



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Staff Paper

**An Analysis of the Importance of Agriculture and the
Food Sector to the Michigan Economy**

John N. (Jake) Ferris
Professor Emeritus
Department of Agricultural Economics
Michigan State University

Staff Paper 00-11

May 2000



Department of Agricultural Economics
MICHIGAN STATE UNIVERSITY
East Lansing, Michigan 48824

MSU is an Affirmative Action/Equal Opportunity Institution

**An Analysis of the Importance of Agriculture and the Food Sector
to the Michigan Economy**

John N. (Jake) Ferris
ferrisj@msu.edu
Professor Emeritus
Department of Agricultural Economics
Michigan State University

25 pages

Executive Summary

The number of workers on farms and in food processing represents about 16 percent of total employment in basic industries in Michigan. Converting farm labor to full time equivalents, however, reduces the proportion to about 11 percent. The industries dependent upon agriculture and food processing enhance the importance of this sector. Adding backward linked industries increases the total employment from about 100 thousand to 200 thousand and output from \$15 billion to \$27 billion. If Michigan agriculture's share of the forward linked industries of wholesaling and retailing is added, total employment related directly or indirectly to farming and food processing is estimated to be 500 thousand and output to be \$37 billion. In terms of employment, this represents a ratio of nearly 10 jobs for every full time equivalent in farming or about 5 jobs for every employee in the combination of agriculture and food processing. The total direct and related employment in agriculture and the food system is about 1 million, about a fourth of total employment in the state.

Not only does agriculture and food processing have a major presence in the state, this sector contributes to the stability of an economy heavily dependent on the manufacture of durable goods which are vulnerable to business cycles. Food processing tends to be located near metropolitan areas, facilitating employment shifts. Similarly, the proximity of alternative employment opportunities provides stability for households involved in agriculture and food processing.

While gross farm income and expenditures have increased in *nominal* terms, trends in the 1980s and 1990s have been stable or negative in *real* terms. Real *net* farm income *declined* in the 1990s. However, both nominal and real farmland prices *increased* in the same period, a paradox reflecting a robust non-farm economy and the close rural-urban interface. Value added by Michigan food processors increased over time in both nominal and real terms until a reversal in the 1990s. Employment in food processing continued a secular decline at the close of the decade.

Introduction

Why do people live in Michigan? A first response might be, "Because of employment opportunities." Another might be, "Because it is a beautiful state and has many amenities." A closer examination would reveal the key reason for Michigan being a fairly populous state is the existence of basic industries of agriculture, forestry, fishing, mining, and manufacturing (including food processing). Agriculture, forestry, fishing, and mining benefit from the state's endowments of soils, topography, climate, water and related natural resources. To some extent manufacturing also draws from the endowments, such as the proximity of the Great Lakes, but also from entrepreneurship. Another reason for industry to locate in Michigan is the nearness to markets. About half of the population of the United States and Canada lies within 500 miles of Michigan.

Clearly, the state does have many amenities attracting people to work and retire here and drawing tourists. Even so, Michigan residents spend more dollars outside the state than those outside the state spend in Michigan (Holecek, 1995). The focus, then, is on the basic industries and, in this study, the importance of agriculture and food processing within those industries.

Only about 28 percent of those employed in the state are in the basic industries (Table 1). And of

those in the basic industries, only about 16 percent are on farms and in food processing. That means that only 4.5 percent of employment in the state is in agriculture and food processing. Even so, the total of 176 thousand estimated to be working on farms and in food processing in 1997 was as much as 60 percent of the total in manufacturing motor vehicles and parts, Michigan's number one industry. However, because of the seasonality in farming and to some extent in food processing, the full time equivalents in these sectors are closer to 100 thousand which would represent only about a third of the jobs in motor vehicles and parts.

To properly evaluate the importance of these basic industries, one must look at those other sectors dependent on the basic industries. Thirty five percent of the employment in the state in 1997 was in the secondary industries of construction, transportation, public utilities, wholesale trade and retail trade. The remaining 37 percent was in the service sector of finance, insurance, real estate, personal and business services, health, education, government, religious organizations, etc. To the greatest extent, these secondary and service sectors operate in the state because of the existence of the basic industries. This study will indicate how these secondary and service industries along with basic industries relate to agriculture and food processing.

Table 1.
Employment in Basic, Secondary and Service Industries in Michigan in 1997 ¹⁾

	Employment Number	Sector %	Total %
Basic			
Farms	141,832	12.7	3.6
Forestry	368	²⁾	²⁾
Fishing, hunting, trapping	109	²⁾	²⁾
Mining	6,743	0.6	0.2
Food processing	34,217	3.1	0.9
Other manufacturing	934,688	83.6	23.4
Total	1,117,957	100	28.1
Secondary			
Construction	168,877	12.2	4.2
Transportation and public utilities	171,518	12.4	4.3
Wholesale trade	221,028	16	5.5
Retail trade	821,172	59.4	20.6
Total	1,382,595	100	34.6
Services			
Finance, insurance and real estate	214,122	14.4	5.4
Other services and unclassified	1,271,618	85.6	31.9
Total	1,485,740	100	37.3
Grand total	3,986,292		100

¹⁾ All the data except for farming were from *Country Business Patterns, 1997, Michigan*, U.S.D.C., U.S. Census Bureau. Employment on farms is from the *1997 Census of Agriculture, Michigan*, U.S.D.A., National Agricultural Statistics Service.

²⁾ Less than .05 percent.

Multipliers

The major analytical tool applied in this study was a computer model called IMPLAN (Minnesota IMPLAN Group, Inc.). A product of Minnesota IMPLAN Group, Inc., IMPLAN was originally developed by the USDA Forest Service to assist that agency in land and resource management planning. The model can be used for different purposes, including the measurement of the impacts of an industry on dependent industries.

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 2.577. The *output* multiplier was somewhat higher than for agriculture at 1.804.

The problem with IMPLAN is that it does not generate the 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. Following is an effort to extend IMPLAN to incorporate forward linked analysis along with the backward linked approach.

Employment on Farms

Employment data has the advantage over output data in that the problem of double counting is essentially avoided. For example, adding workers on farms to jobs in food processing is an acceptable approach. However, adding sales from farms to sales from food processors would have to be adjusted for the value of farm sales that was an input into food processing. On the other hand, employment on farms is highly seasonal and is characterized by many small part-time operators. To some extent, employment is also seasonal in food processing.

The total number of persons employed on Michigan farms in 1997 was 141,832 as estimated by the Census of Agriculture (U.S. Department of Agriculture, 1997 Census of Agriculture). This was the total on 46,027 farms which may have been an undercount as determined by the Michigan Agricultural Statistics Service (MASS) which reported 53,000 farms in 1997 (Table 2) (Michigan Agricultural Statistics Service). However, citing the large number of very small farms, MASS counted only 38,300 persons as “self employed workers” on farms in 1997.

Table 2
Alternative Estimates of Employment on Michigan Farms, 1997 and 1998

Source	Number Employed
<u>1997 Census of Agriculture</u>	
Operators (Number of farms) ¹⁾	46,027
Hired labor	95,805
Total	141,832
<u>Michigan Agricultural Statistics Service</u>	
Operators (Number of farms) ^{1) 2)}	
1997	53,000
1998	52,000
Self employed workers ²⁾	
1997	38,300
1998	36,800
Unpaid workers	
1997	8,500
1998	8,000
Hired workers	
1997	21,800
1998	23,800
Total workers	
1997	68,600
1998	68,600

¹⁾ Difference between the Census and Michigan Agricultural Statistics Service relates to an undercounting by the Census on mostly small farms.

²⁾ Difference between operators and self employed workers refers to those operators on small farms who do not consider themselves as self employed as farmers.

MASS estimated the total workers on farms at 68,600 in 1997 and 1998. Between 1997 and 1998, self employed workers declined from 38,300 to 36,800, unpaid workers from 8,500 to 8,000, both being offset by an increase in hired workers from 21,800 to 23,800. These figures represent averages from surveys taken at four evenly spaced periods during the year, smoothing out the highly seasonal pattern in the employment of hired workers. This helps to explain the difference between total hired labor calculated from the Census and the annual average as calculated by MASS.

As can be discerned in Table 2, estimation of employment on farms can vary widely. The approach subsequently taken was to convert existing data from total numbers to full time equivalents (FTEs). Four alternative procedures or sources are presented in Table 3.

Table 3.
Alternative Estimates of Full Time Equivalents in Employment on Michigan Farms

Source	Total Number	Full Time Equivalent Farm Workers Number
1997 Census of Agriculture		
Aggregate Operators		
<u>Days worked off the farm</u>		
None	17,964	17,964
1-49	2,229	2,006
50-99	1,260	882
100-149	1,414	707
150-199	2,435	730
200+	18,568	1,857
Total of above	43,870	24,146
Not reported	2,157	1,187 ¹⁾
Total	46,027	25,333
Hired farm labor		
<u>Days worked</u>		
150 or more	20,996	20,996
Less than 150	74,869	22,461
	95,865	43,457
Total	141,892	68,790
By Enterprise based on North American Industry Classifications System		
Operators		24,153
Hired farm labor		43,455
Total		67,608
Telfarm Budgets Applied to 1997-99 Averages and Livestock Numbers ²⁾		
Total		55,703
IMPLAN ³⁾		
Total		71,653

¹⁾ Estimated

²⁾ Nott, et al.

³⁾ Minnesota IMPLAN Group, Inc.

Two of the alternative estimates were derived from the 1997 Census of Agriculture. The Census breaks down the operators in terms of days worked off the farm. Interpolation of that data converted the total of 46,027 operators into 25,333 FTEs. Only two categories were published on hired labor, numbers working 150 days or more and those working less than 150 days. Assuming that those working 150 or more were full time and those working less than 150 days worked 30 percent of the time, the total of 95,865 total workers was converted into 43,457 FTEs. The combination of 25,333 operator FTEs plus the 43,457 hired farm labor FTEs summed to 68,790. Almost identical numbers were generated by a similar approach enterprise by enterprise, incorporating the “North American Industry Classification System” reported in the Census.

Enterprise budgets developed by the Department of Agricultural Economics from Telfarm (farm account project) records include estimates of hours of family labor and hired labor. Applying these estimates to acreages and livestock numbers for 1997-99 generated total FTEs of 65,367. However, this included some double counting since some labor involved in feed production was also included in the livestock enterprises. Deducting the proportion of labor involved in feed production that was utilized by Michigan livestock, a net of 55,703 was obtained. While below the Census estimates, this number is reasonable considering that hired labor numbers may not reflect FTEs on a 40 hour week basis. The totals from IMPLAN at 71,653 for 1997 also are not strictly FTEs. The decision was to converge on the FTEs generated from the Telfarm budgets.

Details on how employment is allocated by enterprises on Michigan farms is presented in Table 4.

The first column labeled "Direct Value" tabulates the employment on farms. [Beginning with the 1992 Census of Agriculture, operations with equine have been listed as farms. Estimates of labor involved with equine were derived from a survey of the industry in 1991 and adjusted for

Table 4.
Employment in Michigan Agriculture Extended through the
Backward Linked Industries, 1997-1999

Enterprise	Direct Value Number	Multiplier	Total Value Number
Livestock			
Dairy products	3,690	2.004	7,395
Cull cattle	1,781	1.243	2,214
Steers and heifers	783	2.101	1,645
Hogs	1,020	1.993	2,033
Sheep	309	1.218	376
Poultry	857	1.549	1,327
Equine	3,640	1.100	4,004
Other livestock	3,018	1.590	4,799
Total	15,098	1.576	23,793
Field crops			
Corn for grain	5,253	1.434	7,533
Corn silage	891	1.434	1,278
Oats	166	1.434	238
Hay	8,233	1.222	10,061
Soybeans	2,750	1.868	5,137
Wheat	1,070	1.494	1,599
Dry beans	792	1.868	1,479
Sugarbeets	1,307	1.588	2,076
Potatoes	982	1.555	1,524
Total	21,444	1.442	30,925
Other			
Processing fruit	6,832	1.172	8,007
Fresh fruit	3,848	1.172	4,510
Processing vegetables	3,012	1.552	4,675
Fresh vegetables	2,922	1.552	4,535
Ornamentals	12,211	1.349	16,473
Total	28,825	1.325	38,200
Grand total	65,367	1.421	92,918

perceived developments since then (Michigan Agricultural Statistics Service, 1991 Michigan Equine Survey)]. The gross values were included which means that numbers for livestock also incorporate FTEs used for feed production. The numbers for corn for grain, corn silage, oats and hay relate to total production and not just cash sales. The net FTEs for livestock would be 15,098 less the 9,664 FTEs attributed to feed utilized in livestock enterprises. With that adjustment, labor on Michigan farms is allocated as follows:

<u>Enterprise</u>	<u>Direct Employment</u>	<u>Percent of Total</u>
Livestock	5,434	10
Field crops	21,444	38
Fruit	10,680	19
Vegetables	5,934	11
Ornamentals	<u>12,211</u>	<u>22</u>
Total	55,703	100

In the second column of Table 4 are the multipliers from IMPLAN associated with each enterprise. In the generation of these multipliers, the feed sector was deleted from the livestock enterprises, so the final column reflects that adjustment. Also, processed feed was deleted to the extent that the ingredients originated on Michigan farms. For example, the multiplier of 2.004 for dairy products means that another person is employed in backward linked industries, not including feed, for every FTE producing dairy products. In addition, since about 80 percent of cull cattle is from the dairy enterprise, additional employment is thereby generated, for an aggregate multiplier of 1.793. Total employment credited to dairy farming would be 7,395 for dairy products and 1,753 for cull animals for a total of 9,148 on dairy farms and in backward linked industries.

The employment multipliers for livestock averaged 1.576, somewhat higher than the 1.442 for field crops and 1.325 for other crops. The vegetable multiplier, at 1.552, was close to that on livestock. The average employment multiplier across all enterprises averaged 1.421 generating a total 92,918 jobs that can be credited to agriculture. However, the 1.421 multiplier understates the true multiplier because of double counting in the feed section. The true employment multiplier for the net of 55,703 direct FTEs in agriculture would be 1.668.

Including the direct plus the derived employment shown in column three of Table 4, the allocation to enterprises would be as follows:

<u>Enterprise</u>	<u>Employment</u>	<u>Percent of Total</u>
Dairy	9,148	10
Beef	2,106	2
Hogs	2,033	2
Poultry	1,327	1
Equine	4,004	4
Other livestock	5,175	6
Field crops	30,923	33
Fruit	12,517	13
Vegetables	9,210	10
Ornamentals	<u>16,473</u>	<u>18</u>
Total	92,918	100

Employment in Food Processing

Employment data in food processing were obtained from the U.S. Census Bureau (U.S. Department of Commerce, 1997 Economic Census, Manufacturing Industry Series). Some data were not available from the Census for disclosure or other reasons. Secondary sources were County Business Patterns and IMPLAN (U.S. Department of Commerce, County Business Patterns; Minnesota IMPLAN Group, Inc.) Since some major changes have occurred in food processing since 1997, adjustments were made in some industries based upon 1999 employment data published by the Bureau of Labor Statistics (U.S. Department of Labor).

Table 5 lists the major food processing industries in the state along with the respective direct employment figures, the employment multipliers, and the total derived employment impact. The time period is mainly 1997 with some industries adjusted to 1999. The leather tanning and finishing industry was also included. Total direct employment was estimated to be 40,769, and with an aggregate multiplier of 2.577, the total direct and derived employment reached 105,060.

Table 5.
Employment in Michigan Food Processing Extended through the
Backward Linked Industries, 1997 and 1999 Estimated ¹⁾

Industry	Direct Value	Multiplier	Total Value
	Number		Number
Animal (except poultry) slaughtering	725	1.968	1,426
Meat processed from carcasses	3,625	2.361	8,559
Poultry processing	3,272	2.033	6,652
Cheese	403	3.332	1,343
Condensed and evaporated milk	1,157	4.808	5,563
Ice cream	623	1.970	1,227
Fluid milk	2,490	2.584	6,434
Specialty canned products	1,156	3.693	4,269
Canned fruits and vegetables	3,452	2.243	7,743
Pickles, sauces	1,960	2.308	4,524
Frozen fruits, juices and vegetables	844	2.390	2,017
Frozen specialties	485	1.692	821
Flour and other grain mill products	704	4.776	3,362
Cereal preparations	2,581	5.956	15,372
Blended and prepared flour	620	2.113	1,310
Pet food	155	2.500	388
Prepared feeds, N.E.C.	452	3.286	1,485
Bread, cake and related products	3,995	1.907	7,618
Cookies and crackers	1,750	1.973	3,453
Sugar	804	2.987	2,402
Confectionery products	1,645	2.386	3,925
Soybean oil mills	30	8.219	247
Shortening and cooking oils	152	3.208	488
Malt beverages	464	3.411	1,583
Wines and brandy	174	2.129	370
Distilled liquor, except brandy	439	2.506	1,100
Soft drinks	2,280	4.023	917
Potato chips and similar snacks	790	2.464	1,947
Food preparations, N.E.C.	1,649	2.263	3,731
Leather tanning and finishing	1,893	2.527	4,784
Total	40,769	2.577	105,060

¹⁾ Includes leather tanning and finishing.

The food processing data are not in FTEs, so the totals would be somewhat diminished if calculation of FTEs were possible. Somewhat offsetting is the fact that surveys by the Census and County Business Patterns for total employment were taken in March when employment is at a seasonal low. From monthly estimates by the Bureau of Labor Statistics for 1990 to 1999, employment in food and kindred products was 5.4 percent higher for the annual average than for March. Much of this difference was in preserved fruits and vegetables.

As was done for feed in farm production, food processors' purchases of Michigan farm products was removed in generating employment multipliers for food processing. The multipliers then represent direct employment plus employment derived from backward linked industries except Michigan farm sales to Michigan processors.

By examining the multipliers, one will note substantial differences from industry to industry. The employment multiplier for cereal preparations at 5.956 and soybean oil mills at 8.219 stand out as related to a number of other industries as well as the aggregate of 2.577 for food processing as a whole. These differences relate to the capital-labor ratios and the ability of some industries to become highly mechanized.

Output on Farms

The procedures described for employment were also applied to output. Output of farm enterprises in terms of millions of dollars is tallied in Table 6. The direct values were obtained from the Michigan Agricultural Statistics Service (MASS) and represent averages for 1997 to 1999 (Michigan Agricultural Statistics Service, Michigan Agricultural Statistics, 1998-99). The data for livestock are calendar year averages and on crops represent value of production for the crop years of 1997 to 1999. [Estimates for equine as gleaned from the 1991 survey of the industry represent expenditures since a major portion of the industry is for pleasure and not profit (Michigan Agricultural Statistics Service, 1991 Michigan Equine Survey). A survey by the USDA for 1997 and 1998 found sales only to be \$34 million and \$36 million respectively (U.S. Department of Agriculture, Equine)].

The total direct value for Michigan agriculture of \$4,259 million is inflated because of double counting in the proportion of the feed crops which is input into livestock. Deducting the value of feed fed to livestock, the following allocations are established:

<u>Enterprise</u>	<u>Direct Value of Output</u> Mil \$	<u>Percent of Total</u> %
Livestock	1,150	30
Field crops	1,686	45
Fruit	235	6
Vegetables	177	5
Ornamentals	<u>535</u>	<u>14</u>
Total	3,783	100

As with employment, the multipliers were adjusted so that the feed crops were eliminated from the livestock sector. The output multipliers ranged from 1.288 on poultry to 1.592 on ornamentals. While the average across all enterprises was shown as 1.490 in Table 6, adjusting

for double counting resulted in a higher multiplier of 1.678, very close to the aggregate *employment* multiplier. In essence, the \$3,783 million output in production agriculture generated another \$2,564 million in the backward linked industries for a total value of output of \$6,347 million. This is exclusive of direct government payments to farmers which averaged about \$230 million in 1997-99, mostly for field crops. With a multiplier of 1.5 (average for corn and wheat),

Table 6.
Output of Michigan Agriculture Extended through the Backward Linked Industries, 1997-1999

Enterprise	Direct Value Mil \$	Multiplier	Total Value Mil \$
Livestock			
Dairy products	785	1.364	1,071
Cull cattle	48	1.540	74
Steers and heifers	166	1.556	258
Hogs	200	1.522	304
Sheep	4	1.548	6
Eggs	57	1.288	73
Turkeys	58	1.288	75
Aquaculture	2	1.427	3
Honey	4	1.415	6
Equine	256	1.415	362
Other livestock	46	1.415	65
Total	1,626	1.413	2,297
Field crops ¹⁾			
Corn for grain	504	1.489	750
Corn silage	40	1.489	60
Oats	7	1.489	10
Hay	329	1.478	486
Soybeans	399	1.554	620
Wheat	89	1.568	140
Dry beans	108	1.554	169
Sugarbeets	113	1.506	170
Potatoes	97	1.551	150
Total	1,686	1.515	2,555
Other			
Processing fruit ¹⁾	150	1.576	237
Fresh fruit ¹⁾	85	1.576	133
Processing vegetables ¹⁾	49	1.551	76
Fresh vegetables ¹⁾	128	1.551	198
Ornamentals	525	1.592	836
Forest products	10	1.487	15
Total	947	1.579	1,495
Grand total	4,259	1.490	6,347

¹⁾ Value of production

the total value of direct government payments would be about \$345 million.

The allocation of the total value by enterprise would be as follows:

<u>Enterprise</u>	<u>Total Value of Output Percent of Total</u>	
	Mil \$	%
Dairy	1,130	18
Beef	273	4
Hogs	304	5
Poultry	148	2
Equine	362	6
Other livestock	80	1
Field crops	2,555	40
Fruit	370	6
Vegetables	274	4
Ornamentals and other	<u>851</u>	<u>13</u>
Total	6,347	100

Output of Food Processing

The output of Michigan food processors is listed by industry in Table 7. The total direct output was \$13,250 million with an average multiplier of 1.492. The direct values were not adjusted for double counting while the multipliers were. Deducting the input costs of Michigan processors for Michigan farm products reduced the direct value to \$10,963 million. This output of food processors generated another \$8,780 million in the Michigan economy for a total output impact of \$19,773 million, reflecting an aggregate output multiplier of 1.804.

As can be noted, the variability of output multipliers in food processing is considerably less than the employment multipliers. The range in output multipliers was from a low of 1.169 for animal (except poultry) slaughtering to a high of 1.740 for cereal preparations, the major food processing industry in the state.

Forward Linkages

To recapitulate, the analysis has indicated that approximately 55,703 FTEs on farms expands to a total 92,918 employees through the backward linked industries in the state. In food processing, some 105,060 jobs can be traced to the 40,769 persons employed directly. Adding agricultural production and food processing together, a total of 197,978 jobs are related directly or indirectly to these basic industries. In other words, another person is employed in backward linked industries for each employee in farming and food processing.

In terms of output, farm sales of \$3,783 million generated a total of \$6,347 million for the state as a whole (excluding government payments). Food processor sales of \$10,963 million generated a total of \$19,743 million. The combination of farm and food processor direct sales of \$14,746 million expanded to \$26,090 million reflecting the aggregate output multiplier of 1.769.

Table 7.
Output of Michigan Food Processors Extended through the Backward Linked Industries,
1999 Estimated ¹⁾

Industry	Direct Value Mil \$	Multiplier	Total Value Mil \$
Animal (except poultry) slaughtering	337	1.169	394
Meat processed from carcasses	1,030	1.412	1,454
Poultry processing	824	1.360	1,121
Cheese	243	1.399	340
Condensed and evaporated milk	1,012	1.412	1,429
Ice cream	107	1.548	166
Fluid milk	917	1.412	1,295
Specialty canned products	491	1.534	753
Canned fruits and vegetables	656	1.557	1,021
Pickles, sauces	522	1.423	743
Frozen fruits, juices and vegetables	177	1.574	279
Frozen specialties	76	1.379	105
Flour and other grain mill products	443	1.531	678
Cereal preparations	1,518	1.740	2,641
Blended and prepared flour	119	1.533	182
Pet food	33	1.687	56
Prepared feeds, N.E.C.	227	1.489	338
Bread, cake and related products	535	1.532	820
Cookies and crackers	404	1.521	614
Sugar	307	1.442	443
Confectionery products	372	1.531	570
Soybean oil mills	50	1.447	72
Shortening and cooking oils	75	1.440	108
Malt beverages	256	1.369	350
Wines and brandy	34	1.503	51
Distilled liquor, except brandy	217	1.251	271
Soft drinks	1,182	1.500	1,773
Potato chips and similar snacks	234	1.407	329
Food preparations, N.E.C.	361	1.476	533
Leather tanning and finishing	491	1.718	844
Total	13,250	1.492	19,773

¹⁾ Includes leather tanning and finishing

These figures are all backward linked. Farming and food processing have additional impacts on the Michigan economy through forward links of transportation, wholesaling, retailing and food service. At the first receiver level, the dependence on farm and processed food products is quite strong just as are those industries backward linked in the food chain. As the product moves on through the retailing and food service levels, the degree of dependence is less clear. The food distribution sectors become more dependent on consumer demand and less on the proximity of food production and processing. The dependence shifts toward the other basic industries in the state. Following sections of this report will explore alternative ways to establish ties between the basic industries of agriculture and food processing with the distribution to the state's market.

In 1998, the Michigan population spent an estimated \$30,835 million on food and alcoholic beverages (Table 8). Of this total, \$23,961 million was for food originating on U.S. farms, \$3,516 million was for seafood and imported food, and \$3,358 million was for alcoholic beverages. Of the \$23,961 million spent on food originating from U.S. farms plus the \$3,358 million spent on alcoholic beverages, about half of the expenditures were away from home. Emphasis should be made that these are not official Michigan data but were derived from national totals applied to the Michigan population. The national totals were obtained from the USDA (U.S. Department of Agriculture, Economic Research Service). Of the expenditures for farm produced food consumed at home in Michigan, U.S. farmers received \$3,294 million or 26 percent of the retail value. Of the \$11,291 million spent on U.S. farm produced food away from

Table 8.
Expenditures on Food and Alcoholic Beverages in Michigan, 1998 ¹⁾

Food originating on U.S. farms	Million \$	Million \$
Consumed at home		
Farm value	3,294	
Processing	4,181	
Inter-city transportation	760	
Wholesaling	1,267	
Retailing	3,168	
Total		12,670
Consumed away from home		
Farm value	1,806	
Processing	1,694	
Inter-city transportation	339	
Wholesaling	677	
Retailing	6,775	
Total		11,291
Seafood and imported food		3,516
Alcoholic beverages		
Consumed at home	1,625	
Consumed away from home	1,733	
Total		3,358
Grand total		30,835

1) Data generated from U.S. totals times Michigan's share of U.S. population. U.S. totals were mainly from the Economic Research Service of the U.S. Department of Agriculture (U.S. Department of Agriculture Economic Research Service).

home, farmers received \$1,806 million or 16 percent of the retail value. In total, farmers received an estimated \$5,100 million, 21.3 percent of the retail value.

How much of the \$5,100 million could be credited to Michigan agriculture? As indicated in Table 6, not all of the output from Michigan farms is food. Also, substantial amounts of the product of Michigan farms are shipped out of the state in unprocessed form. This includes about 70 percent of the feed grain crop, 90 percent of the soybeans, a fourth of the hay crop, and large volumes of ornamentals. Most of the fed cattle produced in the state are slaughtered elsewhere, and, since 1998, nearly 90 percent of Michigan's hogs have been slaughtered outside of the state. This presents a major challenge in estimating how much Michigan consumers depend on Michigan farmers for their food supply. This dependence is related more to savings in transportation costs, freshness of product, etc. rather than whether food demands for Michigan consumers could be met from out-of-state suppliers.

If one could monitor strictly quantities of Michigan farm product in the state's ultimate food supply, the amounts would understate the true value of the indigenous industry to the state's economy. In Table 9 is a commodity by commodity comparison of amounts produced in the state and estimated amounts consumed. The production figures are the raw material output of farms and not amounts processed in the state.

Table 9.
Estimates of Michigan's Production and Consumption of Major Farm Commodities, 1997-1999

Item	Unit	Production ¹⁾	Consumption ²⁾	Production as a Percent of Consumption
		Mil. Lbs.	Mil. Lbs.	
Cattle and calves	Carcass wt.	262	967	27
Hogs	Carcass wt.	303	657	46
Sheep and lambs	Carcass wt.	4	13	31
Chicken	Ready-to-cook	2	852	-
Turkey	Ready-to-cook	111	176	63
Fish	"Edible wt."	7	145	5
Eggs	Farm wt.	185	317	58
Milk	Milk equiv.	5432	5720	95
Fats and oils (excl. butter)	Product wt.	795	600	132
Citrus fruit	Farm equiv.	0	1217	0
Apples	Farm equiv.	1073	458	234
Cherries	Farm equiv.	284	17	1671
Other non-citrus fruit	Farm equiv.	270	1218	22
Vegetables	Farm equiv.	1518	2867	53
Potatoes	Farm equiv.	1462	1414	103
Sweet potatoes	Farm equiv.	0	43	0
Dry beans and peas	Farm equiv.	557	81	688
Wheat, soft	Grain equiv.	2088	861	243
Wheat, hard	Grain equiv.	0	2018	0
Rice	Grain equiv.	0	186	0
Grain products ³⁾	Grain equiv.	8196	2083	393
Sugar (cane and beet)	Refined	1054	653	161

¹⁾ Production represents the raw material output of Michigan farms and not the amounts processed in Michigan.

²⁾ Consumption is based on U.S. average per capita estimates.

³⁾ Grain available for food and industrial use after livestock requirements are met.

As can be observed, substantial volumes of farm/food products are shipped into the state just as

major quantities are shipped out. Even these figures understate the total movement across state and provincial lines. For example, cattle are both moved into the state as well as out of the state. While the production of vegetable oil (in soybeans) exceeds consumption, soybeans move out of the state while soybean oil moves in.

While Michigan is dependent on farmers elsewhere for a major share of its food supply, Michigan farmers also furnish substantial amounts to populations elsewhere. Conceptually, the only feasible solution is to evaluate Michigan farmer's share on some type of net basis. One approach might be to add the production column in Table 9 and divide the total by the sum of the consumption column. This would be adding apples and oranges, which, while somewhat troublesome, is not as far fetched as adding cattle and calves to milk. The alternative selected was to estimate the average value Michigan farmers received for livestock and food crops in 1997-99, which was \$2,186 million, and compare that figure with the \$5,100 million estimated to be the farm value of food originating on U.S. farms. The result was 43 percent.

Wholesaling

As indicated in Table 8, wholesaling of U.S. farm produced food (including intercity transportation) consumed at home and away from home was estimated at \$3,043 million. Allocating 43 percent of that amount to Michigan agriculture resulted in a figure of about \$1,300 million. To that figure was added the transportation and wholesaling of non food products.

About \$75 million was attributed to nursery stock and floriculture. Another \$130 million was attributed to transportation of farm products not counted in the state's food chain, such as feed grain, hay and soybeans shipped out of the state. The total, including a small amount for alcoholic beverages, was \$1,506 million.

Alternative procedures incorporating the 1997 Census of Wholesale Trade and the 1997 Census of Transportation and Warehousing were also pursued (U.S. Department of Commerce, 1997 Economic Census, Wholesale Trade, Michigan; 1997 Economic Census, Transportation and Warehousing, Michigan). The results were nearly identical to the procedure described above.

Retailing

As can be gleaned from Table 8, the retailing margins for U.S. farm food consumed both at home and food away from home totaled \$9,943 million in 1998. At 43 percent of that total, about \$4,261 million could be attributed to Michigan agriculture. Michigan's share of expenditures on alcohol is much smaller than for food, which would add a nominal \$22 million to the retailing margin. The retailing margin on ornamentals was estimated to be about \$500 million, bringing the total retail margin assignable to Michigan agriculture to \$4,787 million (U.S. Department of Commerce, 1997 Economic Census, Retail Trade, Michigan).

Alternative procedures for estimating sales of food and alcoholic beverages in Michigan were checked. According to the 1997 Census of Retail Trade, sales from grocery stores, specialty food stores and beer, wine and liquor stores totaled \$12,352 million which, of course, included non-food. If the sales of food consumed at home originating from U.S. farms (\$12,671 million) in Table 8 were added to about half of the sales of seafood and imported food (\$1,758 million) and

to alcoholic beverages consumed at home (\$1,625 million), a total of \$16,054 million is obtained, substantially above \$12,352 million. However, the Census did not break out food and alcohol sales from warehouse clubs, superstores, certain other general merchandise stores, service stations, etc., which may account for the difference.

Total sales of food and alcoholic beverages away from home can be derived from Table 8 to be \$14,782 million. This is substantially more than \$8,614 million attributed to foodservice and drinking places by the U.S. Census (U.S. Department of Commerce, 1997 Economic Census, Accommodation and Foodservices, Michigan). However, estimates by the Economic Research Service of the USDA are similarly above the Census at the national level, reflecting substantial amounts of food consumed outside the establishments tallied in the Census (U.S. Department of Agriculture, Economic Research Service).

Retail margins on ornamentals were calculated from the total sales of nursery and garden stores (\$758 million) and florists (\$271 million) by subtracting farm sales of ornamentals of \$525 million. The net of \$504 million represents something of a combination of wholesale and retail margins. The estimate is crude because substantial amounts of ornamentals are shipped out of the state as well as substantial amounts are shipped in. Some question might also be raised in terms of how much of the \$504 million is tied to agriculture.

Another sector related to ornamentals is landscape and horticultural services. IMPLAN estimated the output contribution of this industry at \$789 million in 1997. Although somewhat removed from production agriculture, this service should be recognized as related.

An Aggregate View

Including the backward linkages in agriculture and food processing, as was discussed earlier in this report, the direct output of \$14,746 million generated a total output of \$26,090 million. The forward linkages, not including landscape and horticultural services amounted to another \$1,506 million in direct output at the wholesale level and \$4,787 million at the retail level. The direct value of the output of Michigan agriculture and food processing plus the state's share of wholesaling and processing adds up to \$21,039 million. Adding \$491 million from the manufacture of leather brings the total to \$21,530 million.

Just as there are spin-offs of output from agricultural production and food processing, wholesaling and retailing also carry extended impacts — not backward linked but in terms of purchases of farm or food products but in terms of other inputs, expenditures of employees, etc. These extended effects are portrayed in Table 10.

Output

The first two columns of Table 10 relate to the direct output of each sector and the total output derived by the associated multipliers. The explanation for agricultural production and processing has been covered in some detail. Note that the total of the wholesaling and retailing margin of \$6,293 million (Michigan's agriculture's share) expanded to \$10,165 million with the application of the relevant multipliers. The multiplier for the combination of wholesaling and retailing was 1.615. Adding the expanded distribution margin of \$10,165 million to the \$26,934 million total

output at the farm and food processor level, a total of \$37,099 million could be attributed to Michigan agriculture and food processing. One might view the direct output of \$15,237 million responsible for \$37,099 million of total output – a multiplier of 2.435.

An extreme view might be that the \$37,099 million is attributable to Michigan farmers who sold an average of \$3,783 million annually in 1997 to 1999. That multiplier would be about 10.

However, Michigan farmers depend on food processors just as food processors depend on farmers. One exception is the prepared cereal industry which buys relatively little product of Michigan farms. Most appropriately, agriculture and food processing should be considered together.

As shown in Table 10, the direct output of landscape and horticultural services expands from the direct output of \$789 million to \$1,276 million with the application of the IMPLAN multiplier. Inclusion of this industry brings the total direct output to \$22,319 million and the total output to \$38,375 million

For some purposes, a measurement of the total agricultural and food system in the state is valid. To do this, the additional direct output in the distribution margin for all food and alcoholic beverages sold in Michigan is appended at the bottom of Table 10. The additional direct output of \$10,489 million results in a sum of \$32,808 million. The expanded value of the additional margin is \$17,012 million for a grand total output of \$55,387 million.

Employment

The last two columns of Table 10 display the direct employment involved with agriculture and the food system and the expanded employment by applying IMPLAN multipliers. The derivation of the direct and total employment numbers has been covered in previous sections of this report. In total, direct employment of 96,472 in agricultural production and food processing (including leather) expands to 197,978, more than doubling when the multiplicative backward linked effects are taken into account.

Forward linked, Michigan's share of the wholesaling margin added direct employment of 15,808 and the retail margin added another 216,326. With an employment multiplier of 2.000, the wholesale employment expanded to 31,616 and the retail margin to 269,475 (Table 10). This brought the total employment related to agricultural production and food processing to 499,069. That is a ratio of 9.0 to 1.0 relative to direct FTEs in agriculture or 5.2 to 1.0 relative to direct employment in the combination of agriculture and food processing.

Table 10.
Aggregation of Direct and Extended Values of Output and Employment in Michigan Agriculture and the Food System

Item	Output		Employment	
	Direct Mil \$	Total Mil \$	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	100,276
Leather processing	491	844	1,893	4,784
Total	18,000	26,934	106,136	197,978
Adjustment for double counting	-2763	0	-9664	0
Net	15,237	26,934	96,472	197,978
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	499,069
Landscape and horticultural services	789	1,276	28,710	36,490
Total of above	22,319	38,375	357,316	535,559
Added values if all food and alcoholic beverages are included in distribution	10,489	17,012	462,879	597,317
Total of above	32,808	55,387	820,195	1,132,876

While the output data derived from USDA's Economic Research Service differed from the Census, Census data were helpful in estimating the gross sales per employee. This relationship

was then applied to sales figures in deriving employment data where such information was not available.

Additional employment can be attributed to agriculture in landscape and horticultural services which directly amounted to some 28,710 in 1997. With an employment multiplier of 1.271, the industry directly and indirectly accounts for 36,490 jobs (Table 10). With this addition, the accumulated employment total reaches 535,559 with ties to Michigan's agriculture and food system.

Of interest may be an accounting for the balance of the food distribution system. The direct employment of an additional 462,879 in food wholesaling and retailing not traced to Michigan farm and food products is shown in Table 10. Applying a multiplier of 1.290, the enhanced employment is estimated at 597,317. This brings the cumulative total of direct employment in Michigan agriculture, food processing and food distribution to 820,195 and the expanded total to 1,132,876. Compared to total employment in Michigan in all sectors, the agriculture and food system represents over a fourth.

Additional Considerations

Not only does agriculture and food 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 1, which illustrates that the fluctuations and trends in Michigan's real net farm income per farm have not matched the variations and trends in real disposable income per capita.

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 those somewhat volatile industries, but to provide ongoing income to households connected to farming and food processing. This has relieved the stress on farms in recent years (Figure 1).

While trends in Michigan's diverse agriculture have been mixed, total cash receipts and expenditures increased over the 1960 to 1999 period in nominal terms, but after 1980 declined or stabilized in real terms. As shown in Figure 2, total cash receipts from farming in nominal terms continued to increase in the 1980s and 1990s after the buoyant 1970s. Cash receipts reached about \$4 billion in 1999. However, after dividing nominal receipts by the Consumer Price Index

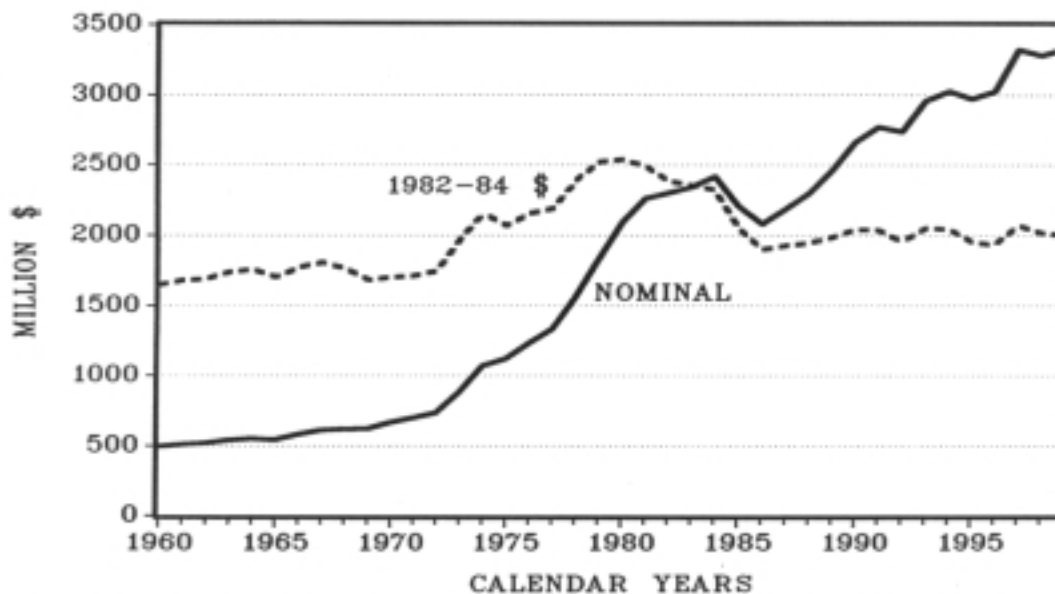
(1982-84 = 100%), receipts declined after 1980. Nominal expenditures have increased along with cash receipts and have been stable in real terms (Figure 3). The result has been little change in *net* cash income from farming in the two decades from 1980 to 1999 (Figure 4). Real net cash income continued on a downward trend which began in the latter part of the 1970s.

Contrary to the secular decline in real net cash income from farming in Michigan, farmland prices increased both in nominal and in real terms in the 1990s (Figure 5)! Even with the pressure on farm income, owners' equity improved. This paradox reflects a robust non-farm economy and the close rural-urban interface.

The trends also point to some recent difficulties in food processing. While the value added by food processors increased in both nominal and real terms since the 1960s, the first reversal in both of these measures was observed by the Census of Manufacturing between 1992 and 1997 (Figure 6). Employment in food processing has been declining since the 1960s with the exception of the 1987 to 1992 period (Figure 7). Based on annual data from the Bureau of Labor Statistics, employment continued to decline between 1997 and 1999.

FIGURE 3

TOTAL CASH EXPENDITURES BY MICHIGAN FARMERS
IN NOMINAL AND 1982-84 DOLLARS*



* Derived from data from the Michigan Agricultural Statistics Service and ERS, USDA.

FIGURE 4

DERIVED NET CASH INCOME FROM FARMING IN MICHIGAN
IN NOMINAL AND 1982-84 DOLLARS*



* Data from the Michigan Agricultural Statistics Service and ERS, USDA. Estimate of rental value of farm dwellings included in the net cash income.

FIGURE 5

AVERAGE VALUE OF MICHIGAN FARM REAL ESTATE PER ACRE
IN NOMINAL AND 1982-84 DOLLARS*

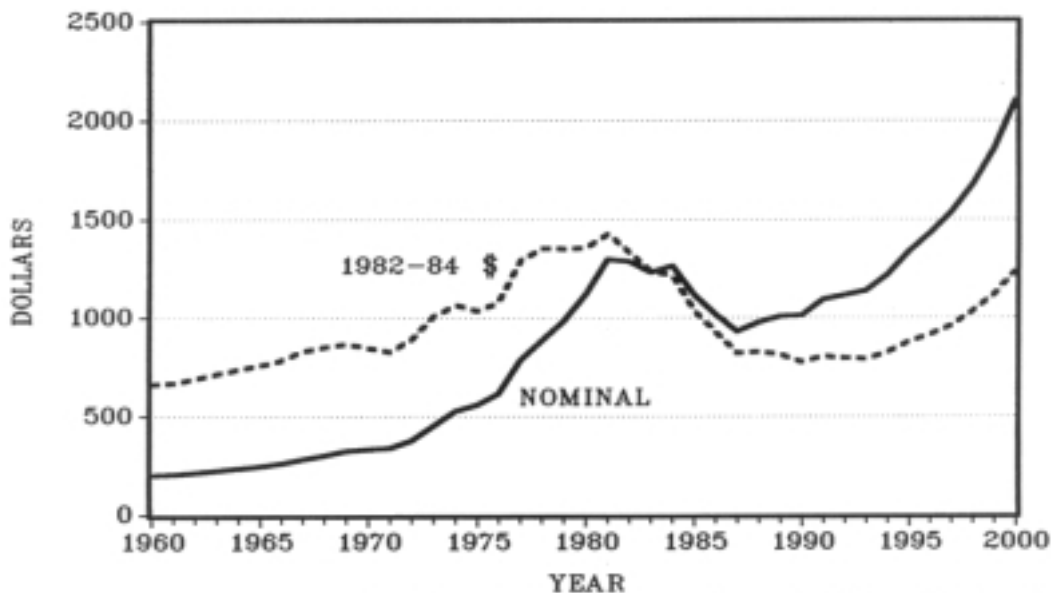
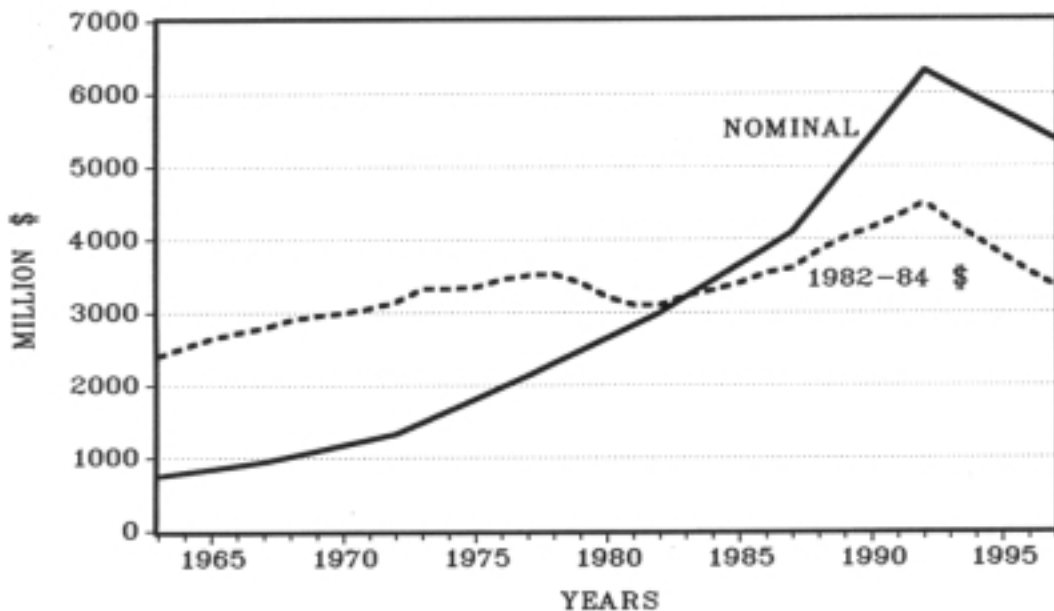


FIGURE 6

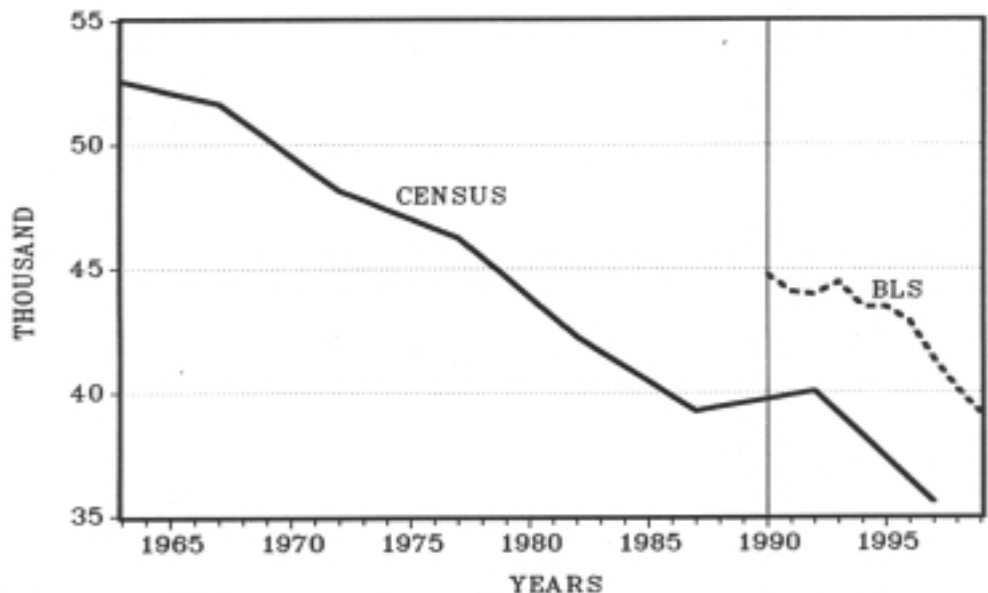
VALUE ADDED BY FOOD PROCESSORS IN MICHIGAN
IN NOMINAL AND 1982-84 DOLLARS*



* Source: U.S. Department of Commerce, Census of Manufacturing

FIGURE 7

EMPLOYMENT IN FOOD AND KINDRED PRODUCTS IN MICHIGAN
FROM THE CENSUSES FOR 1963 TO 1997 AND THE BLS FOR 1990-1999*



* Sources: U.S. Department of Commerce, Census of Manufacturing;
U.S. Department of Labor, Bureau of Labor Statistics (BLS)

References

- Holecek, Donald F., Tourism, Status and Potential of Michigan Natural Resources, Special Report 76, Michigan Agricultural Experiment Station, Michigan State University, January 1995.
- Michigan Agricultural Statistics Service, Michigan Agricultural Statistics, 1998-99, August 1999.
- Michigan Agricultural Statistics Service, 1991 Michigan Equine Survey, Michigan Equine Monitoring System, Michigan Department of Agriculture, January 1992.
- Minnesota IMPLAN Group, Inc., IMPLAN Professional, Version 2.0, Users Guide, Analysis Guide and Data Guide, April, 1999, www.Implan.com.
- Nott, Sherrill, et. al., "1995 Crops and Livestock Budgets, Estimations for Michigan", AER No 581, Department of Agricultural Economics, Michigan State University, May 1995.
- U.S. Department of Agriculture, Agricultural Land Values, National Agricultural Statistics Service, March 2000.
- U.S. Department of Agriculture, 1997 Census of Agriculture, Michigan, State and County Data, Volume 1, Geographic Area Series, Part 22, National Agricultural Statistics Service, March 1999.
- U.S. Department of Agriculture, Economic Research Service, "Total Expenditures on Food and Alcoholic Beverages", <http://www.econ.ag.gov/briefing/foodmark/expend/data/history/foodalc.htm>.
- U.S. Department of Agriculture, Equine, National Agricultural Statistics Service, March 2, 1999.
- U.S. Department of Commerce, County Business Patterns, 1997, Michigan, Economics and Statistics Administration, U.S. Census Bureau, Sept. 1999.
- U.S. Department of Commerce, 1997 Economic Census, Accommodation and Foodservices, Michigan, Economics and Statistics Administration, U.S. Census Bureau, December 1999.
- U.S. Department of Commerce, 1997 Economic Census, Manufacturing, Michigan, Economics and Statistics Administration, U.S. Census Bureau, May 2000.
- U.S. Department of Commerce, 1997 Economic Census, Retail Trade, Michigan, Economics and Statistics Administration, U.S. Census Bureau, December 1999.
- U.S. Department of Commerce, 1997 Economic Census, Transportation and Warehousing, Michigan, Economics and Statistics Administration, U.S. Census Bureau, January 2000.
- U.S. Department of Commerce, 1997 Economic Census, Wholesale Trade, Michigan, Economics and Statistics Administration, U.S. Census Bureau, March 2000.
- U.S. Department of Labor, Bureau of Labor Statistics Data, <http://146.142.4.24/cgi-bin/dsrv>, March 3, 2000.