed to replace or refurbish the facilities. If the numbers under-estimate true replacement-based economic depreciation, then the enterprises may be less profitable than they appear here. The facilities on the exiting farms may have reached the end of their useful lives, and projected profitability may not have justified replacing them.

Table 27 shows that independent feeder pig finishing can still be a lucrative enterprise given sufficient volume. The "over 5,000 marketed per year" group was twice as labor efficient at 0.11 hours per head as was the "2,501-5,000" size category, and as a result averaged $48 per hour over the five years. The number of farms in both of these size categories increased over the five years, while the numbers in the smaller size groups declined. Independent feeder pig finishing is a high risk enterprise, however. In 1996 the largest size group averaged a return of $99 per hour, but lost money at a rate of $32 per hour in 1998.

The wean-to-finish analysis in Table 28 covers only the four-year period 1997-2000 because the five enterprises in the database for 1996 were too few to do a size comparison. The number of farms has increased in the smallest and largest size categories for the wean-to-finish,and for the two largest sizes of contractee enterprises (Table 28).

Table 28. MnSCU-FBMA Farrow-to-Finish Enterprise Costs and Returns by Size, Average 1996-2000

		Litters Farrowed Per Year			
	All	1-100	101-200	201-500	Over 1000
		Estimated Market Animals Marketed Per Year			
	All	9 - 886	844 - 1,672	1,670 - 4,153	Over 7,611
Number of farms:					
1996	249	91	80	60	5
1997	205	77	53	55	5
1998	148	51	46	31	8
1999	112	31	36	28	10
2000	75	19	23	19	10
		(1996-2000 average)			
Average number of sows	152	38	86	163	756
Litters/sow	1.92	1.49	1.70	1.88	2.13
Number marketed/litter	7.98	8.48	8.12	8.18	7.64
Number marketed/year	2,331	485	1,186	2,501	12,285
		($ per hundredweight, 1996-2000 average)			
Average price for raised hogs	$ 45.53	$ 43.06	$ 44.24	$ 45.04	$ 46.86
Gross return	$ 43.24	$ 41.14	$ 42.29	$ 43.18	$ 44.25
Feed cost	$ 24.69	$ 27.05	$ 25.65	$ 24.54	$ 23.98
Hired labor	$ 2.15	$ 0.90	$ 0.88	$ 1.66	$ 3.05
Custom hire	$ 0.79	$ 0.30	$ 0.25	$ 0.50	$ 1.90
Depreciation	$ 2.23	$ 2.56	$ 2.05	$ 2.38	$ 2.00
Interest on debt	$ 1.99	$ 2.32	$ 1.89	$ 1.77	$ 2.24
Machinery & bldg leases	$ 1.81	$ 0.42	$ 0.40	$ 0.73	$ 3.96
Total expenses per cwt	$ 40.41	$ 41.84	$ 38.31	$ 38.29	$ 43.09
Net return	$ 2.83	$ (0.70)	$ 3.99	$ 4.90	$ 1.16
Estimated labor hours[a]	0.38	0.65	0.49	0.40	0.27
Labor & mgmt charge	$ 2.92	$ 5.67	$ 5.14	$ 3.50	$ 0.93
Total of hired labor expense and labor and management charge	$ 5.07	$ 6.58	$ 6.01	$ 5.16	$ 3.97
Hired and operator labor & mgmt charge per hour	$ 13.27	$ 10.06	$ 12.32	$ 12.78	$ 14.94
Est. return over labor & mgmt charge	$(0.09)	$ (6.37)	$(1.15)	$ 1.39	$ 0.24
Net return w/o labor[b]	$ 4.98	$ 0.20	$ 4.86	$ 6.56	$ 4.21
Net return/hour of labor	$ 13.04	$ (3.36)	$ 7.15	$ 16.23	$ 15.83

[a]Estimated labor hours included hired and unpaid labor.
[b]Net return w/o labor is calculated by adding the hired labor expense back into net return. Thus, the operator and other unpaid labor may have earned more or less than this hourly amount depending on how much of total labor hours were hired and at what wage.

Table 29. Independent Finishing Enterprise Costs and Returns by Size, Average 1996-2000

		Hogs Marketed Per Year					
		All	1-500	501-1000	1001-2500	2501-5000	Over 5000
Number of farms:							
	1996	208	75	49	57	19	8
	1997	187	51	42	57	29	8
	1998	167	37	36	54	29	11
	1999	147	26	20	49	32	20
	2000	114	17	23	35	27	12
				(1996-2000 average)			
Average number sold or transferred out		2,006	245	742	1,608	3,395	9,208
			($ per hundredweight, 1996-2000 average)				
Average price for raised hogs		$ 47.03	$ 44.91	$ 44.76	$ 46.40	$ 47.38	$ 47.79
Gross return (less pigs purchased or transferred in)		$ 33.17	$ 34.12	$ 32.26	$ 32.87	$ 33.07	$ 33.76
Feed cost		$ 21.07	$ 23.71	$ 22.97	$ 21.41	$ 21.29	$ 20.01
Hired labor		$ 0.65	$ 0.50	$ 0.52	$ 0.44	$ 0.63	$ 0.87
Depreciation		$ 1.46	$ 2.77	$ 1.22	$ 1.56	$ 1.76	$ 1.12
Interest on debt		$1.78	$2.16	$1.62	$1.73	$1.95	$1.54
Total expenses per cwt		$ 30.35	$ 36.44	$ 31.13	$ 30.22	$ 30.74	$ 29.45
Net return		$2.82	($2.32)	$1.13	$2.65	$2.33	$4.31
Estimated labor hours[a]		0.21	0.55	0.37	0.29	0.20	0.11
Labor & mgmt charge		$ 1.92	$ 4.76	$ 2.95	$ 2.80	$ 1.75	$ 0.96
Total of hired labor expense and labor and management charge		$ 2.56	$ 5.26	$ 3.47	$ 3.24	$ 2.38	$ 1.83
Hired and operator labor & mgmt charge per hour		$ 11.98	$ 9.60	$ 9.38	$ 11.24	$ 11.92	$ 16.93
Est. return over labor & mgmt charge		$0.90	($7.08)	($1.82)	($0.15)	$0.58	$3.36
Net return w/o labor[b]		$ 3.47	$ (2.02)	$ 0.46	$ 3.08	$ 2.96	$ 5.18
Net return/hour of labor		$ 16.20	$ (5.57)	$ 0.66	$ 10.71	$ 14.82	$ 48.00

[a,b]See footnotes on Table 25.

Table 30. Wean-to-Finish Enterprise Costs and Returns by Size, Average 1996-2000

	All	Hogs Marketed Per Year 1001-2500	2501-5000	Over 5000
Number of farms:				
1996	-	-	-	-
1997	28	5	11	6
1998	31	11	6	7
1999	37	13	9	8
2000	41	15	9	14
		(1996-2000 average)		
Average number sold or transferred out	4,172	1,690	3,129	10,870
		($ per hundredweight, 1996-2000 average)		
Average price for hogs	$ 43.84	$ 42.01	$ 44.53	$ 44.24
Gross return (less pigs purchased or transferred in)	$ 30.95	$ 29.84	$ 31.33	$ 31.25
Feed cost	$ 17.99	$ 20.29	$ 18.69	$ 17.19
Hired labor	$ 0.91	$ 0.27	$ 0.67	$ 1.11
Depreciation	$ 1.66	$ 1.22	$ 1.55	$ 1.81
Interest on debt	$ 1.83	$ 1.77	$ 1.72	$ 1.93
Total expenses per cwt	$ 28.61	$ 29.01	$ 28.25	$ 28.62
Net return	$ 1.87	$ 0.66	$ 2.46	$ 2.10
Estimated labor hours[a]	0.18	0.25	0.18	0.16
Labor & mgmt charge	$ 1.08	$ 1.91	$ 1.54	$ 0.65
Total of hired labor expense and labor and management charge	$ 1.98	$ 2.18	$ 2.21	$ 1.76
Hired and operator labor & mgmt charge per hour	$ 11.02	$ 8.73	$ 12.44	$ 10.84
Est. return over labor & mgmt charge	$ 1.01	$ (0.86)	$ 1.23	$ 1.59
Net return w/o labor[b]	$ 2.78	$ 0.94	$ 3.13	$ 3.22
Net return/hour of labor	$ 15.43	$ 3.74	$ 17.62	$ 19.80

[a,b]See footnotes on Table 25.

Table 31. Contractee Enterprise Costs and Returns by Size, Average 1996-2000

	All	Pig Spaces 1-1000	1001-2500	2501-5000
	Approximate Number of Hogs Marketed Per Year			
		3 - 2,680	2,813 - 7,025	6,653 - 13,300
Number of farms:				
1996	38	23	10	5
1997	41	15	16	10
1998	49	21	17	10
1999	67	24	23	17
2000	62	16	23	21
	($ per hundredweight, 1996-2000 average)			
Pigs/pig space	2.69	2.68	2.81	2.66
Average number sold or transferred out	4,463	1,454	4,320	8,997
Gross return (less pigs purchased or transferred in)	$ 34.77	$ 28.19	$ 36.42	$ 35.59
Hired labor	$ 0.95	$ 0.56	$ 0.73	$ 1.20
Depreciation	$ 11.24	$ 7.71	$ 13.91	$ 9.66
Interest on debt	$ 10.35	$ 6.46	$ 10.45	$ 11.44
Total expenses per cwt	$ 32.23	$ 25.38	$ 36.21	$ 31.00
Net return	$ 2.74	$ 3.36	$ 1.21	$ 4.45
Estimated labor hours[a]	0.50	0.85	0.52	0.37
Labor & mgmt charge	$ 5.47	$ 8.11	$ 6.16	$ 4.44
Total of hired labor expense and labor and management charge	$ 6.42	$ 8.67	$ 6.89	$ 5.64
Hired and operator labor & mgmt charge per hour	$ 12.89	$ 10.18	$ 13.25	$ 15.17
Est. return over labor & mgmt charge	$ (2.73)	$ (4.74)	$ (4.95)	$ 0.01
Net return w/o labor[b]	$ 3.69	$ 3.93	$ 1.94	$ 5.65
Net return/hour of labor	$ 7.41	$ 4.61	$ 3.73	$ 15.20

[a,b]See footnotes on Table 25.

The decline in farrow-to-finish and independent feeder pig finishing enterprises and the increasing numbers of wean-to-finish and contractee enterprises may be at least partially explained by their relative financial performance. Two measures of financial performance that are of great interest to most producers are 1) what net returns are expected to average over the long term, and 2) how vulnerable they are to downturns in hog prices and input costs throughout the inevitable production and price cycles. Table 29 shows that wean-to-finish enterprises have been riskier but more profitable than contractee enterprises were between 1996 and 2000, but both offered advantages over the more traditional farrow-to-finish and independent feeder pig finishing enterprises.

The two measures of vulnerability to downturns included in Table 29 are the standard deviation of the individual year numbers, and the coefficient of variation (standard deviation divided by the average). The number of pigs sold or transferred per year is shown first in the table, and used along with net returns/pig to calculate totals per enterprise and totals across all enterprises. Net returns/hour of labor may be a more useful measure of financial performance, however, because labor requirements differ. The wean-to-finish enterprises averaged earnings of over $20 per hour over the five years compared to under $15 for the farrow-to-finish and independent feeder pig finishing enterprises, with lower risk as measured by the standard deviation of annual returns. The contractee enterprises provided the lowest average hourly earnings, more than five dollars per hour less than for farrow-to-finish and independent feeder pig finishing, but did not experience the losses that the others suffered in 1998.

Aside from the lower variability of annual returns, other explanations that have been put forth for the increasing popularity of contractee enterprises are the minimal skill required to manage finishing animals compared to a breeding herd, management assistance provided by contractors, and ease of financing due to the reduced income variability.

It should be noted that the enterprise summaries do not impute a cost of equity capital, so the net returns should be interpreted as returns to equity and risk as well as to labor and management. On the returns side, the annual returns do not account for possible capital gains culminating in a positive salvage value of the facility after debt is repaid. It is also unclear to what extent the fertilizer value of manure is accounted for in the returns.

The second panel of Table 29 shows the estimated labor hours from the previous tables converted to a common basis, per pig sold or transferred out. Size increased and labor efficiency improved over the five years in all of the enterprises on average. The difference in labor efficiency among the enterprises is apparent. The labor requirement for the farrow-to-finish enterprises averaged just over an hour per pig, or more than twice as much as for finishing feeder pigs and for the wean-to-finish enterprises. This difference in labor is to be expected as the farrow-to-finish enterprises involve managing the sow herd, but the net returns have arguably not been adequate to compensate for the added labor. The added labor for wean-to-finish compared to finishing feeder pigs also makes sense in that wean-to-finish involves starting with younger animals. The contractee enterprises appear markedly more labor efficient than the other enterprises, with less than half as much labor per pig compared to independent finishing of feeder pigs, although the largest feeder pig finishers were about as efficient as the contractees (see Table 26, and convert the per hundredweight figures to a per pig basis).

Part of the reduction in contractee labor may be due to the fact that the contractors provide management functions such as marketing, acquisition of feed and other inputs, and general supervision. Five contractor enterprises in the MnSCU database averaged 0.06 hours per pig over the five years. Adding this contractor-provided labor to the 0.20 contractee-provided hours per pig totals 0.26 hours. This seems to indicate that the contractee-contractor system of swine production is around twice as labor efficient as with the other enterprise types.

The flip side of this labor efficiency improvement of course is that the employment potential of the swine industry is declining. The labor hours per pig were multiplied by the total pigs sold or transferred from the enterprises and divided by an assumed 2,500 hours per full-time-worker-equivalent factor to arrive at full-time-equivalent jobs (FTEs) that these enterprises employ. Employment has declined by 35 percent, from 295 FTEs in 1996 to 162 in 2000, despite the 38% increase in pigs sold. However, much of this labor has probably just been shifted to large sow units that are not included in the MnSCU database. When additional labor of 0.35 hours per pig of farrowing the pigs in wean-to-finish enterprises and 0.5 hours per pig of farrowing and nursery labor for the finish-feeder-pigs and contractee enterprises is added in, the employment decline is only 15 percent over the five years.

Despite the decline in the number of farrow-to-finish enterprises, on average over the five years they are provided about half of the total net returns generated by these swine enterprises, which averaged $5.3 million. It is notable that more hogs were transferred from the contractee enterprises has grown to the point where in 2000, more were transferred from that enterprise than were sold from any of the other enterprises. Despite the volume, the contractee enterprises contributed markedly less to the operations' net returns over the five years than did the other enterprises.

Two hypothetical scenarios are also shown at the bottom of Table 29. These show the net returns and employment that would have resulted over the five years if all of the production would have been in farrow-to-finish enterprises at the financial performance levels achieved by that enterprise type. The first scenario assume the same 38 percent increase in volume that actually occurred over the five years, but calculates total returns and employment using the farrow-finish values per pig. Total net returns in 2000 would have been 62 percent greater as they actually were, but the 1998 losses would also have been almost twice as great. The five-year average returns would have been a third greater than the actual amount. Employment of 367 jobs would have been 66 percent greater than the 222 jobs in the MnSCU enterprises themselves, but only 7 percent greater than the 344 jobs when farrowing labor for the purchased pigs is factored in. Employment would have still declined by 35 percent from 1996 to 200, however, because of improvements in the labor efficiency of the farrow-to-finish enterprises over the period.

The difference between the five-year average $5.3 million in actual returns and the hypothetical $7.0 million in returns under the hypothetical all-farrow-finish scenario merits further discussion. The feeder pig finishing, wean-to-finish and contractee enterprises do not include returns to the farrowing phase of hog production, and the contractee returns do not include returns received by the contractors involved. If the farrowing and contractor per-pig returns were added to those of the record farms, the totals would probably be about the same as the per-pig returns of the farrow-finish enterprises shown here6.

If the total per-pig returns are the same, then from a state perspective the $1.7 million difference probably reflects not a loss in revenue but rather a revenue shift - away from the record farms to the large, new farrowing units and contractors involved (who for the most part are not represented in the farm business summary database). Some of the farrowing units and contractor enterprises are owned by large individual Minnesota swine operations or groups of pork producers, so the shifted revenues stay in Minnesota agriculture.

Other farrowing units and contractors are located out-of-state, so that portion of the shift would represent a loss to the state. About a quarter of all hogs marketed in the state in 1999 were shipped in, based on reports from the state board of animal health and reported by the Minnesota Agricultural Statistics Service (see Table 24), but a breakdown is not readily available as to how many of the imports are market hogs ready for slaughter and how many are pigs destined for finishing on Minnesota farms. This is over three times the inshipments of five years earlier. Changes in Minnesota's breeding herd and market animals have tracked closely, however, which implies that these inshipments are probably must entering for slaughter. Labor problems in Canadian slaughter plants in 1998 and 1999 led to Canadian producers shipping hogs to Minnesota plants, which might account for some of the increase. Minnesota's situation is different from Iowa's, where the breeding herd has declined while market animals have increased.

The less attractive farrow-to-finish returns might have dampened the 1996-2000 expansion, however, so the 38 percent volume increase might not have happened if all production had remained farrow-to-finish. The second hypothetical all-farrow-finish scenario simulates returns and employment that might have occurred if volume had remained at 1996 levels. Net returns would still have averaged about 10 percent higher on average than they did, but employment would have averaged 8 percent less. Employment would have declined by 53 percent, from 417 jobs in 1996 to 196 in 2000.

This comparison illustrates the risks that independent finishers face in terms of market volatility, which in a production contract situation is usually experienced by the

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6 In fact, the dramatic shift toward wean-to-finish and contracting must be motivated by something. One motivating factor may be per-pig returns that are greater than for farrow-to-finish. Hourly returns may be greater at least, but on the other hand, if labor requirements per pig are less, higher hourly returns may be achieved without an increase in per-pig returns.

contractor rather than the contractee. It is fairly well documented that in most business enterprises, entrepreneurs demand higher expected returns as a tradeoff for accepting higher risks. Contractee hog producers generally provide a facility (a capital investment) and labor. They generally shift many management decisions to the contractor, along with much of the risk. It would be expected that contractees will earn lower returns per unit over time in return for avoiding these risks.

It is also fairly well documented that contractee producers do not avoid all risks. For example, Production contracts often include performance incentives or bonus plans that shift at least some production risks such as death losses or poor feed conversion to the contractee, and there is also what is sometimes referred to as "relationship risk" that the contractor will go bankrupt or otherwise default on their contractual obligations. One source on the risks and benefits of hog production contracting with additional details on typical contract provisions is (Dotson 1996).

Table 32. Relative Financial Performance Of The Major Types Of Swine Enterprises On MnSCU-FBMA Farms, 1996-2000.

	1996	1997	1998	1999	2000	*Average 1996-2000*	*Standard Deviation*	*Coefficient of Variation*
Number of enterprises								
Farrow-to-finish	249	205	148	112	75	***159***		
Finish feeder pigs	212	190	170	158	114	***169***		
Wean-to-finish	17	28	31	37	41	***32***		
Contractee	38	41	49	67	62	***62***		
Number sold or transferred/year/farm								
Farrow-finish	1,635	1,734	2,000	2,647	3,543	***2,312***		
Finish feeder pigs	1,336	1,527	2,001	2,408	2,490	***1,952***		
Wean-to-finish	1,879	3,573	3,335	3,747	5,469	***3,601***		
Contractee	2,152	3,206	4,195	4,386	5,352	***3,858***		
Net returns/pig								
Farrow-finish	$18.03	$11.17	($17.85)	$7.93	$16.86	***$7.23***	***14.61***	***2.02***
Finish feeder pigs	$17.66	$4.89	($12.12)	$5.47	$12.75	***$5.73***	***11.30***	***1.97***
Wean-to-finish	$17.79	$12.60	($6.37)	$2.80	$12.91	***$7.95***	***9.68***	***1.22***
Contractee	($0.06)	$1.79	$1.30	$0.40	$1.57	***$1.00***	***0.79***	***0.80***
Average net return/enterprise								
Farrow-finish	$29,469	$ 19,377	$(35,702)	$ 20,989	$59,729	***$8,534***	***34,513***	***4.04***
Finish feeder pigs	$23,594	$ 7,467	$(24,252)	$ 13,172	$31,748	***$4,995***	***21,487***	***4.30***
Wean to finish	$33,421	$ 45,023	$(21,249)	$ 10,508	$70,601	***$16,926***	***34,874***	***2.06***
Contractee	$(127)	$5,744	$5,454	$1,734	$8,378	***$3,201***	***3,399***	***1.06***
Estimated labor hours per pig sold or transferred out[b]								
Farrow-finish	1.30	1.14	1.08	0.79	0.61	***1.08***		
Finish feeder pigs	0.57	0.48	0.42	0.38	0.38	***0.46***		
Wean-to-finish	0.77	0.48	0.43	0.41	0.38	***0.52***		
Contractee	0.28	0.19	0.17	0.15	0.15	***0.20***		
Net returns/hour of labor								
Farrow-finish	$ 17.92	$ 14.34	$ (11.95)	$ 16.58	$30.00	***$13.38***	***15.4***	***1.15***
Finish feeder pigs	$ 33.46	$ 13.21	$ (25.93)	$ 16.61	$36.05	***$14.68***	***24.8***	***1.69***
Wean-to-finish	$ 24.97	$ 31.67	$ (8.72)	$ 12.71	$41.56	***$20.44***	***19.4***	***0.95***
Contractee	$ 1.54	$ 10.69	$ 10.15	$ 4.93	$12.39	***$7.94***	***4.5***	***0.57***

Table 29 (continued)

	1996	1997	1998	1999	2000	***Average 1996-2000***	
Total hogs sold or transferred from all enterprises							
Farrow-finish	407,028	355,481	296,038	296,458	265,698	***324,141***	
Finish feeder pigs	283,232	290,130	340,170	380,464	283,860	***315,571***	
Wean-to-finish	31,943	100,044	103,385	138,639	224,229	***119,648***	
Contractee	81,776	131,446	205,555	293,862	331,824	***208,893***	
Total hog enterprises	803,979	877,101	945,148	1,109,423	1,105,611	***968,253***	
Change 1996-2000					38%		
Total employment represented by all enterprises at 2,500 hours per full-time-equivalent job							
Farrow-finish	211	161	128	94	65	***132***	
Finish feeder pigs	65	56	57	58	43	***56***	
Wean to finish	10	19	18	23	34	***21***	
Contractee	9	10	13	12	19	***14***	
Total hog enterprises	295	246	216	191	162	***222***	
Employment change 1996-00					-45%		
Total w/farrowing labor[c]	372	345	340	346	317	***344***	
Employment change 1996-00					-15%		
Total net returns, all enterprises							
Farrow-finish	$7,337,831	$3,972,329	$(5,283,854)	$2,350,824	$4,479,693	***$2,571,365***	
Finish feeder pigs	5,001,877	1,418,736	(4,122,860)	2,081,138	3,619,215	***1,599,621***	
Wean-to-finish	568,160	1,260,636	(658,716)	388,784	2,894,636	***890,700***	
Contractee	(4,736)	231,130	256,603	111,133	519,432	***226,711***	
Total hog enterprises	$12,903,132	$6,882,831	$(9,808,827)	$4,931,879	$11,512,976	***$5,288,397***	
Two hypothetical scenarios							***Difference from Actual***
What net returns and employment in all hog enterprises would have been if all farrow-finish, at actual volumes by year:							
Total net returns	$14,493,987	$9,801,187	$(16,869,522)	$8,797,385	$18,640,714	***$6,972,750***	***32%***
Total employment, FTEs	417	398	409	351	269	***369***	***7%***
Employment change 1996-00					-35%		
What net returns and employment in all hog enterprises would have been if all farrow-finish, 1996 volume:							
Total net returns	$14,493,987	$8,984,093	$(14,349,864)	$6,375,309	$13,555,179	***$5,811,741***	***10%***
Total employment, FTEs	417	365	348	254	196	***316***	***-8%***
Employment change 1996-00					-53%		

[a]Caution should be exercised in interpreting the 1996 contractee data. Economic conditions in the swine industry generally were good that year. MnSCU farm management instructors have suggested that the negative average net returns might have come about because some of the contractee producers were just starting up and provided only partial year data. Normally, if such situations are identified, those farms are not included in the summary but in this case some might have been left in the database.

[b]Estimated labor hours included hired and unpaid labor.

[c]In analyzing the total employment represented by the various enterprises, it must be kept in mind that the labor to manage the sow unit and farrow the pigs is not included for the finish-feeder-pigs, wean-to-finish, and contractee enterprises. Pigs for these enterprises are increasingly being supplied by large units owned by groups of producers, feed companies, or similar entities that typically have their own accountants and do not participate in farm business summary programs. As an approximate measure of this additional labor, this line includes an additional 0.35 hours per pig of farrowing labor for the pigs in wean-to-finish enterprises and 0.5 hours per pig of farrowing and nursery labor for the finish- feeder-pigs and contractee enterprises, based on budgets for a typical 1,400-sow unit described in (Koehler et al. 1996) and on data from the small number of feeder pig production, farrow-to-wean, and wean-to-feeder enterprises in the MnSCU database.

It has been argued that per unit production costs should be dismissed as an indication of economies of size, and to focus instead on where investment is occurring:

> “Because cost studies are inconsistent, the current cost of production may not be the best indicator of the future structure of the pork industry. In the final analysis, investment in facilities may actually provide a better indication of how commodity-side production will occur in the future than either cross-sectional or budgeted cost estimates. The part of the industry investing most heavily in production assets is likely to have the largest share of future production. The vast majority of the new investment in production facilities over the past four years has been made by nonintegrated and partially integrated production contractors. The unwillingness or inability of the independent producer sector to reinvest in production assets will (over time) reduce their position in the industry. This may be more a reflection of the absence of technologies within the financial reach of individual producers than a lack of interest or competence in hog production. But the net result will be to steadily shift a larger and larger percentage of production away from the small- and medium-size independent producers to production contractors and larger independent producers.” (Boehlje and Schrader 1998)

The "survivor technique" is a statistical technique which is limited in its potential for detailed analysis, but is useful for providing an overview of broad trends. Originated in its modern form by (Stigler 1958), it has been applied to many manufacturing and food industries to some degree. It is based on the hypothesis that plant sizes which are efficient will survive and plant sizes that are inefficient will decline. The smallest group which shows an increase in its relative share is classes as the "minimum efficient size." A major problem is the fact that plants may survive for many reasons other than their internal efficiency (French 1977).

Table 30 shows the number of farms selling hogs and pigs by size groups as reported in the last five Censuses of Agriculture between 1978 and 1997. The number of farms in the less than 1,000 head category has been declining over the entire period. The 1,000-1,999 size class shows how the minimum economic size has increased in the 1990’s. The number of farms in this class increased until 1992, but has dropped since then. The 2,000-4,999 size class is still increasing in number of farms, but the bottom two lines of Table 32 show that they sold a smaller percentage of the hogs in 1997 than they did in 1992. The survivor technique would indicate that sales of at least 5,000 hogs and pigs per year are required today for economic viability. This is equivalent to around 250 sows at 20 pigs per sow per year. it should be noted that the Census of Agriculture defines farms on the basis of location rather than ownership. Pigs on "this place" that are being grown under production contracts are lumped together with pigs that are owned by the farm operator who controls or operates the place.

Table 30 is somewhat difficult to interpret because of the increasing segmentation in the swine industry. The swine industry was once made up mainly of operations that both farrowed and finished the hogs for slaughter. Today, the industry appears to be segmenting rapidly into operations that just farrow or just finish, and there are specialized nurseries and breeding stock multipliers which are all lumped together in Table 30.

Table 31 is a little easier to interpret because it shows just farms that farrowed sows. Here again, rapid change is evident. Only the last two censuses are shown. The size class farrowing 500-999 litters per year is equivalent to around 250-500 sows producing two litters per year. This class appears economically viable. The 200-499 litter class is increasing in percent of total farms, but decreasing in percent of total litters. The largest size class, 1,000 litters or around 500 sows, now produces half of the total number of litters.

Table 33. Numbers of Minnesota Farms Selling Hogs and Pigs by Size Groups, 1978-97

	Head Sold Per Year						
	Less than 1,000	1,000-1,999	2,000-4,999	5,000 or more	5,000-7,499	7,500 or more	Total farms
Number of farms by head sold per farm							
1978	25,150	840	236	26	na	na	26,253
1982	19,840	1,483	436	44	na	na	21,802
1987	14,387	1,599	566	100	na	na	16,652
1992	9,158	2,378	2,031	182	107	75	13,749
1997	3,243	1,566	2,391	517	193	324	7,717
Percent of total farms selling hogs and pigs							
1978	95.8	3.2	0.9	0.1	na	na	100.0
1982	91.0	6.8	2.0	0.2	na	na	100.0
1987	86.4	9.6	3.4	0.6	na	na	100.0
1992	66.6	17.3	14.8	1.3	0.8	0.5	100.0
1997	42.0	20.3	31.0	6.7	2.5	4.2	100.0
Number of head sold per farm (000)							
1992	3,146	2,378	2,031	1,586	634	952	9,141
1997	1,483	1,566	2,391	7,503	1,150	6,353	12,943
Percent of total hogs sold							
1992	34.4	26.0	22.2	17.4	6.9	10.4	100.0
1997	11.5	12.1	18.5	58.0	8.9	49.1	100.0

Source: Census of Agriculture

Table 34. Numbers of Minnesota Farms Farrowing Sows by Size Groups, 1978-97

	Litters Farrowed Per Yeear					
	Less than 100	100-199	200-499	500-999	1,000 or more	Total farms
	Number of farms by number of litters farrowed per year					
1992	6,656	1,623	900	161	59	9,399
1997	2,937	769	602	188	196	4,692
	Percent of total farms farrowing sows					
1992	70.8	17.3	9.6	1.7	0.6	100.0
1997	62.6	16.4	12.8	4.0	4.2	100.0
	Number of litters farrowed					
1992	217	217	253	108	98	893
1997	93	107	175	132	522	1,029
	Percent of total litters					
1992	24.3	24.3	28.3	12.1	11.0	100.0
1997	9.0	10.4	17.0	12.8	50.7	100.0

Source: Census of Agriculture

Aging Facilities

Many of the dairy facilities on Midwest farms are old. They are still functional and productive and have limited alternative uses so they remain in use, but they do not lend themselves to the use of some new technologies so that limits the level of efficiency that can be attained. Parlor milking and free stall barns and bunker silos are in the minority. Table 32 shows the average year of construction and most recent improvements made on Minnesota and Wisconsin dairy facilities (Conlin 1995a).

Diversification Versus Specialization

Diversification can be a risk-avoiding strategy. The idea is to spread the risk over several enterprises; low prices of one commodity will be offset by high prices in the other.

The typical Midwest diversified dairy farm produces feed for the dairy herd and relies on milk sales for 70 to 90 percent of its income. In reality, these farms are highly dependent on the price of milk. The diversified cropping enterprises only protect the farm from high feed prices. However, the cost of producing a bushel of corn, oats, wheat or barley is frequently more than the price for which it can be purchased. Production costs of feeds on dairy farms are often higher than on crop farms because of more limited scale efficiencies of the cropping enterprises.

Conlin discussed the diversification/specialization question in a proceeding paper based on a review of literature and farm financial records (Conlin 1995b). (See (Conlin 1998) for a list of additional references.) Most of Midwest dairy farms produce a major portion of the feed for the dairy herd and are diversified in their capital investment, labor activities and management expertise required. Investment capital is almost always a limited resource.

The cropping activities require substantial investments in land and field machinery. Some over-investment occurred in the name of tax management during periods of investment tax credits and favorable profitability. Generally, diversified farms that raise their feed for small herds in stanchion barn systems have higher investments and higher labor inputs per cow.

Leasing of equipment and/or cows are options for reducing investments on the dairy farm. Some farmers use custom hire for some or all cropping activity. In most cases, the cost of leasing cattle exceeds the cost of ownership. It may be advantageous when leased cows will add to the return over feed and other cash costs, particularly if land and labor resources won't otherwise be fully utilized, and especially when the barn won't otherwise be full.

Table 35. Construction date and date of last improvements in facilities on Midwest dairy farms

	Average year built		Average year remodeled	
	MN	WI	MN	WI
Housing	1963	1943	1976	1975
Milking	1964	1957	1978	1979
Feed storage	1969	1964	1978	1979
Feed handling	1973	1972	1980	1981
Waste disposal	1974	1974	1977	1981

North U.S. Dairy Survey, 1990.(Hammond 1989)

USDA researchers (El-Osta and Johnson 1996) compared differences in the traditional milk producing states (MN, MI, WI, NY, VT, PA, NY, VT) with non-traditional milk producing states (FL, CA, WA, TX, AZ). They found significant differences in the resource base, and the structure of profitability and management practices between the traditional (68 cows) and non-traditional (370 cows) dairies. The factor found contributing most to net farm income regardless of location was size of the operation, but size was irrelevant in explaining per unit returns from dairy. High productivity and low debt to asset were strongly related to profitability. The importance of management ability to the profitability of the farm business is also noted in a five-state survey of the northeastern and north central region of the U.S. and Canada which found that well-managed farms are able to compete in per-unit profitability with farms many times larger (Ford et al. 1996). This is consistent with overall conclusion by Hallam of an “L”-shaped cost curve which becomes flat at fairly low farm sizes, discussed under question E1.

El-Osta also found other factors contributing to higher levels of profitability in the traditional dairies were low investment costs in land and equipment, control of purchased feed cost, age of the operator, use of automatic takeoffs and artificial insemination, and level of adoption of capital- and management intensive technologies (record keeping combined with parlors). The authors point out that these dairies had a lower adoption rate (9%) of capital- management intensive technologies compared to non-traditional dairies.

Other factors in non-traditional dairies contributing to profitability included lower per cow expenditure for forage production, purchased feed, hired labor, and per cow investment. Per unit returns for dairies with advanced, more capital intensive parlors rather than traditional parlors were lower. The study show there are incentives for these dairies to continue expansion, such as production and marketing economies, management expertise, tax incentives, specialization, labor saving equipment, timeliness of getting things done, non-farm investment, and farm consolidation. (El-Osta and Johnson 1996)

Milk is a perishable product in a highly competitive national market and is highly sensitive to short range changes in the supply demand balance. The roller coaster ups and downs of milk prices have added a new dimension to management since the mid-1980's. This volatility has been very frustrating for many dairies while some have thrived on it. Federal government support price for milk is equivalent to $10.05 per cwt. in 1998, and scheduled to be lowered then discontinued on January 1, 2000. The support price is intended to serve as a price safety net. As the support price moved well below the average production cost, the market price has become highly volatile. This has led to some price stabilizing tools, futures and options markets, and milk processor contracts that set a price floor. Dairy lenders often encourage their use to stabilize income flows for meeting loan obligations.

Producers can control only 10 to 12% of the price they receive for their milk compared to their neighbors. Quality milk premiums can often make a dollar or more difference in the milk price. Milk is priced on a solids basis (protein, fat and other solids); therefore, high solids milk brings a better price per cwt. Producers need to balance quantity with percent milk component solids to maximize total returns. Some producers have found ways to negotiate additional premiums/benefits such as hauling charges, volume premiums, etc. (Conlin 1998)

A 1992 survey of dairy farms in the northern part of the US and Canada provided a comprehensive comparative analysis of financial performance (Ford et al. 1996). The study looked at the farm level performance of 2,200 dairy farms across four states, Michigan, New York, Pennsylvania, Wisconsin, and the providence of Ontario Canada. The data sets were pooled to provide a descriptive analysis of the financial characteristics of the dairy farm across the region. The results of this study are shown in Table 33, which summarizes financial performance of these farms by herd size. The average herd size was 84 cows and was summarized in six categories ranging from less those 30 cows to over 250 cows.

Table 36. Characteristics and Financial Performance of Pooled Data Set, All farms and by Herd Size, 1992

	Mean Values by Herd Size						
	All farms	10-39 cows	40-79 cows	80-119 cows	120-159 cows	160-249 cows	250 and over
SIZE OF BUSINESS							
Average number of cows	84	32	57	95	136	193	429
Milk sold, LB	1,502,715	519,390	969,236	1,702,880	2,535,201	3,558,784	8,274,866
Worker equivalent	2.49	1.49	1.89	2.72	3.70	4.79	9.67
Total tillable acres	263	129	190	303	434	565	972
RATES OF PRODUCTION							
Milk sold per cow, LB	17,348	15,999	17,058	17,999	18,582	18,450	19,191
Hay DM per acre, tons	2.84	2.32	2.76	3.05	3.19	3.26	3.46
Corn silage per acre, tons	15.74	14.25	15.82	16.23	15.80	15.64	16.97
LABOR EFFICIENCY							
Cows per worker	34	25	33	38	42	44	46
Milk sold per worker, LB	595,572	391,349	555,126	678,577	768,247	795,944	881,696
COST CONTROL							
Grain & conc. Purr. - % milk sales (%)	26	26	25	26	26	26	28
Feed & crop expense/cwt ($)	4.48	4.37	4.41	4.66	4.69	4.60	4.68
Labor & mach. Costs per cow ($)	849	1,074	834	789	810	771	772
Oper. cost of prod. milk ($)	10.04	10.01	9.82	10.32	10.39	10.51	10.52
CAPITAL EFFICIENCY (YEAR AVG.)							
Farm capital per cow ($)	7,798	8,819	8,053	7,368	6,879	6,525	6,108
Machinery & equip. per cow ($)	1,363	1,572	1,391	1,347	1,229	1,062	960
Asset turnover ratio	0.40	0.36	0.38	0.43	0.46	0.49	0.56
PROFITABILITY							
Net farm income w/o apprec. ($)	33,047	11,396	22,510	35,342	54,694	68,570	195,022
Net farm income w/ apprec. ($)	54,555	20,065	37,947	59,991	87,200	116,489	291,951
Labor & mgmt. Income per oper./ mgr. ($)	2,551	-6,862	-861	3,769	3,890	13,118	90,377
Rate of return on equip. cap. w/ apprec. (%)	-1.30	-8.63	-2.01	-0.09	3.89	6.05	8.89
Rate of return on all cap. w/ apprec. (%)	1.96	-2.66	1.39	3.78	4.71	5.24	7.96
FINANCIAL SUMMARY							
Farm net worth, end year ($)	443,355	213,198	336,625	495,188	713,151	857,061	1,676.021
Debt to asset ratio	0.30	0.26	0.29	0.32	0.28	0.39	0.39
Farm debt per cow ($)	2,143	2,098	2,139	2,264	1,818	2,330	2,216

SOURCE: *A Descriptive Analysis of the Characteristics and Financial Performance of Dairy Farms in Michigan, New York, Ontario, Pennsylvania and Wisconsin.* Dept. of Ag., Res., and Managerial Econ., Col. of Ag. and Life Sci., Cornell Univ., Ithaca, NY. R.B. 96-08, July 1996.

The authors concluded that what stood out in their analysis is farms within herd size categories have more performance factors in common with other farms in other states than they do with farms of different herd sizes in the same state. Ontario is an exception due to larger investments and higher debt per cow under the Ontario milk marketing system. The authors provided descriptions of these differences.

Profitability

Net farm income, with or without appreciation, is more than 10 times larger on the largest farms than on the smallest farms. Labor and management income per operator/manager varied from minus $6862 on the smallest farms to over $90,000 on the largest farms. Full time operator/management units were based on 2800 hours per year and excluded hired labor and unpaid family labor. Rate of return on equity capital with appreciation was negative for smaller farms, but almost 9 percent on the largest farms. Rate of return on all capital with appreciation shows a similar pattern but with a smaller range.

Productivity

The larger herds sold 20% more milk per cow, 19191 lbs for herds averaging 439 cows compared to 15999 lbs. for herds averaging 32 cows. Pounds of milk per worker varied from 391,349 lbs annually for the small herd group to 881,000 for herds over 250 cows. It took one worker per for 26 cows in the small herds compared to 46 cows in the larger herds.

Cost Control

Grain and concentrate purchased as a percent of milk sales, and feed and crop expense per cwt. of milk sold generally increased, but by only a small amount, as herd size increased. Labor and machinery costs per cow decreased as herd size increased. Operating costs of producing milk increased with herd size because a greater portion of the labor is a cash cost, where as most labor on small farms in provided by the operator and family.

Capital Efficiency

Farm capital per cow decreased dramatically as herd size increased. Farm capital per cow was one-third less for the largest farms compared to the smallest farms. A similar pattern existed for machinery and equipment investment per cow. Asset turnover rates increased as herd size increased indicating that each dollar invested is being used more productively on larger farms.

Financial Summary

Farm net worth varied from $213,198 on the smallest farms to over $1,675,000 on the largest farms. Debt to asset ratio increased, while farm debt per cow remains relatively constant moving from smallest to largest herd sizes.

The authors noted that the farms in the sample data were a bit larger and higher producing except in Pennsylvania herds when compared to the most recent census data averages.

There are several sources of dairy farm financial data from other states, (Wisconsin, Michigan, Pennsylvania, and New York) that is reported as aggregated averages for author defined classifications. Each has it's own set of characteristics that may limit direct comparison with the data from Minnesota without technical interpretation. Therefore these have not been included in the dairy farm financial performance information reported here.

The Minnesota Farm Business Management Program conducted administered by the Minnesota State Colleges and Universities provides an annual aggregated summary of farm records from across the state. This is the largest farm financial data source in the state. It is very useful, but comes with certain restrictions to protect the privacy of the participating farms. The data is made available only in summary form, with no access to individual farm data. These restrictions make it somewhat difficult to assess how similar the summarized farms are to the entire Minnesota dairy farm population, and do not allow cross-year analysis or factor analysis which might explain in more detail what factors affect profitability. Group aggregated summaries provided by the program are based on dairy farms with more than 70% of gross farm income from dairy. Summaries of this data are shown for two separate years. The 1996 summary below (Tables 34 through 36) provides a high level of detail in order to characterize Minnesota dairy farms. Table 37 includes only selected measures but is included to indicate how economic conditions had changed by 1999. This data source is not necessarily representative of all Minnesota dairy farms relative to size, productivity, enterprise mix, and other management factors.

Summaries of Minnesota Farm Business Management records for dairy farms show large farm-to-farm differences in the economic and production performance of producing milk (Jackson 1999). They also show large swings in profitability from year to year. The 1996 comparison of high and low profit Minnesota dairies (Tables 34 through 36) reveals some important differences comparing the 20% high profit dairies with the 20% low profit group. The profit groups are based on net farm income. This summary is based on more than 800 Minnesota dairy farms in 1996 from the Farm Management Education Program, Minnesota State Colleges and Universities. Conlin has compiled a summary analysis of these records from 804 Minnesota dairy farms and interpreted the results. Some of the compiled summaries reflect subsets of the 804-farm sample because useable data was not available for some farms. Key differences in the overall profit performance of these farms are as follows: (Conlin 1998)

Table 37. Income, Costs and Returns, Minnesota Dairy Farms, 1996

	Low 20%	Average	High 20%
No. of farms	161	804	161
Herd size (cows)	54	64	73
Production per cow, lb	14,639	17,428	19,812
Income			
Milk price	$ 14.56	$ 14.81	$ 14.99
Sale culls/calves/other	1.03	0.87	0.86
Inventory changes	(0.07)	0.39	0.73
Gross income per cwt	15.52	16.07	16.58
Expenses			
Herd replacements	$2.71	$ 2.28	$ 2.08
Feed cost	7.88	6.54	5.66
Other variable cost	3.10	2.50	2.17
Overhead cost	2.45	2.28	2.29
Labor mgmt charge	1.48	1.11	0.95
Total Cost	$ 17.62	$ 14.71	$ 13.15
Net Return to Capital	$ (2.10)	$ 1.36	$ 3.43
Dairy enterprise return to capital	$ (16,601)	$ 15,169	$49,607
Percent income from dairy	77%	75%	68%
Net Farm Income	$ (8,105)	$ 38,502	$ 102,608

Table 38. Minnesota Dairy Farm Balance Sheet, 1996

	Low	Average	High
Farm Assets			
No. of farms	147	705	104
Current	$47,630	$65,857	$135,567
Intermediate	177,631	297,944	327,076
Long term	202,282	217,283	319,909
Total Assets	430,543	491,084	782,555
Farm Liabilities			
Current	51,115	42,271	63,719
Intermediate	82,848	72,077	96,892
Long term	107,269	100,061	123,163
Total Liabilities	241,332	214,409	283,774
Net Worth	219,710	315,903	571,836
Net Worth Change, 1995-96	-4,331	23,623	78,002

Source: Farm Business Management Report 1996, Minnesota State Colleges and Universities (Minnesota Farm Business Management Program, Statewide Annual Reports, 1996 undated).

Table 39. Business Performance Measures, 1996

	Low Profit	Average	High Profit
Profitability			
Return on farm assets	0.4	7.4	11.9
Labor & management earnings	-12,051	26,666	76,243
Operating profit margin	1.40%	22.10%	30.50%
Liquidity			
Current ratio	0.93	1.7	2.51
Working capital	-3,766	32,759	82,903
Solvency			
Farm debt to asset ratio	57%	44%	34%
Farm equity to asset ratio	43%	56%	66%
Repayment Capacity			
Term debt coverage ratio	46%	140%	224%
Capital replacement margin	-16,187	11,321	109,142
Efficiency			
Years to turn over assets	3.8	3	2.6
Operating expense ratio	82.50%	69.70%	65.90%
Depreciation expense ratio	10.30%	6.00%	3.70%
Interest expense ratio	11.80%	7.50%	5.20%
Net farm income ratio	-4.50%	16.80%	25.20%
Dairy Farm Characteristics			
Crop acres	284	329	537
Percent income from dairy	77	76	68
Acres per cow	5.26	5.14	7.36
Assets per cow	7,973	7,673	10,710
Assets per cwt milk produced	55	44	54
Debt per cwt milk produced	31	19	20
Assets per acre	1,516	1,493	1,457
No. of sole proprietors	59	309	48
Average family size	3.0	3.7	4.9
Total family living expense investments & non-farm purchases	25,538	26,851	33,837
No. of farms	165	826	165
Average no. of operators	1.1	1.2	1.7
Average age of operators	42	42	40
Non-farm income	16,573	9,960	7,246

Dairy Farms Compared to All Farms

	Dairy	All Farms
Machinery/equipment assets per acre	344	237
Corn yield, bu per acre	113	125
Corn silage tons per acre	14	15
Alfalfa, tons per acre	3.2	2.8
Soybeans, bu per acre	37	38
Land rent per acre	56	72

Profitability: Return on assets was 11.9% for high profit dairy farms while the low profit group had a return of .4%. This resulted in a higher net return of $3.43 compared to $-2.10 per cwt of milk. The high profit dairy farms had an Operating Profit Margin of 30.5% compared to 1.4% for the low 20% profit group. The net worth growth from 1995 to 1996 was $-4,331 compared to $78,002 for the low and high profit groups.

Family Living and Unpaid Labor: The high profit group enjoyed an advantage of $7,299 more family living and non-farm investment. The average labor management charge per cwt milk for the high profit group was $.95 compared to $1.48 for the low profit group. The low profit group had $16,573 of non-farm income compared to $7,246 for the high profit group.

Price Income Performance: High profit dairies had an income advantage of $1.06 per cwt of milk marketed. The gross income from all of these sources varied from $15.52 for the 20% low profit dairies to $16.58 for the high profit group among 800 Minnesota dairy farms in 1996 (Table 34). High profit dairies received almost $0.43 more per cwt for their milk largely due to premiums for quality and other. Sales of cows and calves and animal inventory changes added $0.63 per cwt to the advantage of the high profit group. Sale of cull cows, dairy animal sales, growth in herd inventory from year to year, and credit for milk fed to calves or used by the family can typically be equivalent to $1.25 to $1.50 per cwt. About 40% of the difference in gross income per cwt was due to milk price; the rest was due to non-milk income sources.

Profit Centers for Income per cwt: High Profit dairies have higher gross income per cwt of milk marketed. They receive a higher milk price because of premiums for quality, etc. Greater income from animal sales and changes in inventory are important contributors to a higher gross income per cwt.

Variable Costs: High profit dairies had a lower operating expense ratio, spending $0.66 to generate $1.00 of income compared to $0.83 for the low profit group. Total cash cost of production was $13.15 compared to $17.62 per cwt. for the low profit group. High profit dairies had lower feed costs by $2.22 per cwt. ($5.66 Vs $7.88) for milking cows, lower other variable costs ($2.17 Vs $3.10), breeding fees, health care, supplies, repairs, etc. Herd replacement costs were $2.08 Vs $2.71 per cwt. of milk in favor of the high profit group (Tables 23 and 25).

Capital Costs: High profit dairies had a lower debt asset ratio (34% Vs 57%) but higher total assets and liabilities. The high profit group had higher investment per cow and about equal investment per cwt. of milk. Debt per cwt. of milk was $20 Vs $31 to the advantage of the high profit group. High profit dairies had lower overhead costs ($2.29 Vs $2.45), they also had a substantial advantage in the depreciation and interest expense ratios and years to turn over assets. The typical $7,500 to $10,000 investment per cow for the income generated is a major profit constraint on many Midwest dairy farms. Machinery and equipment investment on dairy farms was $344 per crop acre compared to $237 on all farms (Tables 23 and 25).

Production Performance: High profit dairies marketed about 5,200 more LB of milk per cow and had larger herds (73 Vs 54 cows per herd). Minnesota studies showed that with good cost control and balanced management, returns to labor and management increased by $0.30 to $0.50 per cwt. of milk for each additional 1,000 LB of milk produced per cow. Milk and feed prices will affect this return. Dairy farms when compared to all farms had crop performance per acre yields: corn grain, 113 Vs 125 Bu; soybeans, 37 Vs 38 Bu; corn silage, 14 Vs 15 ton; alfalfa 3.2 Vs 2.8 tons. Land rent paid was $56 per acre for dairy farms compared to $72 for all farms (Table 36).

The summary shown in Tables 37 through 39 was developed by the author to reflect more current Minnesota dairy farm economic information than the 1996 summary data above which has more detail. This summary is consistent with previously referenced studies on dairy profitability from other states and previous years. Higher levels of profitability (net farm income) are an evident reflection of relatively high milk prices and relatively low feed prices enjoyed in 1998 and 1999. Milk produced per cow also increased.

Table 37 shows that about three quarters of all dairy sales are coming from specialized dairy farms (those with over 70 percent of gross sales coming from milk and dairy animals). This is a greater degree of specialization than for swine, where about half came from more diversified operations.

Table 40. Dairy Farms as a Percentage of All MnSCU-FBMA Farms, 1996-99.

	1996	1997	1998	1999
		(number)		
Total farms	2,730	2,703	2,577	2,721
Dairy farms[a]	663	529	567	533
Dairy farms as a percentage of all farms	24%	20%	22%	20%
		(millions)		
Dairy sales on all farms	$156	$136	$169	$175
Dairy sales on dairy farms	$119	$96	$137	$133
Dairy farm share of all dairy sales	76%	71%	81%	76%

Table 38 shows whole-farm financial results for the specialized dairy farms in the database. The worst of the four years was 1997 when net farm income declined 25 percent from a year earlier, but net farm income averaged nearly the same over the four years as for the swine farms ($45,658 compared to $44,255) and was less variable (refer back to Table 29). Dairy farm returns on assets and on equity were higher on average for swine, and the dairy farms ended with a lower debt-to-asset ratio and better liquidity (higher current ratio and term debt coverage ratio). Non-farm income has remained nearly constant on the dairy farms, in contrast to the sharp increase on the swine farms.

Table 39 attempts to address the issue of economies of size in dairying by summarizing the dairy enterprise costs and returns by size over the four years in a format similar to that used for the swine enterprises. The number of dairy enterprises has been declining in each of the size groups up to 100 cows. The enterprises in the 101-200 cow group and the 201-500 cow group increased over the four years.

The question of whether systems of dairying based on grazing can be competitive with confinement operations relying totally on harvested feeds is of considerable policy interest. The first five columns include a small number of operations that indicated that they used rotational grazing. Those grazing operations are also summarized separately in the far-right column. The grazing dairies averaged 48 cows, and the majority fell in the 1-50 cow group with a few in the range of 51 to 100 cows. Net return per cow was positive in all size groups, and did not increase with size beyond the 51-100 cow size. The grazing dairies' net return per cow was less than the average for all sizes and slightly less than for all in the 1-50 cow size. Experts familiar with the dairy industry report that there are a few, larger grazing-based dairy operations in the state that have herds of several hundred cows. Anecdotal information is that these larger grazing-based operations are proving to be as profitable as similar-sized confinement operations. Not enough of these larger grazing dairies participate in the farm business summary programs to do a separate set of averages for them, however, so the accuracy of those anecdotal reports can not be confirmed.

It is apparent that the largest group (201-500 cows) does not include several of the state's largest dairies. Several dairies with over 500 cows that have been recently been developed in the state, with a few having over 1,000 cows. These large dairies typically use private proprietary services for their accounting rather than participating in the public-sector farm business summary programs. It is evident from this summary that productivity, cost control, capital efficiency, and herd size are factors affecting the financial performance of dairy farms. The higher depreciation and interest expenses per cow suggest the herds in the two largest categories are in a period of expansion which typically increases production costs until the expanded operations have stabilized.

"Estimated labor hours" are shown in table 39. There is a marked improvement in labor efficiency as size increases, with labor per cow declining from 47 hours in the 1-50 cow group to 30 hours at 201-500 cows. As indicated above, these labor estimates are generally regarded as not being very precise because producers do not usually keep records on how much time is spent on different enterprises. The labor estimates are nevertheless used in the tables because their use make it possible to standardize the returns numbers to an hourly basis that the general public can relate to non-farm employment. "Labor & mgmt charge" is the share of the operator's labor and management opportunity cost that is allocated to the enterprise. That number is added to the hired labor expense to arrive at a total labor and management charge. The total labor and management charge is then divided by labor hours to arrive at an hourly "hired and operator labor & mgmt charge per hour" which represents the hourly rates that the operators felt their time was worth plus what they paid to hired labor. If the enterprise earned more than this amount, then the "est. return over labor & mgmt charge" line is positive. A negative indicates that the enterprise was not able to return what the operator's time was worth.

The next-to-bottom line adds the hired labor expense and operator labor and management charge back in to arrive at a net return without considering any labor cost. The bottom line then is calculated by dividing that net return by estimated labor hours to arrive at what the enterprise earned per hour of labor. The charge for hired labor plus operator labor and management, and the net returns per hour both increased with size. Net returns per hour varied from $11.21 for the smallest size to $24.20 for the largest. The grazing dairies earned less per hour than the overall averages.

Table 41. MnSCU-FBMA Dairy Farm Financial Performance, 1996-99.

	1996	1997	1998	1999	Average
Number of Dairy Farms	663	529	567	533	
Liquidity:					
Current Ratio (Ending)	1.47	1.48	1.76	1.69	1.60
Term Debt Coverage % (accrual)	137%	121%	191%	191%	163%
Solvency:					
Farm Debt to Asset Ratio (ending, mkt)	48%	51%	51%	50%	50%
Profitability:					
Return on Assets %	7.5%	5.3%	11.4%	11.5%	9.1%
Return on Equity %	7.0%	2.2%	15.9%	16.2%	10.9%
Operating Profit Margin %	18.8%	14.1%	25.7%	25.2%	21.8%
Net Farm Income	$35,268	$26,353	$58,297	$63,155	$45,658
Efficiency:					
Production per cow, lb.	17,489	17,991	18,712	19,310	18,381
Feed cost/cwt milk	6.56	6.16	5.50	4.94	5.76
Asset Turnover rate (cost)	39.7%	37.5%	44.2%	45.5%	42.0%
Operating Expense Ratio	69.2%	71.6%	65.4%	65.6%	67.7%
Depreciation Expense Ratio	6.1%	8.1%	6.3%	6.2%	6.6%
Interest Expense Ratio	7.7%	8.3%	7.3%	6.8%	7.5%
Net Farm Income Ratio	16.9%	11.9%	20.9%	21.4%	18.3%
Family Income:					
Total Non Farm Income	$9,736	$10,701	$11,520	$12,524	$11,048

Table 42. Dairy Enterprise Costs and Returns by Size, Average 1996-99

	Number of Cows					
	All	1-50	51-100	101-200	201-500	Grazing
Number of farms:						
1996	840	370	367	84	19	22
1997	721	307	314	76	23	17
1998	682	279	287	86	29	19
1999	676	253	287	100	33	13
Average number of cows	73	38	68	132	290	48
Milk produced per cow	18,376	16,561	18,192	19,178	19,950	15,158
Average milk price (per cwt.)	$ 14.54	$ 14.27	$ 14.46	$ 14.69	$ 14.86	$ 14.38
Feed cost/cwt milk	7.57	7.56	7.52	7.70	7.56	5.81
			($ per cow)			
Gross return	$ 2,505	$ 2,217	$ 2,469	$ 2,641	$ 2,776	$ 2,054
Hired labor	128	39	86	168	271	46
Depreciation	97	81	94	101	118	79
Interest on debt	120	103	109	118	164	93
Total expenses per cow	$ 1,989	$ 1,739	$ 1,906	$ 2,112	$ 2,324	$ 1,586
Net return	$ 516	$ 479	$ 563	$ 529	$ 452	$ 468
Estimated labor hours	39	47	39	36	30	47
Labor & mgmt charge	$ 190	$ 267	$ 201	$ 157	$ 107	$ 245
Total of hired labor expense and labor and management charge	$ 318	$ 306	$ 286	$ 325	$ 378	$ 292
Hired and operator labor & mgmt charge per hour	8.16	6.57	7.27	9.11	12.65	6.25
Est. return over labor & mgmt charge	$ 326	$ 212	$ 362	$ 372	$ 345	$ 223
Net return w/o labor	$ 644	$ 518	$ 649	$ 698	$ 723	$ 514
Net return/hour	$ 16.51	$ 11.21	$ 16.69	$ 19.53	$ 24.20	$ 11.01

The number of milk cows in Minnesota and the number of dairy farms by herd size are shown in Tables 40 and 41. The actual numbers as reported by the USDA National Agricultural Statistics Service are shown for 1993 through 1999. Hammond used a Markov chain technique to project the trend out from 1998 to the year 2004, based on the assumption that the probability of increasing or decreasing numbers in each size group is the same as observed for the changes from 1996 to 1997. This also implies that the factors causing the changes: milk prices, demands for milk products, adoption of improved milk production technologies and other determinants of changes in industry structure will, on average, continue to impact as they did for 1996-97. The 1997 data was the latest available when Hammond did the projections. The actual 1998 and 1999 data has since been added as a way of gauging the accuracy of the earlier projections. The rate of structural change appears to have slowed down in 1998 and 1999 compared to 1997. Milk prices were lower in 1997 (Minnesota average $13.16 per hundredweight all milk price) than in 1996 ($14.60 average), but then were generally higher throughout 1998. the Minnesota price peaked out at $18.99 in December before retreating to average $13.99 for calendar year 1999. Milk prices have continued to decline, reaching $12.20 in November 2000 (Agricultural Prices various issues). The more favorable milk prices in 1998 may have resulted in less economic pressure to either exit the industry or to maintain family income by expanding, two actions which would have been reflected in this data. The drop in milk prices in 1999 and 2000 may force more rapid change like that seen in 1997. The survivor technique applied to Table 41 indicates that the minimum sized dairy operation required to be economically viable is at least 100 cows, because numbers in the size classes less than 100 are clearly declining.

Table 43. Number of Milk Cows on Minnesota Farms by Herd Size, 1993 to 1999 with Projections to 2004

	Year	Cows (000) by Herd Size Category: 1-29	30-49	50-99	100-199	200+	Total Cows
Actual	1993	60	206	263	89	17	635
	1994	54	189	256	91	19	609
	1995	47	168	257	96	31	599
	1996	42	155	245	102	54	598
	1997	35	134	239	99	76	583
	1998	32	121	220	88	89	551
	1999	29	114	207	82	113	545
Projected	1998	29	116	231	97	97	570
	1999	24	100	223	94	118	559
	2000	20	86	214	91	138	549
	2001	17	74	204	89	158	542
	2002	14	64	194	86	177	535
	2003	12	55	184	83	196	530
	2004	10	48	175	79	214	526
Avg herd size for group, 1999		19	36	63	109	322	60
Annual % change 1993-99		-11.4%	-9.4%	-3.9%	-1.1%	39.0%	-2.5%
% change 1997-98		-8.6%	-9.7%	-7.9%	-11.1%	17.1%	-5.5%
% change 1998-99		-9.4%	-5.8%	-5.9%	-6.8%	27.0%	-1.1%

Percent of state's cows in herds with cow numbers of:

		1-29	30-49	50-99	100-199	200+	Total
Actual	1993	9%	32%	41%	14%	3%	100%
	1994	9%	31%	42%	15%	3%	100%
	1995	8%	28%	43%	16%	5%	100%
	1996	7%	26%	41%	17%	9%	100%
	1997	6%	23%	41%	17%	13%	100%
	1998	6%	22%	40%	16%	16%	100%
	1999	5%	21%	38%	15%	21%	100%
Projected	2004	2%	9%	33%	15%	41%	100%

Source: Actual data is from USDA National Agricultural Statistics Service, “Milk Production.” Projections are from Hammond, Jerome W., The Changing Structure of Minnesota’s Milk Production Sector,” Department of Applied Economics, University of Minnesota, presented at the Annual Conference of the International Association of Milk Control Agencies, Airport Hilton Hotel, Bloomington, Minnesota, August 16-18, 1998.

Table 44. Number of Minnesota Dairy Farms by Herd Size, 1993 to 1997 with Projections to 2004

	Year	Herd Size Category: 1-29	30-49	50-99	100-199	200+	Total Farms
Actual	1993	3,300	5,400	4,000	730	70	13,500
	1994	2,900	4,700	4,100	720	80	12,500
	1995	2,600	4,500	4,100	780	120	12,100
	1996	2,100	4,100	3,800	830	170	11,000
	1997	1,700	3,600	3,600	850	250	10,000
	1998	1,600	3,500	3,500	800	300	9,700
	1999	1,500	3,200	3,300	750	350	9,100
Projected	1998	1,376	3,161	3,411	880	334	9,162
	1999	1,114	2,775	3,231	901	421	8,442
	2000	902	2,437	3,061	914	510	7,824
	2001	730	2,140	2,900	920	600	7,290
	2002	591	1,879	2,747	921	691	6,829
	2003	478	1,650	2,603	917	782	6,430
	2004	387	1,449	2,466	908	872	6,082
Annual % change							
1993-99		-12.1%	-8.3%	-3.1%	0.6%	31.6%	-6.3%
% change 1997-98		-5.9%	-2.8%	-2.8%	-5.9%	20.0%	-3.0%
% change 1998-99		-6.3%	-8.6%	-5.7%	-6.3%	16.7%	-6.2%

Percent of state's dairy farms with herds with cow numbers of:

		1-29	30-49	50-99	100-199	200+	Total
Actual	1993	24%	40%	30%	5%	1%	100%
	1994	23%	38%	33%	6%	1%	100%
	1995	21%	37%	34%	6%	1%	100%
	1996	19%	37%	35%	8%	2%	100%
	1997	17%	36%	36%	9%	3%	100%
	1998	16%	36%	36%	8%	3%	100%
	1999	16%	35%	36%	8%	4%	100%
Projected	2004	6%	24%	41%	15%	14%	100%

One final comment on the study questions is that the introduction to topic E mentions economies of scale and government policies, but does not explicitly ask the question of how government policies, and especially federal commodity programs, may influence economies of scale or have a "large farm bias." There is an extensive body of literature on this topic, and we will not address it in depth but rather just mention that the issue exists. The question is focused mainly on the major crops and to some extent dairy, rather than on other livestock and poultry, because the commodity programs do not directly cover other livestock and poultry. One book that focused on the debate leading up to the 1996 farm bill was (Cochrane and Runge 1992), but there are many other publications as well.

QUESTION E2. HOW IS THE PROFITABILITY AND ECONOMIC VIABILITY OF FARMS AND FIRMS AFFECTED BY DIFFERENT PRODUCTION AND MARKETING ARRANGEMENTS? WHAT ARE THE COMPARATIVE INTERNAL ECONOMIC COSTS AND BENEFITS OF VARIOUS LIVESTOCK PRODUCTION SYSTEMS?

Question E2a. How is the profitability and economic viability of farms and firms affected by different production and marketing arrangements?

An overview of farmers' use of marketing and production contracts as provided in the 1993 USDA Farm Costs and Returns Survey is provided in (Farmers' Use of Marketing and Production Contracts, Agricultural Economic Report No. 747 1997). Figures on the percentage of pork producers utilizing various types of production and marketing contracts in 1997, and perceived contract advantages and disadvantages are available in (Lawrence et al. undated). An update on marketing contracts is available in (Hog Marketing Contract Study, University of Missouri and National Pork Producers Council 1999).

There are obviously many different production and marketing arrangements in use in livestock production. In responding to this question with respect to an individual livestock operation, it is necessary to make assumptions about the rest of the industry. A bit of Economics 101 - Generally speaking, at any point in time in any industry made up of more than one firm, the different firms operate at different levels of efficiency, profitability, and risk. They compete, and over time the more profitable firms expand and drive down prices while the less profitable firms shrink or gradually leave the industry. This scenario assumes that all firms produce an identical, generic commodity.

The impact of different production and marketing arrangements on the profitability and economic viability of a particular, representative farm will depend on how broad the adoption of the arrangement is in the rest of the industry. Increasingly, it is becoming more feasible to produce agricultural products with specific characteristics which may bring different prices when marketed though “niche” marketing channels. Over time, livestock operations, like other businesses, tend to adopt the most promising new arrangements. The “treadmill hypothesis” states that the early adopters reap higher profits for awhile when they adopt, but when the rest of the industry adopts then profits return to normal levels. Any particular production or marketing arrangement aimed at a niche market may provide high returns to the first few farms that get into it, but the market may become saturated quickly so that later adopters may suffer losses under the same arrangement (Cochrane 1979), pp. 389-390.

Changes in hog procurement practices are causing a number of problems for farmers who continue to rely on the spot market. Some of these problems were identified by 28 hog farmers in Minnesota, Iowa and South Dakota who were interviewed in 1997. The main problems identified were ((Land Stewardship Project 1999)):

- delays of several days until packers can accept delivery of animals, rather than the previous situation where farmers could call and deliver their hogs the same day,

- closing of local buying stations, requiring greater travel distances,

- perceived price reductions relative to what large producers were receiving (it is not clear what information about large producers' prices they were using to make this comparison, or how accurate their information was), and

- missing out on quantity premiums or other "special deals" that large producers were receiving.

Much of the debate about the fairness of long-term hog marketing contracts revolves around whether quantity premiums paid to producers under long-term marketing contracts or for larger spot market lot sizes are unreasonable compared to what is paid for smaller spot sales (see, for example section V of Land Stewardship Project). "Reasonableness" relates to how such premiums compare to differences in packers' procurement and operating costs. Two relationships that have not been quantified very well in past research include: 1) how packers' hog procurement costs vary with lot size (number of animals involved in the individual transaction), and 2) how much slaughter plant per unit operating cost increases when the plant is operated below or above optimum rates on any given day. This may be an area that can only be effectively researched using data obtained under the auspices of the USDA Packers and Stockyards Administration's or other government agency's subpoena power.

The increased use of contracts together with more concentrated ownership of germplasm has raised concerns of a possible shift in bargaining power away from producers and their receiving a smaller share of revenue from production (Harl undated). The changes and driving forces are well laid out in this paper, although as discussed in the introduction, like any predictions it is up to readers to judge the likelihood of their coming to pass.

Swine Farm Profitability

The more major agricultural commodities also go through production and price cycles, but over a longer time period. Hogs, for example, tend to follow a cycle of about four years. An arrangement that appears profitable when prices are at a high point in the cycle may not look nearly as profitable at the low point.

Less efficient arrangements may have negative impacts on profitability in an economic environment where more efficient arrangements are competing. The same, less efficient arrangements may provide adequate profits in a different economic environment where the more efficient arrangements are restricted by government policies, provided that the policies are adopted over a large enough geographic area that competing products cannot be imported. This restriction scenario does not specify what the rationale might be for such restrictions. The restrictions could be instituted on economic, environmental, animal welfare, or other grounds.

Marketing arrangements generally address two goals: enhancing the expected price, and reducing risk. The major types of livestock marketing arrangements include the traditional daily spot markets, futures and options trading though the established futures markets, and marketing contracts with processors that may extend for periods of a few months up to five years or more. In the case of pork, marketing contracts may be fixed price, fixed basis, formula price, cost plus, price window, and price floor. The price established under the contract may be a final price, or the contract may be of a cash flow assistance nature in which case the final price may be based on the spot market price with the difference between the spot price and the contract price being a loan balance kept in a ledger account (Buhr Undated). Direct marketing to local consumers is another arrangement that is being utilized by some producers.

We assume that we are mainly interested in how different production and marketing arrangements might affect profitability in the future, rather than just in the past. Prices fluctuate daily. Any comparison of marketing arrangements must take into consideration this price variability. Buhr compared three types of hog marketing contracts and found that when averaged out over three years, the contract price averaged from 98 to 104% of the spot market price (Buhr Undated). Simply comparing the prices that a representative farm would have receive on any given day, or even in any one year in the past, under different marketing arrangements will not necessarily predict how the arrangements will perform in the future.

One way to address the price variability issue is to look at processing costs. At least two assumptions must be made: 1) the retail price is constant, and 2) packers will compete and pass any processing cost savings on to farmers. If we accept these two assumptions, then the implication is that a marketing arrangement that reduces processing costs will improve farm profitability compared with a marketing arrangement that involves higher processing costs. Over the long run, however, assumption (1) that the retail price is constant, is probably not valid. Over the long run, economic theory suggests that any arrangement that increases farm profits above normal levels will result in expansion and a farm-level supply increase. In order to sell the increased production to consumers, it will probably be necessary for prices to decline which will return profits to normal levels. The validity of assumption (2) depends on the relative elasticities of demand at the farm-packer and packer-retailer levels.

Martinez and others used a simulation model to estimate the changes in hog prices that would result from a packer purchasing hogs under various levels of marketing contracts or integration which specify genetics and market weight, compared to buying on the spot market (Martinez et al. 1998). Also see (Martinez 1997) and (Martinez 1998). They estimated shifts in retail demand related to increased leanness, shifts in retail supply related to increased leanness, and hog acquisition costs. They assumed a packer savings of $6.32/head by slaughtering a hog that is 19% leaner than average, for a potential marketing cost savings of 2.86%. They assumed that contracting or integration would reduce hog purchasing costs by $0.48/head. They also assumed that consumers would be willing to pay 4.3% more for pork that is 10% leaner. They look at several scenarios of 11%, 29% and 100% contracting or integration, and with or without consumer demand changes. They find that in the short run (one year), hog prices would increase from 0.2 to 2.0 percent at 29% contracting or integration. After more than five years, however, hog prices would return to normal while hog production would increase by 0.2 to 1.7% at 29% contracting or integration. Higher or lower levels of contracting or integration would result in larger or smaller impacts.

Poultry Farm Profitability

How have contract livestock and poultry producers fared financially in recent years? Contract poultry production has had a reputation in recent years of being a fairly low-return enterprise. Empirical evidence on the financial performance of farms with broiler contracts is provided in a recent USDA report. Broiler farms with sales of $50,000 are compared with 1) other farms growing just crops and 2) farms with other livestock but not contract broilers. The report is based on 1995 data from the Agricultural Resource Management Study (formerly known as the Farm Costs and Returns Survey (Perry et al. 1999). It also discusses the types of contractual arrangements in use. Broiler farms were in fair financial condition in 1995, with net farm income of $15,969. They had less invested in the business than other farms, and worked fewer hours on the farm. The broiler farm net farm income was less than half of the average $38,966 earned by other farms. One question the analysis does not address is whether the broiler farms would have earned more if they had been engaged in some other enterprises, or whether they chose broilers in the first place because their resources were too limited for other enterprises. The broiler farms averaged $392,353 in farm equity compared with $673,155 for other farms.

One interesting fact identified in the study is that, on average, spouses were more heavily involved in decision-making and management, and worked more hours, on broiler farms than on other farms with comparable sales. Three quarters of the broiler producers said that their major occupation was farming. These operators' household income was 78 percent of the average U.S. household's income, largely due to lower off-farm income. There does not seem to be any comparable financial analysis of other commodities' contract production done on a national basis.

Question E2b. What are the comparative internal economic costs and benefits of various livestock production systems?

<u>*Alternative Swine Systems*</u>

Basic information about conventional swine production systems, including some information on investment and profitability, is available in (Pork Industry Handbook (collection of individual fact sheets) fact sheets individually dated). There is a great deal of interest in alternative swine housing and production systems, especially hoop barns, pasture farrowing, and the Swedish deep-bedded system. (Honeyman 1996) lays out the requirements for a sustainable swine production system, with characteristics such as industry structure, barriers to entry, diversity, utilization of manure and dead pigs, and pork quality. He lays out four levels of issues, from the farm, the rural community, the society or consuming public, and the ecosystem or environment. Another overview of alternative swine systems is provided in (Field Notes No. 2, Swine Production 99).

Two sources of descriptive information about the Swedish deep-bedded system are (Honeyman 1995) and (Halverson et al. 1997). Neither of these publications includes an economic comparison of the Swedish system versus conventional confinement systems.

Dutch swine researchers have studied different housing systems for pregnant sows at the Rosmalen Research Institute for Pig Husbandry. (Backus and et al. 1997) is a summary of several research projects conducted between the late 1980s and 1994. Generally, they found that technical performance of group-housed dry sows was similar to sows housed individually in gestation stalls. They conclude that group housing is economically feasible, but will require more management skill by the farmer compared to individual housing.

Producer-oriented planning information on hoop barns is provided in (Hoop Structures for Swine Housing, AED-41 1997). According to their economic analysis, hoop barns as swine housing do not have a great economic advantage or disadvantage compared to conventional confinement buildings. Hoop barns involve a lower initial investment but higher operating costs, and little history exists to show how reliable and durable they will be.

One budget analysis of swine production systems under Minnesota conditions is (Lazarus et al. 1991). The purpose of this study was to evaluate the potential economic impacts in representative swine facilities of adopting production systems and equipment which address selected animal welfare concerns. Specific systems studied included:

- conventional, confinement breeding herd housing and finishing
- outdoor farrowing, one litter/year and two litters/year, with confinement finishing

- gestation stalls which allow sows to turn around and move more than conventional stalls
- electronic sow feeders with pen gestation
- straw-bedded, solid-floored sow housing with individual farrowing pens
- sow-pig nursery where weaning is delayed and pigs are moved less frequently
- marketing lighter-weight, intact boars rather than castrating

All of the alternative systems were found to reduce profitability compared to conventional confinement systems to some degree. The electronic sow feeder system and the turnaround gestation stalls had little impact on profitability, while the outdoor farrowing and straw bedded systems increased costs by about $4-5.00 per hundredweight of pork produced. As in any pro forma budget analysis, the study was based on expert opinion about hypothetical situations, because few or no commercial farms were using these systems at the time, so actual performance may be different from what was projected.

There is considerable interest in the economic viability of alternative swine production systems that require less investment, or offer improved animal welfare or working conditions that are different from those in environmentally controlled confinement buildings. A project currently underway under the University of Minnesota's Minnesota Institute for Sustainable Agriculture is intended to produce case studies and business record analyses of a set of Minnesota swine operations that are using alternative systems such as hoop barn finishing or pasture farrowing. The project goal for 1999 is to identify the farms and help them to standardize their financial records in a form that can be used for comparative analysis, probably using the University of Minnesota's FINPACK farm financial analysis software through the Minnesota State College University's farm business management program. It will probably take three or four years of data to produce an adequate picture of the long run comparative economics of alternative systems, so useable results will probably not be available until early in 2004.

Oltjen and Beckett discussed the valuable role ruminants serve in sustainable agricultural systems. They are useful in converting vast renewable resources from rangeland, pasture, and crop residues or other by-products into food edible for humans. Further, ruminant livestock production is consistent with proper agronomic practices in which forages are grown on 25% of arable land to minimize soil and water erosion. They point out that net returns from of humanly edible energy and protein are dependent on the production system used. Production efficiency has varied from 96% to 276% on humanly consumable protein for dairy. Beef production efficiency is highly dependent on time spent in the feedlot. Their protein efficiencies range from 28% to 59%, and energy efficiency from 52 to 104%. They indicate the protein from ruminant livestock production is of higher quality with greater biological value. (Oltjen and Beckett 1996)

Alternative Dairy Systems

The most popular alternative dairy system in Minnesota is one that relies on grazing to varying degrees as opposed to conventional systems that rely totally or mainly on mechanically harvested feeds. Table 41 above summarizes financial performance of grazing dairies in the MnSCU-FBMA database between 1996 and 1999. The grazing dairies had smaller herd sizes and produced less milk per cow, but also incurred lower feed costs and total expenses per cow. The grazing dairies earned less per hour than the overall averages, however.

Cornell workers reported on the financial performance of 253 specialized dairy farms in New York state in 1997. These farms averaged 190 cows with 20,651 pounds of milk per cow sold. Net farm income averaged $39,928 per farm with a rate of return on assets of 3.2%. Differences in profitability varied from 15% for the top 10% to –241% for the lowest 10%. Farms adopting bovine somatotropin experienced greater increases in production, had larger herds, and were more profitable than herds not using this technology. Farms adopting rotational grazing generally produced less milk per cow than non-grazing farms, but had somewhat lower costs of production and higher profitability. Large freestall farms averaged the highest milk output per cow and per worker, with the lowest cost of production and investment per cow, and the greatest returns to labor and management. Farms milking three times per day produced more milk and were $.09 per cwt less than herds milking twice daily. (Knoblauch 1998)

Penn State workers reported findings on the performance of 53 representative randomly selected dairy farms in 1993. They found moderate intensive grazing achieved a $129 per acre return to operator labor and management compared to $20 and $58 returns for all hay and maize enterprises, respectively. Debt per cow was substantially higher for farmers increasing rotational grazing intensity. They indicated that pasture acres per cow, high debt to assets, and negative cash flows provided an important motivation to increase grazing intensity. A drawback of intensive grazing was the likelihood of lower milk production than with confinement feeding while the main economic benefit was a reduction of costs associated with forage production.(Hanson et al. 1998)

Minnesota workers compared milk production and profitability for confinement feeding and rotational grazing with Guernsey and Guernsey X Holstein cows grazing perennial rye grass pastures from mid-May to October. Over the two year period confined cows produced 7% more milk with similar fat percent compared to the grazed animals. Body weight change and health were similar for both groups. Net return per cow averaged $64 greater for the rotational grazed group because of lower cost for feeding, facilities, equipment, and labor. They point out that stored feeding is still required from late autumn to early spring in the North USA. (Rust et al. 1995) Minnesota workers surveyed 29 dairy farms using management intensive grazing practices through personal interviews. The respondents cited a change in the use of their time: reduced time doing chores, baling hay, repairing equipment, planting, harvesting, feeding and manure handling, and which allowed more time for duties of managing the pastures and the business. These farms reported reduced input purchases such as feed and fuel. (Loeffler et al. 1996)

Wisconsin workers reported survey results of almost 1200 dairy farms in 1995. About half of the surveyed farms were confinement operations that used no pasture forage. About 35% of the farms rely on some pasture to some degree (non-intensive), and 14% were actively pursuing management intensive rotational grazing of some type for a portion of their forage needs. Of the total farms surveyed, about 8% used pasture as their primary source of total feed during the grazing months. The heaviest concentration of grazers were in three Southwest Wisconsin counties. The authors note the highest adoption rates to be in areas of lower farmland values, but also suggested that social, and institutional factors unrelated to the agronomic and socioeconomic characteristics of the region may have influenced the higher adoption rates. Adopters had smaller herds, less likely to use total mixed rations, rBGH, sell grade A milk, have milking parlors, or use farm business management tools such as DHI records. Grazers spent more total labor hours per cow, had lower farm income, lower capital investments, and higher off farm income. (Jackson-Smith et al. 1996)

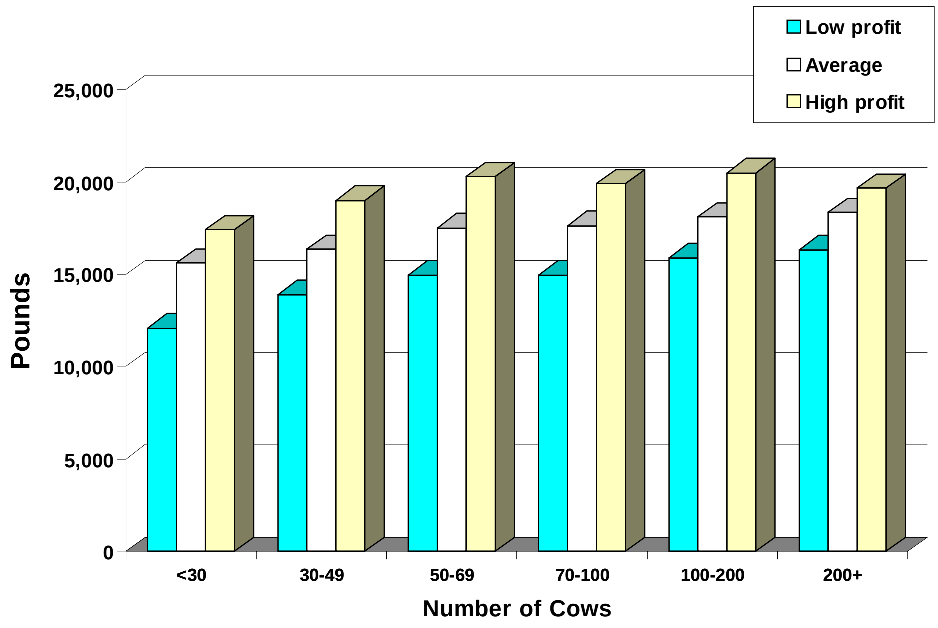
Cornell workers attempted to explain why the characteristics of dairy farmers in two different communities with similar resources but quite different in performance may take on certain patterns. This was a study of the human capital component of dairying. Farmers in the two communities were following the same path toward optimization of milk production but receiving very different results. The high production community was more advantageous for formal education, access to markets, and proximity to an urban center. Among the differences found, farmers in the high production community used more techniques associated with good management practices, and they were better educated. (Cruise and Lyson, Cornell). The work is consistent with others that identify the importance of human capital, and management skills in operation of a successful dairy. ((Center for Epidemology and Animal Health 1996)

USDA-APHIS conducted an extensive national dairy survey covering the major milk producing regions which was intended to monitor dairy health and management practices. The results covered herds larger than 30 cows, and reveal management characteristics by herd size and region. There were several areas of management where differences related to herd size were small such as the quality of milk produced and mastitis management control practices implemented (Center for Epidemology and Animal Health 1996). There are major differences in the way manure was handled, stored, and applied to the land. Gutter cleaner use declined and flush systems with recycled water increased in larger herds. More than 90 percent of the herds over 200 cows used some type of liquid manure storage; primarily either a lagoon or a slurry system. Lagoons were more popular in the western states because of greater evaporation from more arid conditions. Most of the smaller herds handled manure as a solid and were more likely to spread manure daily during winter months. The practice of incorporating the manure into the soil within twenty-four hours after land application to minimize odor and nitrogen loss increased as herd sizes increased.

Herd Size and Production Costs

The summary of all herds by profit level suggests large herds produce milk at a lower cost and have a higher return than small herds. (Jackson 1999) The 1996 Minnesota Farm Business Management records were summarized by high and low profit groups within 6 herd size classes to gain more insight. The results suggests production cost per 100 pounds of milk to be similar for the high profit farms within all size categories except the very smallest herd size group. The Margin of difference between the low and high profit herd within the size groups diminished as herd sizes increased. The cost structure appears to change with different size herds. However, some caution should be used in this conclusion because of the smaller number of herds in the largest group and a relatively higher portion that were in a typically more costly herd expansion period. This summary shows wide differences in the cost and returns in all the size classes from herds less than 30 cows to those over 200 cows. The summaries are based on costs and returns per cwt. of milk (Figures 1 through 6) and Figure 7 represents total returns from the dairy herd.

Figure 1. Milk Production Per Cow By Profit Levels Within Herd Size Classes



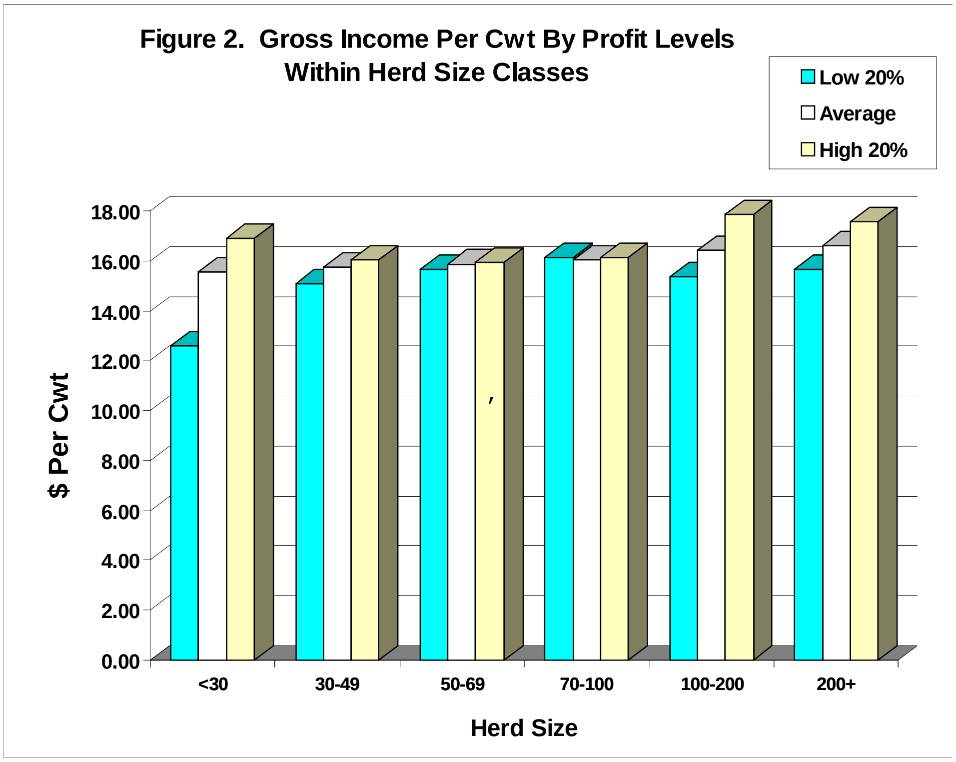


Figure 2. Gross Income Per Cwt By Profit Levels
Within Herd Size Classes
Low 20%
Average
High 20%
$ Per Cwt
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
<30
30-49
50-69
70-100
100-200
200+
Herd Size

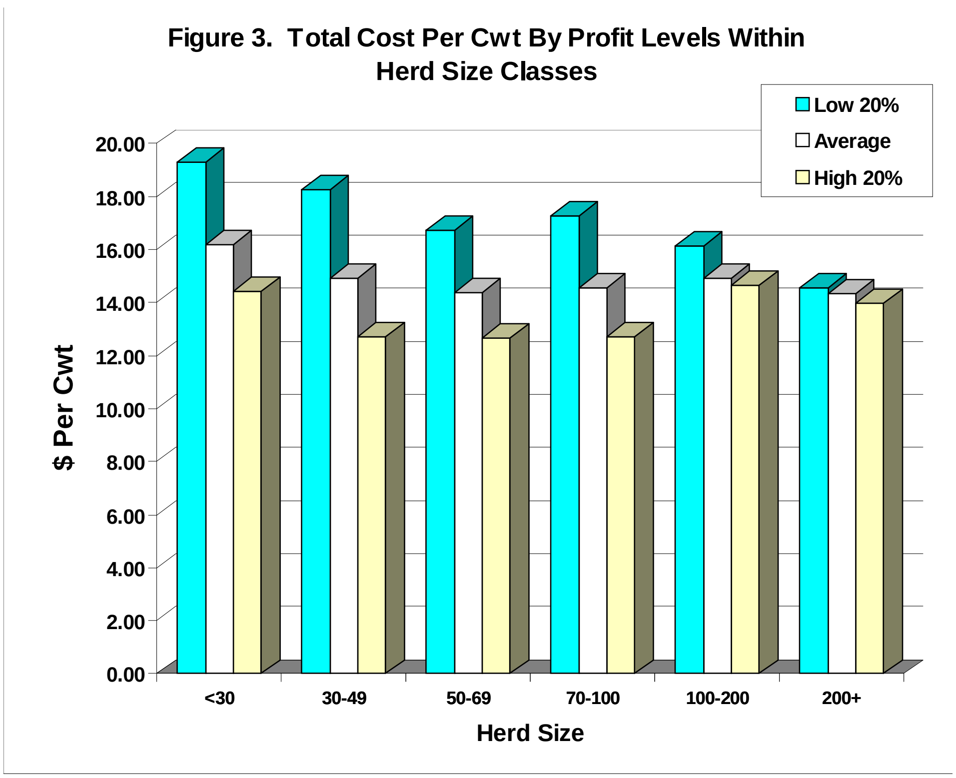


Figure 3. Total Cost Per Cwt By Profit Levels Within
Herd Size Classes
Low 20%
Average
High 20%
$ Per Cwt
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
<30
30-49
50-69
70-100
100-200
200+
Herd Size

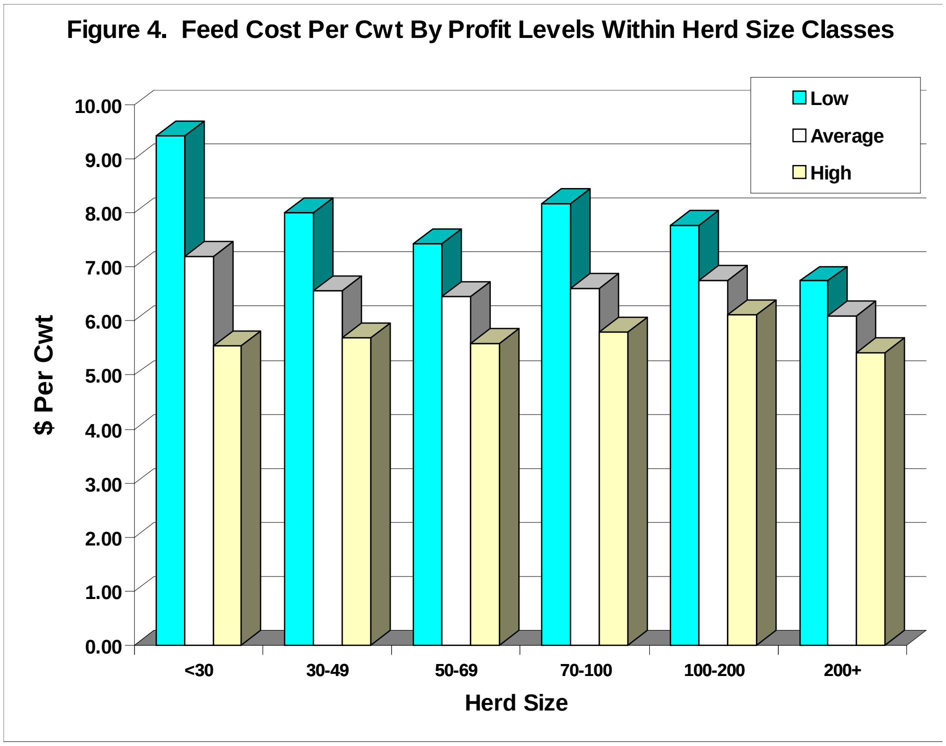


Figure 4. Feed Cost Per Cwt By Profit Levels Within Herd Size Classes
Low
Average
High
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
$ Per Cwt
<30
30-49
50-69
70-100
100-200
200+
Herd Size

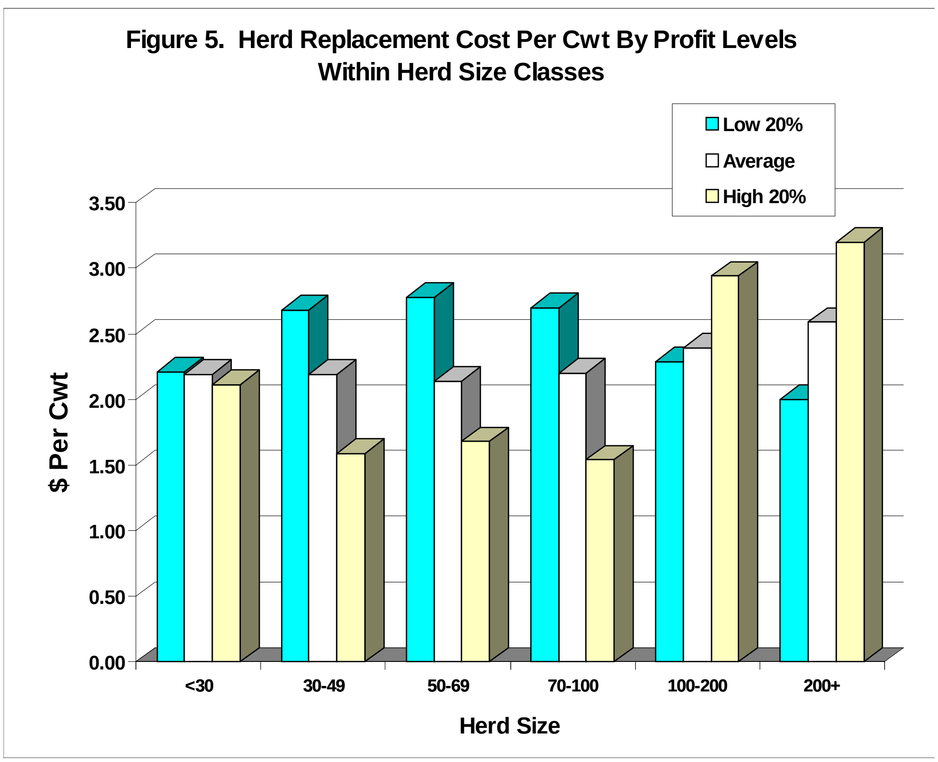


Figure 5. Herd Replacement Cost Per Cwt By Profit Levels Within Herd Size Classes
Low 20%
Average
High 20%
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
$ Per Cwt
<30
30-49
50-69
70-100
100-200
200+
Herd Size

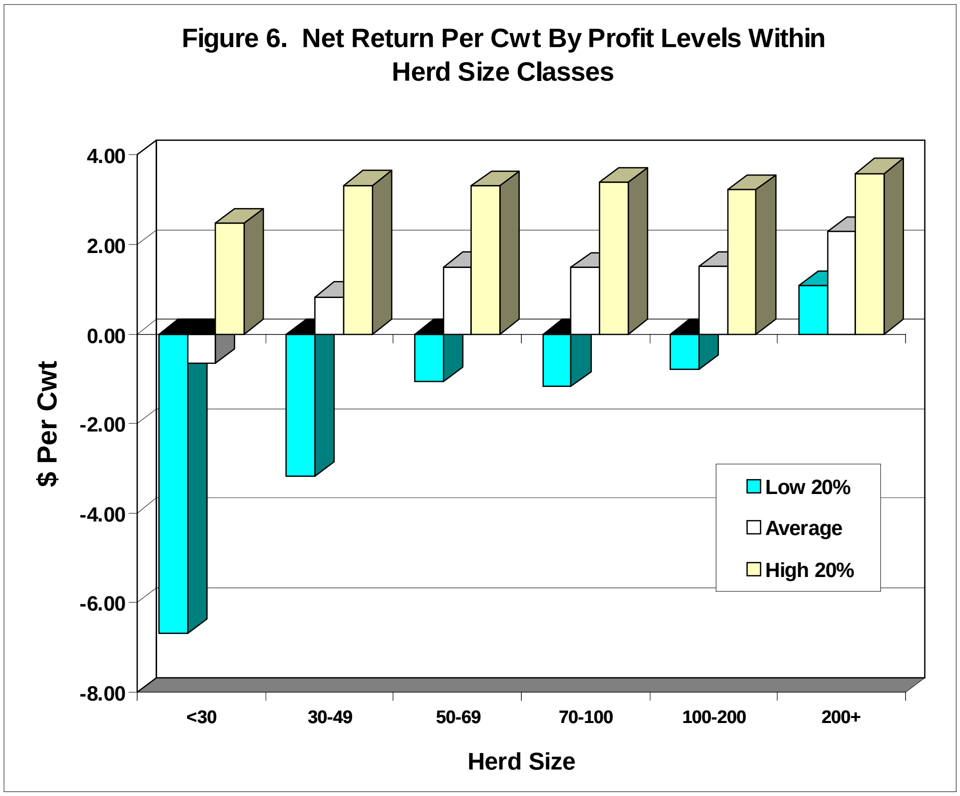
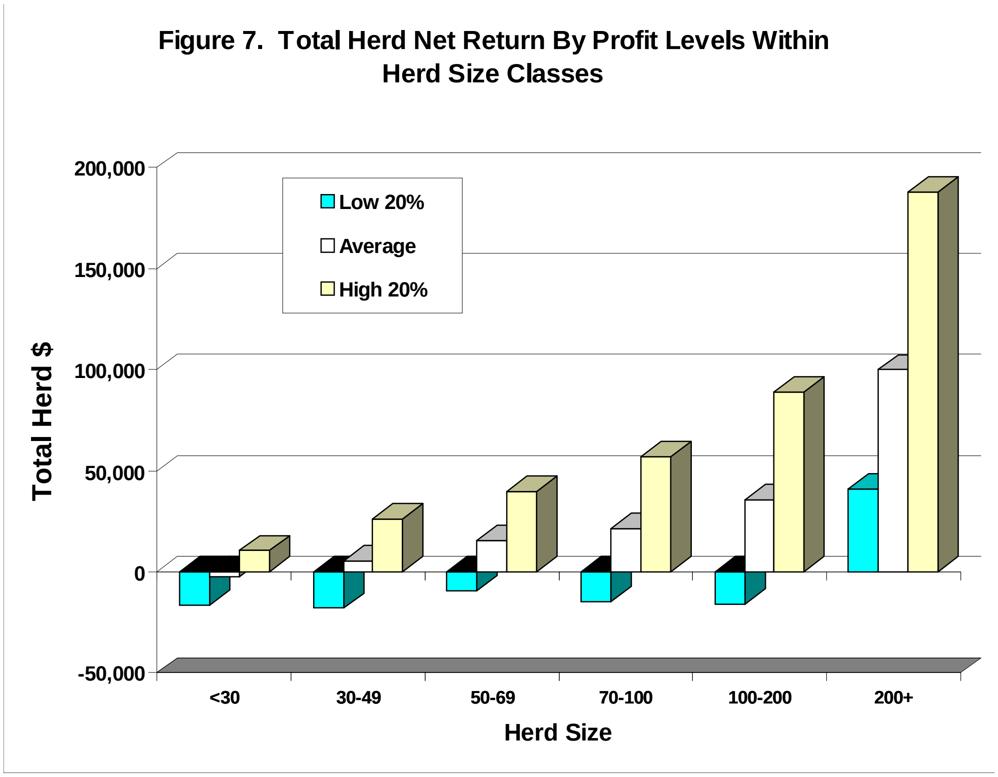


Figure 6. Net Return Per Cwt By Profit Levels Within Herd Size Classes
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
$ Per Cwt
<30
30-49
50-69
70-100
100-200
200+
Herd Size
Low 20%
Average
High 20%



The highest average cost was for herds less than 30 cows ($19.30 per cwt) by a big margin and lowest for the largest herd group ($14.32) by a small margin compared to the other size groups above 30 cows. The spread between the low and high profit groups was greatest in the herds less than 30 cows ($14.92 vs $19.30 per cwt) and this spread between profit groups tended to be smaller among the larger herds. Feed cost per cwt of milk ranged from $5.41 for the most profitable herds with over 200 cows to $9.42 for the low profit herds with less than 30 cows.

There was also much variability in the gross income per cwt, ranging from $12.61 per cwt for the least profitable herds with less than 30 cows to more than $17.50 for the most profitable larger herds. Milk price was only a part of this variability; just as important were the sale of culls and other animals, and changes in animal inventory from one year to the next.

The difference in returns per cwt between high profit large and small farms were relatively small compared to the larger differences between high and low profit farms within the size classes. Returns per cwt were negative for the low profit herds in all size classes except the largest. Low productivity, feed costs and change in animal inventory are major contributing factors to lower returns in all size classes. The profitability margins per cwt were similar for the high profit groups for all size classes but the smallest herds. (Conlin 1998) These Minnesota results are consistent with those of Ford et al.

Interpretations of farm level data can provide valuable insights but conclusions are limited by the by the data sample, and wide variability among farms and years. For example the number of herds in the largest group in the above data was relatively small, 11 herds. Availability of financial performance of larger Midwest dairies is very limited. There are other data sets that have been collected within the private sector that are not available in that they are proprietary. More intense statistical analysis on issues of size and scale efficiencies, alternative dairy farming systems and strategies to optimize use of resources is needed to provide more conclusive evidence. Development of an ongoing program to monitor and provide performance benchmarks for comparisons by producers would provide a valuable management tool.

The most significant issue is to market enough milk to generate the desired level of family income. Unprofitable farms have significant opportunity to enhance their profit level through improved management control and increasing productivity. Adding cows to an unprofitable dairy is seldom an effective strategy. The more profitable dairies are the best candidates for increasing family living through increases in cow numbers.

It is useful to compare the discussion in the previous few paragraphs to the discussion of the "L"-shaped cost curve under question E1. Note that the last paragraph focused on income for family living, not efficiency or per unit cost.

> "This is an important point for two reasons. First, many people assume that the larger units are needed for efficiency and that to keep the costs of food low farms have to be big. Second, the current production techniques we employ narrow the profit margin for the farm. They are getting bigger for the income not to lower costs of production. Realizing this opens more options for the farmer and society to pursue if the increase in size is for income not efficiency." (see reviewer comments)

Many of the already profitable dairies will need to increase herd size to maintain a competitive and viable dairy farm business. Increasing cow numbers in an unprofitable or marginally profitable dairy business has a poor chance for success. The profitability problems should be solved first. The above discussion based on review of literature and farm financial records.

Many upper Midwest dairy farms are at a crossroads in trying to find better ways to reach their goals. Profitability and family lifestyles are two primary driving forces. The typical upper Midwest dairy farm is highly diversified in demands for capital, labor and management know-how. All of these resources are stretched so thinly that it is often difficult to compete. Farm families are looking for ways to work smarter, not harder and longer.

Options under consideration include: grazing, expansion, use of consultants, networking with other farmers, specialization, contracting, exiting the dairy business, surviving to retirement, etc. In 1994, a University of Minnesota study explored three alternative dairy production systems:

1. Purchasing all feed on minimum land base.
2. Raising forages and purchasing grains and concentrates.
3. Raising forages and grains to feed the herd.

The analysis was based on a new start-up dairy with the land and field machinery investment determined by the cropping plan. The systems were analyzed over a range of herd sizes from 138 to 828 cows. The dairy facilities, parlor, manure system, feed storage and housing were designed to meet herd sizes. Summary results are shown in Table 42.

Table 45. Economic performance comparison of three dairy farming systems.

	Herd size (stalls/cows)					
	100/138	200/276	300/414	400/552	500/690	600/828
Total assets, $/cow						
Purchase all	3,361	3,152	2,997	2,883	2,845	2,859
Raise forages only	5,393	4,831	4,590	4,447	4,402	4,410
Raise forages & grains	6,594	5,863	5,603	5,391	5,334	5,300
Return on assets, %						
Purchase all	2.5	9.9	12.8	15.6	16.8	17.5
Raise forages only	5.8	11.5	14.2	16.1	16.8	17.2
Raise forages & grains	4.7	10.0	12.4	14.3	15.2	15.5

University of Minnesota, 1994.

These estimates would be most representative of a new start-up dairy and may not be applicable to an individual farm or an existing dairy operation that is planning to expand. The results suggest some key points:

1. Dairying is capital intensive and there are substantial capital efficiencies gained up to 300 to 400 cows for all three systems. Gains are still realized beyond 400 cows but at a slower pace. These capital efficiencies are largely due to dilution of two large fixed cost items: the milking center and waste management systems. These costs are not increased greatly by increasing cow numbers.
2. Cropping machinery and the land base required to produce the herd feed supply add greatly to the capital requirements. Capital investment requirements are reduced by 15 to 20% for the option of raising forages and buying grains compared to raising all the forages and grains. The capital investment was further reduced by 40 to 45% for purchasing all feed.
3. Increasing returns on assets (profitability) demonstrates substantial scale efficiency. Returns on assets increased most up to 300 to 400 cows, then more slowly up to 800 cows. This was true for all three systems.
4. Profitability levels (return on assets) favored the two more highly specialized systems:

purchasing all feed, and raising forages only. The more diversified system of raising all feeds was the least favorable relative to returns on assets, but still acceptable at larger herd sizes.

Making the leap to a full-fledged modern system is not feasible for many of our current dairy farm businesses. The availability of the investment capital needed to move out of the stall barn to a modern freestall system with pit parlor milking in one step requires a major investment of new capital and additional management competencies. These units have to be large enough to dilute a large capital cost with enough cows to be profitable. Milking centers with pit parlors and manure systems are typically the largest fixed cost items in these new systems. A 1994 Minnesota study showed 400 to 500 cows were needed to achieve an acceptable level of return on assets of at least 12%. Typically, the capital requirements for developing complete new units from the ground up are \$1.5 to \$2.0 million or \$3,000 to near \$4,000 per cow. This level of investment may be beyond the available loan capital and/or the tolerance for financial risk for many dairy farm families. The Minnesota study illustrates the impact on the investment per cow if all crops and only forage crops are raised compared to purchasing all the feed. (Conlin 1998)

Discussion of the Dilemma of Growing Cow Numbers

Most upper Midwest dairies are relatively small herds in stall barns that have reached obsolescence. Modern freestall barns coupled with milking centers are more labor efficient, kinder and gentler on the backs and knees of milkers, are well ventilated, provide a healthier and more comfortable animal environment, are easier to adopt new technologies, have major scale efficiencies in investment per cow, and are more flexible for growth options in the future. Finding a way to move out of the stall barn is a challenge for many wanting a long term, healthy and profitable future in dairying that will enable a quality life style.

The dilemma many face is the lack of adequate capital to quickly modernize to freestalls and pit parlors to support a profitable size at tolerable levels of risk. Few have had experience or training in the skills required to manage these modern dairy systems. Moving out of the stall barn changes the way cows are housed, fed and milked. The move also affects routine work, purchasing feed, handling manure, using consultants, managing people, establishing control systems, and budgeting and forward planning. The skills of managing finances, production and people can be learned with commitment, study, experience and training.

Typical Midwest dairy farms are highly diversified, raising forage and grain crops for feed for the dairy. Dairy income is the primary income source while the invested capital, labor and management talents are diluted over several enterprises. Many farms can benefit from evaluating which enterprises are contributing most to their profitability and then reallocating their resources to those that contribute most. (Conlin 1998)

List of Major Relevant Ongoing Work

NE-165 Regional Research Project, •Private Strategies, Public Policies, and Food System Performance,• which includes researchers from 24 U.S. land grant universities and several government agencies, was mentioned earlier as a source of general information on structural change in agriculture. Its objectives are to: 1) To analyze the impacts of changes in strategies, technologies, consumer behavior, and policies on the economic performance of the food system, and 2) To provide economic analysis of private and public strategies in order to assess their impact on improvement in food safety and other quality attributes. The administrative advisor is Dan Rossi at Rutgers University, Cook Office Building, 55 Dudley Road, New Brunswick, N.J. 08901, Phone: (732) 932-9155. Termination date is 9/30/2001.

Northeast Regional Research Project NE-177, "Impacts of Structural Change in the Dairy Industry," has two objectives, 1) Determine the interrelationships among and relative importance of social, economic, technological and political environments, regional conditions, and entrepreneurial strategies affecting restructuring of the dairy industry in different dairy localities, and 2) Identify, examine, and assess the effects of structural change in the dairy sector on local communities and related enterprises. The chair is Douglas Jackson-Smith, University of Wisconsin-Madison, Program on Agricultural Technology Studies, 1450 Linden Drive, Rm. 146, Madison, WI 53706-1562, 608-265-2908. Termination date is 9/30/2001. Three states (WI, MI, and NY) have done one or two years of survey work in a dairy-dependent community in the state. Several other states, including Minnesota, have only participated in a limited way due to lack of operating funds and faculty time.

North Central Research Project NC-221, "Financing Agriculture and Rural America: Issues of Policy, Structure and Technical Change," has the objectives to 1) determine the effects of changes in federal and state policies affecting agriculture on the financial and economic performance of farm and rural non-farm businesses and rural financial markets, 2) identify and evaluate the costs and benefits of structural changes in production agriculture, rural non-farm businesses, and rural financial markets, and 3) measure the effects of technical change on rural financial products, services, and firm decision making. The administrative adviser is E.O. Hoiberg, Iowa State University. Termination date is 9/30/03. Fifteen states are involved in this project, which generated one of the publications cited above regarding effects of bank mergers on agricultural lending.

The Alternative Swine Production Systems project is a project funded by the Minnesota Legislature and organized by the Minnesota Institute for Sustainable Agriculture, a partnership between the University of Minnesota and the community as represented by the Sustainers' Coalition. Its major objectives are to 1) research and develop low-emission and low-energy alternative pork production systems, 2) promote alternative pork production systems, including hoop houses, the Swedish model for farrowing and feeder pig production, and pasture farrowing, and 3) disseminate information on new low-emission and low-energy alternative pork production systems to farmers and agricultural service providers including lenders, educators, and vendors.

One component of the project is to conduct case studies and summarize production and financial performance data for farms using alternative swine production systems. Farms are currently being identified for the study, and the expectation is to assist the farms to implement a standardized financial analysis system for the year 2000 calendar year. Given the year-to-year variability usually experienced in financial performance of individual farms, several years of data will be needed to make credible comparisons between alternative and conventional swine production systems. The project coordinator is Mr. Wayne Martin, Associate Program Director, Alternative Swine Production Systems, University of Minnesota, (612) 625-6224, 385E Animal Science Building, 1988 Fitch Ave., St. Paul, MN 55108.

There are a large number of individual agricultural experiment station research projects at north central U.S. land grant universities that relate in a very general way to the GEIS study questions, but nothing seems focused very specifically on any particular questions. Topics include revitalizing or improving the profitability of particular livestock enterprises or production systems; improving marketing practices; assessing the economic potential of particular livestock industries in a locale; assessing linkages between economic, environmental, and quality of life indicators; and assessing public policy. The agricultural economics departments at Purdue University and Kansas State University are particularly active in the areas of livestock price discovery, supply chains, and contracting issues. Project descriptions are available on the USDA National Agricultural Library's Current Research Information System web site http://cris.csrees.usda.gov/.

RECOMMENDATIONS FOR FUTURE RESEARCH

Question D2. With respect to the following factors, what is the current situation in the Minnesota livestock industry, what are the changes taking place, why are the changes occurring, and what are their implications:

<u>a. geographic distribution and</u>

<u>b. competitiveness in national and international markets</u>

Research could be conducted on the adequacy of policy measures to "democratize" or deal with the consequences of globalization, such as tax breaks and pilot projects for public employment for temporarily displaced farm workers and farm operators; and increased support and promotion of retraining programs and job-hunting assistance. Because the effectiveness of retraining programs for unskilled workers has been questioned, subsidies could also be extended to workers whose wages are depressed due to trade-related competition, rather than being limited to those workers who lost their jobs.

At the county level, if there was a single aggregate indicator of the restrictiveness of county feedlot ordinances or local opinion (and to our knowledge there is no such indicator at this time), it might be interesting to examine the correlation and causal relationships between market share and that indicator.

One question that was raised in the GEIS discussions is whether there are other states or regions where a type of livestock production was declining and then rebounded, and what had been done to bring about the turnaround. The Missouri swine industry is the main example that has been identified, but we have so far been unable to find a concise summary of the history which documents the timelines, what was done, what proved effective, and the economic, social, and environmental impacts of the turnaround. This could be a subject for future economic and sociological research.

<u>c.</u> <u>type of business organization and degree of vertical integration or coordination</u>
If more information was desired on this topic, the type of information presented in the 1993 Packers and Stockyards study could be updated with an emphasis on Minnesota. This might involve interviews of such industry leaders as Hormel, Swift, IBP, Cargill, LOL, Hubbard, Harvest States, and large Minnesota pork and dairy producers, for an MS or PhD thesis.

Question D1b. To what degree are livestock producers allowed to operate agricultural systems interdependently as opposed to independently in Minnesota and in other states and what is the significance?

A more in-depth research approach than that used by Mo and Abdalla might be to describe the ownership and control structure of interdependently-operated agricultural systems which are operating in at least one state, and then to compare their structure with the restrictions in other states of interest. If the restrictions would prevent their operation "as is", a further step would be to determine what adjustments in the ownership and control structure would be required to comply with the other states' rules, and to use some sort of economic simulation model to estimate the impacts on profitability. Figuring out what adjustments would be most realistic and the cost of each would be difficult. If the economics favor an interdependent structure, then entrepreneurial farm operators tend to exercise considerable ingenuity in coming up with new business arrangements to take advantage of the opportunities within the legal restrictions they face. It may be difficult for a researcher to anticipate the array of adjustments that entrepreneurs may come up with. For example, it has been suggested (but not proved!) that the present use of production and marketing contracts in swine production is a result of corporate farm laws which prevent coordination of production through direct ownership. Perhaps another example might be use of limited liability partnerships for Minnesota dairy farms as a way of involving more than the five unrelated owners allowed for an authorized farm corporation.

The business organization form known as a Limited Liability Company or LLC, which is not allowed for agriculture in Minnesota, is another alternative to an authorized farm corporation as a way for farmers to operate interdependently. The administrative costs of setting up and operating an LLC are said to be less than for a corporation, so documenting those differences could be one aspect of this research.

Another research topic that was suggested in the GEIS discussions would be to quantify the extent to which farm operations are utilizing multiple forms of legal organization, business arrangements, and capital sources as described in Boehlje and Lins.

Question D4. What is the current market situation, how is the market changing and what are the implications for livestock producers with respect to the following factors (concentration of buyers, contractual buying and selling arrangements, price discovery and market fairness, andlending practices):

The studies cited by Azzam and others on policy response to meatpacking industry concentration were done before the disastrous downturn in the hog market in late 1998 and early 1999. Retail pork prices have apparently not fallen as much as many pork producers think they should have in light of how little producers have been receiving. A specific question which this report does not address in detail is, • What is the farm-retail margin for pork and other livestock products, why have retail prices not fallen further, and who has been benefitting from recent increases in the margin?

The main source of information on farm-wholesale and wholesale-retail margins is the USDA Economic Research Service. The estimation of margins is becoming more complicated as product mixes change and the production, processing, and distribution stages become more integrated, as has been noted by some of the authors cited in the report. For example, more and more meat reaches consumers in further processed products such as pizza which include dairy products and other components. Putting a retail value on the meat portion of such products can be a challenge. The USDA margin figures are probably the most accurate available, but their exact magnitude needs to be viewed cautiously.

One reason economists feel that retail prices did not fall further was that limited slaughtering capacity would have made it difficult to move more meat through to consumers even if price reductions had stimulated demand. Normal price lag times and the cost of processing/distribution labor, packaging, shipping, etc. may have been other factors limiting retail price discounts, but few specifics are available at this point. This is a matter of considerable debate at the present time, and is an important topic. The time constraints under which we were operating did not allow us to address it.

Further research could be conducted on the adequacy of financing, technical and business planning assistance available to producers to facilitate rapid adjustments to marketplace changes. Commercial lenders are often said to pressure producers into signing production or marketing contracts in order to reduce operating risk. Thus, it seems possible that increased credit availability from programs such as those listed above would give producers more access to alternatives that leave them with more control and independence. If true, these programs may slow the trend toward increased vertical coordination and consolidation.

Question E2a. How is the profitability and economic viability of farms and firms affected by different production and marketing arrangements?

Perhaps more work could be done on different production and marketing arrangements affect costs at different stages of the supply chain, and which players in the supply chain would benefit from the improvements in the short run and in the long run, along the lines of the publications by Martinez and others that were cited.

Much of the debate about the fairness of long-term hog marketing contracts revolves around whether quantity premiums paid to producers under long-term marketing contracts or for larger spot market lot sizes are unreasonable compared to what is paid for smaller spot sales (see, for example section V of Land Stewardship Project). •Reasonableness• relates to how such premiums compare to differences in packers• procurement and operating costs. Specific research needs include: 1) how packers• hog procurement costs vary with lot size (number of animals involved in the individual transaction), and 2) how much slaughter plant per unit operating cost increases when the plant is operated below or above optimum rates on any given day. These cost differences are difficult for university researchers to study, due to lack of access to individual transaction and contract data. This may be an area that can only be effectively researched using data obtained under the auspices of the USDA Packers and Stockyards Administration•s or other government agency•s subpoena power.

Question E2b. What are the comparative internal economic costs and benefits of various livestock production systems?

As was mentioned in the critique of the study questions, one issue that is not specifically is the impact of possible higher future energy prices on the ways livestock is produced and marketed. This is a question that often comes up in discussions about the future of agriculture. This is a possible topic for future research.

More research is needed to better understand and the factors driving profitability, and development of models to help farm operators to strategically optimize the use of farm resources in the context of limited assets in order to achieve environmental and farm family life quality goals. These studies would include assessments of the cost and returns of environmental stewardship practices, adoption of technologies, management protocols, alternative business structures and networking with others, transition strategies, to the development of benchmarking and monitoring systems for better control of management processes.

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V-2. Literature Review Update: Regional Economic Impacts of Animal Agriculture

by George W. Morse and Steffanie Guess-Murphy

TABLE OF SECTION V-2 CONTENTS

INTRODUCTION

This section is an update of the 1999 Literature Review on External Costs and Benefits, Section II on community monetary flows. It focuses on the employment and income impacts to communities, regions, or states of livestock production and processing. For brevity, the earlier report is referred to as the 1999 GEIS Report and this current report as the "2001 GEIS Report."

The purpose of this literature review is to see how regional and community economies are impacted by animal agriculture. This literature review will explore the following questions:

1) What are the overall economic benefits of animal agriculture (from all sources, including spin-off economic activity?

2) How do the benefits vary by type of production method, size, and location of operation and the animal population/ density in area?

3) How are the economic benefits distributed locally (between owners, operators, employees, neighbors, and others) and in the state economy?

Primary attention is given to studies that have been done on Minnesota's livestock industry. Studies done in other parts of the nation that appeared to have useful insights for Minnesota are also covered. The studies are organized by species, followed by general livestock studies. Both farm production and processing plant studies are considered. Several very useful linkage studies of agriculture's contribution to a state's economy were found but these did not focus on livestock and thus were not reviewed in detail (Tanjuakio and others 1996; Carter and Goldman 1998; Senf and others 1992).

Ongoing research is integrated into the sections rather than having a separate section as in the 1999 GEIS report.

Under each section, we first report those studies which have been published in peer reviewed journals or are in Ph.D. theses. Then we report the ongoing research studies which are in working papers, staff papers, conference proceedings, or conference papers. We discuss these separately because they have not been reviewed by the profession as carefully. We give conclusions and the strengths and weaknesses of each study so that policymakers could use those they feel are sufficiently strong and ignore the rest. However, we caution the readers to use these very carefully. First, this review of strengths and weaknesses come from only one set of authors and not a team of three independent reviewers plus an editor. Second, these reviews are not anonymous which potentially introduces some bias.[7] The pieces of on-going research are also

[7] For non-academics, this might need some clarification. Consider the consequences if you review an article authored by someone controlling grant funds for which you are applying and your review is very critical. Consider the consequences if you write a very negative review on a very well known person in the field. In both cases the anonymous review, where you neither know the author nor they know the reviewer leads to better reviews.

listed separately in the References section.

A primer on the terminology and methods used in regional economic analysis is included in Appendix A.

SUMMARY OF NEW LITERATURE ADDED

Twenty-six additional research publications, not available for the 1999 GEIS Report, are included in this paper. Greater emphasis has been put on the results from anonymously peer reviewed articles rather than ones that are still in the formative stages. All journal articles which have met the minimum standard of having been published in a peer reviewed journal are included; we do not take into account the journals• rankings in terms of rigor and academic prestige.

SUMMARY OF FINDINGS

The following summarize the major findings of this portion of the literature review:

1) None of the studies found provide estimates of the net impacts of changes in the size of the livestock industry, after considering potential offsetting effects. In very tight labor markets, reductions in the livestock industry will release labor which will be used in other industries. If those industries contribute more to the state's gross state product than livestock, the net impacts would be positive rather than negative. While we doubt this would be the case, none of the current research provides insights on this question.

2) Nearly all of the studies found, although labeled "impact" studies, were descriptive studies that traced the economic linkages between livestock and other sectors. While these studies can show the economic importance of the sector, the data they provide can not be used to estimate the net impacts of a change in the livestock industry.

3) Studies of the impacts of livestock or livestock processing that use a with/without approach, comparing changes between economic variables in a given community and in "twin" communities have to be very careful in selecting the twins. We found no studies that reported on the characteristics of the twins in sufficient detail that we could be confident that the livestock plants caused the changes noted.

4) The literature on whether small farmers buy more locally than large ones yields mixed results. An early study suggested that the percent of local purchases was lower for large farms but that the total amount was as high as for small farms. A more recent study shows that generally the small farms do buy more within their county but buy almost all of their

inputs within the state.

5) The local employment and income impacts of larger pork farmers are higher than small ones when the survival rate is considered. If it were possible to keep all small farms in operation over time, they would contribute more to the local economies. The quality of jobs, in terms of wages per worker, was higher for large pork farms whether or not survival is considered.

6) Meatpacking plants provide benefits to local farmers but the wages paid are considerably lower than the average manufacturing wage. These wages have fallen greatly over the past decade as the meat packing plants have moved from urban unionized plants to rural non-unionized plants. However, the studies that use a before/after approach to examine the impacts of these plants are not methodologically correct. Given the changes in the structure of the industry, the studies would have needed to use a carefully designed with/without approach.

7) Presumably the labor in the meat packing plants are better off than their next best alternative employment or they won't stay. Many workers do not stay with turn over rates being high. However, if the plants are able to find employees, the current ones must be better off than they would be in their next best alternative. The impacts on the social aspects of the community are less clear but beyond this part of the report.

8) Meatpacking and poultry processing is moving to fewer big plants in remote rural areas. This reduces the odds that communities can use this as a development strategy. However, if the community is remote enough and other alternative jobs are scarce these plants can have a positive impact.

9) Wages appear to be competitive in the livestock production, after controlling for skills and regional differences. However, the research base for this conclusion is very thin.

10) The public sector fiscal impacts of livestock operations appear to be positive. Again, the research base for this is very preliminary and needs much greater attention. Further, this research does not tell us what would happen if the size of the livestock sector changed in a community or region.

11) Research on the impacts of farm size on poverty has used either the comparable area approach or a variation using multiple regression analysis. The most comprehensive study found rural poverty rates were influenced most by social relations and economic structure of the region and least by the size of farms.

12) In order to evaluate the trade-off between economic benefits and environmental or social costs of livestock production, changes have to be studied at the community or regional level. Studies done in other regions can not be extrapolated onto a local economy since the regions are likely to have different economic structures. Consequently, the same type and size of

livestock operation will have very different impacts in different types of local economies. Similar differences are probably true on the environmental side. The value of this generic study is in guiding future research rather than in guiding public policy.

CRITICAL REVIEW OF INFORMATION SOURCES

Minnesota Dairy Production Studies

No peer reviewed journal articles were found on the regional impacts of the Minnesota dairy industry.

Two studies reported in sponsored projects examined the dairy industry•s regional economic impacts within Minnesota. The first is an impact study but ignores offsetting effects. The second is a linkage study. A third study was found that tried to examine the impacts of different sizes of dairy farms.

In 1992, Ag*nomics Research estimated the impacts that differing production trends in the dairy industry would have on support industries and on state tax revenues by the year 2000. This study used regional input-output analysis to estimate the changes in payroll, employment, value-added income, and state tax revenue of alternative trends in dairy farm production.

The impacts are overstated because the authors failed to account for the offsetting effects of increases in employment in other sectors due to the labor released from the dairy industry. The estimates provided in this study assume that none of the workers who lose their jobs as a result of reduced dairy farm production will ever find new jobs. Especially in tight labor markets, this is very unlikely. While some of those that stop farming will not work again, many of these are simply retiring. The reduction in employment comes from the fact that the younger generation is not going into the dairy farm. However, if that younger generation goes into a more lucrative type of work and earns more than they would have on the farm, the state's economy could actually improve. It is difficult to determine what the net effect would be if this type of offsetting effect had been included.

In 1999 the University of Minnesota Extension Service published a linkage report on the ***Economic Importance of Minnesota's Dairy Industry*** (Doherty and Morse 1999). This is a descriptive report that traces the linkages between dairy farms, dairy processors, and other sectors in the state's economy. While this study demonstrates the importance of the dairy industry, it can not be used to estimate the impact of expansion or contraction of the size of the dairy industry. Estimates of the impacts of expansions or contractions in the dairy industry would need to examine potential offsetting effects in other industries. To examine the net effects would require explicit definition of the offsetting effects in other sectors.

While this study by Morse and Doherty (1999) did not make the same mistake regarding offsetting effects, it is on the edge. Readers might assume that they could extrapolate the descriptive results shown in these types of descriptive linkage studies when there is a change in the size of the livestock industry. This is only correct if the proper offsetting effects are considered.

Doherty (1999) estimates the economic contributions of several sizes of dairy herds. Using input-output, she compares the contributions on the state if all herds were in different size categories. She points out in the preliminary work that the survival rate of the different sizes of firms will make a difference in the actual impact. For example, if the larger dairy farms have a larger impact (controlling for total output) but a lower survival rate, then their impact would be diminished. Unfortunately, her research does not have the survival rate factored into the final estimates. This could be done in future research, however.

All of these studies used IMPLAN regional input-output models. A discussion of IMPLAN strengths and weaknesses comes at the end of section 2.1.

Dairy Production Studies in Other States: Only one peer reviewed journal articles was found on the regional impacts of dairy operations (Hanson, 2000). Unfortunately, this article discusses an integrated modeling approach, which is currently under development, for examining sustainable dairy production in eastern Pennsylvania. The express purpose of this article is to illustrate the complexity of this issue and to urge authors to empirically demonstrate the impact of equality issues on sustainability. It presents no empirical results.

Two working papers or Extension publications on the regional economic impact of dairy production were found. The first is an impact study of expanding dairy herds in North Dakota, but it does not consider offsetting effects. The second is a linkage study to show the contributions of the current industry in Idaho.

A 1993 study examined the impact on North Dakota of adding twenty 500-cow dairy herds to the state's economy. Using regional input-output analysis, this study estimated the total increase in value-added income to full-time jobs from the addition of the twenty 500-cow dairy herds (Leistritz 1993). These estimates appear valid if the following two assumptions are valid. First, the new jobs go to in-migrants or to new entrants to the labor force. If the new jobs go to existing workers who are commuting to jobs outside the region then the new income to the region would be lower than estimated here. Second, if the jobs go to workers who already work within the region and in-migrants do not come in to take their jobs, this development could drive up wages in the region. Then the number of total jobs would not increase as rapidly as shown by this model. While it is unlikely that wages in the dairy farms would be high enough to cause these shifts, additional analysis would be needed to evaluate the degree to which these two factors are likely to influence the results.

Another 1993 linkage study examined the importance of dairy production in Idaho (Robison and others 1993). Idaho had 24 percent more cows in 1991 than in 1970, compared to a 25 percent drop nationally (p.1). Using an Idaho regional input-output model, the authors estimate the percent of the state's gross income in 1989 due to milk and milk processing, measured in value-added terms. Due to differences in the local economic structure the multiplier effects varied considerably from region to region. Like the Doherty and Morse (1999) study for Minnesota, this is a descriptive linkage study that has no implications about the potential impacts of changes in the size of dairy herds.

Dairy Processing Studies in Minnesota: No peer reviewed journal articles were found on milk processing plant regional impacts.

In Minnesota, there were three working papers prepared for the Rural Design Center, University of Minnesota (Guess-Murphy 1999a, 1999b, 2000). All three studies used input-output analysis with type SAM multipliers in the estimation process.

The first study (Guess-Murphy 1999a) estimated the employment and income impacts of the expansion of First District Association (a milk processing plant located in Litchfield, Minnesota) on a six-county region in Minnesota. This six-county region consisted of Kandiyohi, McLeod, Meeker, Renville, Stearns, and Wright counties. Further, this study estimated the economic impacts that would result from an increase in the local milk supply to the milk processing plant. The author estimated the economic impacts under three different scenarios. The first scenario used data from the processing plant to develop a basis to compare the next two scenarios. Therefore, the first scenario just shows the linkages of First District Association (FDA) when it operates at its 1998 level of production. Further, it assumed that FDA receives 60 percent of its milk supply from within the six-county region. The second scenario estimates the impacts of an increase in local milk supply to FDA. It assumes that FDA's level of production is fixed at its 1998 level of production, but now it receives 100 percent of its milk supply from within the six-county region. The final scenario estimates the impacts of a 25 percent increase in the level of production of FDA assuming that it can receive 100 percent of its milk supply from within the region.

The second study (Guess-Murphy 1999b) also estimated the employment and income impacts of the expansion of a dairy processing plant. However, this study estimated the economic impacts of the expansion of Associated Milk Producers Incorporated (AMPI) on the eight-county region of Dodge, Fillmore, Goodhue, Houston, Mower, Olmstead, Wabasha, and Winona. Like the above study, this study also estimated the impacts associated with an increase in the local milk supply to the dairy processing plant. Further, the same scenarios were used as in the first study.

The main objective of the third study (Guess-Murphy 2000) was to estimate the impact of an increase in the number of dairy cows on three different regions under two different scenarios. The scenarios dealt with the size of the farms that would receive the additional dairy cows (30,000 additional dairy cows to be exact). First, it was assumed that only small farms (50-99) head would receive the 30,000 additional dairy cows. Then, the economic impacts associated with the increase in milk production from the additional dairy cows were estimated for Meeker County, a six-county region consisting of Kandiyohi, McLeod, Meeker, Renville, Stearns, and Wright, and Minnesota as a whole. Next, it was assumed that only medium-sized dairy farms (200+ head) received the 30,000 additional dairy cows. As in the first scenario, the economic impacts associated with the increase in milk production was estimated on the three regions.

The purpose of all three of Guess-Murphy studies was to examine the relative impacts of different arrangements within the dairy industry. As such, the question of offsetting effects are probably not as relevant as with other studies. However, these studies can not be used to show the net impacts of reductions in dairy production.

Summary of Dairy Regional Economic Impact Studies: The research on the regional economic impacts of dairy production and processing is in its infancy. No peer reviewed journal articles were found that estimated either the economic linkages or the economic impacts of changes in the dairy production or processing.

The working papers and Extension publications either are linkage studies which show the current importance of the industry and its support industries or are impact studies that do not report on the offsetting effects. Consequently, it is impossible to determine the net impacts of these changes from these studies.

Only two of the studies report on wages or personal income. However, all eight of the studies reported on the total value-added income impacts which includes wages as well as profits, interest, and indirect business taxes. Three of the studies reported the changes in value-added to crops or the number of additional jobs in crops as a result of the dairy production. None of these studies examined the changes in property values. Two estimated the changes in tax revenues, and seven of eight estimated the changes in total number of jobs in the state economy.

Three of the studies are descriptions of the linkages of the dairy industry to the rest of the economy and make no predictions of the impacts on the economy from changes in the dairy industry (Doherty and Morse 1999; Doherty 1999; Robison and others 1993). Five studies attempt to predict changes in the state's economy from changes in the dairy industry. The Ag*nomics study estimates overall trends in milk production and uses these estimates to predict the changes in the input and consumer sectors stemming from these changes. Since this study did not address the potential for offsetting effects, it is not possible to determine whether the net results will be positive or negative.

The Leistritz (1993) report examines the impacts of twenty, 500-cow herds on the state's economy. If there are no price effects due to increased wages stemming from lack of sufficient in-migration of labor or due to shortages in other inputs, then these estimates are reasonable. Additional research would be needed, however, to confirm the validity of these conditions.

All of the studies address the general importance of dairy. Yet, none of them satisfactorily address the net changes in a region's economy due to changes in the dairy industry. The North Dakota study probably comes the closest to doing this but both the estimates and the offsetting effects would need to be localized to guide zoning policies. Since the nature of the impacts depends on the structure of the local economy, both the size and the distribution of the impacts will vary with the region being studied. This was demonstrated in the Idaho study that reported differing multipliers for the same processing sectors in different regions.

Research on local feedlots would need to factor in offsetting effects. This will also vary widely from region to region. In areas of very high unemployment and little rural residential development there will be minor offsetting effects. However, if labor markets are tight and the land is likely to be used for high valued residential developments, the offsetting effects will be high

Minnesota Pork Production Studies: One Ph.D. thesis examines the linkages between the pork industry and local economies and the linkages between the pork industry and the state's economy (Platas, 2000). This also is reported in a popular article (Lazarus, Morse, Platas, and Guess-Murphy, 2000) , Since this study focuses on regional purchasing patterns it is reported under the section on "Purchased Supplies by Location of Purchase."

A second study is reported in a working paper. A 1992 study by Jahae and van Staalduinen estimated the impacts of a proposed 1200 sow unit on Redwood County, Minnesota and on the economy of Minnesota as a whole. They concluded that final demand, total industrial output, property income, employee compensation income, total income, total value added, employment, and population would all increase in both the county and the state due to the proposed sow unit. They estimated a total effect, including indirect and induced effects, of 17 jobs in Redwood County (p. 19) and 25 jobs in Minnesota (p. 24). The production function was adjusted to reflect the fact that this new unit would be more efficient than the average unit in southern Minnesota (p.1).

Pork Production Studies in Other States: Nine studies have released non-peer reviewed articles on the pork industry. These are now summarized.

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 and others 1998; Otto and others 1996). Thompson and Haskins (1998) provided a critique of these articles. All three are reviewed 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 and others 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 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 less 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 a farm in each of the four sizes of 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.

As discussed in a later section, the local impacts depend on the level of local spending for inputs and consumer spending by farmers. The Otto, et al. studies did not make any adjustment for potential differences due to size. As discussed later, this omission probably gave a slight advantage to the smaller farms since larger livestock farms spend more per acre (Chism 1993). Note that this conclusion is very tentative since the data on this relationship is based on a very small sample.

Thompson and Haskins (1998) correctly criticize the 1998 article (Otto and others 1998) 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. That is, they argue that Otto, et al. should have held the level of output constant for the four different sizes rather than comparing one very small farm with other larger farms. Using the data from Otto et al. reports, Thompson and Haskins show that twenty-three of the smallest farms would produce the same amount as the largest farm. Using Otto et al.'s data, Thompson and Haskins go on to show that if all the production was in the smallest farms they would employ considerably more persons than the one large one (p. 4).

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. make this type of estimate.

Thompson and Haskins correctly state the strengths and weakness of formal mathematical models such as regional input-output models. They state:

> "They use a mathematical model to compute the conclusions that must follow from the assumptions they make. That way, if the methods are sound and they have done the arithmetic correctly, a reader is forced either to accept their conclusions, or to argue with the assumptions. The model rules out accepting the assumption but disagreeing with the conclusions that follow. That's the benefit and the power of formal methods of mathematical modeling. But it's also their weakness." (p. 7)

Note, however, that the conclusions that Thompson and Haskins refer to are the factual consequences of a specific economic shock. Input-output models can provide no "conclusions" on the correct policy to follow. Policy conclusions can come only with a blend of the factual impacts provided by the models and value judgements (Barrows 1993).

Thompson and Haskins then question the veracity of the cost data used by Otto, et al. While possibly this data is incorrect, Thompson and Haskins provide no evidence to this effect. An evaluation of the accuracy of this data is beyond the scope of this literature review and would take a team of production economists rather than regional economists.

The Iowa State study on the impacts of different sizes of pork operations (Otto and others 1996; Otto and others 1998) did not adjust the level of input purchases by farm size. As outlined in the original report, the Otto, et al. papers found that larger pork operations had more positive economic impacts than smaller ones. As Thompson and Haskins (1998) point out the Otto, et al. papers should have set the total level of output equal before making a comparison but did not. When this is done, the smaller farms appear to have the advantage in terms of number of jobs but the disadvantage in terms of the quality of those jobs (i.e. income per worker). However, the Thompson and Haskins analysis fails to consider the survival rate of different sizes of farms. If larger pork farms are more likely to survive than smaller ones, as Otto, et al. suggest, then the economic benefits of large farms are likely to be larger than the small ones.

The Platas study reviewed in detail under the section on regional purchase coefficients corrects for many of the concerns identified by Thompson and Haskins. It found that larger pork operations had a greater impact than smaller ones when controlling for the expected differences in survival rate.

In a 1994 study, DiPietre and Watson used input-output analysis to estimate the impacts of Premium Standard Farms on the state of Missouri and a five county region where the hogs and the employees are located. They estimated the impacts during the five-year construction phase as well as annually after the farm was in full operation (Table 2). These were ex ante estimates so it is uncertain if the direct impacts were as high as estimated. Naturally, the total impacts would be less than these estimates if the direct ones are lower.

The construction costs were industry estimates on a per sow basis not exact figures from Premium Standard Farms (p. 26). Type III multipliers, a special version of Type II which yield 15 to 20 percent lower results than the Type II, were used to estimate the total effects.

Table 2: Economic Impacts of the Premium Standard Farms, Missouri

Phase	New Jobs		Personal Income *	
	Five Counties	Missouri	Five Counties	Missouri
Construction #	873	1291	$87.2	$ 119.0
Operation +	957	1639	$82.0	$ 199.0

Results over the five
+ Annual impacts
* in Millions of dollars

Three additional studies estimated the economic impacts of pork production in their respective state using input-output analysis (McKissick and others 1998; Thornsbury and others 1993; Warner and Plaxico). The three states that were covered in these analyses were Georgia, Virginia, and Oklahoma, respectively. The Georgia study used IMPLAN for their analysis. The Georgia study estimated the total economic output, wages, and employment impacts of four different size plants on Bacon County, Georgia. 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 Virginia study 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 combined 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 to evaluate proposals concerning the most desirable structure of pork farming (mostly large or mostly small) are the ones by DiPietre and Watson, 1994; Otto, Orazem, and Huffman, 1998; and Otto, Lawrence, 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.

Minnesota Poultry Production Studies: No peer reviewed journal articles were found on poultry industry linkages or regional economic impacts for Minnesota. One Extension bulletin was found that dealt with the economic contributions of the poultry industry in Minnesota.

A 1998 linkage study examined the importance of the poultry industry on Minnesota's economy (Morse 1998). This study only traced the linkages between the poultry production sector, the poultry processing sector, and the other sectors in Minnesota's economy. The study did not try to estimate the economic impacts of expansions or contractions in the poultry industry.

By using regional input-output analysis, Morse found that the total number of jobs that were created in Minnesota due to the poultry industry was 26,344. Only 10,308 of these jobs depended directly on the poultry industry. Over 10,000 jobs were created in the supply industries, and over 5,000 jobs were created due to increased spending by employees in the poultry industry.

Besides employment impacts, this study estimated the income impacts associated with the poultry industry. It was found that poultry producers and processors earned income of $317 million. When the supporting industries are included, the estimated earned income for the poultry industry was $905 million.

Poultry Production and Processing Studies in Other States: Three peer reviewed articles were found related to poultry production and processing. All three were linkage or economic importance studies.

Ryan, Carey and Birkhold (1999) trace the linkages between the broiler and egg industries to the rest of the Texas economy. While they refer to this as the "economic impact" they use this term incorrectly. Refer to the earlier discussion on the differences between linkage studies and impact studies.

An eight question survey was sent to twenty-three turkey, broiler, and egg producers. Since only one turkey grower responded, this sector was dropped from further analysis. The article reports on the total employment, payroll, feed milled, and gross income for broilers and eggs.

To estimate the indirect effects or multiplier effects, the article uses a generalized multiplier rather than one specific to Texas. They suggest that this " probably understates the true economic impact of these industries." Yet, without the data on Texas they have no way of knowing whether it understates or overstates the contribution to the Texas economy. Further they do not tell us whether they are using Type I, Type II, or SAM multipliers.

Brown (2000) compares the contributions of five red-meat-packing and five poultry-processing plants in their local economies. The study concludes that a $10-million expansion of poultry processing plants would contribute more to their local economies than a similar expansion of red-meat packing plants. Brown attributes this to the greater labor intensity of the poultry processing plants.

However, what would be the impact of the poultry processing plants if they were located in the same communities as the red-meat packing plants and vice versa? Since both types of plants tend to locate close to areas with high levels of production, the impacts of these reverse locations is likely to be much lower. That is, poultry plants located in the red-meat areas are likely to have much lower impacts than the red-meat plants simply because they would have to import their poultry from outside the region. Even if the poultry plants could survive, they would have very low multiplier effects.

A 1995 study estimated that the poultry industry, including both production and processing sectors, in North Carolina helped to create approximately $1.6 billion in state income (Vukina and others 1995). The poultry industry also supported close to 52,000 jobs. However, this study is also a descriptive one and can not be used to estimate the impacts of changes in the size of the poultry industry.

Another 1995 study examined the impacts of the poultry industry (Hurst and others 1995). The authors studied the impacts of the broiler and egg industry on Alabama. They used the RIMS II input-output model to estimate these impacts. The authors of this study did not explain their procedure for estimating the economic impacts of the poultry industry. Thus, we do not report the results since it is impossible to evaluate the validity of their assumptions and methods.

All of the poultry studies are descriptive ones which trace the linkages between sectors. They can not be used to estimate the impacts of an expansion or contraction of the poultry sectors.

Minnesota Beef Production Studies: No articles were found dealing with the economic impacts of the beef industry on Minnesota.

Beef Production in Other Studies: Two working papers were found about the economic impacts of the beef industry. Both studies were for North Dakota.

A 1992 linkage study by Bangsund and Leistritz estimated the economic contribution of public land grazing to the North Dakota economy. This study was only a descriptive study. It did not try to estimate the impacts that a contraction or expansion in public land grazing would have on North Dakota.

The authors estimate that public land grazing contributed about $153.4 million to the North Dakota economy in 1991. Public land grazing also generated over 1,800 jobs. The authors only gave secondary employment impact estimates. Thus, public land grazing probably generated more jobs than just the 1,800 stated in the study.

A 1993 impact study by Leistritz and Sell estimates the economic impacts of expanded backgrounding on the North Dakota economy. Backgrounding is a program in which producers of feeder cattle retain the cattle until they achieve a gain of 150 to 300 pounds after weaning instead of selling the calves out of state. The authors estimate that expanded backgrounding would generate 1,030 full-time secondary jobs. State tax revenue from additional use and sales tax, personal income tax, and corporate income tax receipts were estimated to total approximately $1.4 million.

The employment impact estimate was only for secondary effects. Thus, the total employment impact is probably higher. Also, part-time employment was not considered in this study. When adding full-time and part-time employment, the number of jobs generated will increase. However, the estimates in this study assume that these jobs are going to in-migrants or currently unemployed residents. If current residents who are employed by other industries quit their jobs to seek work in this industry, the employment impact will be dampened.

Impacts of Meat Packing Plants: If rural areas attract new meat packing plants will this stimulate additional economic growth and development in the community or region? What are the odds that a community can attract these types of firms?

These questions are explored in an article by Drabenstott, Henry, Mitchell (1999). Meat processing is the largest rural manufacturing industry, accounting for about 50 percent of all rural food processing jobs. Further, "meat processing plants buy more material input per plant from local sources (defined as being within a one-hour drive of the plant) than any of the other eight sectors in the food processing group" (Drabenstott, Henry, Mitchell, 1999, p. 66).

This article tracked the movement of meat packing plants using the Census Bureau's Longitudinal Research Database (LRD). The LRD provided data on each plant for 1963, 1972, 1982, and 1992.

Poultry processing plants moved from the Midwest and Northeast to the South, which had about half of all poultry processing jobs in 1992. The Midwest remained the center of meat packing (58% in 1992) but the plants moved from urban to rural areas and from the eastern Corn Belt to the western Corn Belt. The processed meats industry is primarily in the Midwest with some shifts from the Northeast to the South.

Drabenstott, Henry, and Mitchell suggest that remote rural areas appear to capture the most new jobs from new meat packing plants. They hypothesize that meat packing plants are searching for lower labor costs and moving closer to livestock herds in remote rural areas. Livestock production has moved to more remote areas as the size of herds has increased. The ability to ship boxed meat has made it better for plants to locate near the livestock. This has also resulted in larger plants. Additional vertical integration in the pork and beef industries is expected to lead to greater geographic concentration in processing plants and larger production units. This suggests that few rural areas will attract new meat packing plants.

Wages have fallen abruptly in meat packing plants. This has lead to many of these jobs being filled by immigrants.

Farmers, however, are likely to benefit from new meat packing plants being located in their region. This research was also reported in a popular article by Drabenstott, Henry, and Mitchell, 2000.

Pork Processing Impact Studies: Two studies examined the impacts of pork processing plants. One was published in a peer-reviewed journal and the other was not.

Broadway (1999) reports on six case studies of hog-processing plants that reopened or moved to small towns in the Corn Belt. The plants offered more jobs than could be supplied by the unemployed labor force so commuters and immigrants filled the jobs. He suggests that only one of the six serves as an example of what attracting a processing plant would do for a community with no experience with the industry. In this very small town (1,600), the 1,250 new jobs resulted in population growth and higher wages. However, these did not significantly increase retail sales.

A key to any study is that it provides sufficient detail on its research methods so someone else could replicate it. Broadway's article doesn't pass this test. He only mentions that he "surveyed the towns in 1991." This study used a before-after impact methodology which is subject to the concern that other factors might influence the changes.

In a report to the Kerr Center for Sustainable Agriculture, the impact of the 2,200 job Seaboard pork processing plant was examined. This study used the with/without method for estimating impacts of the Seaboard plant on Texas County, Oklahoma. The authors compared the rate of change in economic, social, environmental and human capital factors in Texas County with the changes in the same factors in thirteen other farm-dependent counties in Oklahoma between 1990 and 1996. If the rate of change between the comparison counties and Texas County was found to be significant, "then the result arrived at was the presence of Seaboard made a difference." (Flora, 1999, p. 23).

The report concludes that jobs and bank loans did not increase significantly compared to the comparison counties. Income per capita fell in both areas with the processing plant paying an average of $8.31 per hour. The tax base and the value of housing increased faster in Texas County than in the comparison counties.

The report suggests that it was not the residents of Texas County that benefited from the new pork processing jobs, but outsiders who moved into the area.

Unfortunately the report tells very little about the comparison counties. It only says that "all the farming dependent counties in Oklahoma are included in the analysis. Farming contributed a weighted annual average of 20 percent or more of total labor and proprietor income over the three years from 1987 to 1989 in these counties." Does this make these counties twins which would change in the same way as Texas County except for the addition of the plant?

The following questions need to be considered before concluding that the comparison counties are good matches:

1) What have been the trends in employment in the comparison counties and the target county?

2) Was Texas County growing slower, the same or faster than the other counties?

3) What is the economic structure of the counties outside of agriculture?

4) Did Texas County have a mix of industries likely to grow more slowly than the other counties? Or faster?

5) What was the location of Texas County and the others in relationship to the regional trade centers?

If the mix of non-agricultural industries in the comparison counties was more dynamic than in Texas County or they were located close to other trade centers and receiving spillover growth, then it is not reasonable to attribute the differences to the pork processing plant. The impacts of the pork plant might be greater than or smaller than those shown.

Strengths and Weakness of IMPLAN Regional Input-Output Model and Data:
Since most of the regional input-output models used were built around the IMPLAN model and database, we consider the strengths and weakness of this model and database.

There are three major data weaknesses in the IMPLAN input-output models. They are: 1) the value of inputs purchased by a livestock producer reflect national averages for usage/head and national prices; 2) the amount of labor used in livestock is estimated to be one worker per farm, regardless of size of the farm; and 3) the regional purchase coefficients are estimated from secondary data and might be inaccurate.

Ikerd suggests that the default IMPLAN data might understate the impacts of owner-operated family farms on retail employment and overestimate their impacts in manufacturing (p. 165).

From the data perspective, the major strength of the IMPLAN software is that it allows the analyst to modify all three of these with local data when it is available. For example, Otto, Lawrence and Swenson (1996) use cost data from Indiana to run the analysis of different sizes of pork operations in Iowa. Morse used data from the Minnesota poultry industry to adjust the input purchases when studying turkeys, eggs, and broilers. Doherty used cost data on different sizes of dairy herds to avoid the first two problems. The third problem was addressed by several authors but none adjusted the regional purchase coefficients.

Two general weaknesses of all input-output models are: 1) they are inappropriate to use for very large impacts; and 2) they do not account for commuting. If the impact is large enough that it leads to increases in wages or in the prices of any inputs, the results stated by IMPLAN will be overstated (Kraybill, 1993). After commuting is accounted for the employment impacts are likely to be considerably smaller than derived from IMPLAN.

In evaluating IMPLAN studies, one should ask if the researcher did the following:

1) Compared the national expenditure patterns to regional ones and adjust where necessary?

2) Validated the models estimated regional purchase coefficients and adjust as necessary?

3) Examined the labor and employee compensation coefficients and adjusted as necessary?

4) Considered the offsetting effects when defining the economic shock scenario?

5) Considered whether the size of the economic shock would be so large that prices would increase for labor or other inputs?

The major strength in regional input-output models is that they can provide detailed estimates by sector. This allows the researcher or the public to check the validity of the assumptions used and the reasonableness of the results.

HOW DO THE BENEFITS VARY BY TYPE OF PRODUCTION METHOD, SIZE AND LOCATION OF OPERATION AND THE ANIMAL POPULATION AND DENSITY IN THE AREA?

Is a community's economy better off with a lot of small farms or a few large ones? This is the question examined in this section. In many cases size is also related to the production methods with small farms being independently owned and operated and the larger ones being vertically integrated. This section looks at the research on whether large operations and vertically integrated ones yield more or less community benefits than small independent operations. While the density of animals is often greater in the large integrated operations, no separate studies were found of the separate impact of the population and density, controlling for size. This section looks at research which has been done on the differences in wages, value added to crop prices, purchased supplies, property values, tax base, jobs, and poverty.

Wages: This section reviews the literature that deals with the effects that animal agriculture can have on wages, salaries, and benefits.

Hurley, Kliebenstein and Orazem (1999) used data from 967 pork producer employees, or 11% of a sample of National Pork Producers Council-National Hog Farmer magazine subscribers, to examine wages in the hog industry for 1995. They found that: 1) wages in the pork industry appear to be set by the regional or national markets, and 2) differences in wages were largely due to differences in human capital, gender, and firm size. Wages in the Southeast and West of the USA were higher, apparently due to the rapid expansion of large-scale operations there. These operations may have needed to offer higher wages to support this growth.

Hurley, Kliebenstein, and Orazem (1999) state, "Should similar expansion occur in the Midwest, we would expect similar increases in wages. Larger firms pay more than small firms, in part because of a production complementarity between skilled labor and technology. However, even controlling for technology, a strong positive relationship between wages and annual hog production remains."

If the one large buyer had a "buyer's monopoly," it is called a "monopsony." Assume it had a buyer's monopoly on both labor and livestock. Then it would pay lower wages than it would if it was a perfectly competitive buyer. And it would pay lower prices for the livestock than if it was in a perfectly competitive market. Hurley, et al. found that the higher wages offered by larger firms do not support the hypothesis that larger firms locate in labor markets with low wages or that larger firms exercise monopsony power in local labor markets. The more generous compensation packages paid by larger firms suggest that rents accrued as a result of cost savings due to economies of scale are shared with employees (p. 161).

Hurley, Orazem and Kliebenstein (2000) report on the changes in wages in pork production from 1991 to 1995. They found the predicted wages increased by 61 percent for 1991 to 1999 compared to a 33 percent increase for the average civilian USA wage (p. 11). This resulted in wages in the pork industry moving from 20 percent less than the US average in 1991 to only 3 percent less in 1999 (p. 12). Between 1991 and 1995 wages grew for all pork employees. Between 1995 and 1999, the primary factors pushing up pork industry wages were increases in education, operation size, and technology use.

However, the results depend on the assumption that the sample in each year is representative of the full population. The response rate dropped from 18 percent in 1991 to 11 percent in 1999. Is it possible that the lower response rate in 1999 is skewed toward those with greater education and that the predicted wages have an upward bias? Despite this, the regression coefficients, which allow the authors to trace the source of wage increases, probably are not effected by this potential selectivity bias.

In the 1998 study written by Otto, Orazem, and Huffman, they found that the earnings per worker were positively related to the size of the farrow-to-finish operation. Workers in the 3,400 sow units earned an average of 16 percent more than those in the150 sow units. Thompson and Haskins (1998) do not challenge these estimates on the quality of jobs by size of operation.

Grey's (1998) chapter about the effect of the new IBP plant in Storm Lake illustrates the difficulties of comparing changes in wages in two points in time. Grey compares the wages at the previous Hygrade plant that went bankrupt with the new IBP plant rather than comparing the IBP wages with what was currently available in the community.

While it would have been better for IBP workers to have earned the same wage rates as the Hygrade workers, the high wages were one of the factors for the closure of the Hygrade plant. Were the IBP workers better off with their IBP jobs at the low wages than if they had been unemployed or had to move or to commute? Since the IBP workers were free to either commute or move, one could reason that they picked their best feasible alternative and thus are better off with the IBP jobs than without them. On the other hand, to conclude this we would need to know if the workers were given reliable information on the wages, benefits, cost of living, and working conditions. While a comparison to the Hygrade jobs is not realistic simply because those jobs no longer exist, we do know that the IBP jobs were relatively low paying.

Miller (1991) reported on a survey sponsored by the National Pork Producers Council of 1,472 producers and 1,270 employees. Approximately 91 percent of the employees worked in hog operations that produced 100 or more head of hogs per year, with 25.7 percent working in herds of 500 sows or more. Eighty-nine percent of the employees were in units of less than 1,000 sows. Twenty-eight percent of the employees had a four-year college degree or more, while another 33 percent had two-year college programs.

Fogleman, et al. (1999) did personal interviews on 92 Northeastern USA dairy farms to collect data on wages and other employee compensation. The sample included Northeast Dairy Producers Association members. For the 709 employees included in the study the average total compensation was $27,433. This average ranged from an average of $21,712 for competency level 1 to $38,847 for competency level 5. At all competency levels there was a fairly wide range of compensation. In contrast to Hurley, et al. (2000) additional education did not have a significant impact on compensation. Yet the competency level variables were all significant. The relationship between competency levels and education was unclear. We expect the reason education had no effect is that the competency levels were highly correlated with education.

Farms with more cows paid high compensation. Experience in other dairy farms did not result in higher pay while longer tenure on a farm did.

Value-Added to Crop Prices: Will additional production in a county or region lead to higher crop prices? Or will imports from other counties and regions result in a fairly uniform price across large regions? No articles were found on this topic but one is underway as mentioned later.

Purchased Supplies: Two streams of research are relevant here. First, regional input-output analyses provide details on the types of supplies that are estimated to be purchased by animal producers. The second stream of research examines the question of whether large livestock farmers buy less locally than small ones.

Purchased Supplies from Other Economic Sectors: Table 3 shows the distribution of economic impacts by various sectors for a 1200 sow unit on the state of Minnesota in 1991 (Jahae and van Staalduinen 1992). Not all of these supplies were purchased directly by the hog operation. For example, the dairy farm products would have purchased some feed grains, soybeans, and hay to produce milk that was purchased by hog operations. However, all of the amounts shown in Table 3 are spin-offs of the 1200 sow unit.

Table 3: Indirect Effects of the 1200 Sow Unit on Minnesota, 1991

Industrial Sector of Purchased Supplies	**Value of Supplies**
Dairy farm products	28,200
Feed grains	103,700
Hay and pasture	31,700
Oil bearing crops	14,900
Agricultural forestry	17,200
Maintenance and replacement	10,700
Farm equipment	15,800
Railroads	12,200
Motor freight transportation	38,600
Electric services	33,500
Other wholesale	107,400
Other retail trade	11,900
Banking	46,600
Credit agencies	9,700
Insurance carries	21,200
Insurance agents	4,900
Real estate	100,100
Hotels and lodging	3,500
Misc. Repair shop	7,900
Accounting, audit	6,000
Eat/drinking place	6,000
Auto repair	13,500
Other medical	21,700
Other indirect	195,200
Total	**862,200**

Regional input-output analysis can trace the impacts to 528 sectors in the economy. Most of the reports aggregate to avoid overloading the readers. Table 3 is included only to illustrate the type of information provided on purchased supplies by regional input-output models. 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 which 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 and others 1989; Ralston and others 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.

The second stream of research attempts to examine the location of the purchases of inputs. In fact, the above estimates include data on the percentage of local purchases that come from local supplies (called the regional purchase coefficient).

Purchased Supplies by Location of Purchase: 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.

Diego Platas' Ph.D. thesis (2000) examines the linkages between the pork industry and local economies and the linkages between the pork industry and the state's economy. This also is reported in a popular article (Lazarus, Platas, and Morse, 2001) and a research report (Lazarus, Morse, Platas, and Guess-Murphy, 2000).

This study provides an interesting examination of whether large or small pork producers contribute more to local economies and the state economy. This study made several innovations over prior studies done in other states (reported next). First, this input-output study used farm level data in Minnesota to create local production functions for two different sizes and two different types (farrow-to-finish and finishing only). Second, pork producers were surveyed to learn their spending patterns for their major inputs. The producers were asked what county and state they purchased their key inputs. With this data the percentage of local demands satisfied by local production, called regional purchase coefficient or RPC, was estimated for each input. Third, estimates of the regional economic impacts were made for four different local economies and for the state for each size/type combination. Fourth, the impact scenarios assumed all production was in a given size/type so that the differences would not be due to the difference in output levels. Fifth, the consequences of considering the likely survivability of different sizes of pork operations are considered. These innovations overcome most of the methodological concerns raised by Thompson and Haskins (outlined below).

At the state level, Platas found the overall percentage of inputs purchased within the state to range from 78 percent for large finishing operations to 89 percent for small finishing operations. Large farrow-to-finish operations purchase 85 percent of their inputs within the state compared to 88 percent for small farrow-to-finish producers. At the county level, the overall percentage of inputs purchased within the county was lower for every county and every size and type of operation. However, there was huge variation between the counties and operations. Generally, small operators purchased more locally than the large ones. At the state level this difference was very small for farrow-to-finish operators (3%) and relatively small for finishing operations (11%).

In two counties, the small finishing operators purchase 25% (Blue Earth) and 27% (Pipestone) more locally than the large operators. But in Martin County the small finishing operators purchase one percent less than the large ones. For the farrow-to-finish farmers the smaller ones purchase more locally in all cases than the larger ones. However, the difference varies from only 7% (Pipestone) to 15% (Blue Earth County) to 25% (Martin County). While this project provides new information on pork producer purchasing patterns, policy decisions require a picture of the regional economic impacts. We turn to this next.

Platas used the above data in sixteen different input-output models to explore whether small pork producers contribute more to local economies than large ones. Platas found that the three county average value-added income of large farrow-to-finish farms was 40 percent greater than small ones, assuming both were producing $40 million in pork per county. At the state level, the difference was even greater (45%). Similar results for the other types/sizes are shown in Table 4.

Table 4: Relative Income Impacts under Other Types of Operation Compared to Small Farrow-to-Finish Operations*

Type of Operation	Three-County Average**	Minnesota
Small farrow-to-finish (baseline)	0%	0%
Small finish and large sow	+56%	+45%
Large farrow-to-finish	+40%	+45%
Large finish and large sow	+10%	+28%

*Assumes a 33% attrition rate among small operations, identical to that observed in Minnesota over the past four years. ** Includes Blue Earth, Martin, and Pipestone Counties. No large farrow-to-finish operation was in Murray County so it was omitted.

While the large producers yield more economic benefits than the small ones, this doesn't tell a policy maker that they should be preferred. These benefits have to be balanced against any environmental costs or benefits by size. Table 4 suggests, however, that state policy makers are likely to be more favorable toward large producers than local ones. First, the relative economic benefits of larger producers are higher at the state level than at the local level. Second, any environmental damages are more likely to be local than state-wide.

Platas did not consider offsetting effects but his study is not simply a linkage study as we outlined earlier. Given the issue he is studying the lack of the offsetting effects is not as relevant.

Sociologist Walter Goldschmidt predicted the demise of rural communities based on the view that large farms would buy less locally (1978).

Marousek (1979) surveyed 84 Idaho farmers (49 small ones and 35 large ones) and found that small farms spent a higher percentage of their production expenditures locally than large ones (59 versus 55 percent). However, large farms spent nearly five times more than small farms in the local area. He found that 22% of the small operators expected to cease farming within five years but none of the large ones did (p. 58).

The Marousek (1979) study is one of the few input-output studies that uses survey data to develop the regional input-output model. The model is highly aggregated (19 sectors compared to recent models of 528 sectors) and has only two agricultural sectors. These are: "large farms" and "small farms." To use input-output with this type of aggregate sectors in agriculture, it is necessary to assume that the type of crops and livestock in large and small farms is identical. Assuming this, he uses the model to examine the tradeoffs between large and small farms on the rest of the community's economy. He found that:

> "Displacement of small farms by large farms results in greater regional income whereas increasing the number of small farms yields greater regional employment. Agricultural output is comparable for the two farm size structures" (p. 61).

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 by those opposed to large farms (Ikerd, 1998, p. 157; DeLind, 1998, p. 29; Thu and Durrenberger, 1998, p. 7; Lasley, 1995, p. 127). In fact, the Chism/Levins article reports that large farms buy as much per acre as small ones in absolute terms. However, the per acre comparison is problematic since the large farms had fewer acres. If a large confinement operation with 500 cows on 15 acres buys most of its feed, the expenditure per acre is going to be much higher than for a 100 herd dairy with 160 acres that grows all or much of its own feed.

The Chism/Levins study has two methodological problems. . First, the livestock conclusions are based on a very small sample (12 farms). Second, "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" (p. 17 and 18).

Property Taxes: Property values might increase in value due to the additional economic demand stemming from growth in the livestock industry. Or, property values might fall due to the negative influence of odors or water pollution or other externalities. This aspect is reviewed in the externalities part of the report done by Carl Philips.

Tax Base/Taxes: This section reviews the documentation regarding the effects of animal agriculture on the tax base, and taxes in general, of the respective region. First, the findings from articles that deal with Minnesota agriculture will be summarized. Then, the findings from other states are reported.

Minnesota: Currently there are no completed studies on the tax base or taxes stemming from animal agriculture.

Other States: Only two studies were 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.

DiPietre and Watson (1994) also estimated the public sector fiscal impacts. They left plenty of room for improvement in the estimation methods for the public expenditures. They simply assumed that the cost of repair to county roadways damaged by construction vehicles was $3.7 million or equal to the amount paid by Premium Standard Farms for this same purpose. In addition, they included $115,000 for “on the job training.” Despite the addition of 873 jobs over five years, they assumed no additional costs for police, fire, sanitation or other general public service costs. Equally as interesting is that they assumed no additional costs for any local public services during the operational phase, despite the addition of 957 new jobs. This might be reasonable, given the depressed conditions in the region. However, the report provides little justification for these assumptions on expenditures.

Poverty: Goldschmidt (1978) suggested that communities that have primarily small farmers are better off because the smaller independent farmers will be more interested in the well being of their local communities and will invest in its institutions. In contrast, he reasoned that large commercial farms will have separate management from labor and absentee ownership, resulting in lack of interest in the well-being of the local community. He compared two California communities, confirming his hypothesis. Goldschmidt examined the communities of Arvin, CA (with primarily large farms) and Dinuba, CA (with primarily small farms). He examined detailed information on the character of their agriculture and a wide variety of other social and economic variables. On the retail businesses, he found that Dinuba had more than twice the number in Arvin, “showing that the small farm population supports small business to a far greater extent” (p. 381). In addition, Goldschmidt points out that the “total volume of expenditure and the volume per person is appreciably smaller in Arvin than in Dinuba” (p.391). However, he also suggests that this could be due to the influence of another urban center near Arvin. As with other comparable area studies, it is difficult to know how much of the difference between two areas is due to the farm size and how much is due to completely unrelated variables which also influence the number of businesses and extent of local shopping.

Durrenberger and Thu examined Goldschmidt’s findings relative to the Iowa pork industry. They conclude that “it is more advantageous for Iowa to have more hog farmers rather than more hogs” (p. 409). Quoting a longer summary passage, they write:

> Since total hog production is a function of the number of small-to-moderate hog farms, large hog operations have a deleterious relationship to rural hog production. Large hog operations are related to a decline in small and moderately sized operations. The more farms that produce hogs, the fewer people that use food stamps. This analysis suggests it is important to maintain and create small-to-moderate sized hog operations, not large ones (p. 413).

However, the evidence and the analysis in their article does not support these conclusions. First, Durrenberger and Thu examine the correlation between farm size and number of farms. They find that as farm size increases, the number of farms decline, implying one causes the other. However, their data shows that the most urban counties have the largest number of farms and the smallest ones. They do not explore the possibility that this reflects the non-farm opportunities in more urban areas. Seventy-five percent of small farm operators report their principal occupation outside of farming. On the average, the small farms earned $42,686 in non-farm income while losing $4,593 on their farming operations (Steele, 1992). The smaller farms near urban areas are more feasible because of the greater number of non-farm jobs. The larger farms in rural areas might not be forcing small farms out but simply required for families to earn sufficient income. A second factor might contribute to small farms near urban areas. Near urban areas many farmers expect to sell their land for subdivisions as part of their retirement plan. Consequently they can afford to hold onto the land in smaller farms in order to qualify for lower agricultural taxes.

Next they observe a negative correlation between the number of farms per capita and the percentage of people on food stamps. Note, however, that the relationship between the percent on food stamps and the number of farms would have been positive rather than negative if they had not first divided farms by population. They did not explore whether the more urban counties had higher rates of participation in food stamp programs or other factors that might have influenced the differences in rates between these regions. Rather, they attributed all of these changes to farm size. A complete model of the factors that influence food stamp participation is needed and a multivariate analysis to control for the multiple factors. Without this, it is difficult to know if the correlation they find has any meaning.

Why was food stamp participation selected as “the most direct measure of social and economic well-being,” (p. 411)? Why not income per capita or percent in poverty? While food stamp participation might indeed be the best measure, Durrenberger and Thu provide no conceptual or empirical justification for their assertion. Would the conclusions they reach hold if these other measures for local well being were used? Since this is only a literature review, we do not attempt to answer this. Further research should explore this.

Using regression analysis, MacCannell (1998) studied the relationship between farm size and poverty rates and family incomes. This study is not germane to the livestock issues in Minnesota since it dealt with conditions in four Sunbelt states: California, Arizona, Texas, and Florida. Further, he excluded the counties that were principally grain and livestock counties (MacCannell 1988).

Flora and Flora (1988) studied the relationship between farm size and community well being in farming areas west of the Mississippi River. Minnesota is not included in the areas studied except for wheat production in the northwest part of the state. They examined 234 counties that had 20 percent or more of the personal income from wheat and/or livestock but excluded the industrial agriculture counties in California and Arizona (p. 80-81). The Floras found that poverty declined most rapidly in the livestock counties but was initially higher (p. 100).

Lobao (1990) found that industrialization of agriculture had little impact on the quality of life. Summarizing the conclusions about regional differences in farm structure and well being, Lobao and Shulman (1991), write:

> First, compared to non-farm industry, farming is not a strong determinant of socioeconomic conditions even in agriculturally dependent areas (van Es and others

> 1988). Second, the effects of medium-sized farms tend to be constant over the regions examined; the studies verify or imply that such farms are related to better socioeconomic conditions. The impacts of small and large farms by region are less clear. Skees and Swanson's (1988) study suggests that small farms may lower well being, a finding that was confirmed in a national study of U.S. counties (Reif 1987). The effects of large-scale farms do not manifest a consistent pattern across regions (p. 568-569).

Lobao and Shulman (1991) studied the impact of farm size and farm industrialization while controlling for the non-farm economic structure and other variables within regions. They found that the impact of industrialization in agriculture varied by region with fewer adverse affects in the midwest than in the south. Using data on 2,349 nonmetropolitan counties for the 1970 to 1980 period, Lobao and Shulman ran multiple regression analyses on poverty rates. They summarize their work as follows:

> "Rural poverty is largely a function of the prevailing economic structure, the balance of social relations and spatial characteristics. Of these sets of factors, social relations variables tend to explain more of the variation in rural poverty rates, and farming patterns explain the least. Industrial structure followed social relations as an important correlate of poverty" (pp. 587-594).

The farming patterns included indexes for industrialized farming, larger family farming, and smaller family farming. The regional industrial structure variables included: percent in peripheral employment, percent in state employment, and non-farm establishment size. Social relations variables included: percent unionized, per capita AFDC payments, percent nonwhite, median education, percent unemployed and earlier poverty. The spatial variables included: percent farm-to-rural population in the county, the percent urban, and metropolitan adjacency.

Employment Comparisons: Contract vs. Independent Farmers: Two pieces were reviewed on this topic.

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 and Watson 1994).8 Ikerd argues DiPietre's 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 writes:

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8 The DiPietre 1992 study was not available for review. Comments reflect Ikerd's discussion.

> "Only to the extent that it results in higher quality employment opportunities does increased hog production contribute to economic development of rural communities. Since large-scale confinement hog operations seek to reduce total costs by using production methods that allow fewer people to produce more hogs, the substitution of capital and mass-production technologies for labor and management is the primary advantage that large, specialized hog production units have over smaller, diversified operations. The displacement of family farms by large-scale hog production systems reduces rather than increases total employment in pork production." (p. 161)

Ikerd goes on to provide estimates of the number of farmers displaced by a $5 million investment in contract farrowing and finishing operations. There are two critical assumptions in his analysis. First, he assumes the multiplier effects for both the contract units and the independent units are the same. Yet, since contractors buy much of their feed while independent producers often grow theirs, the multipliers would be higher for contractors than for independents. Second, he assumes a fixed demand for hogs so that growth of one type of producer directly displaces another type of producer. This might or might not be true but Ikerd provides no evidence on this. In summary, the estimates provided by Ikerd are only valid if these assumptions are valid and no evidence is provided on them.

Tweeten and Flora (2001) discuss the economic impact of vertical coordination on communities. Vertical coordination refers to the methods of synchronizing vertical stages in the production and processing chain. Contract farming is the most common form of vertical coordination. This piece uses economic theory and prior research to explore how vertical coordination impacts:

1) employment in rural areas

2) farm size and incomes

3) overall economic benefits to rural communities.

While many factors are driving farms to be larger, Tweeten and Flora suggest that vertical coordination saves input and increases productivity and profits. With the productivity gains, there are employment losses in rural areas. There is some evidence that small farms buy more locally. These two factors suggest that policies to maintain small independent farms are best for rural communities. Yet, Tweeten and Flora suggest that such a policy "is unlikely to be a viable alternative" because the small farms can not produce enough income to support families and have higher costs of production.

Many farms are too small to support a family and depend upon off-farm income. Tweeten and Flora write: "Because many farming-dependent counties do not have access to off-farm income, the increased average size of contract producers was not necessarily undesirable."

The article points out that rural communities are changing in many respects regardless of the changes in farm size. Better and cheaper transportation leads to more commuting to urban areas for jobs and longer travel for shopping. Both of these change the nature of local employment opportunities and community services.

HOW ARE THE ECONOMIC BENEFITS DISTRIBUTED LOCALLY (BETWEEN OWNERS, OPERTORS, EMPLOYEES, NEIGHBORS, AND OTHERS) AND IN THE STATE ECONOMY?

Table 5 illustrates the type of employment impacts sometimes reported in regional input-output studies. Estimates can also be made for these same groups for all the spin-off industries as well. However, generally the total change in value-added income is reported rather this specific breakdown.

Table 5. Estimates of Income Impacts by Type of Recipient for the Dairy and Poultry Industries, Producers and Processors, Minnesota

Type of Income	Dairy Industry *	Poultry Industry #
Employee wages and salaries	50.0	54.5
Self-employment income	9.3	14.5
Returns to capital	33.4	24.5
Indirect business taxes	7.3	5.5
Total Value-Added Income	100.0	100.0

* Doherty and Morse, 1999

\# Morse, 1998.

RECOMMENDATIONS FOR FUTURE RESEARCH

Discussion

Current research does not provide much evidence of the potential economic and fiscal impacts of new feedlots on communities or counties. The net economic impacts will depend upon the current economic structure of the area, the spending patterns of local farmers, and the characteristics and commuting patterns of local labor. The net fiscal impacts will depend on both additional tax revenues, changes in state aid, and additional local expenditures. Only two studies (DiPietre and Watson 1994; Otto and others 1998) tried to measure these changes. However, these estimates are specific to their states and there are some questions on the data. Even in Minnesota, the same industry will have different fiscal impacts on different counties.

To estimate the overall economic benefits of animal agriculture as called for in question #1 of section F, either regional input-output or integrated econometric/regional input-output are the most accurate and practical. Computable general equilibrium models will not give the detail needed and are very expensive to build. Export base models are inexpensive to build but give no detail. Comparable area and before/after studies can not be used ex ante and have many problems in developing truly comparable areas. But more importantly, with the comparable areas or before/after models, it is difficult to determine the extent to which the changes are due to factors other than feedlots.

However, the input-output and integrated econometric/input-output models will give accurate results only when the data used is accurate and when the impact scenarios are properly defined to include both the impacts on the livestock industry and any potential off-setting effects. An example of an offsetting effect related to the livestock industry would be the reduction in the number of houses built on a new sub-division as a result of a new feedlot. The net effect would be the positive economic impact offset by the negative economic impacts of the loss of the additional housing. This offsetting effect only occurs if the houses definitely would have gone in without the feedlot.

Recommendations

To use integrated econometric/regional input-output models on feedlot issues, additional research is needed on:

1) estimation of the regional purchase coefficients in order to accurately estimate the purchases within a region;

2) examination and verification of the fiscal impact models components of integrated econometric/input-output models;

3) integration of the social impacts work with the fiscal impact analyses;

4) examination of the regional production functions in input-output models;

5) studying the potential off-setting effects and means of accurately defining the impact scenarios;

6) greater collaboration between economists, sociologists, anthropologists, ecologists, and production agriculture scientists in studying the economic, social and environmental impacts of different types of agriculture;

7) practice in using integrated econometric/input-output models in local settings for educational purposes;

8) determination of alternative regional scales;

9) incorporation of a temporal dimension to the economic impact estimates;

10) examination of the overall structure of agricultural production in terms of the local economic impacts.

The recommended additional research listed above is necessary if clear conclusions are to be reached on question 1. The following section provides greater detail on the recommendations.

Suggestion one deals with estimates of the regional purchase coefficients. Given the importance of the purchasing patterns on the multiplier effects and the very thin database currently available, additional work should be done to expand on the work of Chism and Levins (1994). While their work used an excellent methodology, the sample size of livestock farms was very small (12 farms over all types of livestock). The sample size should be expanded greatly so that estimates of purchasing patterns can be determined for different types and sizes of livestock operations. Two, the fiscal impact models are in their infancy. They need careful examination and verification in a variety of ways, including detailed tracing ex poste of the impacts predicted in ex ante models.

Three, there is a need for integration of the social and fiscal impacts. While sociologists often predict that social program costs will increase with the establishment of large-scale livestock operations, the current fiscal impact models do not adequately incorporate differential growth in public sector costs. The achievement of the third suggestion would require an interdisciplinary team with a sufficient budget to do longitudinal studies.

Four, we need to examine the regional production functions in input-output models. As some have pointed out, the data used in I-O models pre-determines many of the results. To improve regional I-O models in this respect will take an interdisciplinary team of farm management economists working with regional economists and a long-term database from farms of different sizes and types.

Five, the development of scenarios in input-output analysis often ignores the offsetting effects. While CGE models automatically capture some of these, I-O models cannot. These offsetting effects can be handled outside the model and entered as a secondary shock.

Sixth, greater collaboration is needed between a wide range of social and physical scientists, industry groups, environmental groups, local governments, and citizens to trace the consequences of different types of agriculture.

Given the many competing research needs, suggestion #6 will only happen if some state agency invests sufficient funds to create incentives for ongoing focus on these issues.

Seventh, there is a need to practice using existing integrated econometric/input-output models in local settings for educational purposes. While there is much research needed to improve the accuracy of regional models, much could be learned from applying the existing models in educational settings now. If used in the fashion suggested by Barrows (1993) and readily pointing to the limits of the models, they can help community leaders recognize new questions and frame issues more clearly.

Eighth, the definition of •local• needs to be considered. In prior studies (Chism 1993), local was defined as being within 20 miles of the farm. From the state•s perspective, is this the correct definition? If farmers buy inputs 40 miles from their farm but still in Minnesota, the economic impacts on the state of Minnesota are positive even if the sales are lost to vendors within 20 miles. Insistence on buying within 20 miles might be good for one local community but result in higher costs for the farmer as well as hurt another local community. This is an area where policy and research methods overlap. To help sort this out, additional research is needed on alternative definitions of •local.•

Ninth, a temporal dimension to the economic impact estimates needs to be incorporated. Nearly all of the impact models estimate the impacts for a year. Some analyses split out the difference between construction and operation (DiPietre and Watson 1994). Few consider the changes over time in the levels of operation. This should be explored.

Tenth, there is a need to examine the overall structure of agricultural production in terms of the local economic impacts. As Dr. Leatherman outlined in his comments, livestock production is changing in both scale and vertical integration. As he points out current research focuses either on specific facilities or industry-wide impacts. It would be useful to do more research on the large integrated systems such as the one he describes of a network of production and processing facilities with 40 confined animal feeding operations and processing for 1 million hogs annually.

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Section V-3. Literature Review Update: External Costs and Benefits

by Carl V. Phillips

INTRODUCTION/SUMMARY OF NEW LITERATURE ADDED

This document is an update of the 1999 literature review on •External Costs and Benefits• that dealt with pollution and similar spillover effects. It excludes the half of that report that dealt with community monetary flows. The previous report will be referred to as •the 1999 Report.• Highlights of the 1999 Report appear in Phillips (1999). The references and resulting analysis in the present document were almost all published or made available after the 1999 Report was completed. A few additional references and explanations that could have been included in the 1999 Report, but were not due to the limited time and resources available, are also included.

As an update, this document is not meant to stand alone with full explanations. In particular, there is important information about how to interpret these concepts and studies in the 1999 Report. A recent paper (Stavins, 2000), included in Appendix C, does a nice job of explaining the concept of economics-based environmental regulation and the key question of externalities

This document is organized hierarchically, starting with the underlying concepts of externalities and their valuations, proceeding to methods, and then addressing specific topical areas of research.

SUMMARY OF FINDINGS

Like the 1999 Report, this update contains no numbers. Two years has not changed the basic fact that the available studies of externalities are limited and subtle, and taking individual numbers out of them, out of context, as if they were scientific constants, remains inappropriate. In the worst case, some of them would be used as if they were The Answer to some interesting quantitative question. The numbers from many of the papers mentioned here would be useful for informing optimal policy in Minnesota, but not without expert interpretation with specific questions in mind, something that is beyond the scope of this review. By the same token, in cases where specific titles do not stand out, a body of literature is summarized with general statements about the output of research in an area.

The concept of economic externalities remains an excellent way to structure thinking about agriculture policy in Minnesota. Quantification of those externalities is possible and has been done to some extent. Those results can be of great use in response to specific policy questions (though they are of little use in a free-form discussion). However, progress toward a grand generalizable set of quantifications is not likely to come in time to afford this decade's agriculture policy. Indeed, in many ways, increasing doubts about the narrowly-drawn cost-benefit approach among supporters of economic approaches (let alone opponents of such approaches) suggests that we may be moving further from technocratic analyses of complicated policies that affect material goods, aesthetic preferences, ethics, and social structures. Cherry picking seems to be the best policy strategy: take the useful structure, take what quantification there is available and strategically fill in a few gaps, and use the resulting tools and inputs without depending on filling all the gaps.

CRITICAL REVIEW OF INFORMATION SOURCES

Concept

The primary observation at the conceptual level is that there is no apparent change in the attitudes that make it difficult to use welfare-economics based calculations to aid policy. Scholarly and technical publications that focus on agriculture practice do not seem to have changed their emphasis nearly as much as the policy and popular discussion of agriculture, which is increasingly devoted to externalities (though typically not using that piece of jargon). This contrasts with other areas of regulation and environmental analysis in general, where externality analyses are a huge part of the research literature and effort. This implies that an analysis of agricultural externalities in Minnesota will have to draw much more on the environmental literature than the agriculture literature for methods and data, even for topics that are more social than environmental.

Externalities from animal agriculture are increasingly seen as a subsidy granted to the industry (an uncompensated transfer of society's wealth in the form of environmental goods and social capital), but policy use of externality-based analysis remains very limited. This, in turn, leaves the literature devoid of analysis of how well such approaches have worked. (By contrast, there is a burgeoning literature about how economics-influenced policies have worked in other areas of environmental and social policy.) This is possibly attributable to the disconnect • largely unchanged over the last few years • between "true believers" in valuation methods and cost-benefit analysis as the right tools for environmental policy and those who find these to be the wrong approach because of practical difficulties or fundamental objections to the underlying liberal philosophy.

Castle (1999) presents a very cogent recent review and criticism of economic approaches to environmental and agricultural policy (see also Randall, 1999). The mood of this discussion is one of continuing erosion of the notion of a traditional objective economic analysis of these issues. This possibly signals a retrenchment of the role of economic externality analysis, from some of the quixotic roles it has been cast in, and to more useful advisory roles.

At a less philosophical level, analyzing agricultural externalities is particularly challenging because of the heterogeneity of different regions and operations (Lovell and Kuch, 1999).

Studies of complicated systems never result in universal constants, but agricultural externalities are particularly difficult because results from North Carolina or England, where many studies take place, may not be even remotely applicable to Minnesota (or they may be great approximations for Minnesota -- but it is difficult to determine).

Economists generally recognize that because of the negative externalities from animal agriculture production, too much (i.e., a higher than socially optimal quantity) production takes place (Innes, 1999; Gray and Malla, 1998). Furthermore, there is reason to believe that willingness to pay to preserve environmental and other public goods will systematically underestimate the socially optimal expenditure (Brekke and Howarth, 2000). The question of *how much* (how much too much, how much more people would be willing to pay) cannot be answered precisely with current technology, but the direction is generally agreed upon (there is too much, not too little) and the rough magnitude can be estimated for a particular change in a particular place at a particular time.

Some analysis has emphasized the dual-sided nature of the externalities (Peterson, 1999): pollution, human health, animal well-being, and the loss of natural land on the negative side and desirable neighbors, favored communities, and an appreciation of the agricultural landscape on the positive side. A method was recently proposed for estimating the latter of these positive values, and applied to the U.S. and other countries (Brunstad, Gaasland, and Vardal, 1999). The consolidation of animal agriculture into factory farms can be seen as causing the loss of the positive externalities (which is equivalent to the creation of a negative externality). When structural change results in the loss of former positive externalities, it is difficult to protect the public's interests without proactive policy action because what is being lost (or taken) was never an entitlement (in contrast with taking someone's clean water), and thus is hard to defend under existing policies.

In a discussion about Wisconsin, Tweeten (1998) emphasizes the family farms and lifestyle issues as the major externalities relating to agricultural industrialization in the Midwest. He argues that under the present trends, the only way livestock production will return from its exodus to the South and West is in the form of large operations, creating a choice in communities between factory farms and no farms at all. The only alternatives from the perspective of a Midwestern state involve rather deep forays into the market because minor local adjustments are not likely to change production methods in given the national context (other than by shifting producers' incentives within the dichotomous choice of factory farms vs. no farms).

Beyond such discussions, there seems to be almost no economic information on the "Main Street" issue, the question of how much loss people suffer as a result of the disappearance of the traditional rural and small-town lifestyles that results from consolidation in the animal agriculture industry. In particular, there does not seem to be much interest in quantifying this externality, even though is just as legitimate as any other consumer preference. Given that this unquantified desire remains a major motivating force in Minnesota agriculture policy, and given that the policy discussion is (as is typical) dominated by numbers, it remains difficult to use the available economic findings to assist with the core disagreements. There is very limited literature on this topic available to apply to the Minnesota experience, a situation that has remained true as the GEIS has proceeded. The well-developed technologies for measuring externalities, including these (see the 1999 Report), could be brought to bear. (NB: As a conflict of interest disclosure: the author of this paper has no interest in carrying out such research and would participate very little or not at all, and thus this is not a self-interested statement.)

The question of whether concentration of production makes particular externalities worse, better, or neither remains open and controversial, though there is a clear concern about structural change and the resulting externalities. One recent study in the North Central U.S. (Wachenheim and Rathge, 2000) found a positive view of agriculture (in general) and concern that consolidating structure would hurt the environment, society, and local wealth. One important implication of this, that policy makers do not seem to have considered, is that production that is more efficient (in the colloquial sense, measured from a business accounting perspective) may be less efficient in the economic sense • that is, it produces lower total social welfare. Policy makers should, perhaps, not feel inclined to apologize for restricting farming practices based on a specific externality (e.g., blocking the building of new factory farms because of local pollution concerns), even though this increases production costs and raises prices. Given the broad collection of externalities, the socially optimal level of production and consumption is much lower than the free-market level, and so higher prices will move us toward the social optimum.

Technical improvements in cost-benefit analysis continue to be developed. Most are of little specific interest for present purposes. The particularly controversial area of discounting future benefits is taken up in a recent book (Portney and Weyant, 1999). One area of cost-benefit analysis and regulation that should be kept in mind are the observations about how estimates of the cost of complying with regulation (reducing pollution, changing production methods, etc.) is systematically overestimated because of the failure to recognize the benefits of improving technology (Hammitt, 2000; Harrington, Morgenstern, and Nelson, 2000; Stavins 2000). At the same time, appreciation for rare amenities (unspoiled environment, unique communities) tends to increase with population and wealth, while concern about a few extra dollars tends to decrease with wealth.

Methods

The basic methodological issues and tools were described in the 1999 report. Researchers continue to refine and apply these methods, but there have been no particular breakthroughs. Many economists of various political leanings continue to strongly advocate externality-valuation-based approaches to improving policy. (However, given the increasing evidence that these approaches are very informative in some cases but are far out of reach in others, this breadth of this advocacy sounds increasingly like religion rather than science.)

A recent summary of the field can be found in a dedicated issue of *Environmental Science &*

Technology (Farrow, Goldburg, and Small, 2000; etc.). The articles provide an excellent approachable primer, though provide limited balance in terms of conceding that there is a large gulf between theory and our ability to apply it. One article in the collection (Bockstael, et al., 2000) does note that the evolution of environmental policy from environmental health (where externality valuation is relatively easy) to ecosystem protection (where it approaches prohibitively difficult) has resulted in a poor "forced marriage" (p. 1384) of different methods and situations. The authors go on to emphasize the importance of measuring costs and benefits for some well-defined change, rather than hypothetical aggregate values (which relates closely to the next subsection in this report).

The overall lesson for the GEIS from this and other current state-of-the-art reports is that cost-benefit thinking regarding externalities can be useful for specific questions but not so useful for sweeping, open-ended policy discussions beyond providing some rough assessments. As discussed in the 1999 Report, it is also quite useful for identifying cases where the benefits of a policy outweigh the costs (or fall short of them) by a factor of, say, ten, but not so useful for close calls.

For those who think that conservative (in the sense of using it only when it clearly works) cost-benefit approaches can make better policy for everyone involved, it is important to start agreeing on the terms of the discussion. Agriculture offers a rare opportunity to apply these win-win approaches to policy making because it has substantially escaped the adversarial process that is built into most U.S. environmental laws. This could change. Law-centric environmental policy thinkers are "discovering" that agriculture is a major polluter and are likely to try to increase their influence over it (e.g., Ruhl, 2000).

<u>The Broken Chain</u>

The 1999 Report emphasized the major limitation of existing methods and literature for measuring the externalities from a particular change in policy or practice. It is worth reiterating that point:

> It is important to realize that the analysis of how an action leads to a measured cost or benefit has two distinct steps, the path from action to change in the physical world (such as an injury to an environmental good), and the path from the change in the physical world to a change in human well-being (valuation). The first step is the topic of many of the other areas of the GEIS, while this report focuses on the latter. The critical importance of the two step process is that while we have the technology to map a certain agricultural practice or policy to human welfare outcomes, it has not been done in very many cases. In many cases, someone has gone from Point A (the action) to Point B (the injury), and someone has gone from Point B' (seldom exactly the same Point B, unfortunately) to Point C (change in welfare), but no one has gone from A to C. As a result, a literature review is not sufficient to produce many values -- it can only show what

> groundwork has been laid to produce those values. Actually providing the values would be new research, not simply a review of the literature. (from the 1999 Report)

There are exceptions (particularly in the area of recreational uses of surface water), but a few exceptions can do little to remedy the huge gaps. It does not appear from the last few years' literature that researchers in the field have taken up this challenge as an object of specific study. Many quantitative analyses of the value of environmental goods and bads do not even contribute much to the "A to B" and "B to C" parts of the policy question. There is still a habit of reporting "here is what this whole resource is worth, and policy makers should consider that," as if total destruction were being contemplated, and sometimes "here is the measured value of a hypothetical change in quality," without regard to whether that change is relevant to any proposed or predicted changes.

This is not a criticism of the quality and quantity of work in the fields. The research that attempts to value environmental externalities remains technically complicated, extremely broad in scope, and in pursuit of ever-changing values. Thus, we would expect only slow progress over the course of a few years.

Some cause for optimism can be found in approaches like that of Magat, Huber, and Viscusi (2000), who structured their analysis of the value of water quality to be able to answer questions of where marginal cleanup expenditures should be directed (which bodies of water, which uses) to maximize the reduction of negative externalities. This contrasts with most studies which simply put a value on an arbitrary difference in quality levels for a single resource. While this falls short of linking a specific policy to a physical outcome and through to a value, it is a step in that direction.

Until a much larger body of valuation literature is developed, and there is more of an eye toward the entire chain of causality, it will be difficult to estimate the valuation of externalities from a particular policy or action without a study effort specifically devoted to making the links for that policy/action.

<u>Benefits Transfer</u>

Further complicating the use of existing valuation studies for policy decisions is the limited progress in improving benefits transfer methods over the last few years. Benefits transfer techniques, methods for accurately using measured valuations from one time/place/situation to estimate valuations for a time, place, and situation of interest, are key to broadening the use of valuation in policy making. Much of the thinking in the GEIS process related to valuation seems to focus on this possibility. As discussed in the 1999 Report, this is difficult and methods have not been widely validated. Considering the value that would come from improving these techniques, as opposed to doing more and more specific, non-applied valuation studies, it is unfortunate that such limited research attention is directed toward this area.

There is currently a push to include gains and (more often) losses of environmental values in national statistics for net production (Nordhaus and Kokkelenberg, 1999). If this goes forward, it will have to include a huge increase in the number of valuation studies and the methods for transferring the results. This should produce great tools for states and others to make policy. Furthermore, Europe is moving to catch up with the U.S., providing more data (Pearce and Seccombe-Hett, 2000; Pearce, 1998).

However, recent assessments (Delavan and Epp, 2000; Brouwer, 2000) conclude that such transfers are still very difficult and full of uncertainty. Some studies still report success in doing transfers by comparing the results to direct studies (Scarpa et al., 2000), but there are still fairly few such tests in the literature.

The lack of solid methods for benefits transfer does not mean that valuation studies are useless for advising policy. At the very least, existing valuation studies will provide useful rough cuts at whether something is very valuable or not so valuable. As long as the rough nature of the estimate is recognized, it can be very informative to compare Minnesotans' valuation of traditional rural lifestyles, for example, to the price of maintaining them, to see if they are about the same or differ by a factor of ten in one way or the other.

Survey Methods

As discussed in more detail in the 1999 Report, contingent valuation (CV) • which, roughly speaking, consists of asking people how much they would be willing to pay for some good • is the only method for measuring many of the externalities associated with animal agriculture. Since the time of the original literature review, CV has remained controversial but still popular to use. (For a recent summary, see Carson, 2000.)

CV methodology remains a work in progress. Most proposed variations and new methods (presumably improvements) involve relatively minor changes. The details and an evaluation of these are beyond the present scope, though it is worth mentioning a few highlights. Several recent works have offered particular substantial innovations in the use of CV. This includes Park, Bowker, and Leeworth (2001), which applies a method suggested by Englin and Cameron (1996) to use travel cost data to help calibrate and anchor CV results. It also includes techniques for blending of CV and revealed preferences, the more widely accepted sources of individual value (Hite, 2000). Alternative survey methods have been proposed, such as Gregory's (2000) multi-attribute method. But despite the insider rhetoric that these are fundamental departures from CV, they are still based on most of the same premises and methods and subject to the same limitations.

The bottom line is simple: Survey methods remains necessary for estimating certain values • if we are to do so • and continue to improve, but remain highly imperfect.

Other Methods

As with CV, the other methods for valuing externalities that were described in the 1999 Report have progressed, but there have been no notable changes in their usefulness.

A new set of measures involving actual market data are emerging, thanks to the increasing popularity of "eco-labeling" • the inclusion of environmentally friendly or community oriented attributes with a food product, such as organic food products. Since these products are generally more expensive than their non-eco-labeled counterparts, the extra cost provides a direct revealed willingness to pay to reduce externalities (Blend and van Ravenswaay, 1999; Nimon and Beghin, 1999). There remain several substantial limitations to this method, however. Producers and advertisers have made limited progress in bringing these options to the public's attention and making the labels and certifications effective (Teisl, Roe, and Levy, 1999). Furthermore , it is not entirely clear that what is being measured is what we want to measure. The major problem is that a voluntary donation in the form of paying more for something than necessary in order to help the world almost certainly understates someone's true value for the service provided. At the same time, consumers may be purchasing the satisfaction of knowing they did the right thing, despite it being easier to do otherwise, which might result in the price paid overstating true willingness to pay for the improvement per se. Thus, the study of eco-labeling is likely to remain of interest to marketers and environmental advocates, but not of those trying to compute environmental valuation. The one area where new revealed preference data might someday prove more useful is valuing food safety. Since food safety is a private good, the purchase price premium for safer food should reflect its full value. However, skepticism and lack of information will continue to make this difficult to measure for the near future.

Topical Areas of Research

The current trends are promising for generating an ever-increasing number of useful findings regarding externality valuation. While it remains extremely difficult to transfer measures made in one area or for one project or policy to another, a larger volume of studies improves the prospects substantially.

<u>Air Pollution</u>

Research on air pollution is increasingly dealing with LULU (locally undesirable land use) issues (e.g., Schiffman, 1998). This is useful for agriculture policy because the usual emphasis on health alone misses much of impact. Sometimes a link to health problems can be established from agricultural air pollution, but complaints usually are aesthetic (costs which are no less real).

Air pollution presents a particularly good opportunity to deal with the broken chain problem. Real changes in welfare occur over a short time due to reasonably simple • and thus quantifiable in terms of cost causes (or with reasonably simple solutions, anyway). Thus it should be possible to simultaneously study the cost of the LULU air pollution problem and the cause or actions necessary to mitigate it (and their corresponding costs). There is a substantial body of existing and ongoing research about the physical and health effects sides of the issue (the specifics of which are covered in the corresponding reports from the GEIS better than they could be here).

In the area of global air pollution, particularly gasses that contribute to climate change, animal agriculture is a significant contributor, and this is being increasingly recognized in the popular discussion of the topic (and thus it is increasing in policy and resource attention). There is a huge literature on the physical side of this and the relation to agriculture (though there does not seem to be much examination of the effect of industry structure). There is also an increasing literature on the economic effects of global warming (and thus the measure of the externalities), but this remains rather uncertain and distant for making state-level policy.

Water Pollution

The greatest progress in terms of new methods, findings, and publications since the time of the original GEIS Literature Review seems to be in the area of water quality, both surface and groundwater. There are dozens of new studies in the literature that attempt to value water quality issues that relate to agriculture. This is probably due to the combination of a mature set of technologies for measuring water quality (as opposed to the much weaker methods for measuring LULU issues or ecosystem injury), the fact that agriculture is by far the largest contributor of such pollution (as opposed to air pollution), and the fact that the results are fairly local and traceable (as opposed to global warming). It is important to avoid "lamppost" policy making by responding primarily to water pollution issues because they are best studied. However, we should be pleased by the progress in this area.

A project to analyze CV studies of groundwater quality, ongoing since the early 1990s, continues to make progress, but still concludes that there is not enough of the right kind of analysis to draw firm conclusions (Bergstrom, Boyle, and Poe 2000 and other published and unpublished work by the same authors). As with most analyses of the progress of CV studies, the major conclusions have more to do with the increasing solidity of the method rather than premature conclusions about general numbers resulting from it (which is in keeping with the underlying philosophy of the present analysis). One particular conclusion from their work (see particularly Bergstrom et al., 1996) is that the multiple values of groundwater over time (current extraction for drinking water, current extraction for agriculture, future extraction, and non-extractive value) need to be considered, and that current extraction should be analyzed in light of the externalities for other uses. Other models (Zachariah and Rollins, 1999; Zachariah, 1999) have demonstrated the need to integrate regulation of pollution of groundwater, including pollution from livestock, and the regulation of groundwater extraction, which also is often an externality from livestock production.

Specific to the interest of the GEIS, there is evidence that, as suspected, concentrated animal operations increase per-acre application of manure (Navin and Innes, 1999; Innes, 1999), and thus the resulting runoff and surface water pollution.

Minnesota-specific data about surface water quality valuation is available (Mathews, Homans, and Easter, 1999). Other findings (Magat, Huber, and Viscusi, 2000) provide a wide variety of values for North Carolina, which continues to offer much of the available data on agricultural externalities.

Other Human Health Impacts

Most human health issues are captured in the traditional, media-oriented classifications above, but a few defy easy classification.

Hormonally active chemicals (endocrine disruptors) remain a hotly debated environmental health concern (as well as a concern for wildlife and ecosystem protection). These chemicals, whose impacts are primarily in the form of water pollution, are traced to agricultural chemical use in the form of pesticides and hormones. There is little agreement on how big this problem is and how much can be attributed to agriculture, and it is difficult to find neutral presentations of the issues and findings. A recent summary can be found in Safe et al. (2000).

The smoking gun confirming the always-suspected link between the use of antibiotics in animal agriculture and antibiotic resistance in medical settings was established at about the time of the 1999 Report. Since that time, there has been surprisingly little attention to the topic. Technical discussion about the effect on production can be found in the animal science and veterinary literatures. On the public health side, there have been several news- and editorial-level discussions (e.g., Ferber, 2000; Woodman, 1999), but limited scientific review (but see several articles in supplemental issues of *Acta Veterinaria Scandinavica* (the 2000 issues includes Threlfall et al. 2000, which reviews the U.K. experience, and the 1999 issue includes Tollefson et al. 1999, which reviews the U.S. experience).

A substantial portion of foodborne pathogens can be traced to animal agriculture practices. But despite overstated claims about having quantified the problem (Mead et al. 1999),we really know little more about the total impact than we did (LaPole, Phillips, and Hedberg, 2001), let alone the specific effects of agriculture practices.

On the economics side of these impacts, there has been relatively little attention to this as a matter of externality analysis. In short, these concerns have been established as major externalities over the last few years, but addressing it from a policy economics perspective remains difficult and specifically relating it to the issues of primary interest to the GEIS process is not yet possible.

Ecosystems

It has never been clear how the changing structure of animal agriculture changes its effects on ecosystems and biodiversity. Any concerns about increased local pollution are offset, to an unknown degree, but the reduction in agricultural sprawl, particularly in the form of grazing, across most U.S. land. There does not seem to be much literature that addresses this. A good summary of issues relating agriculture to biodiversity can be found in Tilman et al. (1999).

It is difficult to write about agricultural externalities today without mentioning biotechnology or genetically engineered species. This is largely an issue of plants, due to limitations of the current technology, but the centrality of feed crops makes the issue relevant to animal agriculture. The goals of the GEIS, however, focusing on the structure of the animal agriculture industry, are orthogonal to concerns about biotechnology. Inevitably partisans on one or both sides of this contentious issue will try to introduce it into any discussion of animal agriculture, but nothing useful can be said about it here.

Animal Well Being

This area of concern in Minnesota remains understudied, despite repeated calls for more science and less "politics." While debates about the topic continue to be energetic, there does not seem to be any economics literature since the 1999 Report. As with many issues, politics is probably more useful than the very limited economic science and the natural/agricultural sciences that cannot answer the question of what matters to whom and how much.

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VII. Appendices

Appendix A
Primer: Introduction to Measures of Regional Economic Impacts

This section presents the terminology that is commonly used in economic impact studies looking at the effects of one industry on other industries and businesses, communities and the state as a whole. While many of these terms are commonly used and understood, sometimes there are several common ways of using the terms, and this can create communication problems. The definitions used in this report are as follows.

Region is defined to be any size from a small town or city, county, state, or even the nation. In this report we do not consider national studies.

TYPES OF INCOME

Employee compensation includes wages or salary plus fringe benefits such as health and life insurance, retirement payments, and any other non-cash compensation.

Proprietary income consists of self-employed income. For example, the income of self-employed lawyers, doctors, or business owners would fit here.

Profits and other property income include payments from interest, rent, royalties, dividends, as well as profits.

Indirect business taxes consist of excise and sales taxes but not income taxes or corporate taxes.

Personal income is the sum of employee compensation and proprietary income or the total of all forms of employment income.

Value-added income is the sum of personal income plus profits and other property income and indirect business taxes.

Gross Regional Income is identical to the value-added income of the region.

Gross Regional Product (GRP) equals the gross regional income. However, GRP is defined as the total spent on regional consumption and investment goods, total government purchases, and the total value of net exports from the region.

Generally, gross regional income or total value-added is used as the key measure of the size of a regional economy. When measuring the impacts on the entire region, gross regional income or value-added is often reported because it is the most comprehensive measure.

MULTIPLIER (SPIN-OFF) EFFECTS

The economic impacts of adding a new industry to a region will vary depending on the extent to which that firm buys raw materials and other inputs within the region. The larger the volume of purchases within the region, the larger the regional multiplier or spin-off impacts. Conversely, the smaller the **leakages** (purchases from outside the region) the greater the spin-off effects.

Regardless of the type of models used, there are several basic concepts used in estimating the multiplier effects. While most of these concepts are directly applicable to input-output models described in the next section, they also apply to nearly all of the methods of examining multiplier or spin-off effects. These are defined below:

Economic Shock: In measuring the economic and fiscal impacts of the changes in an industry, we need to define exactly what that change is. Generally, this is called the economic shock. It is an exogenous change (a change from outside the model that you are using to explain the changes in other variables). With the feedlot issue, economic shocks might be drops in demand for livestock, changes in regulations at the state or local level that restrict the number of animals grown, or addition of a new meat packing plant that increases the demand for livestock locally. The economic shock is taken as a given or the starting point in any economic impact analysis.

Direct effects are the changes in expenditures in each industry or for each commodity that stem from the economic shock. These do not include any spin-off or multiplier effects. Estimates of these direct effects come from surveys or interviews with firms rather than from economic models.

Indirect effects are the changes in industries that sell to the industries in which the direct effects occur. For example, if a new hog operation opened in Murray County, the additional feed sold to that unit would be an indirect effect. The corn sold to the feedmill would also be counted. The fertilizer used on the corn and the trucking services used to deliver the fertilizer would be counted.

Induced effects are the changes in expenditures by consumers who work either in the industry directly affected or in industries that are indirectly affected.

Offsetting effects are changes in the local economy that occur as a result of your direct effect but which are not captured by backward linkages. For example, if you add a new hotel to a community, you need to check that this new hotel is not simply taking business away from the existing hotels. If this offsetting effect happens the direct effect could be zero. When a firm is lost from a community, other existing firms might simply expand and service the market. Again, there could be no net direct effect due to this offsetting effect.

Type 1 Multipliers report on the total change in income, counting both direct and in-direct incomes stemming from the economic shock compared to the direct change in income coming from the shock. A multiplier of 2.5 means that total income is 2.5 times as high as direct income and that the indirect effect is 1.5 times more than the direct. Type I multipliers are available for all types of income and employment.

Type 2 Multipliers report on the total change in income, counting direct, indirect, and induced income divided by the direct change in income. Type 2 multipliers are always higher than type 1 multipliers, which leave out the induced impacts. Type 2 multipliers are controversial because they assume that any new income will be spent in exactly the same spending patterns as the average spending. This is rarely true and generally means that type 2 multipliers overestimate the true impacts of an economic shock. On the other hand, type 1 multipliers completely ignore consumer spending and tend to underestimate the economic impacts. In practice, some economists use modified type 2 multipliers that give some consumer effects but not the full effect.

Backward Linkages refers to the purchases by an industry from its suppliers or the purchases by a household from the producers of the goods and services it uses. For a pork producer, the backward linkages are for feeds, equipment, trucking services, etc.

Forward Linkages refers to the sales to other industries or to final consumers. For a pork producer, sales to a meat packing plant are part of her forward linkages.

Final demand includes sales to consumers within the region being studied and to consumers and industries outside the region. Sales to governments within the region are also included in final demand.

Intermediate demand includes sales to all industries that use the product as part of their production process.

MODELS FOR MEASURING MULTIPLIERS

This section looks at the models used to estimate the regional spin-off effects. We provide a general description of these models and a critique, outlining their strengths and weaknesses. Models are simply maps of the economy. As a map outlines the major features of the land, a model outlines the major features of how an economy works. Just as no one type of map (U.S. interstate highway map, state road map, topological map) will serve all purposes, none of these models is useful in every context.

Economic Base Models are the simplest type of multiplier models. The multiplier is simply defined as:

Multiplier = Total employment/ Basic Export Employment

Exports are sales outside the region being studied, not necessarily international exports. Nearly all industry sectors have some export sales, especially when considering domestic exports (sales to people or firms in other states within the country).

When we consider the fact that some industries will purchase more raw materials and inputs within a region than others, it is apparent that the multipliers will differ between industries. However, the economic base model only has a single multiplier. Input-output models provide multipliers for each industry. For details on economic base models, see Shaffer (1989).

Input-Output Models: These are a double entry accounting system for all industries within a region. In the rows it traces the sales of each industry to each other industry, to consumers in households, and to exports (See the rows in Table 1). For example, the Agriculture sector has total sales of 100 million in this hypothetical economy and sells 5 million to itself, 10 million to manufacturing, 10 million to retail, 15 million to households, and exports 60 million. In the columns it also traces the expenditures by each industry as it purchases raw materials and inputs from other industries, pays workers, and imports goods (See the columns in Table 1). For example, agriculture has total expenditures of $100 million. It buys 5, 20, 30 million from agriculture, manufacturing, and retail respectively. It pays households 25 million, partly as wages and partly as self-employment income and partly as profits. In addition it has to buy 20 million in imports from outside the region. The multipliers are derived from this table as shown in Appendix A. The only difference from the example in Table 1 and actual input-output models is the scope. Most have 528 industrial sectors rather than only three as shown in Table 1.

Table 1: Transaction Table for an Area Economy*

Economic Sectors	Agriculture	Manufacturing	Retail	Household	Export	Total Sales
Agriculture	5	10	10	15	60	100
Manufacturing	20	5	5	10	140	180
Retail	30	5	5	90	15	145
Household	25	80	30	10	25	170
Imports	20	80	95	45		
Total Expenditures	100	180	145	170		

* Example from Goode, 1982. See Appendix A for non-technical explanation of multipliers

Several authors are critical of input-output models. For example, Thompson and Haskins (1998) write that input-output models are •severely limited by both the assumptions made and the data used• (p.2). They are correct, but this can be seen as virtue rather than a weakness. It ensures that users can trace exactly what assumptions and data are used rather than having a mysterious black box.

When the input-output model is used to predict the economic impacts of a change in an industry, the following assumptions are made:

2) The output of each sector has a fixed production function, and there is no substitution between the input factors as change in the level of output occurs;

3) The change in the level of output being studied is not large enough to result in changes in the economies of scale;

4) The change in the level of output being studied is not large enough to result in changes in the prices of outputs or inputs;

5) The change in the level of output is not large enough to cause a change in the technology being used;

6) The percentage of imports for each industry will not be changed by the size of the impacts;

7) All increases in employment come from in-migration or new entrants to the labor force;

8) The estimates of transactions (as shown in Table 1) are accurate.

None of these is likely to be true for large changes in a business or economy. But if the change is small enough relative to the total economy that prices do not change, then the first four will be true. Assumption # 5 simply says that the market share of inputs between the region and the outside world will remain the same as the regional economy grows. Assumption #6 could be a problem in areas with large amounts of in- and out-commuting. This assumption is removed in the integrated econometric/input-output models. Assumption #7 seems obvious. However, since some of the input-output models have over 250,000 cells of information and over 3,600 pieces of regional data this can be a problem.

Regional input-output models typically are non-survey models that are built from the national model using regional data for each sector on output, employment, and value-added components. These non-survey models are 90 percent as accurate as the survey models but only about 10 percent as expensive. Consequently, practically no one uses survey models at the regional level.

Non-survey models have two additional assumptions. These are:

8) the technology used in the region is identical to that used nationally; and

9) the percentage of regional purchases from local supplies is estimated accurately.

When the regional technology appears to be very different from the national average, many nonsurvey input-output models allow users to substitute survey data for the primary industries being studied. Likewise, semi-survey methods are sometimes used to improve the accuracy of the regional purchase coefficients for the principal industries. For additional detail on input-output models see Shaffer, 1989, p. 274-284; Miller and Blair, 1985; Goode, 1982; Olson and Lindall, 1996; or Otto and Johnson, 1993.

Integrated Econometric/Input-Output Models: These blend the virtues of the econometric and input-output models. The most common integrated model (Johnson and Scott 1997) estimates the changes in out-commuting and in-commuting for a county, adjusting the number of in-migrants and new entrants.

This adjustment is important when estimating the fiscal impacts changes. If a person who lives in community A but commutes to work in community B takes a new job in his home community (A), he adds very little to the local demand for services and little to the local tax base. Likewise, additional in-commuters add much less demand on schools and other local public services than do new in-migrants.

The other advantage of these models is that the econometric portion includes equations to estimate the additional local government revenues and additional local government expenditures. These models, however, are in their infancy and need additional testing (Johnson 1996; Johnson and Scott 1997; Shields and Deller 1997; Shields 1998; Ha and Morse 1998).

Computable General Equilibrium Models (CGE): These are simulation models which do not require all the assumptions in input-output models. Most CGE models allow impacts large enough that they result in changes in the prices of inputs or the outputs. Since economists spend most of their life studying the impacts of price changes, this drives them wild and these models have been wildly popular. Unfortunately, the data required for these models is massive. In fact, so much data is needed that the equations are not estimated using local data but rather coefficients are borrowed from other earlier studies. An advantage of these models is that they make explicit the many assumptions that often go into any analysis. The complexity of the models often makes them very time consuming and costly to develop.   For an excellent overview of CGE models, see Robinson, 1989.

The CGE modeling that has been done on agriculture deals with national and international issues (Hertel 1990; Kilkenny 1991; Kilkenny and Otto 1994). No CGE studies were found that dealt with state or sub-state regions and livestock.

Impact Studies vs. Linkage Studies: The models outlined above can be used to either estimate the impacts on the rest of the economy of a change in a given sector or simply to describe the linkages between a sector and the rest of the economy. For brevity, we will call the former •impact studies• and the latter •linkage studies.•

Many of the input-output studies reviewed here are linkage studies. As a description of the linkages between a livestock sector and the sectors that support it, they are valuable. Further, there is little reason to be concerned about the assumptions inherent in input-output in linkage studies. These assumptions only become problems when impact studies are done. This means that a reader can not assume that if a livestock industry has 10,000 direct jobs and another 16,000 support jobs for a total of 26,000 jobs that a policy that reduces the direct jobs by 10% will lead to a reduction in state jobs of 2,600. In fact, maybe the net impact on the state•s economy is a positive 2,600 jobs! Next we explore why this is so.

For impact studies using input-output, one of the major limitations is that •off-setting effects• are not built into the model (endogenous). For example, assume the losses in an agricultural sector of 1,000 farm level jobs due to a new tough environmental policy. With the multiplier effects, assume that this costs a total of 2,600 jobs related directly to this agricultural sector. The net effect on the state is only 2,600 jobs if these people never get a new job in the state. If, however, the labor market is very tight, many of these people will get new jobs. If some of the workers in the agricultural sector are very close to retirement and elect to retire a little early, the loss of jobs is only for the years left until their regular retirement age. If the new jobs are in industries with higher value-added incomes (wages, proprietor incomes, and profits) than the agricultural industry, the state•s economy actually benefits from the loss of the farms and agricultural processing plants.

It is impossible to determine whether the net impacts on the state•s economy or even the regional economy will be positive or negative. Given the public•s tendency to mistake linkage studies for impact studies, or at least to misapply the results of linkage studies, it is possible that they are inherently misleading.[9] Even in the short-run, many of the workers who lose their jobs will receive public unemployment assistance. So the consumer spending, while lower, will not go to zero. Either input-output or computable general equilibrium can be used to do impact studies and can account for the offsetting effects. In input-output models, the offsetting effects must be explicitly established in the impact scenario. This is very difficult and seldom done in input-output studies. The computable general equilibrium models incorporate the feedback loops so that the offsetting effects will be identified by the model itself. Unfortunately, the complexity of

[9] As the authors of several of these linkage studies, we have seen a number of users make this error, even after the difference is pointed out.

these feedback loops makes it difficult to have models with sufficient detail to identify different livestock species. In fact frequently CGE models only are able to have an agriculture section, much less separate sectors for dairy, pork, beef, etc.

ALTERNATIVES FOR MEASURING IMPACTS

In addition to using models to simulate the impacts of development, researchers can examine actual changes in local economies. Three approaches have been taken to do this (Bartik and Bingham, 1995). They are:

1) Before and after measures of local economies;

2) With/Without comparisons of local economies; and

3) Surveys of local citizens or leaders.

Before and After Measures: In the Before and After approach, data is collected on some variable of interest (jobs, incomes, wages) before the development and then again after the development. The impact is simply the difference between the value after development minus the value before development. The problem with this measure is that there might have been other factors which caused the change other than the program or development being considered. The longer the time between the before and after measures the more likely that outside variables will influence the outcome.

With/Without Comparisons: The With/Without comparison is done in two steps and requires a comparison community or region. In the first step, the before and after measures are taken in both the region of interest and in •identical• regions. Identical means that approximately everything, except for the development being measured, is the same between the regions. The impact of the development is then the difference in the before/after developments in the two areas. The advantage of this approach is that it removes some of the problems of the outside changes influencing results since both of the regions will be subject to the same influences • provided they are identical twins. The problem is that it is very difficult to find identical trends. The inference that the difference in growth between two regions is due to the development is only valid if the two areas are identical and all the influences on their economies are identical. If they are of different sizes or different economic structures (percentage of firms in each industry), then we would expect different rates of growth and change in the two areas without any shock.

Survey Approach: This allows the researcher to ask community leaders about whether development occurred or the nature of the development. The advantage is that the researcher can gain insights in the process. The disadvantages are that respondents might not remember details or have precise answers. Also, the respondents might have incentives to exaggerate impacts. The key question in evaluating survey studies is whether respondents have strong incentives to lie. Before and After Impact Studies This is identical to the comparable areas impact studies except that the same area is used. The changes in key economic variables are measured before and after an economic shock. Like the comparable area studies, this is only valid if the only difference is the economic shock. However, this is seldom the case.

Appendix B
Regional Input-Output Models: A Non-Technical Explanation

The following extended quote, from the University of Wisconsin-Extension bulletin (Goode 1982), gives a non-technical description of how regional input-output models and multipliers are developed. This was a regional project and Frank Goode is a Professor of Agricultural Economics at Pennsylvania State University. The extended quote follows:[10]

THE TRANSACTION TABLE

The input-output model takes its name from one of the tables typically constructed in such studies. This table shows the distribution of sales of each of the sectors in an area economy to each of the other local sectors and to the export sector. Suppose that we have a rural community in which we can assign each of the firms to one of four sectors: the agricultural sector, the manufacturing sector, the retail sector, or the household sector. The input-output transactions for such a community are shown in Table A1. The first (row) of Table A1 indicates the distribution of total sales of the agricultural sector to the other sectors in the local economy and for export. Agricultural production in the region totals $100. Of that $100, sales to other agricultural firms accounts for $5, sales to manufacturing firms for $10, sales to retail establishments, such as grocery stores, for $10, and direct-marketing sales to the household sector for $15. The balance of $60 of agricultural output is exported to individuals and firms outside the region. Conversely, each column of the table represents the distribution of input purchases for each of the four sectors. Thus, the columns of such a table represent the inputs and the rows represent the outputs of the sectors in the local economy. Generally, these flows are measured in dollars.

THE INPUT COEFFICIENT TABLE

[10] This publication is in the public domain and not copyrighted so it can be quoted at length with full citation and without explicit permission.

The next step in input-output analysis is to use the information in Table A1 to develop an input coefficient table. The input coefficients for a particular sector indicate the amount of input purchases by that sector, per dollar of output, from each of the sectors. The input coefficients in Table A2 are obtained by dividing the entries of each column of Table A1 by the total of the corresponding row. For example, each of the entries in the first column would be divided by the total of the agricultural row. To produce one dollar's worth of agricultural output requires 5 cents' worth of input from other agricultural firms, 20 cents' worth of inputs are required from the manufacturing sector, 30 cents' worth of inputs from the retail sector, 25 cents' worth of inputs from the household sector in the form of labor, and 20 cents' worth of various imported inputs.

THE MULTIPLIERS

The next step in input-output analysis is to develop multipliers. There are a variety of multipliers, but those most commonly used reflect the total change in output in the economy associated with a $1 increase in exports from one of the sectors. That is, for an economy such as that represented by Tables A1 and A2 there would be four multipliers. These multipliers would indicate how much total output in the local sectors would increase as a result of a $1 increase in exports from the agriculture, manufacturing, retail, or household sector. These multipliers are obtained as follows.

Suppose we are interested in finding the multiplier for the manufacturing sector because of an anticipated increase in export demand for that sector's output. This could be reflected in the expansion of employment in an existing firm or the arrival of a new firm. If the manufacturing sector's exports increased by $1, the immediate and so-called *direct effect* is the $1 increase in output in the manufacturing sector. However, increasing output by $1 in the manufacturing sector requires inputs of other sectors. Namely, the $1 increase in manufacturing output requires 6 cents' worth of inputs from the agricultural sector, 3 cents' worth of inputs from both the manufacturing and retail sector, and 44 cents' worth of inputs from the household sector. These increases in output are referred to as the first-round *indirect* effects.

The first-round increases in output require each of the four sectors to increase their input purchases. For example, the first round required agricultural production to increase by 6 cents; thus, the agricultural sector must purchase additional inputs. The increased output of 6 cents in the agricultural sector again required inputs of (only 3/10 of 1 cent from agriculture and) 2 cents from the (retail) l sector, and 1 cent each from the manufacturing and household sectors.[11] Likewise, the first-round increased output of 3 cents in the manufacturing and retail sectors and 44 cents in the household sector requires additional inputs from the other sectors. The inputs

[11] The interested reader is referred to William M. Miernyk, The Elements of Input-Output Analysis for a full description of the mathematics. Goode had an error in this sentence. His numbers in Table 3 are ok but this sentence had a math error. We•ve corrected that for ease of exposition.

required to support the first round are referred to as the second-round *indirect effects* and are found in Column 3 of Table A3. That is, to support the first-round impacts listed in Column 2 of Table A3 requires 5 cents' worth of input from agriculture, 4 cents from manufacturing, 25 cents from the retail sector, and 4 cents from the household sector. The round-by-round procedure continues until the magnitudes are so small as to be negligible. Summing all of the rounds yields the amount that output each of the four sectors would increase in response to the original $1 increase in manufacturing-sector exports. In this example the $1 increase in manufacturing exports would require increased output of approximately 16 cents in the agricultural sector, $1.12 in the manufacturing sector (this includes the original $1 increase in demand), and 45 cents in the retail sector. The total income of the household sector would increase by about 67 cents. In total, the entire economy will increase by $2.40 in response to the original $1 dollar increase in export sales of the manufacturing sector. Put another way, each dollar increase in export sales from the manufacturing sector generates an additional $1.40 worth of business in all four sectors in the economy. The multipliers for all of the sectors are shown in Table A4.

Table A1: Transaction Table for an Area Economy*

Economic Sectors	Agriculture	Manufacturing	Retail	Household	Export	Total Sales
Agriculture	5	10	10	15	60	100
Manufacturing	20	5	5	10	140	180
Retail	30	5	5	90	15	145
Household	25	80	30	10	25	170
Imports	20	80	95	45		
Total Expenses	100	180	145	170		

Table A2: Input Coefficients for an Area Economy

Economic Sectors	Agriculture	Manufacturing	Retail	Household
Agriculture	.05	.06	.07	.09
Manufacturing	.20	.03	.03	.06
Retail	.30	.03	.03	.53
Household	.25	.44	.21	.06

Table A3: Direct and Indirect Effects Associated with a $1 increase in Manufacturing Exports.

Economic Sectors	Direct		Indirect Rounds*		
		(1)	*(2)*	*(3 to 13)*	*Total*
Agriculture		.06	.05	.05	.16
Manufacturing	1	.03	.04	.05	1.12
Retail		.03	.25	.17	.45
Household		.44	.04	.19	.67
				Total:	2.40

*While Goode•s article shows indirect rounds 3 and 4, the typical input-output model uses the equivalent of 13 indirect rounds. The total impact of these indirect rounds is shown above even thought Goode left them blank in table 3 even though it is clear from the text that they must be calculated. We add them for clarity.

Table A4: Direct and Indirect Requirements (Sector Multipliers)

Economic Sectors	(1) Agriculture	(2) Manufacturing	(3) Retail	(4) Household
Agriculture	1.18	.16	.13	.19
Manufacturing	.30	1.12	.09	.15
Retail	.71	.45	1.28	.81
Household	.61	.67	.36	1.36
Total	2.80	2.40	1.86	2.51

Appendix C is a reprint explaining the concept of "externalities", found on pages 356-358 from the book Encyclopedia of Economics, Douglas Greenwald, editor in chief, McGraw-Hill, 1982,. Copyright restrictions prohibit posting copies of the reprint on the Internet or making copies for general distribution. The book may be obtained at your local library or bookstore, or through Interlibrary Loan.