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Staff Paper

TRENDS IN MICHIGAN AGRICULTURE AND FOOD PROCESSING

by
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Michigan Agriculture and Food Processing

Executive Summary

Agriculture, prominent in the early settlement of Michigan in the 1800s, was joined by food processing in the 1900s to become a major component of the economy even as the auto industry became predominant. Michigan farmers have adjusted to new opportunities and have taken advantage of the unique aspects of the soils and climate to generate a very diverse system of crops and livestock. The close rural-urban interface is mutually beneficial to the agricultural/food processing complex and the rest of the state.

The interdependence of agriculture and food processing suggests that they be considered in combination in evaluating trends and prospects for both. The state being well suited for forage production and with an expanding urban population, dairying became the most important enterprise. New hybrids pushed corn production to far exceed the livestock requirements of the state, stimulating cattle feeding, hog and turkey production. Michigan farmers have competed more effectively in the national scene with crops than with livestock, particularly on soybeans, sugarbeets and ornamentals. Real value added by food processors in the state increased over time with the strongest performance relative to national totals in dairy processing.

While some recent trends have been negative, agricultural production and processing remain as a key sector in the economy. Broadly defined, the output of this sector totaled $27 billion annually in the late 1990s if backward linked industries supplying agriculture and food processing are included; $37 billion if wholesaling and retailing are added. Agricultural production and processing employed nearly 100 thousand directly and an additional 100 thousand in backward linked industries; a total of over 500 thousand if direct and indirect effects of wholesaling and retailing are compiled. The expanded 500 thousand jobs represent nearly 13 percent of total employment in the state.

Besides its strong presence in the state, the agricultural production and processing sector provides diversification to an economy heavily dependent on durable goods industries, principally motor vehicles and parts. Cycles in agriculture are not highly correlated with the business cycle which swings Michigan's economy more than other states. Efficiencies in agricultural production have resulted in lower real farm prices, contributing to reduced level of inflation in food prices. Also, farmers perform key roles as stewards of the Michigan landscape. A tradition in Michigan agriculture and the food business has been entrepreneurship and innovative leadership which will be essential for the future.

History

Some of the earliest assessments of the potential for Michigan as an agricultural state were not very optimistic. The Indians had made only nominal use of the land for agriculture. One survey made in 1815, in an effort to locate two million acres of land in Michigan as bounty for soldiers in the War of 1812, cited extensive swamps and marshland and concluded, "not more than one acre in one hundred would admit of cultivation" (Chase, 1922). Others, however, found the dense forest as evidence of superior soil qualities. Settlement and clearing of the forest proceeded rapidly in the 1830s and 1840s. Settlers found many wild fruits including cherries, plums, apples, grapes, raspberries, strawberries, huckleberries and cranberries.

The first white farmers were French locating mostly in the southeast part of the state. The opening of the Erie Canal in 1825 provided passage to the state for New Englanders. Not long after, immigrants of farm stock from the old world began arriving including Germans, Dutch, and Finns among others. Accompanying the expansion in agriculture were improvements in transportation facilities, drainage laws, and attention to education including the establishment of the pioneer land grant Michigan Agricultural College (1855). Other institutions also played a role in the development of a modern agriculture including federal and state government and agricultural organizations. The State Horticultural Society was formed in 1870 (Fuller, Historic Michigan).

Around the turn into the twentieth century, agriculture was cited as follows (Utley, Cutcheon and Burton, 1906):

> The backbone of industry in Michigan has always been agriculture. The soil of the state for the most part is productive and bears abundant crops with but small outlay for fertilizers. The climate is favorable for the growing of all crops profitable in any part of the United States, except cotton, sugar cane and rice.

At that time, nearly 300 thousand persons were engaged in agriculture, equal to the total employed in manufactures, trade and transportation.

The number of farms in Michigan in 1900 was about 200 thousand, very near to the peak of 207 thousand reached in 1910 as shown in Figure 1 (U.S. Department of Commerce, Census of Agriculture). In the 50 year period from 1860 to 1910, the number of farms had increased more than three fold from the 1860 total of 62 thousand. After 1910, farm numbers declined to nearly 50 thousand by the end of the twentieth century.

Land in farms, which reached a peak of 19 million acres in 1920, also declined but less percentagewise as consolidation into larger units was a prevalent trend (Fig. 2). By 1998, land in

Figure 1

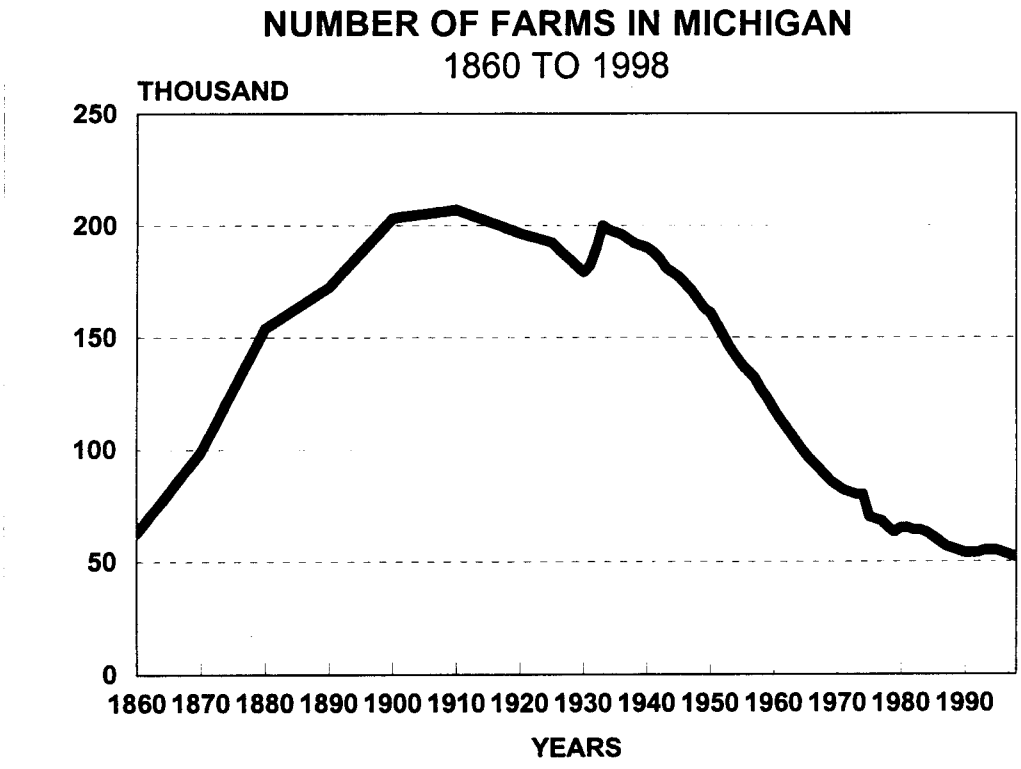
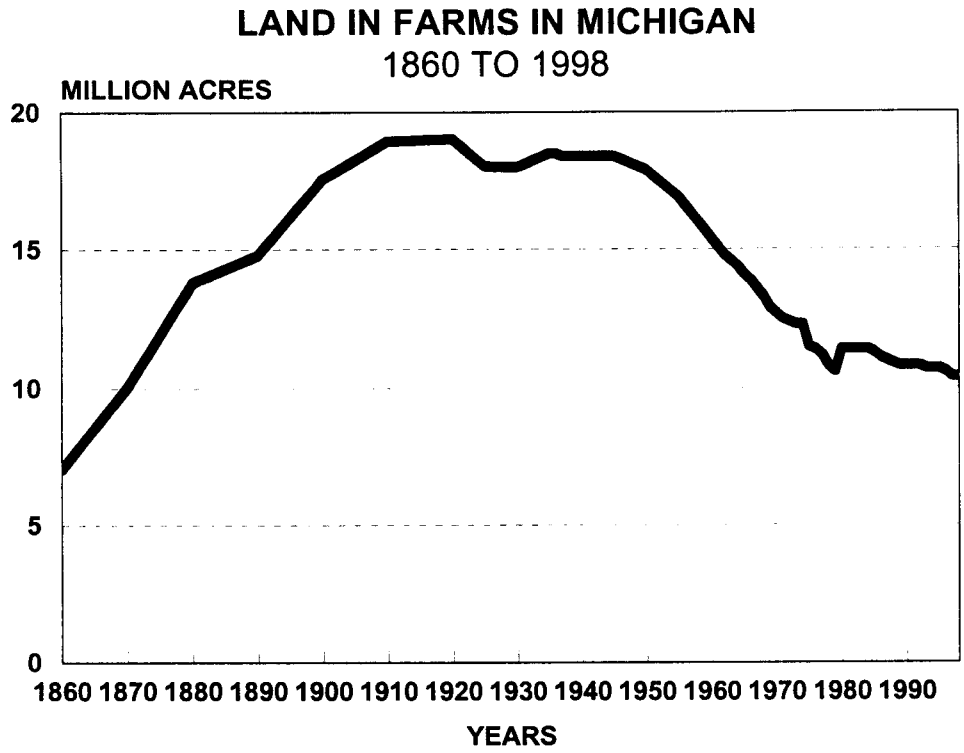

NUMBER OF FARMS IN MICHIGAN
1860 TO 1998
THOUSAND
250
200
150
100
50
0
1860 1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990
YEARS

Figure 2


LAND IN FARMS IN MICHIGAN
1860 TO 1998
MILLION ACRES
20
15
10
5
0
1860 1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990
YEARS

farms had dropped to 10.4 million acres (Michigan Agricultural Statistics Service, 1999). The average acreage per farm had doubled from about 100 acres in 1920 to 200 acres in 1998.

The Census definition of a farm, however, is rather minimal, with any unit annually selling $1000 or more of agricultural products qualifying. With the rapid growth of manufacturing in Michigan, opportunities for off farm employment have resulted in many part-time farms in the state. While numerous, their contribution to the total agricultural product has been relatively small. In 1997, 84 percent of farmers grossed less than $100,000 annually and produced only 17 percent of the total product; or on the other side, 16 percent of the farmers grossed $100,000 or more and were responsible for 83 percent of the product (U.S. Department of Agriculture, 1997 Census of Agriculture). A gross of $100,000 is about the lower limit to be considered a full time farmer.

Long Term Commodity Trends

Even though land in farms, by the end of the twentieth century, had declined to nearly half of the peak level of 1920, the output of Michigan farms had increased. Farmers were able to extract more product from less land not only by increasing yields per acre and output per head of livestock but also by shifting from less profitable to more profitable enterprises.

The performance is illustrated in Figures 3 and 4 which chart yields per acre on prominent crops since the mid to latter part of the 1800s. Corn yields averaged just over 30 bushels per acre from 1866 to 1950 with very little trend, then moved up to top 125 bushels by 1999. The introduction of new earlier maturing hybrids favored Michigan substantially. Wheat yields held close to 15 bushels per acre in 1866 to 1910, then increased steadily to about 55 to 60 bushels by 1999 (Fig. 3). Hay acreage dropped sharply after 1940, but because of increased yields, production reached a new high plateau in the late 1980s and 1990s (Fig. 4).

Dairy farmers, with the assistance of research, extension and breeding services increased milk production per cow from 6000 pounds per year in 1950 to 18,000 pounds in 1999 (Fig. 5). This and other developments in the livestock industry enabled farmers to gain feed efficiency.

Early in the agricultural history of the state, livestock enterprises on farms served mainly to provide the household with meat, eggs, dairy products and even wool for clothing. Soon, though, production exceeded household requirements. For example, the Michigan Pioneer and Historical Society reported for Shiawasee County (Chase, 1922):

> Besides cattle slaughtered at home, the amount sold and taken out of the county for each of the years 1852 and 1853 was not less than $10,000. Almost every farmer has a flock of sheep and wool-growing has become an important business, the amount sold in 1853 exceeding $10,000. Nearly every farmer raises or makes his surplus amount of butter and pork.

Figure 3

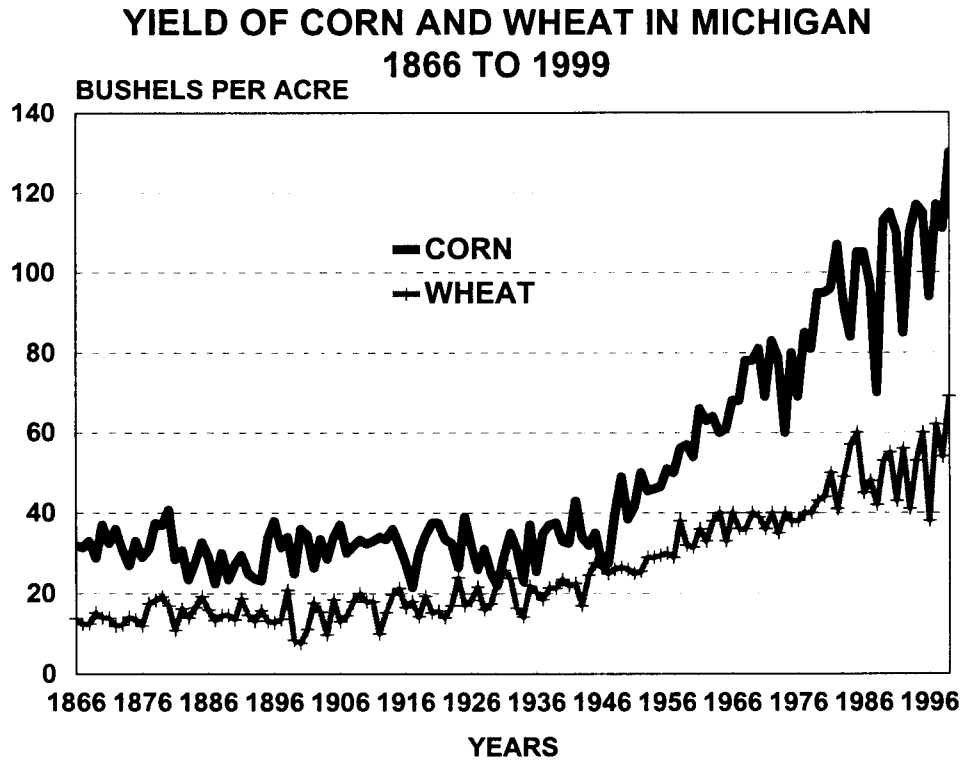

YIELD OF CORN AND WHEAT IN MICHIGAN
1866 TO 1999
BUSHELS PER ACRE
140
120
100
80
60
40
20
0
CORN
WHEAT
1866 1876 1886 1896 1906 1916 1926 1936 1946 1956 1966 1976 1986 1996
YEARS

Figure 4

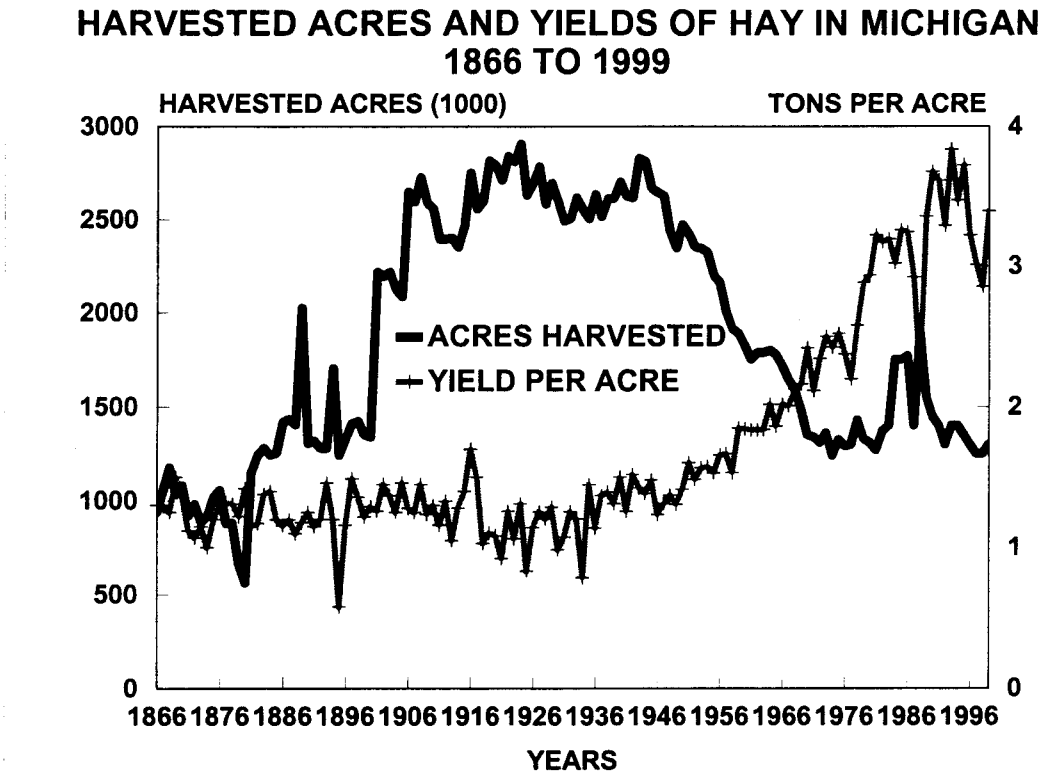
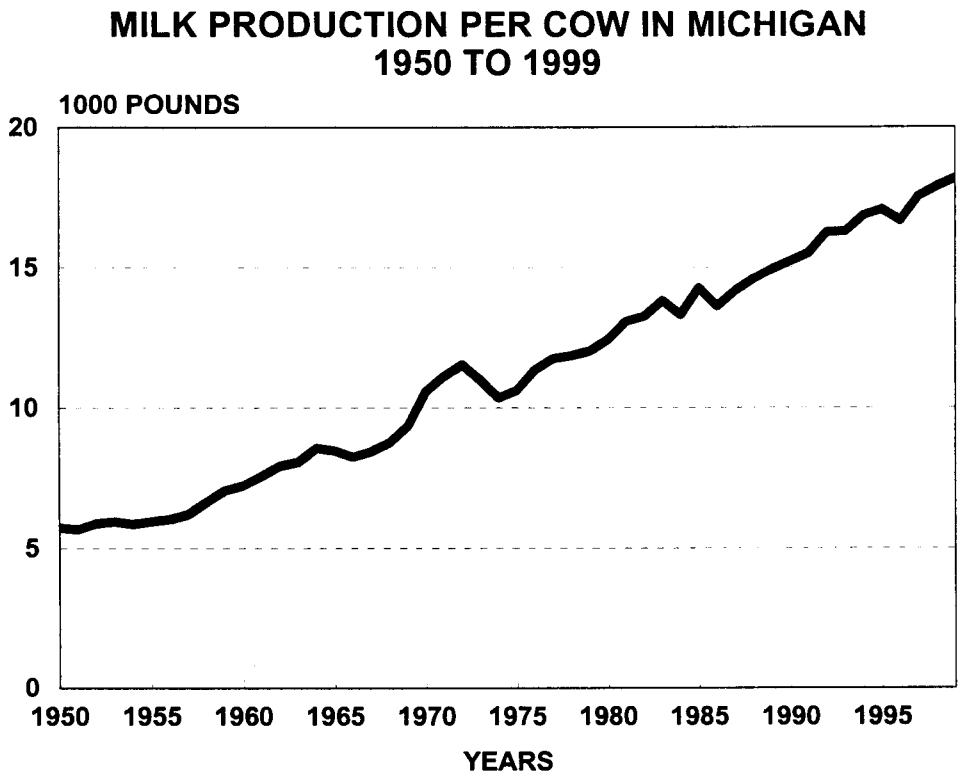

HARVESTED ACRES AND YIELDS OF HAY IN MICHIGAN
1866 TO 1999
HARVESTED ACRES (1000)
TONS PER ACRE
3000
2500
2000
1500
1000
500
0
4
3
2
1
0
ACRES HARVESTED
YIELD PER ACRE
1866 1876 1886 1896 1906 1916 1926 1936 1946 1956 1966 1976 1986 1996
YEARS

Figure 5


MILK PRODUCTION PER COW IN MICHIGAN
1950 TO 1999
1000 POUNDS
20
15
10
5
0
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
YEARS

With the comparative advantage of Michigan in producing forages and with the growing population, dairying emerged as the most viable livestock enterprise which continued through the twentieth century. With fluid milk being perishable and relatively costly to transport, the expanding urban market fit in well with the ability of dairy farmers to capitalize on the productivity of the land in producing hay, pasture and also corn silage. Corn production increased rapidly during the last half of the twentieth century, outpacing the livestock requirements. By the end of the century, nearly 70 percent of the corn crop was shipped out of the state to eastern livestock operations and/or to export. At the same time, the abundant feed supplies favored expansion of cattle feeding, hog and turkey production. Hog and turkey production was also encouraged by the presence of local slaughtering capacity.

A trademark of Michigan agriculture has been its diversity. The variety of soils contributed, with ample areas of muck land suited to certain vegetable crops and the sandy soils in the north and other areas providing opportunities for potato production. The moderating influence of Lake Michigan on the west enabled fruit growers to establish a strong industry in that area. Perhaps no other state, except California has such a diverse agriculture. Without heavy investment in irrigation, which came with federal help, California's agriculture would be much more limited.

Coupled with diversity, Michigan farmers have adjusted over time to explore new opportunities in crops and livestock. The shifting of land among crops since 1866 is vividly displayed in Figures 6, 7 and 8. In Figure 6, land continued to shift to corn over time particularly with the introduction of hybrid seeds in the 1930s. In recent years, about 85 percent of the acreage harvested has been for grain and the balance for silage. Oat acreage, which had been nearly equal to corn before 1930 dropped off sharply afterward as horsepower exited the Michigan scene.

As shown in Figure 7, farmers have shifted acreage out of wheat over time. However, with increased yields, production has expanded, holding at about 32 million bushels in 1950 to 1999 compared to 17 million bushels in the first half of the century. Michigan produces soft white and soft red wheat used for pastries. Michigan ranks first in production of soft white wheat outside the Pacific Northwest. The most dramatic change in crop acreage and production has been in soybeans. From 1930, when hardly any soybeans were harvested, acreage pushed up to nearly 2 million acres by 1999. In 1999, soybean acreage was exceeded only by corn, but not much. Early on, soybeans were used as a forage, then more for the oil and later their value for meal exceeded their value for oil.

Other major field crops included dry beans, sugarbeets and potatoes. Michigan has been predominant in U.S. dry bean production, particularly navy beans, over time but has lost ground to the Red River Valley of North Dakota and Minnesota. This is indicated by the acreage, charted in Figure 8, which trended lower after the early 1960s. Recognizing the growing demand for colored beans, Michigan growers shifted to those varieties, and by the end of the 1990s, over 60 percent of the acreage were in colored beans. Sugarbeets became a fixture in the farm scene at the beginning of the twentieth century (Fig. 8). Acreage edged lower in the first half of the

Figure 6

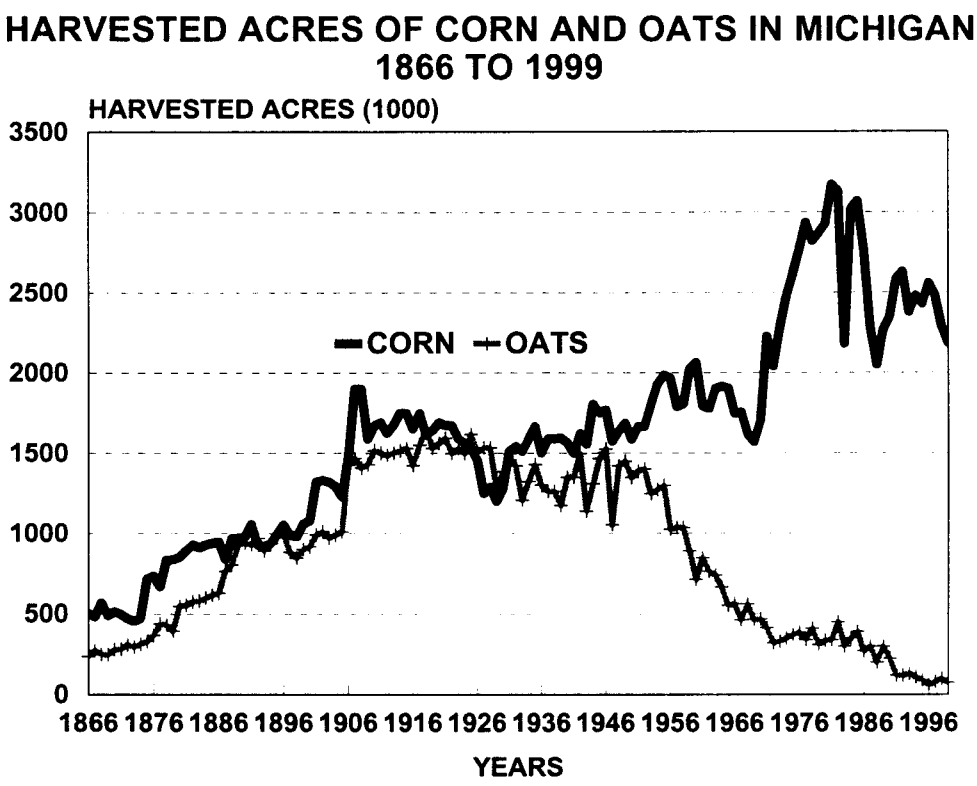

HARVESTED ACRES OF CORN AND OATS IN MICHIGAN
1866 TO 1999
HARVESTED ACRES (1000)
3500
3000
2500
2000
1500
1000
500
0
CORN
OATS
1866 1876 1886 1896 1906 1916 1926 1936 1946 1956 1966 1976 1986 1996
YEARS

Figure 7

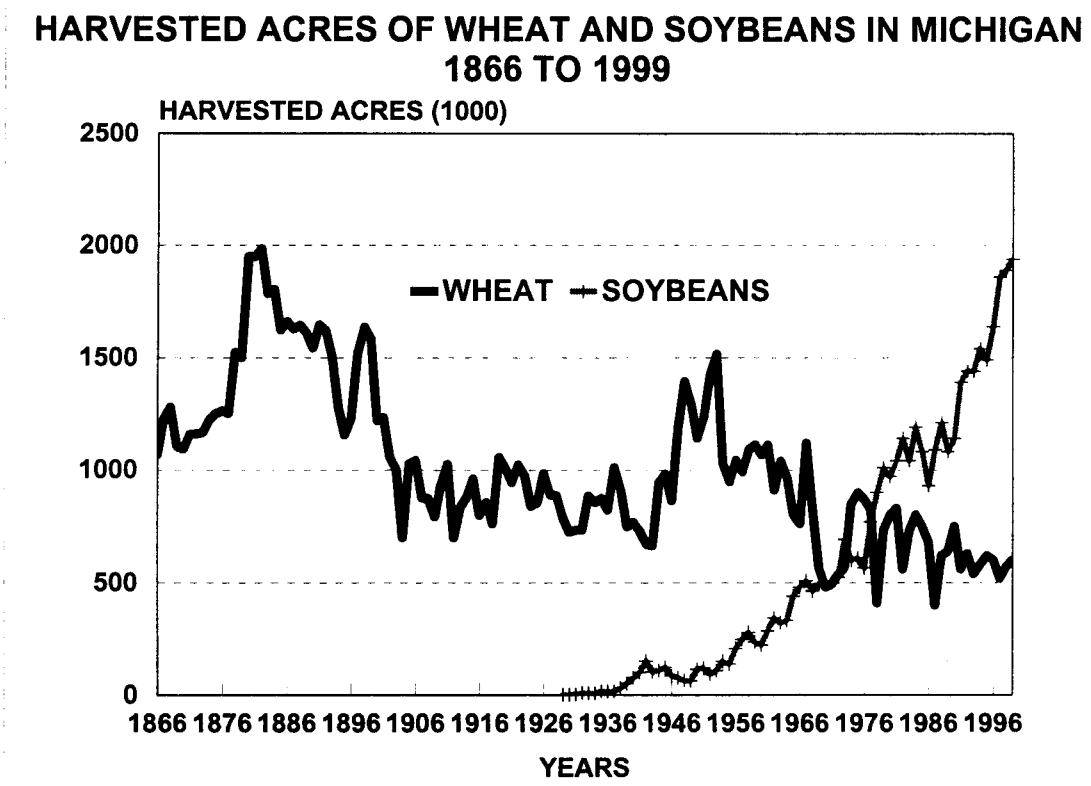
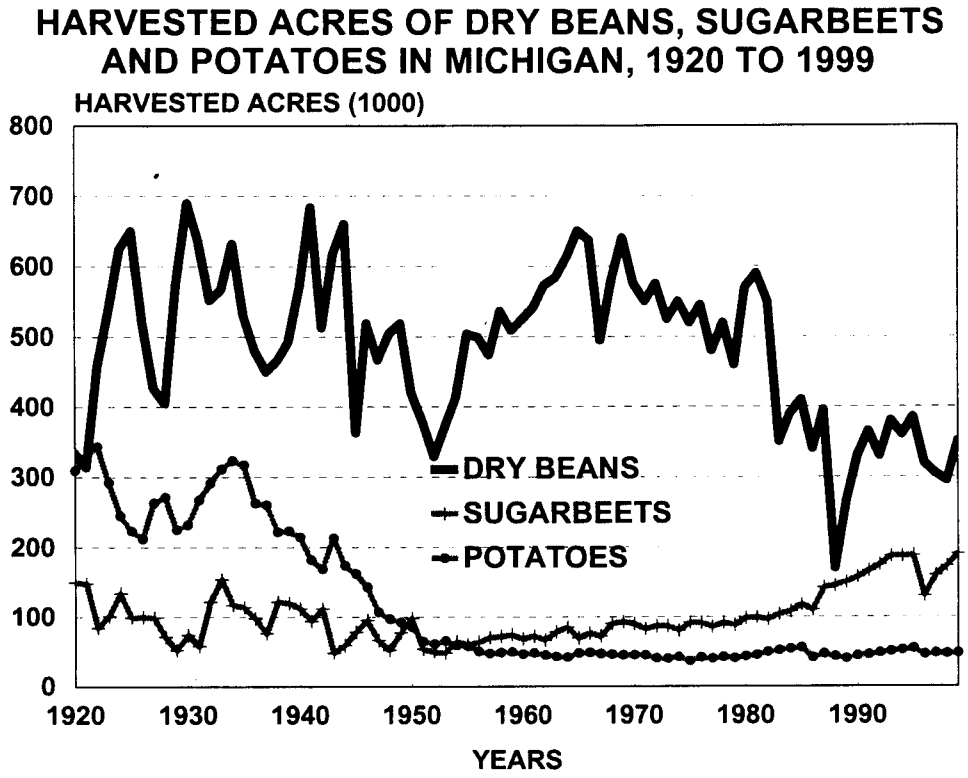

HARVESTED ACRES OF WHEAT AND SOYBEANS IN MICHIGAN
1866 TO 1999
HARVESTED ACRES (1000)
2500
2000
1500
1000
500
0
WHEAT
SOYBEANS
1866 1876 1886 1896 1906 1916 1926 1936 1946 1956 1966 1976 1986 1996
YEARS

Figure 8


HARVESTED ACRES OF DRY BEANS, SUGARBEETS AND POTATOES IN MICHIGAN, 1920 TO 1999
HARVESTED ACRES (1000)
800
700
600
500
400
300
200
100
0
1920
1930
1940
1950
1960
1970
1980
1990
YEARS
DRY BEANS
SUGARBEETS
POTATOES

century but more than doubled after 1970. Sugarbeet yields, which averaged about 8 tons per acre in 1909 to 1950, increased to a plateau of about 18 tons in 1970 to 1999.

Of note is that only about 50 thousand acres of potatoes were harvested in the 1990s compared to an average of about 275 thousand acres in 1920 to 1935 (Fig. 8). This indicates that Michigan has considerable room for expansion of this crop if the need arises. Yields increased from 60 cwt. in 1920 to 1935 to over 300 cwt. in the latter part of the 1990s. Production trended steadily upward after 1955 reversing a steep decline earlier.

The number of dairy cows on Michigan farms at the end of the twentieth century was only a third of the level at the midpoint of the century (Fig. 9). The decline was particularly sharp between 1950 and 1970. After 1970, increased milk production per cow brought total milk output up to levels of 1950 to 1965.

Beef cow numbers increased fourfold from 1950 to the mid 1970s to over 200 thousand head, then dropped back to about 100 thousand by the end of the century (Fig. 10). Cattle feeding also increased into the mid 1970s, fell back into the early 1980s and then recovered, holding at about 200 thousand head in the 1990s.

Both hog and turkey production increased sharply in the 1980s, stimulated by relatively low corn prices and nearby slaughtering facilities (Fig. 11). Increased competition from the expansion of large hog operations in North Carolina coupled with the loss of the major slaughterer in the state caused hog production to level off in the 1990s. Turkey growers also lost their major slaughter facilities late in the 1990s, putting production on hold. In the meantime, they have launched efforts of their own to replace that loss. Egg production has fluctuated around 1500 million eggs annually without much trend in evidence (Fig. 12).

Trends in Cash Receipts from Farming

Because of the large number of commodities involved in the fruit, vegetable and ornamental (nursery and floriculture) industries, trends in those sectors are treated in aggregates of cash receipts. Data on cash receipts and value of production also allow one to compare one commodity group with another.

Cash receipts from sales and direct government payments increased between 1960 and 1998 as shown in Figure 13. The expansion in receipts was particularly buoyant during the 1970s followed by a recession in the 1980s. Shortfalls in global grain supplies in the 1970s drove up prices on not only grain but on other major commodity groups as well. Exuberance from those unprecedented prices generated overproduction in the following decade coupled with a strong dollar which trimmed exports.

Figure 9

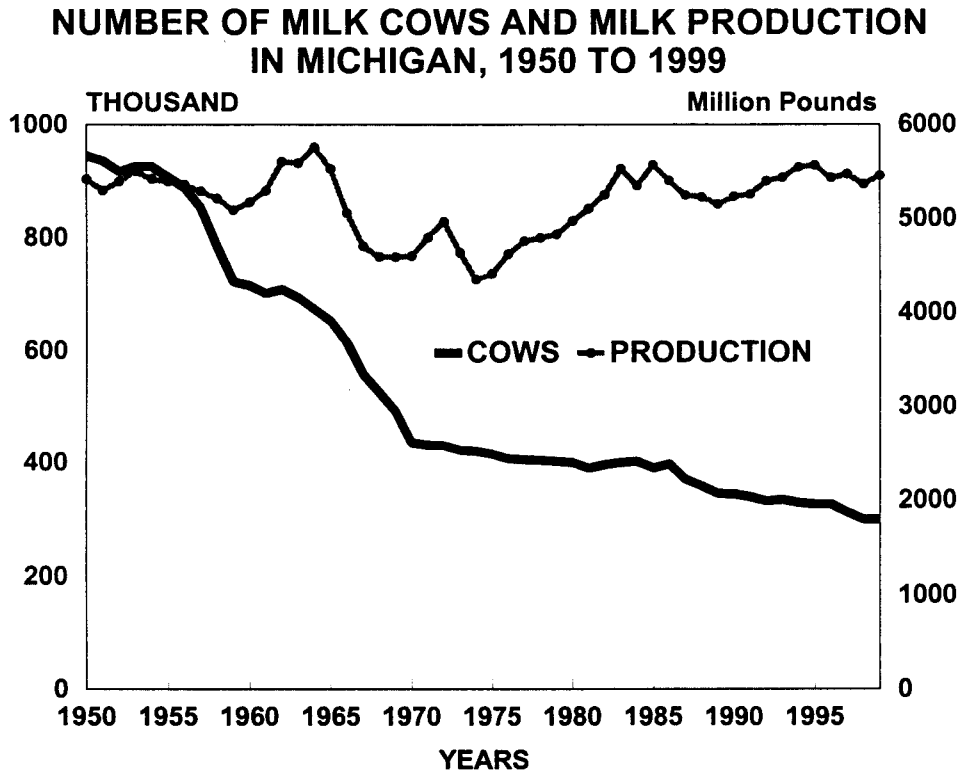

NUMBER OF MILK COWS AND MILK PRODUCTION
IN MICHIGAN, 1950 TO 1999
THOUSAND
Million Pounds
1000
800
600
400
200
0
6000
5000
4000
3000
2000
1000
0
COWS
PRODUCTION
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995
YEARS

Figure 10

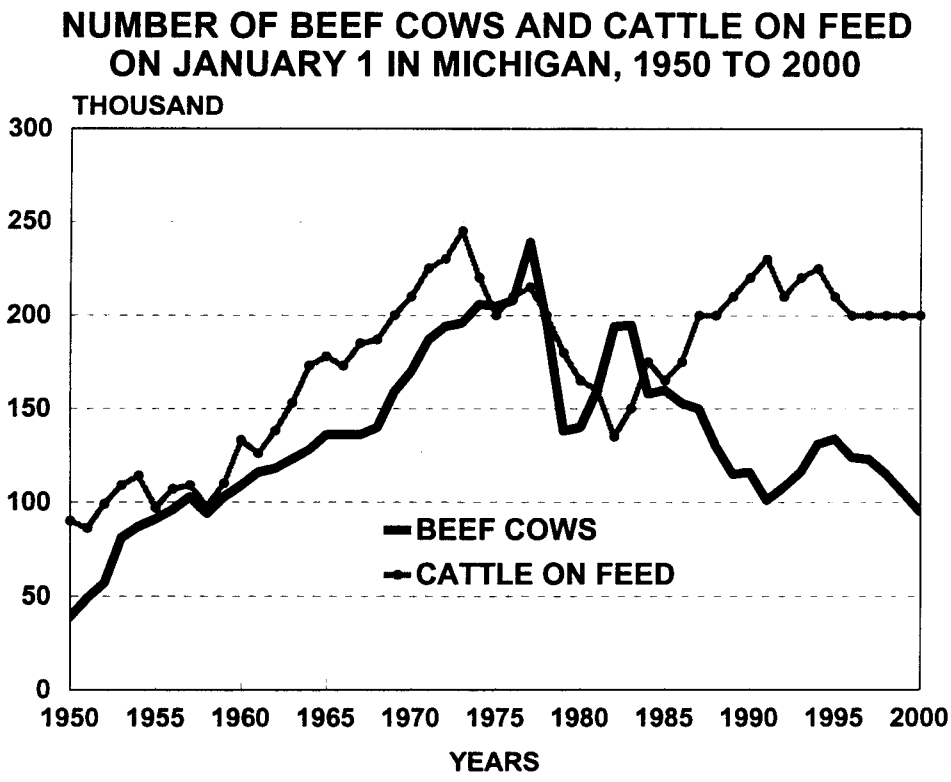

NUMBER OF BEEF COWS AND CATTLE ON FEED
ON JANUARY 1 IN MICHIGAN, 1950 TO 2000
THOUSAND
300
250
200
150
100
50
0
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
YEARS
BEEF COWS
CATTLE ON FEED

Figure 11

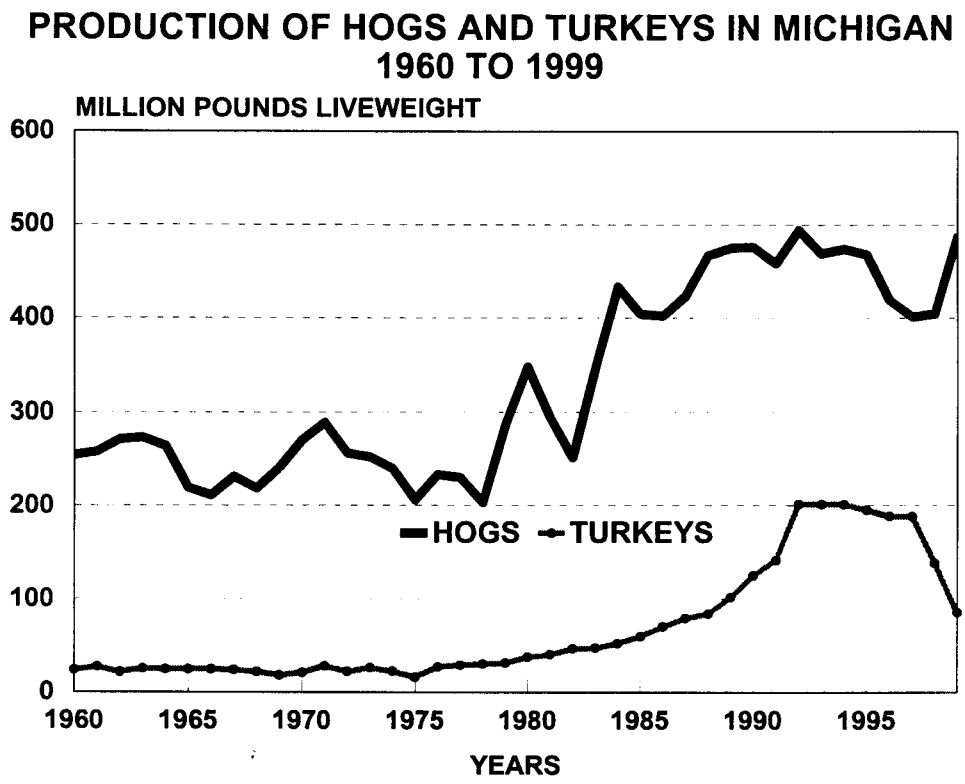

PRODUCTION OF HOGS AND TURKEYS IN MICHIGAN
1960 TO 1999
MILLION POUNDS LIVEWEIGHT
600
500
400
300
200
100
0
HOGS
TURKEYS
1960
1965
1970
1975
1980
1985
1990
1995
YEARS

Figure 12

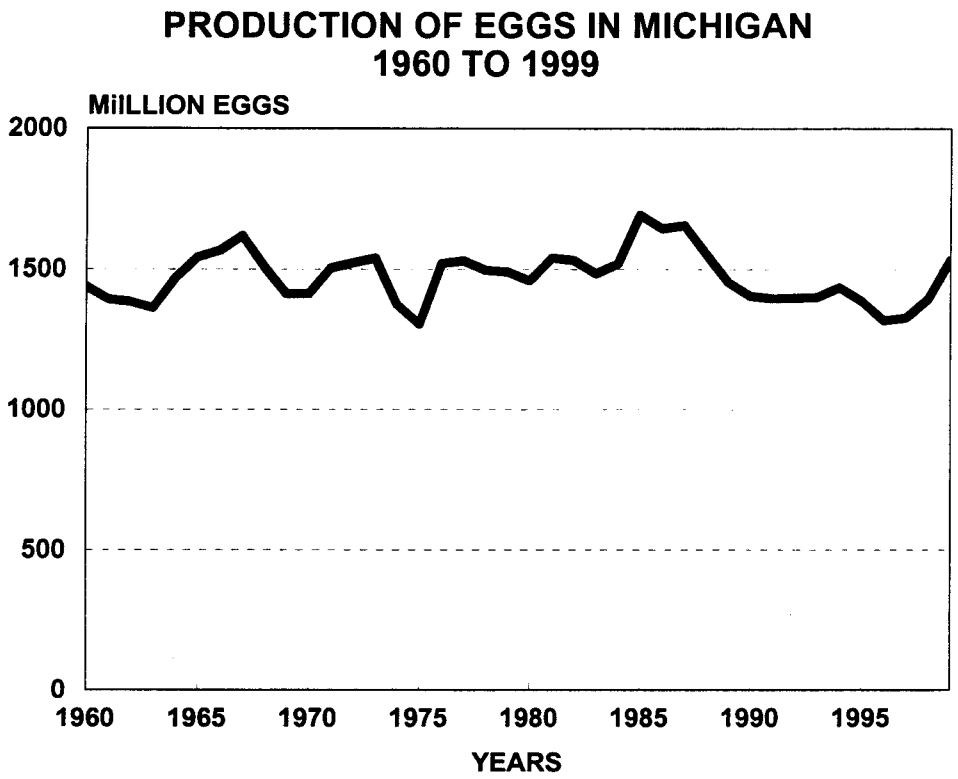
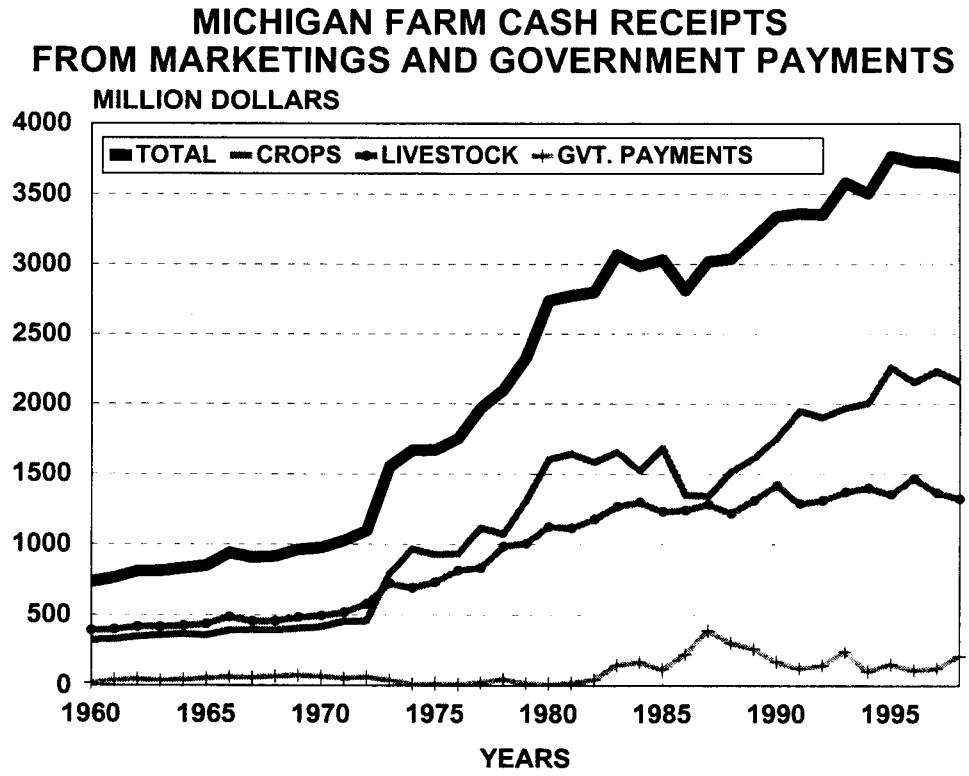

PRODUCTION OF EGGS IN MICHIGAN
1960 TO 1999
MILLION EGGS
2000
1500
1000
500
0
1960
1965
1970
1975
1980
1985
1990
1995
YEARS

Figure 13


MICHIGAN FARM CASH RECEIPTS
FROM MARKETINGS AND GOVERNMENT PAYMENTS
MILLION DOLLARS
TOTAL
CROPS
LIVESTOCK
GVT. PAYMENTS
4000
3500
3000
2500
2000
1500
1000
500
0
1960
1965
1970
1975
1980
1985
1990
1995
YEARS

Crop sales have increased more than livestock sales, exceeding $2 billion in the latter part of the 1990s. Livestock sales have approached $1.5 billion. Government payments averaged $175 million in the 1990s. In total, gross receipts to Michigan farmers were close to $4 billion annually at the close of the twentieth century.

If the receipts are presented in *real* terms, the picture is somewhat different. Dividing actual cash receipts by the Consumer Price Index (1982-84 = 100%), trends since the 1970s have been negative, or with crops in the 1990s, stable (Fig. 14).

Figures 15 and 16 are similar charts with details on crops. Receipts from field crops increased sharply in the 1970s, dropped into the early 1980s and recovered to about the $1.2 billion level (Fig. 15). These figures do not include direct government payments from the Feed Grain, Wheat, and Conservation Reserve programs.

Fairly consistent increases can be noted for the other crop classifications, particularly ornamentals, vegetables and potatoes (Fig. 15). By the late 1980s, receipts from ornamentals had exceeded the combination of sales of vegetable and potatoes and also of fruit. By 1998, ornamentals accounted for $475 million in gross income. Receipts from vegetables and potatoes each increased fairly steadily over time, with vegetable sales reaching $250 million by 1998 and potato sales around $90 million. Marketing of fresh fruit, vegetables and potatoes benefitted from the growing urban market not only in Michigan but also in the midwestern and eastern states as well.

Put in real terms (Fig. 16), receipts from field crops and vegetables and potatoes fell back from peaks of the 1970s and stabilized at a lower level after 1985. The decline after the 1970s on vegetables and potatoes was mostly in vegetables. Over the entire 1960 to 1998 period, real receipts from ornamentals displayed fairly consistent upward trends and potato receipts were relatively stable. Real receipts from fruit declined after the 1970s.

Trends in actual and real cash receipts from livestock are portrayed in Figures 17 and 18. The relative importance of milk in Michigan agriculture can be observed, with actual receipts leveling off after the mid 1980s but approaching the $800 million level by the end of the 1990s. Following milk were receipts from cattle and calves, hogs and poultry (eggs and turkeys), all of which trended upward in actual terms until the end of the 1990s. About $40 million of the sales of cattle in the 1990s should be attributed to the dairy enterprise as cull cows and calves. In real terms (Fig. 18), livestock sales have declined since 1980 with the exception of relatively stable receipts from poultry.

Trends in Food Processing

Increasingly, the strength of agricultural enterprises depends upon the linkages with food processing. With bulky products like sugarbeets, local processing facilities are prerequisite. The construction of sugarbeet factories in Michigan at the turn of the last century initiated that

Figure 14

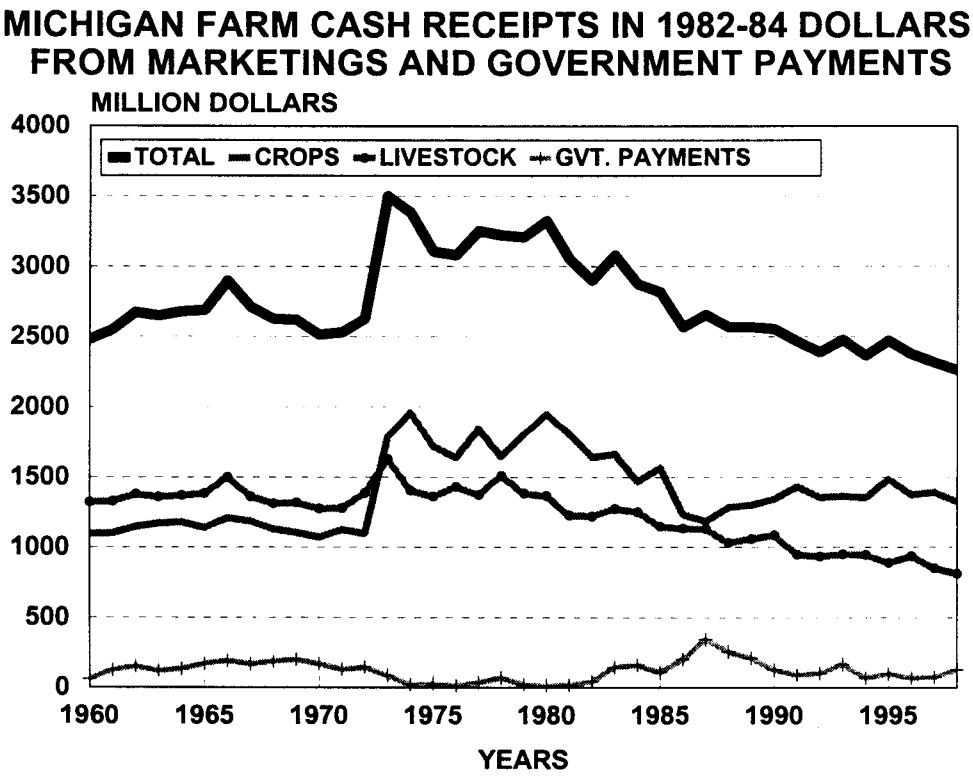

MICHIGAN FARM CASH RECEIPTS IN 1982-84 DOLLARS
FROM MARKETINGS AND GOVERNMENT PAYMENTS
MILLION DOLLARS
4000
3500
3000
2500
2000
1500
1000
500
0
TOTAL
CROPS
LIVESTOCK
GVT. PAYMENTS
1960
1965
1970
1975
1980
1985
1990
1995
YEARS

Figure 15

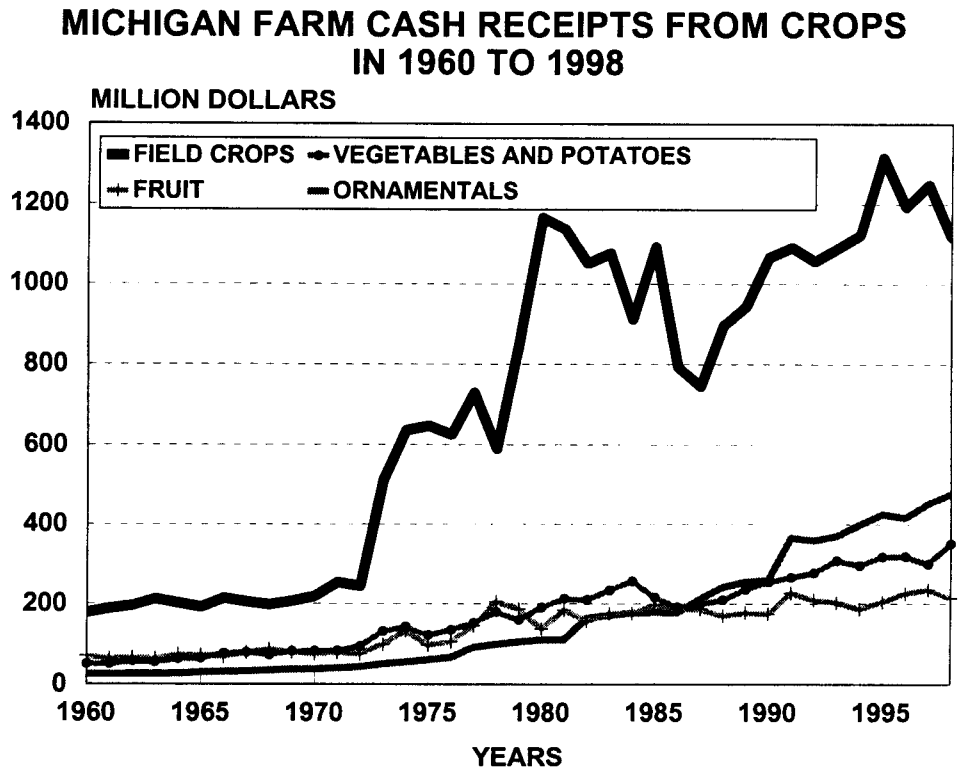

MICHIGAN FARM CASH RECEIPTS FROM CROPS
IN 1960 TO 1998
MILLION DOLLARS
1400
1200
1000
800
600
400
200
0
FIELD CROPS
VEGETABLES AND POTATOES
FRUIT
ORNAMENTALS
1960
1965
1970
1975
1980
1985
1990
1995
YEARS

Figure 16

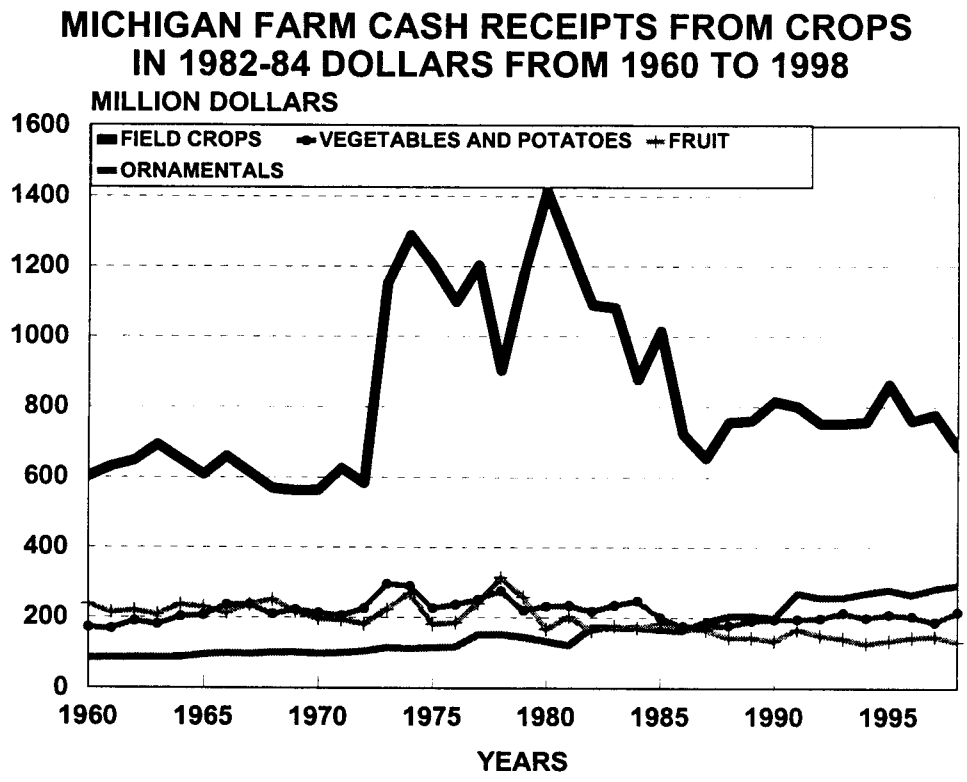

MICHIGAN FARM CASH RECEIPTS FROM CROPS
IN 1982-84 DOLLARS FROM 1960 TO 1998
MILLION DOLLARS
FIELD CROPS
VEGETABLES AND POTATOES
FRUIT
ORNAMENTALS
1600
1400
1200
1000
800
600
400
200
0
1960
1965
1970
1975
1980
1985
1990
1995
YEARS

Figure 17

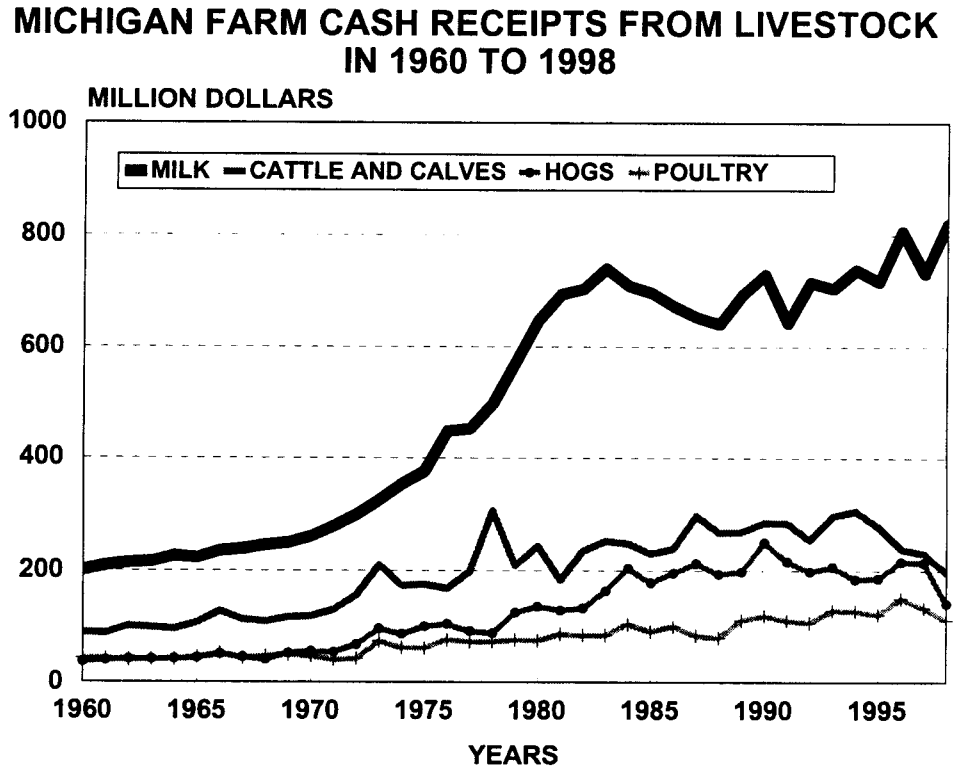
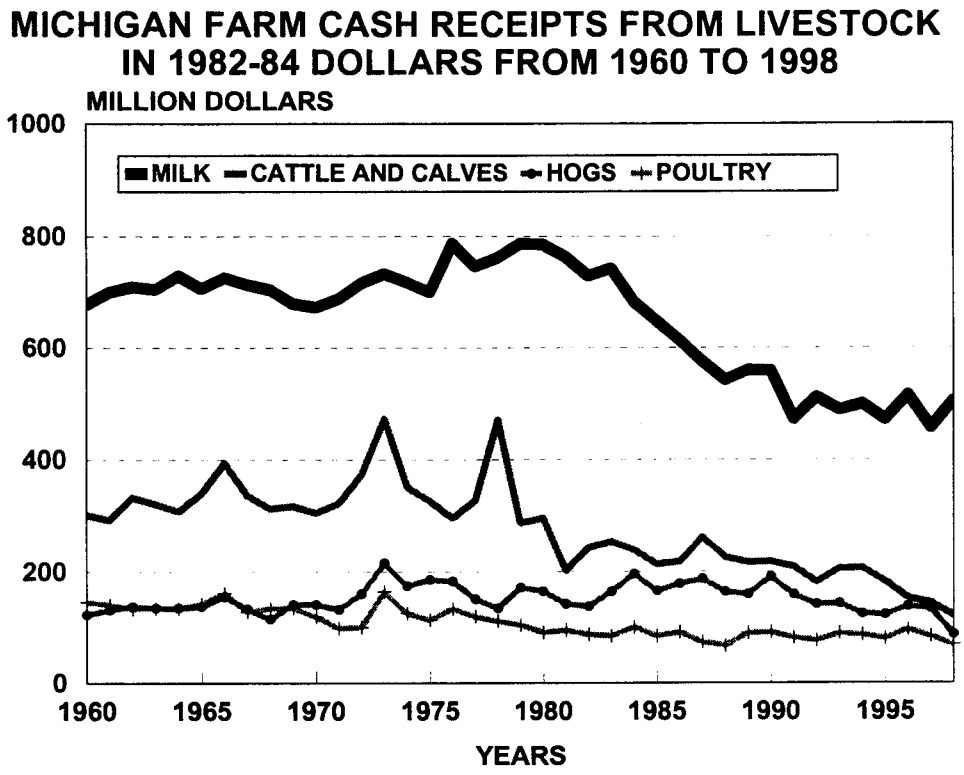

MICHIGAN FARM CASH RECEIPTS FROM LIVESTOCK IN 1960 TO 1998
MILLION DOLLARS
1000
800
600
400
200
0
MILK
CATTLE AND CALVES
HOGS
POULTRY
1960
1965
1970
1975
1980
1985
1990
1995
YEARS

Figure 18


MICHIGAN FARM CASH RECEIPTS FROM LIVESTOCK
IN 1982-84 DOLLARS FROM 1960 TO 1998
MILLION DOLLARS
1000
800
600
400
200
0
MILK
CATTLE AND CALVES
HOGS
POULTRY
1960
1965
1970
1975
1980
1985
1990
1995
YEARS

industry. And, of course, the viability of processors relates to dependable local supplies. One exception is the breakfast cereal industry which has purchased a relatively small proportion of its grain from Michigan. This is partly attributed to the nominal costs of transporting the raw material compared with the value of the finished product. The presence of a major breakfast cereal industry in Michigan is an example of the role of entrepreneurship in determining the location of an industry.

In any case, the natural resource base of Michigan as it contributes to agricultural production is also extended through value added in food processing. This sector has expanded its contribution to the Michigan economy over time. Value added refers to the value of shipments less the cost of materials utilized by the industry. In food processing, this includes packaging materials as well as the farm product. Also, the inputs may include prepared items, that is farm products which have been subjected to some processing. The value added represents compensation to labor, capital and management.

In 1958, the value added by Michigan food processors (including beverages) was about two-thirds of a billion dollars, which happened to be about the same as gross receipts from sales by Michigan farmers (Fig. 19). The value added increased steadily to a peak of $6.3 billion in 1992, then dropped off to about $6.0 billion in 1997 (U.S. Department of Commerce, Bureau of the Census). Data for 1997 are not quite comparable to the previous censuses but the direction of change would have remained the same regardless. The $6.0 billion on value added in 1997 was about $2.5 billion more than farmer's cash receipts from marketings in that year.

Even in real terms, value added by Michigan food processors had been increasing over time until the 1992-97 period (Fig. 19). Between 1958 and 1997, the annual real growth in value added was about 1.25 percent. Real value added is calculated by dividing the actual value added by the Consumer Price Index (1982-84 = 100%).

Trends in actual and real value added by seven food processor sectors are presented in Table 1. Value added has increased in both actual and real terms over the 1958 to 1997 period except for major reversals in real value added on beverages after 1977 and for dairy, fruits and vegetables, grain mill and "Other" between 1992 and 1997. However, loss of hog and turkey slaughtering facilities after 1997 has also attenuated the meat sector. Another commentary is that the counting criteria for bakeries was expanded in the 1997 census of manufacturing, rendering data inconsistent with previous censuses.

Of particular note is the drop in actual value added in the grain mill sector from $1866 million in 1992 to $1247 million in 1997. Of this decline of $619 million, $547 million was in breakfast cereal manufacturing.

Meat slaughtering and processing was Michigan's most rapidly growing food industry, percentagewise, in terms of value added through 1997 before the loss of slaughtering facilities. Following meat were bakeries, dairy products, grain mill products and beverages, in that order.

Figure 19

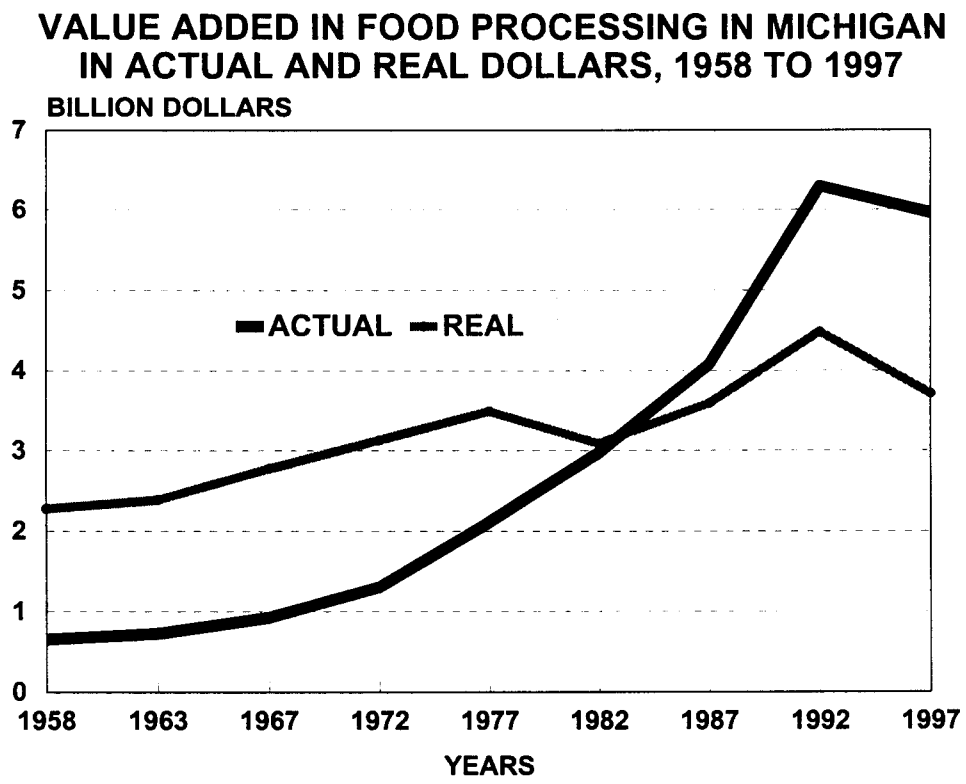

VALUE ADDED IN FOOD PROCESSING IN MICHIGAN
IN ACTUAL AND REAL DOLLARS, 1958 TO 1997
BILLION DOLLARS
7
6
5
4
3
2
1
0
ACTUAL
REAL
1958
1963
1967
1972
1977
1982
1987
1992
1997
YEARS

Table 1. Value Added by Michigan Food Processors in Censuses from 1958 to 1997[1]

Industry	Year								
	1958	1963	1967	1972	1977	1982	1987	1992	1997
	Million $								
Nominal									
Meat	72	74	82	135	216	361	385	631	882
Dairy	143	133	144	153	260	410	653	1,171	1,048
Fruit and Vegetables	60	92	132	174	273	451	511	700	687
Grain Mill	157	182	250	344	559	772	1,199	1,866	1,247
Bakery	89	100	126	175	231	297	476	680	857[2]
Beverage	81	94	136	227	366	379	402	586	610
Other	56	54	57	99	208	304	451	659	628
Total	658	729	927	1,307	2,113	2,974	4,077	6,293	5,959
1982-84 Dollars									
Meat	250	243	246	323	356	374	339	450	550
Dairy	494	434	433	367	429	425	575	834	653
Fruit and Vegetables	206	300	394	416	451	467	450	499	428
Grain Mill	543	596	748	822	923	800	1,055	1,330	777
Bakery	308	328	376	418	382	308	419	485	534[2]
Beverage	280	308	406	5543	604	393	354	417	380
Other	194	175	170	236	343	315	397	470	391
Total	2,275	2,384	2,773	3,125	3,488	3,082	3,589	4,485	3,713

[1] Source: US Department of Commerce, Census of Manufacturers, various issues.
[2] Not consistent with previous censuses.

Through 1992, the grain mill industry registered the strongest growth as had the beverage industry through 1977 before falling back.

Employment in food processing in the state has been declining as indicated in Figure 20. Employment was tracked by both the Bureau of the Census and by the Bureau of Labor Statistics (U.S. Department of Commerce; U.S. Department of Labor). The Bureau of Labor Statistics (BLS) has been estimating employment in food processing in Michigan about 10 percent above the Census figures. As can be noted in Figure 20, employment declined from around 60 thousand in 1958 to around 40 thousand in 1997 and continued to decline into 1999 (BLS). Detail by industry is presented in Table 2.

Through 1997, employment had been trending downward in all sectors except meat and a "catch all" category labeled "Other". As shown in the BLS data, employment in meat slaughtering and processing dropped sharply from 9.3 thousand in 1997 to 6.2 thousand in 1999, a loss of one-third of the jobs. While beverage data are included in BLS totals, the figures have not been published.

Based on the Census data for 1997, the highest employment was in bakeries at 8.6 thousand. However, the Census included numerous small bakeries in their survey for 1997 not included previously. BLS statistics show substantially less employment in that sector and a continued decline through 1999. Outside of the "Other" classification, BLS estimates for 1999 put fruit and vegetable processing as the number one employer at 7.4 thousand, followed by meat at 6.2 thousand each and dairy at 4.9 thousand. Beverages as shown at 3.1 thousand for 1997 by the Census would be ranked last. The "Other" category in the Census includes sugar and confectionary (2.6 thousand), snack food (.9 thousand), seasoning and dressing (.3 thousand) and other (1.1 thousand). On beet sugar, under "sugar and confectionary", 5 plants employed 500 to 900 persons. For disclosure reasons, other data were not published on beet sugar.

Just as farm numbers have declined and farms have become more productive, similar trends are noted in food processing in Michigan. The total number of food processing establishments in 1992 was 569, just over a third of the 1548 in operation in 1958 (Table 3). The 925 establishments shown for 1997 is distorted because of elevated counts of bakeries and candy establishments. The counts in 1997 for meat, dairy, fruits and vegetables, and grain mill appear consistent with previous censuses. On meat, the 88 operations in 1997 were a third of the number in 1958. On dairy, the 57 establishments were only 13 percent of the 1958 number. On fruits and vegetables, the 68 operations in 1997 were 43 percent of the 1958 numbers. On grain mill, the 44 processors in 1997 represented about half of the 1958 numbers.

With increased real value added (1982-84 dollars), combined with the sharp drop in establishments, the increased scale of operations is obvious. Real value added per establishment for meat increased from about $1 million in 1958 to $6.2 million in 1997; for dairy from $1.1 million to $11.4 million; for fruits and vegetables from $1.3 million to $6.3 million and on grain mill from $6.5 million to $17.7 million.

Figure 20

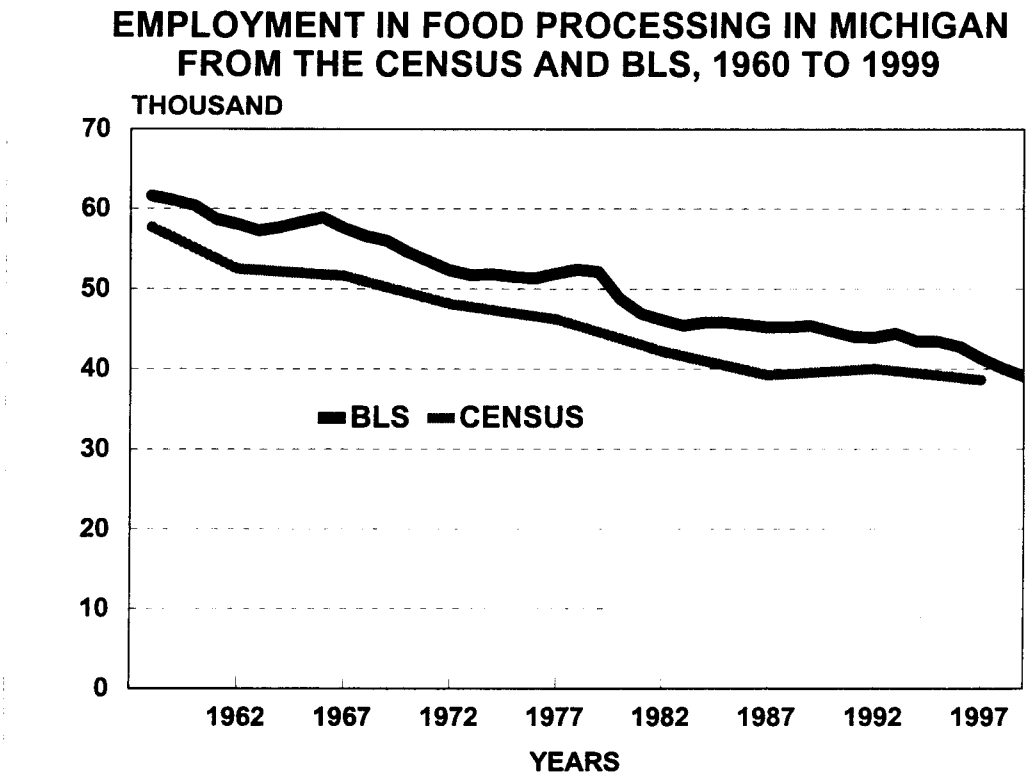

EMPLOYMENT IN FOOD PROCESSING IN MICHIGAN FROM THE CENSUS AND BLS, 1960 TO 1999
THOUSAND
70
60
50
40
30
20
10
0
BLS
CENSUS
1962
1967
1972
1977
1982
1987
1992
1997
YEARS

Table 2. Employment in the Michigan Food Processing Industry Estimated by the Census and by the Bureau of Labor Statistics[1]

Industry	Year									
	1958	1963	1967	1972	1977	1982	1987	1992	1997	1999
	Thousands									
Census										
Meat	6.8	6.2	6.1	7.0	6.6	7.7	7.5	8.2	7.7	
Dairy	12.6	9.6	8.2	6.2	5.8	4.8	4.2	4.7	4.7	
Fruit and Vegetables	7.1	7.4	8.0	8.3	8.4	7.3	6.6	6.7	5.7	
Grain Mill	7.6	6.9	7.5	6.8	6.7	5.7	5.1	5.5	3.7	
Bakery	10.9	11.0	10.3	8.7	7.3	6.5	7.3	7.4	8.6[2]	
Beverage	6.6	6.5	7.3	6.8	6.4	5.2	3.5	2.4	3.1	
Other	6.1	4.9	4.2	4.3	5.0	5.8	5.0	5.1	5.1	
Total	57.7	52.5	51.6	48.1	46.2	43.0	39.2	40.0	38.6	
Bureau of Labor Statistics[1]										
Meat				7.2	7.1	7.9	8.2	8.2	9.3	6.2
Dairy				6.3	5.7	3.8	3.5	4.7	4.3	4.9
Fruit and Vegetables								7.9	7.1	7.4
Grain Mill				8.7	8.7	7.3	7.1	6.5	5.4	5.6
Bakery				9.4	8.7	7.5	6.5	6.7	5.9	5.6
Other								9.9	9.3	9.4
Total	61.6	57.3	57.6	52.3	51.9	46.1	45.2	43.9	41.3	39.1

[1] Source: US Department of Commerce, Census of Manufacturers, various results; US Department of Labor, Bureau of Labor Statistics.

[2] Not consistent with previous censuses.

Table 3. Number of Establishments in Food Processing in Michigan in Censuses from 1958 to 1997[1]

Industry	Year								
	1958	1962	1967	1972	1977	1982	1987	1992	1997
	Number								
Meat	245	246	215	191	170	119	94	96	88
Dairy	449	346	235	153	113	79	73	56	57
Fruit and Vegetables	159	162	142	126	128	105	90	89	68
Grain Mill	83	78	59	56	60	50	45	55	44
Bakery	260	224	168	149	128	85	85	92	451[2]
Beverages	152	134	120	103	89	63	53	42	62
Other									
Sugar			5	5	5	5	5	5	5
Candy	37		24	21	31	21	28	29	63
Fats and Oil				14	19	12	10	7	
Other	163	154	105	87	86	87	96	98	87
Total	200	154	134	127	141	125	139	139	155
Grand Total	1,548	1,344	1073	905	829	626	579	569	925

[1] Source: US Department of Commerce, Census of Manufacturers, Michigan, various issues.
[2] Not consistent with previous censuses.

Another measure of the efficiency of the food industry is the increase in real value added per employee. As shown in Table 4, real value added per employee for the food industry as a whole increased from $39 thousand in 1958 to $112 thousand in 1992. The decline to $96 thousand in 1997 is somewhat puzzling but may be due to changing definitions and a tendency for lags between a drop in real value added and adjustments in employment.

Shift-Share Analysis with the United States

In monitoring and evaluating industries in Michigan over time, comparing trends in the state relative to other states can be incisive. A strong industry would be one in which the state's share of a national growth industry is increasing. A weak sector would be one losing ground in an industry declining at the national level.

Agriculture

As can be discerned from Table 5, the major sectors of Michigan agriculture are operating in U.S. growth industries. From Table 5, one can observe the annual rate of growth of the major crop and livestock enterprises in the long run (1960 to 1999) and the short run (1990 to 1999) for the U.S. as a whole. Also tabulated is the statistical significance of the growth rates. For example, in the crop sector, the most rapidly expanding agricultural enterprise in 1960 to 1999 was ornamentals at 3.44 percent per year followed by soybeans at 3.01 percent per year. Both measures were highly significant statistically. In the decade of the 1990s, both continued to expand significantly, ornamentals at a slower pace of 1.53 percent per year and soybeans at 4.04 percent per year, a somewhat faster rate than in the total period of 1990 to 1999. On livestock, the expansion in turkey production at 4.01 percent per year was quite prominent for the long run, slowing down to 1.92 percent per year in 1990 to 1999. Only on beef cow numbers were the long run upward trends not statistically significant, but for the decade of the 1990s the rate of increase was significant.

The next question is, "How has Michigan fared in capturing its share of these growth markets?" In the aggregate, Figure 21 portrays the trends in real crop receipts by Michigan farmers from 1960 to 1999 (left scale) *and* trends in the percentage crop receipts in Michigan represents of the U.S. (right scale). As can be noted, real crop receipts in Michigan dropped sharply after the buoyant 1970s, but because crop receipts in the U.S. fell back even more, Michigan retained its share which has been averaging about 2.2 to 2.3 percent of the U.S. total.

Similar to Figure 21 on crops is Figure 22 on livestock. Real cash receipts from Michigan livestock have been declining since the 1970s but the state's share of U.S. livestock gross income held near to 1.6 to 1.7 percent until late in the 1990s.

For detail on Michigan agriculture's position in the national scene, Table 6 reveals a substantial amount of information. Shown here is the percent that Michigan farmers produced relative to

Table 4. Real Value Added by Food Processors in Michigan Per Employee in Censuses from 1958 to 1997

Industry	Year								
	1958	1962	1967	1972	1977	1982	1987	1992	1997
Meat	37	39	40	46	54	49	45	55	71
Dairy	39	45	53	56	74	106	137	178	140
Fruit and Vegetables	29	40	49	50	54	64	68	74	75
Grain Mill	71	86	100	121	138	140	207	242	210
Bakery	28	30	37	48	52	47	57	65	62
Beverages	42	47	56	80	94	76	101	174	123
Other	32	36	40	55	69	54	79	92	77
Total	39	45	54	65	76	73	92	112	96

Table 5. Annual Percent Changes in Output of Major Crops and Livestock in the US and Level of Significance, 1960 to 1999

Commodity	Period			
	1960-1999		1990-1999	
	Annual Percent Change	t-Value[1]	Annual Percent Change	t-Value[1]
Crops				
Production				
Corn for Grain	2.30	10.45	2.40	1.65
Soybeans	3.01	16.13	4.04	4.85
Wheat	1.76	8.66	-0.8	-0.8
Dry Beans	1.63	6.97	.79	.49
Sugar Beets	.91	5.45	1.83	2.37
Potatoes	1.50	16.13	1.99	4.89
Hay	.73	12.16	.62	2.95
Real Cash Receipts				
Fruit - All	.87	5.64	.54	1.12
Fruit - Non Citrus	2.12	14.41	.11	.13
Vegetables	.94	9.36	1.60	2.60
Ornamentals	3.44	25.41	1.53	4.94
Livestock				
Milk Production	.08	11.65	.89	8.12
Beef Cow Numbers	.12	.73	.62	2.24
Cattle on Feed	.61	4.02	1.31	4.30
Hog Production	.60	5.59	2.21	6.14
Egg Production	.45	8.38	2.09	20.90
Turkey Production	4.01	17.82	1.92	6.13

[1] Values of 2.00 and above are considered statistically significant at the 95 percent level.

Figure 21

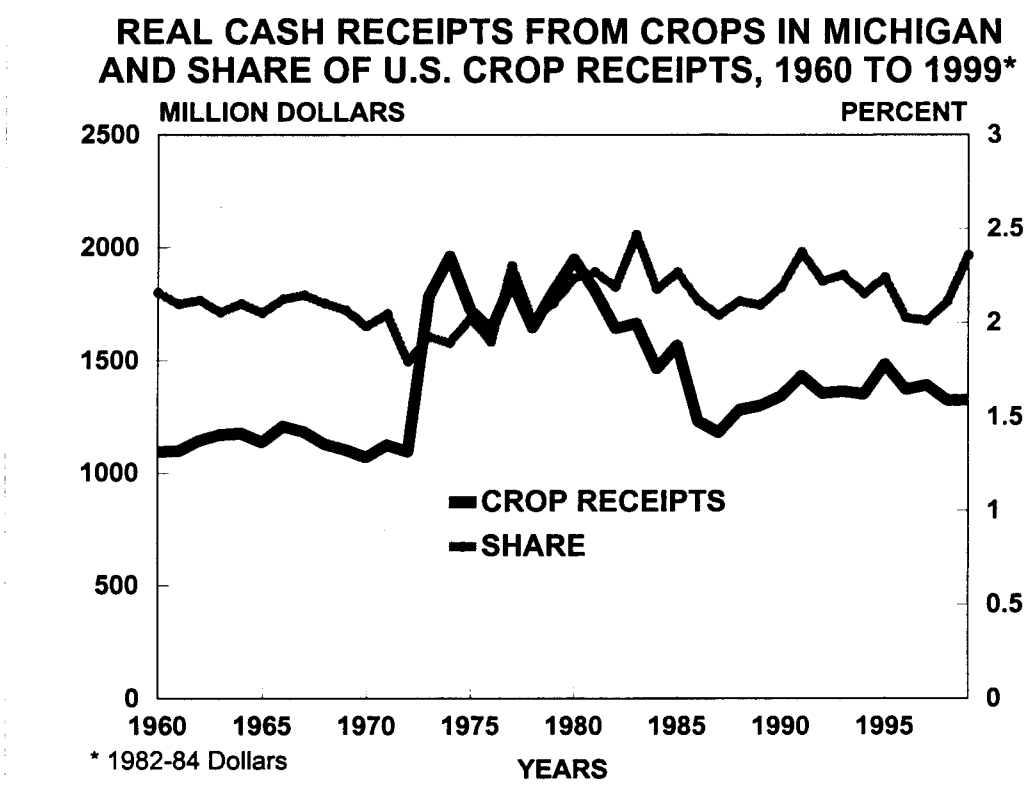

REAL CASH RECEIPTS FROM CROPS IN MICHIGAN AND SHARE OF U.S. CROP RECEIPTS, 1960 TO 1999*
MILLION DOLLARS
PERCENT
2500
2000
1500
1000
500
0
3
2.5
2
1.5
1
0.5
0
CROP RECEIPTS
SHARE
1960
1965
1970
1975
1980
1985
1990
1995
* 1982-84 Dollars
YEARS

Figure 22

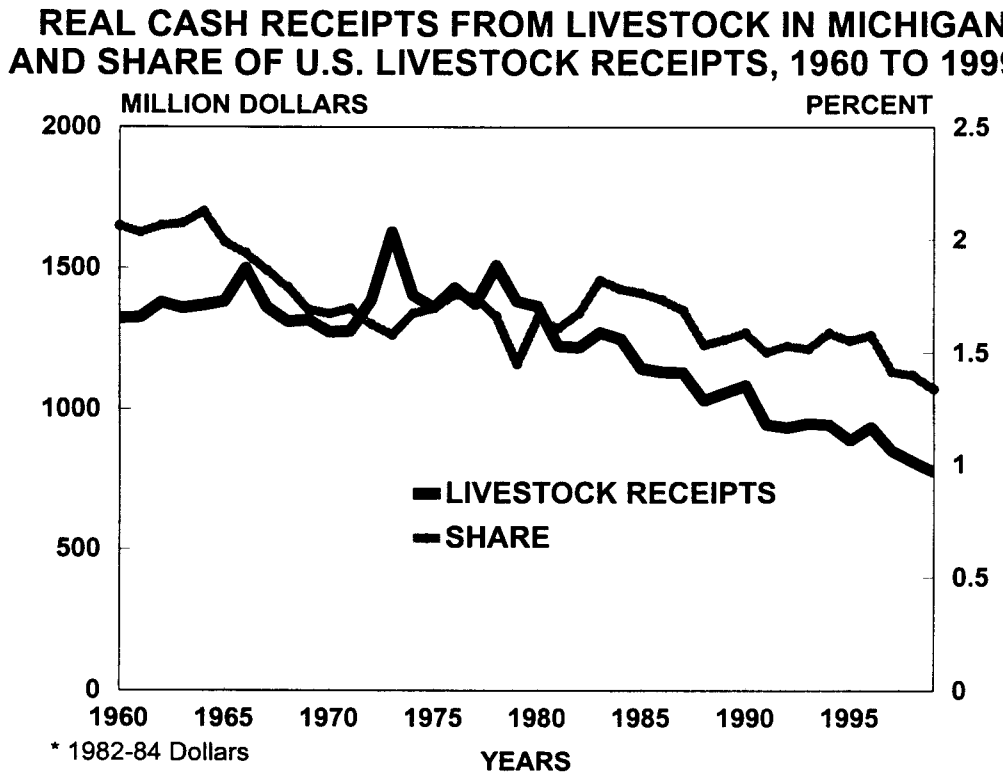

REAL CASH RECEIPTS FROM LIVESTOCK IN MICHIGAN AND SHARE OF U.S. LIVESTOCK RECEIPTS, 1960 TO 1999*
MILLION DOLLARS
PERCENT
2000
1500
1000
500
0
2.5
2
1.5
1
0.5
0
LIVESTOCK RECEIPTS
SHARE
1960
1965
1970
1975
1980
1985
1990
1995
* 1982-84 Dollars
YEARS

Table 6. Michigan's Share of the US Output on Major Crops and Livestock and Changes in the Share in 1960 and 1990 to 1999

Commodity	Period					
	1960-1999			1990-1999		
	Annual Share %	Annual Change in Share	t-Value[1]	Annual Share %	Annual Percent Change	t-Value[1]
Crops						
Production						
Corn for Grain	2.745	.0154	2.78	2.799	-.584	-1.03
Soybeans	1.624	.501	12.78	2.526	.0391	1.06
Wheat	1.683	-.0351	-5.25	1.342	.151	.47
Dry Beans	28.277	-.7092	-11.30	19.25	-.1717	-.37
Sugar Beets	7.891	.1475	9.24	10.07	-.1982	-1.29
Potatoes	3.096	.0020	.46	3.133	.0010	.03
Hay	2.877	.0149	2.67	3.044	-.1183	-3.57
Real Cash Receipts						
Fruit - All	2.921	-.0709	-15.55	1.929	-.0229	-1.37
Fruit - Non Citrus	5.316	-.1956	-18.68	2.728	-.192	-1.26
Vegetables	2.410	-.0352	-11.62	1.935	-.0322	-1.74
Ornamentals	3.629	.0190	1.65	3.852	.0436	1.28
Livestock						
Milk Production	3.873	-.0231	-13.13	3.522	-.0183	-2.55
Beef Cow Numbers	.414	-.0021	-2.69	.346	-.0003	-.11
Cattle on Feed	1.612	-.0009	-.37	1.667	-.0466	-10.56
Hog Production	1.554	.0247	7.21	1.895	-.0656	-5.49
Egg Production	.026	-.0001	-5.13	.23	-.0004	-4.84
Turkey Production	2.063	.0540	6.01	3.340	-.1156	-1.33

[1] Values of 2.00 and above are considered statistically significant at the 95 percent level.

U.S. totals on major crops and livestock both the long run (1960-99) and the recent short run (1990-99). Of some interest is the fact that the population of Michigan has been in recent years about 3.6 percent of the U.S. total. Keeping this proportion in mind, one can determine roughly the extent to which Michigan is a net surplus or deficit state in particular products. Also shown is the rate of change, positive or negative, in *share* of national totals for both periods as well as the statistical significance of those changes.

For the long run on crops, the most impressive gains were with sugarbeets with annual gains in share of .1475 percentage points per year, with insignificant declines in the 1990s. The Michigan sugarbeet share of national output was 7.891 percent in 1960 to 1999 and 10.07 percent in the decade of the 1990s. Second in the long run was soybeans with increased shares at .0501 percentage points per year. For the entire 40 year period, Michigan's share of soybean production was 1.624 percent, but for 1990 to 1999, the percentage had risen to 2.526 percent. Improved varieties and the establishment of the first solvent-type soybean processing operation at Zeeland Farm Services in 1996 stimulated the industry. The increased share continued upward during 1990 to 1999 but not at a significant pace statistically.

Significant long term gains were also registered for corn and hay with reversals noted in the last decade of the twentieth century. Potato shares gained in the long and short run but not significantly. Michigan's share of wheat and dry bean production lost ground over the 1960 to 1999 period with some evidence of leveling off in the last decade. Similar comments could be made about fruit and vegetables. Both lost shares significantly in the long run but at a reduced rate in 1990 to 1999. Michigan's share of the rapidly growing ornamental industry has been notably positive although not quite statistically significant at the 95 percent confidence level. The only long term gainers of national shares in the livestock sector were hogs and turkeys, both reversing in the decade of the 1990s. The short term decline in shares in turkeys was not significant. Michigan's share of the nation's milk output, at 3.873 percent in 1960 to 1999, dropped to 3.522 percent in 1990 to 1999. The rate of decline was .0231 percentage points in the long term, .0183 percentage points in the recent short term. Michigan's share of cattle feeding has been relatively stable, although declines were significant in the 1990 to 1999 period. The state's share of egg production has edged lower over time.

From the preceding presentation on absolute and relative trends, one would conclude that crops have maintained a stronger position in Michigan agriculture than livestock. This may be due to technologies which have favored Michigan over other states. However, new technology is spread around the nation fairly evenly. A factor somewhat unique to Michigan agriculture is the availability of off farm employment. With the predominance of part-time farmers in the state, crop enterprises have accommodated such a structure more so than have livestock, particularly the most important enterprise, dairying. Also with the close proximity of non farm population, large livestock operators have had to deal with more nuisance problems than have crop producers.

Structural changes in the dairy and hog industries outside Michigan have weighed negatively on producers in the state who are in the process of adjusting to new realities. The loss of TB free

status for the state in 2000 will provide additional challenges. On the positive side is a tradition of strong leadership in the livestock industry and a supporting infrastructure.

Food Processing

Like agriculture, food processing at the national level is a growth industry. Real value added by U.S. food processors expanded by 1.57 percent annually in 1958 to 1997 with a somewhat slower increase of 1.24 percent in 1987 to 1997. Details by sectors are presented in Table 7. Outside of the "Other" category, the most rapid growth for the long run was in grain mill at nearly 2 percent per year followed closely by fruits and vegetables at 1.85 percent per year. However, both were fairly stable in the recent decade, ie. negative but not significant. The growth in value added on meat was a solid 1.61 percent per year for the entire 1958 to 1997 period and accelerated to 4.73 percent per year in 1987 to 1997. The growth rate in real value added by dairy processors has been slow, not significant in the long run but did increase to a significant .45 percent per year in 1987 to 1997.

How Michigan fared in the growth of the food processing industry is presented in Figure 23. Shown here is the real value added by Michigan food processors (left scale) and their share of the value added at the national level (right scale) in census years from 1958 to 1997. Through 1992, Michigan food processors were faring relatively well with a peak share of 4 percent in that year. However, between 1992 and 1997, the state's share dropped to the lowest level since the tabulation started in 1958. This may be an aberration but the employment data since then suggest otherwise.

Trends in shares by subsectors are presented in Table 8. In 1958 to 1997, Michigan food processing represented from 2.602 percent of the value added in the U.S. beverage industry to 8.095 percent in the grain mill sector, not including the 1.613 percent in the "Other" category. In the last 10 years of this period, shares had increased on meat, dairy and other, with bakeries remaining at about 3.36 percent of the total industry. In the long run, only the increase in Michigan's share of the dairy processing sector was significant. In 1987 to 1997, only the increase in the state's share of the beverage industry was significant.

Referring back to Table 4 on real value added by Michigan food processors per employee, a similar table on the U.S. would reveal that Michigan's productivity was about 25 percent higher than the national average. While part of this difference may be explained by the different mix in Michigan versus the U.S., a plausible reason is that the higher than average wage structure in the state has forced food processors to improve labor efficiency above the national norms.

Status and Role of Agricultural Production and Processing in the Michigan Economy

Having examined the trends in Michigan's agriculture and food processing, what position does this sector occupy and what role does it play in the state's economy at the beginning of a new

Table 7. Annual Percent Changes in Real Added by Food Processing Sectors in the US and Level of Significance, 1958 to 1997

Sector	Period			
	1958-1997		1987-1997	
	Annual Percent Change	t-Value[1]	Annual Percent Change	t-Value[1]
Meat	1.61	4.42	4.73	2.93
Dairy	.15	.75	.45	2.04
Fruits and Vegetables	1.85	7.29	-.42	-.30
Grain Mill	1.99	8.72	-.18	-.14
Bakeries	1.31	5.37	2.43	1.27
Beverages	1.52	6.88	-.71	-.73
Other	2.11	13.42	2.18	1.62
Total	1.57	16.84	1.24	6.18

[1] Values of 2.00 and above are considered statistically significant at the 95 percent level.

Figure 23

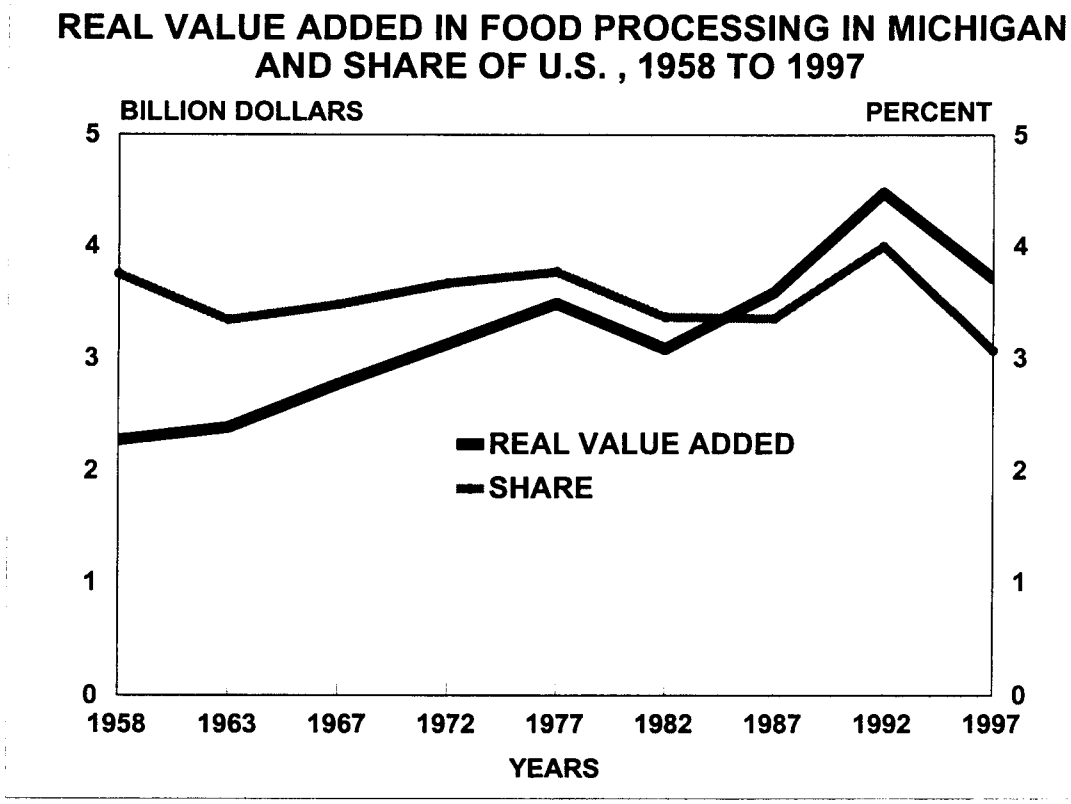

REAL VALUE ADDED IN FOOD PROCESSING IN MICHIGAN AND SHARE OF U.S. , 1958 TO 1997
BILLION DOLLARS
PERCENT
5
4
3
2
1
0
REAL VALUE ADDED
SHARE
1958
1963
1967
1972
1977
1982
1987
1992
1997
YEARS

Table 8. Michigan's Share of the US Real Value Added by Food Processors and Changes in the Share in 1958 to 1997 and 1987 to 1997

Sector	Period					
	1958-1997			1987-1997		
	Average Share %	Annual Change in Share	t-Value[1]	Average Share %	Annual Change in Share	t-Value[1]
Meat	2.845	.0119	1.60	2.976	.0065	.12
Dairy	5.087	.0627	2.68	6.390	.0470	.21
Fruits and Vegetables	3.332	-.0122	-1.37	2.943	-.0021	-.69
Grain Mill	8.095	-.0391	-1.61	7.501	-.1945	-.81
Bakeries	3.365	-.0047	-.51	3.363	.0036	.05
Beverages	2.602	-.0272	-1.81	1.946	.0278	2.92
Other	1.613	.0064	.77	1.775	-.0358	-.59
Total	3.533	-.0043	-.55	3.474	-.0286	-.31

[1] Values of 2.00 and above are considered statistically significant at the 95 percent level.

millenium? The diversity of the agricultural sector has become obvious. As average cash sales in 1997 to 1999, Michigan farmers received about $2.2 billion from crops and $1.3 billion from livestock for a total of $3.5 billion. Of relevance to the economy is that farmers have spent nearly 80 percent of their cash income on inputs.

Allocation by Enterprises and Industries

Because about 30 percent of the corn crop and 75 percent of the hay crop are fed to animals in the state, the value of *production* of crops was over $2.6 billion in 1997-99. Put another way, corn production increased to the point that nearly 70 percent is shipped out of the state and the hay output exceeds the state's livestock requirements by 25 percent. Even with the new soybean plant, about 90 percent of the soybean crop is processed elsewhere. Large volumes of ornamentals are also transported to out-of-state markets.

The distribution of the value of production of crops for 1997-99 is presented in Figure 24. Corn remained as the most important crop representing nearly 21 percent of the total value with ornamentals close behind at 20 percent. Next is soybeans at 15.2 percent, hay at 12.5 percent, fruit at 8.9 percent and vegetables at 6.7 percent. Sugarbeets, potatoes, dry beans and wheat each represented about 3.5 to 4.0 percent of the total value of production of crops in the state. The most notable shift in the last half of the twentieth century was increased relative importance of ornamentals, soybeans and sugarbeets and a reduction in wheat, hay and corn.

The distribution of livestock sales is portrayed in Figure 25. Sales of milk continued to dominate at nearly 60 percent of all livestock receipts. Following were cattle at 16.5 percent, hogs at 12.4 percent and poultry at 9.0 percent. Over the last half of the twentieth century, the major shifts were the increased importance of milk and the reduced share of eggs and cattle.

The diversity of Michigan agriculture can also be articulated by the rankings of enterprises in the 50 states. In 1998, Michigan ranked number one in black and cranberry beans, blueberries, cherries, cucumbers for processing, geraniums, Niagra grapes, flowering bedding plants and flowering hanging baskets (Michigan Agricultural Statistics Service, 1999). Among numerous other products, Michigan was number two in dry beans, fresh market carrots and celery; number three in apples, asparagus and sweet cherries; number four in cucumbers for the fresh market, grapes, and processing tomatoes; and number five in sugarbeets, poinsettias, mushrooms and bell peppers. Among major enterprises, Michigan ranked eighth in milk production, ninth in potatoes and eleventh in corn and soybeans.

Taking inventory of Michigan food processors, total shipments in 1997 amounted to $12.2 billion with about half of that being value added, ie. $6.0 billion. The distribution of the value added is illustrated in Figure 26. The most prominent category was grain mill representing 21.0 percent of the total. Within grain mill, value added by breakfast cereal manufacturers, at $1147 million, was 92 percent of the total. Dairy processing was the second most important industry at 17.6 percent of the total. Within dairy, the primary sector was dry, condensed and evaporated dairy products

Figure 24

DISTRIBUTION OF VALUE OF CROP PRODUCTION IN MICHIGAN, 1997 TO 1999

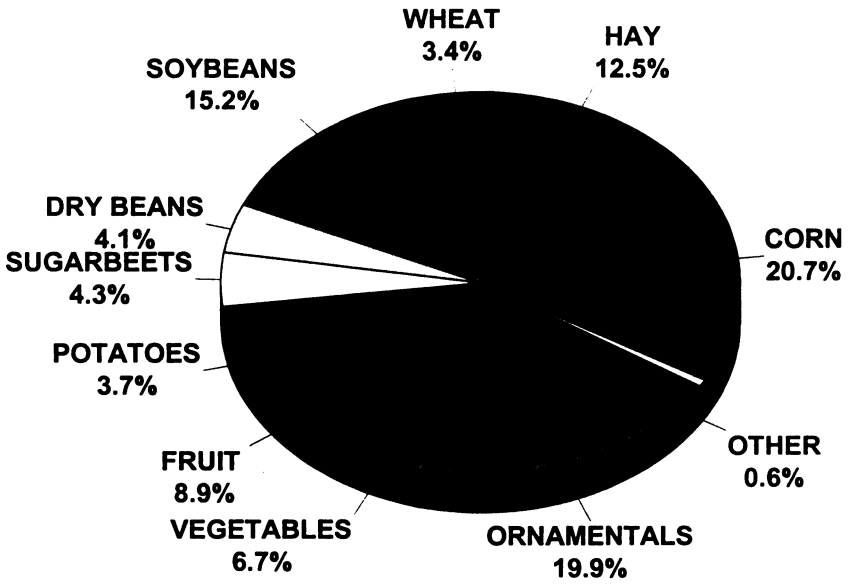


Figure 25

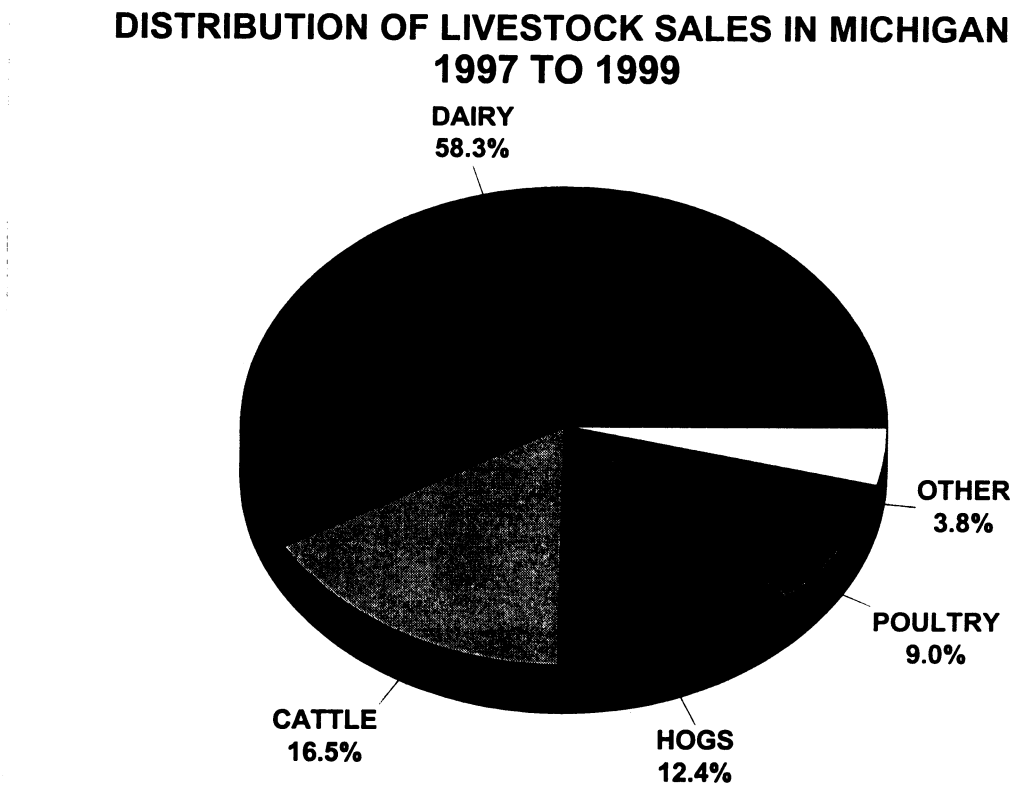
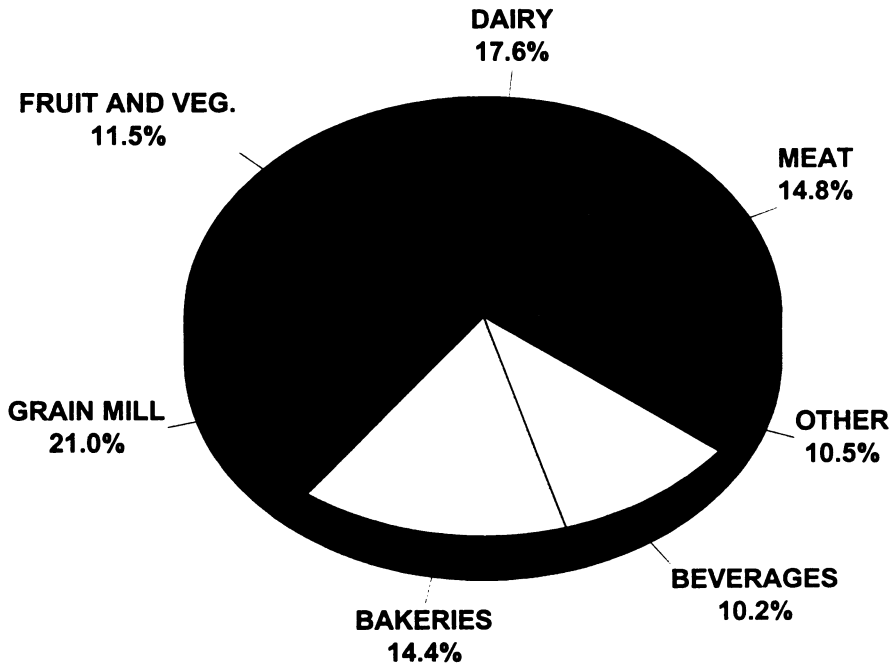

DISTRIBUTION OF LIVESTOCK SALES IN MICHIGAN
1997 TO 1999
DAIRY
58.3%
OTHER
3.8%
POULTRY
9.0%
HOGS
12.4%
CATTLE
16.5%

Figure 26

DISTRIBUTION OF VALUE ADDED BY FOOD PROCESSORS IN MICHIGAN IN 1997



at $618 million, followed by fluid milk at $325 million, cheese at $65 million and ice cream and frozen desert at $40 million.

Meat slaughtering and processing, at $882 million of value added, was 14.8 percent of the total, followed closely by bakeries at $857 million (14.4 percent). Value added in processing fruit and vegetables totaled $687 million (11.5 percent). Of this amount, canning, pickling and drying added $555 million and frozen foods $131 million. Of the $610 million of value added in beverages (10.2 percent), $431 million was for soft drinks and ice. The balance of the $179 million included breweries and distilleries. Prominent in the "Other" food category (which was $628 million and 10.5 percent of the total) was "snack food other than roasted nuts and peanut butter" at $114 million.

Direct and Indirect Impacts

Even though some of the trends in agriculture and food processing have been negative in Michigan, these sectors continue to contribute in a major way to the state's economy. This role was examined in detail in a study which incorporated measures of the dependency of other industries on agricultural production and processing (Ferris, 2000). Two industries not included in the previous discussion were equine and leather tanning and finishing. Multipliers were derived for each sub-sector from a computer model called IMPLAN (Minnesota IMPLAN Group, Inc., 1999).

The IMPLAN computer model provides a systematic way to estimate how an industry affects the employment and dollar output of suppliers to a given industry, and, in turn, to suppliers of the supplying industries. These relationships are called *employment* multipliers and *output* multipliers. For example, the *employment* multiplier for Michigan agriculture was estimated to be 1.668. This means for every full time equivalent in production agriculture, about two-thirds of a job exists in industries supplying agriculture, such as fertilizer, pesticides, fuel, insurance, etc. plus other industries supplying the fertilizer industry, the pesticide industry, etc. The *output* multiplier for production agriculture was nearly equal to the employment multiplier at 1.678, which means for each dollar the farmer receives, 67.8 cents is generated in the backward linked industries. Included is an "induced" effect which reflects income and expenditures of households.

In food processing, the original employment and output multipliers included the impacts on production agriculture, one of the backward linked industries. In order to avoid double counting, IMPLAN was edited to remove the related production agriculture from food processing. The contribution of feed production was also removed from livestock industries so that strictly livestock production could be examined separately from feed production. The resulting *employment* multiplier for food processing was above that for agriculture at 2.779. The *output* multiplier was somewhat higher than for agriculture at 1.804.

The problem with IMPLAN is that it does not generate the impacts of forward links that clearly must be taken into account. For example, farm commodities not processed in the state must be

transported. Handling fresh fruits and vegetables and ornamentals in the marketing chain is overlooked. To account for wholesaling and retailing, estimates were made of the volume of Michigan products involved and IMPLAN multipliers were applied to those activities.

The direct and extended impacts of Michigan agricultural production and processing on output and employment are summarized in Table 9. The time period is the latter part of the 1990s. Adjustments were made to account for changes in processing which followed the 1997 census of manufacturing.

The first column tabulates the direct output from farms, food processors, and leather manufacturers plus the margins at the wholesale and retail levels. The margins relate only to derived estimates of Michigan agriculture's share of the Michigan food supply. This is a net figure since substantial amounts of the product of Michigan's farms are shipped out of the state. The proportion so estimated was 43 percent. Also, ornamentals were included in these estimates.

Because the data for agriculture includes the production value of feed crops (mostly corn and hay), part of which is fed to livestock within the state, double counting in the amount of about $476 million was involved. Similarly, the output of food processing includes the input of raw product from Michigan farms in the amount of $2287 million. These sources of double counting add to $2763 million which is deducted from the gross figure of $18,000 million to establish the aggregate of $15,237 million attributable to the direct effect of agriculture, food processing and leather manufacturing on the Michigan economy.

Adding a wholesaling margin of $1506 million and a retailing margin of $4787 million (including away-from-home eating) results in a total of $21,530 million with links to agricultural production and processing.. At each step in this chain is a multiplicative impact on other sectors. The second column is an accounting of that impact and includes both the direct and indirect effect. The output multiplier, backward linked for the combination of agricultural production and processing was 1.77, calculated by dividing $26,934 million by $15,237 million. The multipliers were adjusted for double counting so no deductions were made in column two.

The multipliers for wholesaling and retailing are not backward linked but represent expenditures by employees, inputs other than agricultural products, etc. Adding the $10,165 million in the distribution channels to the $26,934 million representing the total impact of agricultural production and processing resulted in a total of $37,099 million as the contribution of these sectors to the economy. The degree of dependence is fairly strong in backward linked industries at the farm and food processor level and at the first receiver level at wholesale, much less so at the retail level.

The third and fourth columns on employment were compiled similarly to output. Employment on farms was estimated from enterprise budgets from Telfarm, Michigan State University's farm account project (Nott, et. al., 1995). The budgets have estimates on the day requirements for family and hired labor per acre or livestock production unit. This data were converted into "full

Table 9. Aggregation of Direct and Extended Values of Output and Employment in Michigan Agriculture and the Food System

Item	Output		Employment	
	Direct Million$	Total Million$	Direct Number	Total Number
Agricultural Production and Processing				
Agricultural Production	4,259	6,347	65,367	92,918
Food Processing	13,250	19,743	38,876	108,531
Leather Processing	491	844	1,893	4,784
Total	18,000	26,934	106,136	206,233
Adjustment for Double Counting	-2,763	0	-9,664	0
Net	15,237	26,934	96,472	206,233
Distribution of Michigan's Share				
Wholesaling Margin	1,506	2,485	15,808	31,616
Retailing Margin	4,787	7,680	216,326	269,475
Total	6,293	10,165	232,134	301,091
Total of above	21,530	37,099	328,606	507,324

time equivalents" (FTEs). Even though the 1997 Census of Agriculture counted 141,832 persons employed on farms, many would be classified as part-time farmers and seasonal hired labor. The FTEs were estimated at 55,703. The 65,367 FTEs listed at the top of column 3 includes double counting of labor used in production of the portion of feed crops fed to Michigan livestock. The deduction of this allowance of 9664 from 65,367 equals the 55,703 FTEs.

Employment in food processing at 38,876 and leather manufacturing at 1893 added to agriculture's 55,703 FTEs equals 96,472. Distribution adds another 232,134 for a grand total of 328,606 directly employed in the production, processing and distribution of Michigan farm products. This total represents a ratio of about 6 persons for every FTE on farms.

Expanded to include the multiplier effects, over 200 thousand are dependent on agricultural production and processing in the sector itself and in the backward linked industries -- a multiplier of 2.138. Forward linked, another 300 thousand are directly or indirectly employed in the distribution. A grand total of nearly 500 thousand are connected to agricultural production. In a sense, the 500 thousand related to the direct employment of about 100 thousand in agricultural production and processing represents an employment multiplier of five, or, relative to the 55,703 FTEs on farms, a multiplier of nearly 10. As with output multipliers, the backward linked multipliers at the farm or food processor plus the first handling of the product at the wholesale level carry much heavier weights of dependence than levels closer to consumers.

To illustrate the relative importance of agricultural production and processing to the Michigan economy, the 96,472 directly employed represent about a third of the jobs in motor vehicles and parts, the state's premier manufacturing industry. The conversion of 141,832 workers on farms as counted by the Census to 55,703 FTEs may diminish the importance of agriculture in the sense that the rewards from that sector are spread across many more individuals than the FTE count.

The expanded total to 206,233 jobs directly or indirectly (backward linked) related to agricultural production and processing would represent about 5.2 percent of the total employment in the state. The extension to over 500 thousand jobs, direct and indirect, with the addition of the forward linked distribution sector would bring the grand total to nearly 13 percent of the Michigan work force. At the extreme, if all those involved in wholesaling and retailing food (the other 57 percent) were included, employment in the agriculture and food sector would add to more than a million jobs and represent over one-fourth of the employment in the state. How one might choose to interpret Table 9 depends on the purpose of the information.

Additional Considerations

Not only does agricultural production and processing have a major presence in the state, this sector contributes in other ways, some not easily measured. A key role is to provide diversity in an economy heavily tied to durable goods manufacture, mainly motor vehicles and parts. Agriculture and food processing are themselves diverse, especially in comparison to states dependent on three or four major farm products. Durable goods industries are vulnerable to

business cycles. In recessions, consumers postpone expenditures on such items. Unemployment rates are much more variable in Michigan relative to the rest of the nation.

While cycles exist in agriculture, the timing is not closely aligned with the general business cycle. In 1970 to 1999, the correlation between real net farm income per farm and real disposable income per capita for the state as a whole was actually negative. This can be noted in Figure 27 which illustrates that the fluctuations and trends in Michigan's real disposable income per capita have not matched the variations and trends in real net farm income per farm.

When high unemployment has emerged in the non-farm sector, evidence points to intensification in agriculture, particularly in livestock enterprises, as labor shifts back to the farm and/or the long term exodus of labor from farm households slows. Food processing tends to be located near to metropolitan areas, which facilitates employment shifts. Similarly, the proximity of alternative employment is a plus for agriculture and food processing, not only to help stabilize these somewhat volatile industries, but to provide ongoing income to households connected to farming and food processing. Alternative employment opportunities helped ease the downward pressure on Michigan agriculture in the 1990s.

Contrary to the secular decline in real net cash income from farming in the 1990s, farmland prices in Michigan increased both in nominal and real terms (Fig. 28)! Total assets and equity on Michigan farms actually increased in this period. At the end of 1998, total assets were $20.8 billion compared to $13.2 billion at the end of 1988 (U.S. Department of Agriculture, Economic Research Service, 2000). Equity increased from $10.3 billion to $17.7 billion in the same period. The debt to asset ratio at the end of 1998 was 15.0 compared to 21.6 at the end of 1988. As is typical in agriculture, most of the assets are in real estate, at $14.6 billion at the end of 1998 compared to $8.7 billion at the end of 1988. The paradox between falling net farm income and increased equity reflects a robust non-farm economy and the close rural-urban interface in Michigan. Land continued to be attractive for non-farm purposes.

Farmers in Michigan and throughout the U.S., in combination with agribusiness, have contributed to holding back on inflation in food prices. This is evident from trends in prices of Michigan's most important farm products, corn and milk and (Fig. 29 and 30). Since the mid 1970s, the price of corn has fluctuated between $2 and $3 per bushel without exhibiting much trend. The real price of corn (1982-84 dollars) in the late 1990s was about a third of the level of the late 1970s. Similarly, the slow rise in the farm price of milk after 1980 from about $13 per cwt. to $15 per cwt. in the late 1990s was much slower than the rise in the Consumer Price Index. The real price fell from $13 to about $9 per cwt. by the end of the 1990s. Similar price trends can be observed in other farm products.

Of course, farmers' role as stewards of Michigan's landscape should also be noted. While land in farms has declined, the 9873 thousand acres in farms in 1997 represented 26 percent of the surface of the state and a third of rural non-federal lands (U.S. Department of Agriculture, Natural Resource Conservation Service, 1999). Of the land in farms in 1997, 68 percent was in

Figure 27

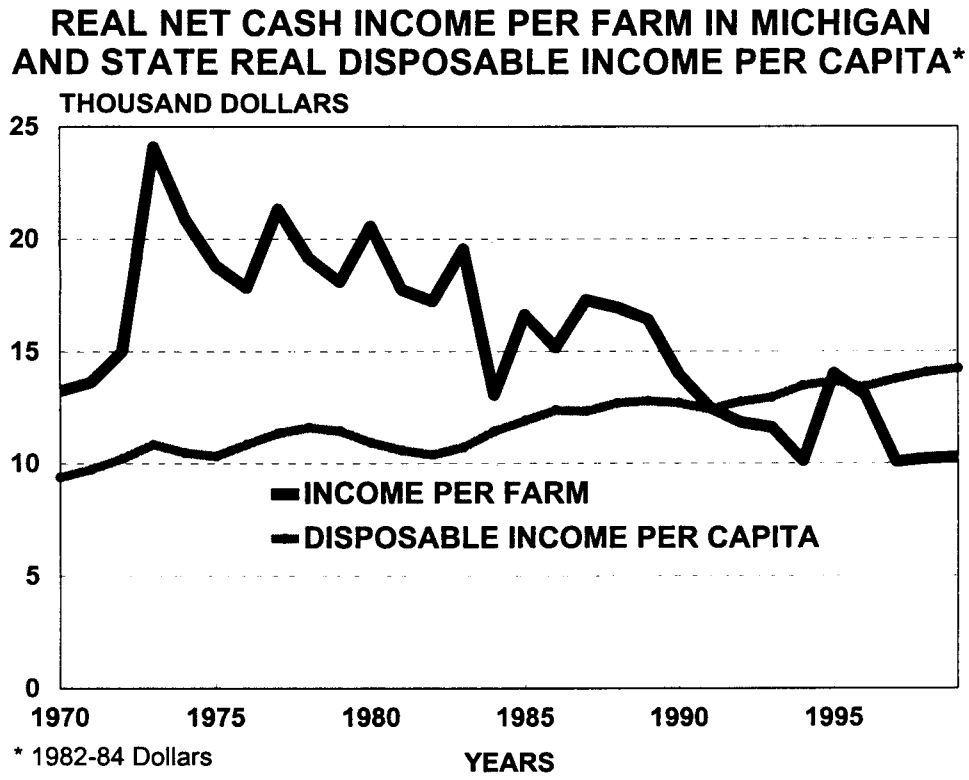

REAL NET CASH INCOME PER FARM IN MICHIGAN AND STATE REAL DISPOSABLE INCOME PER CAPITA*
THOUSAND DOLLARS
25
20
15
10
5
0
INCOME PER FARM
DISPOSABLE INCOME PER CAPITA
1970
1975
1980
1985
1990
1995
* 1982-84 Dollars
YEARS

Figure 28

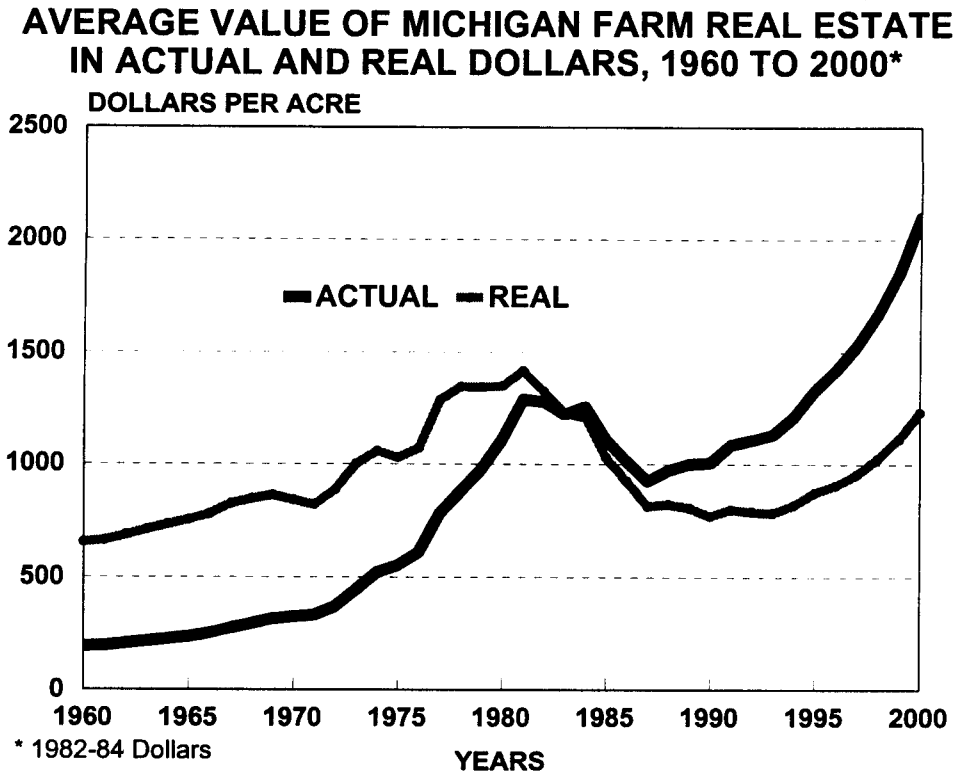

AVERAGE VALUE OF MICHIGAN FARM REAL ESTATE IN ACTUAL AND REAL DOLLARS, 1960 TO 2000*
DOLLARS PER ACRE
2500
2000
1500
1000
500
0
ACTUAL
REAL
1960
1965
1970
1975
1980
1985
1990
1995
2000
* 1982-84 Dollars
YEARS

Figure 29

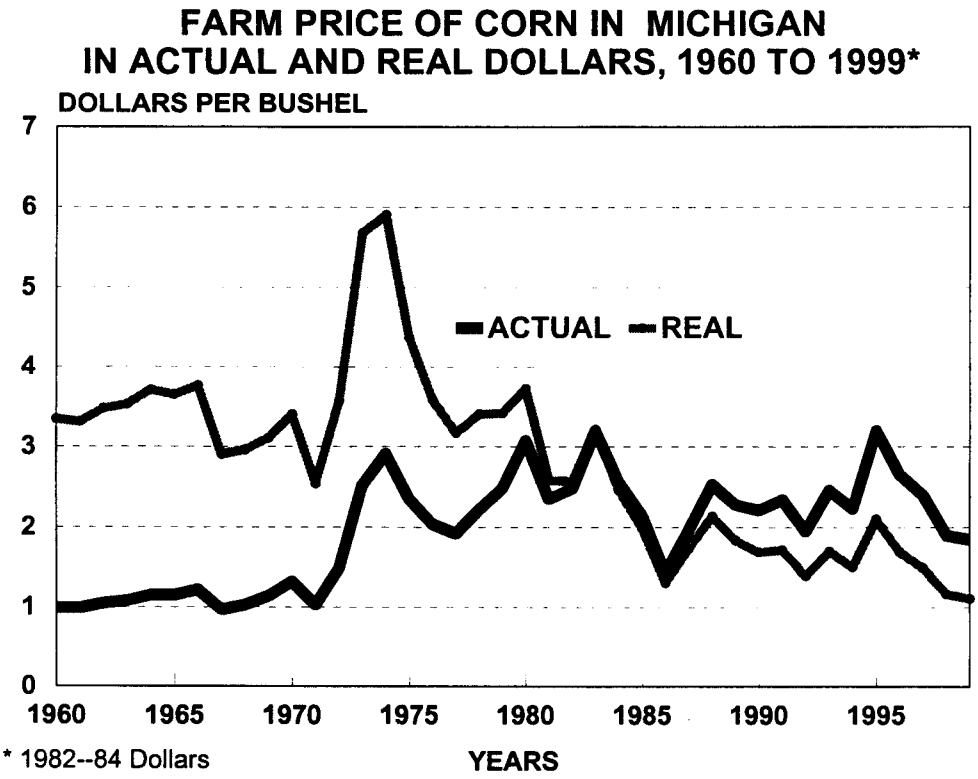
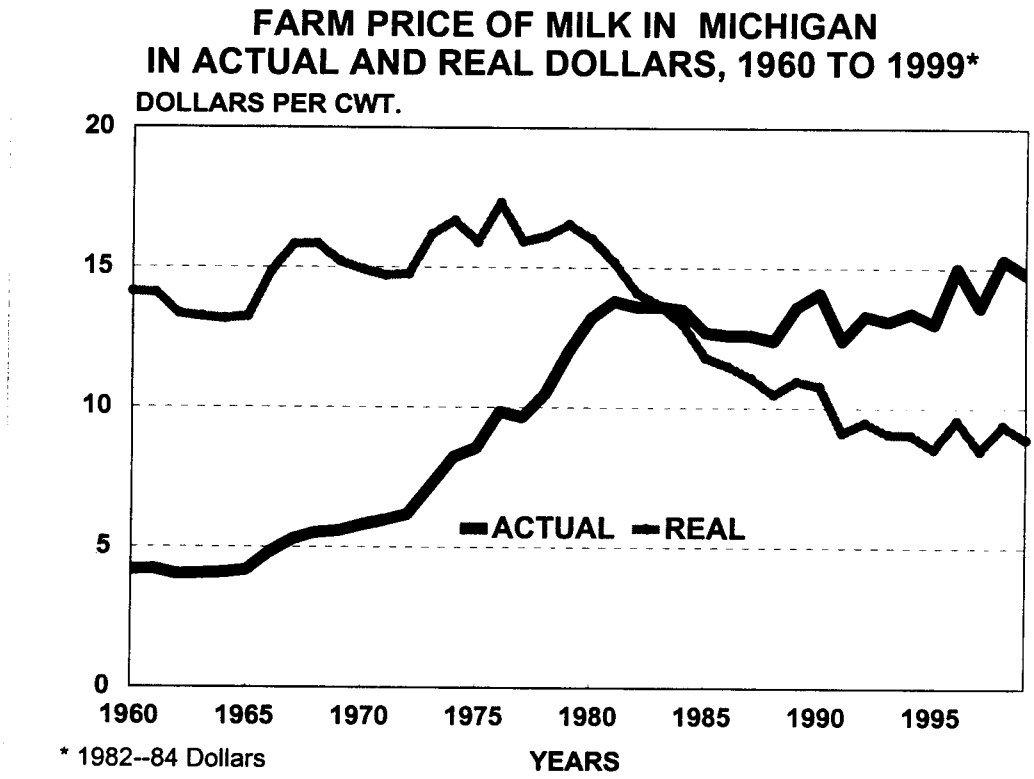

FARM PRICE OF CORN IN MICHIGAN
IN ACTUAL AND REAL DOLLARS, 1960 TO 1999*
DOLLARS PER BUSHEL
7
6
5
4
3
2
1
0
ACTUAL
REAL
1960
1965
1970
1975
1980
1985
1990
1995
* 1982--84 Dollars
YEARS

Figure 30


FARM PRICE OF MILK IN MICHIGAN
IN ACTUAL AND REAL DOLLARS, 1960 TO 1999*
DOLLARS PER CWT.
20
15
10
5
0
ACTUAL
REAL
1960
1965
1970
1975
1980
1985
1990
1995
YEARS
* 1982--84 Dollars

harvested cropland, 5 percent was used only for pasture, 7 percent was cropland not harvested, 12 percent was woodland and the balance of 8 percent was mostly for lots, ponds and wasteland (U.S. Department of Agriculture, 1997 Census of Agriculture).

Finally, a tradition of Michigan agriculture and the food system has been strong leadership and entrepreneurship supported by an infrastructure of government, educational institutions and private service sectors. This partnership will have an important role in the new millenium.

Summary and Conclusions

Agriculture was predominant in the formative period of Michigan in the 1800s and remained so in combination with food processing until the rapid expansion in automobile manufacturing in the first half of the twentieth century. The urban population also grew rapidly in this period. Michigan farmers adjusted quickly to changing demands and took advantage of the soil and climate resources to generate a highly diverse agriculture.

The state was particularly well suited to forage production and, with the growing population, dairy farming became the most important enterprise. But also, new hybrids suited to shorter growing seasons became available pushing corn production to levels far exceeding the livestock requirements of the state. This, in turn, stimulated the expansion of cattle feeding, hog and turkey production. The lake effects provided opportunities for fruit along the western counties and muck land accommodated vegetable production as did other soils suited for potatoes, dry beans and sugarbeets. The transition from horse power to tractor power enabled farmers to transfer hay and oat ground to other crops. Soybean production expanded rapidly.

Food processing became a more important element in the agriculture scene in the last half of the twentieth century adding to beet sugar factories which were a fixture in the state at the beginning of the century. The combination of the availability of raw materials and a growing urban population contributed to this expansion as well a providing markets for fresh products.

Increased efficiency has been evident in Michigan agriculture measured by higher yields per acre and increased production per animal. This has enabled farmers to expand production on a shrinking land base approaching 50 percent of the peak of 1920. Efficiencies have also been generated in food processing as real value added per employee increased about 2.5 times between 1958 and 1997.

Michigan farmers have competed somewhat more effectively in the national scene in crops versus livestock. This is evident in the relatively constant share of crop receipts as a percent of the U.S. totals while share of livestock receipts have been declining. In the last 20 years of the twentieth century, this may be due to strong demands for ornamentals and improved soybean varieties on the crop side coupled with major structural shifts in dairy and hog production outside of Michigan on the livestock side. Also, crop production has fit more neatly into part-time farming than has

livestock production, particularly dairying. In any case, these shift-share trends, coupled with the loss of slaughtering facilities in hogs and turkeys, plus the loss of TB-free status, presents major challenges for the livestock sector.

The food processing industry grew in terms of real value added until the late 1990s, and maintained a share of the U.S. total at about 3.50 to 3.75 percent. Michigan dairy processors increased their share of the national total. The loss of slaughtering facilities reduced employment in meat by a third in 1997 to 1999. Michigan processors have been forced to become more labor efficient and have succeeded in generating significantly higher value added per employee than in other states.

While some sectors of Michigan agriculture and food processing have experienced negative trends, the industry in total continues to command prominence in the economy. Total output of the system was about $15 billion late in the 1990s and responsible for about $27 billion if the backward linked industries dependent on agricultural production and processing are taken into account. Adding forward links into wholesaling and retailing, a broad definition of agricultural production and processing would total $21.5 billion directly and $37 billion if the multiplicative effects are measured.

Employment of 55.7 thousand full time equivalents on farms plus 40.7 thousand in processing adds to nearly 100 thousand. Backward linked are another 100 thousand jobs, bringing the total to over 200 thousand which represents about 5.2 percent of total employment in the state. Forward linked in wholesaling and retailing are another 300 thousand directly or indirectly involved. The total of over 500 thousand employed represents nearly 13 percent of the total employment in the state.

Additionally, agricultural production and processing provide stability to an economy heavily dependent on durable goods. The close rural-urban interface has been mutually beneficial to farmers and non-farmers alike. The efficiency of the industry has been a force in holding down inflation in food prices over time. Also, farmers perform an important role as stewards of the landscape.

Michigan agriculture and the food system have benefitted from strong leadership, entrepreneurship and a facilitating infrastructure in the past. This tradition will continue to be a crucial element in forging the future of the industry.

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