OHFOOD:
An Ohio Food Industries Input-Output Model
Version 6.0

The Ohio State University
AED Economics Department
June 2003

AEDE-RP-0033-03

OHFOOD

An Ohio Food Industries Input-Output Model

Version 6.0

June 2003

by

Thomas L. Sporleder

Keywords: food, agriculture, economics, gross state product, input-output, food cluster
JEL codes: D57 and Q11

Farm Income Enhancement Program

Suggested Citation Format:

Sporleder, Thomas L. *OHFOOD: An Ohio Food Indistries Input-Output Model, Version 6*. AED Economics Report AEDE-RP-0033-03, The Ohio State University, Columbus, Ohio, June 2003

OSU AED Economics (AEDE-RP-0033-03)

OHFOOD: An Ohio Food Industries Input-Output Model

(Version 6.0)

Table of Contents

List of Tables

List of Figures

OSU AED Economics (AEDE-RP-0033-03)

OHFOOD: An Ohio Food Industries Input-Output Model
(Version 6.0, June 2003)

by
Thomas L. Sporleder[1]

Abstract

OHFOOD, an acronym for **Oh**io **food**, is a sophisticated input-output model. The model is designed specifically to capture the inter-dependencies and linkages among various sectors and industries composing the complex economy of Ohio. The input-output model of Ohio's economy also maintains substantial detail on the food and agricultural sectors. The interindustry model describes the linkages among various sectors of the economy and is specifically designed to provide estimates of the economic importance of the food and agriculture-related cluster, along with the general manufacturing and service sectors, of the economy. Also, **OHFOOD** provides several types of economic multipliers for detailed food and agriculture-related sectors of the economy. These multipliers may be useful in investigating the statewide economic influence of induced changes in output or employment in a particular sector.

This documentation provides a succinct analysis of the importance of food and agriculture to the state's economy, based on the interindustry model. The analysis indicates that for 2000 the food and agricultural cluster of Ohio's economy contributed approximately 12 percent of the output, added 10 percent to Ohio's gross state product, accounted for 15 percent of the total employment, and contributed 10 percent of total income. In 2000, the Ohio economy generated a gross state product (GSP) of $372.6 billion. The food and agricultural cluster's share of this GSP was $36.5 billion, or $9.80 of each $100 of Ohio GSP.

Of the 5 major components comprising the food and agricultural-related cluster, the processing sectors of food and forestry-related products are the largest in terms of output, contributing $10.4 billion to Ohio's GSP in 2000, or just over 28 percent of the total contribution to GSP of $36.5 billion by the entire food and agriculture cluster. Food and forestry wholesaling and retailing sectors within the food and agriculture cluster are notable for their contribution to employment. These sectors combine to account for nearly 720,000 jobs, or nearly seven of every ten jobs accounted for by the food and agriculture cluster. The entire food and agriculture complex accounted for over one million jobs in Ohio in 2000, or about one of every seven jobs (15 percent).

Keeping the OHFOOD model updated with the latest data available is an on-going task of the Farm Income Enhancement Program and the Agribusiness Research Group within the Department of Agricultural, Environmental, and Development Economics of The Ohio State University. Individual county analyses of the importance of the food and agriculture cluster are available over the Internet.

[1] Thomas L. Sporleder is Professor and Farm Income Enhancement Endowed Chair, Department of Agricultural, Environmental, and Development Economics, The Ohio State University. The author acknowledges computational and word processing support from Julie Chance Louiso, M.S. Graduate Student in Agribusiness, and Charlene Hanna, Undergraduate Student in Agribusiness and Applied Economics, both of the Department of Agricultural, Environmental, and Development Economics, The Ohio State University.

OHFOOD: An Ohio Food Industries Input-Output Model

Introduction

Measuring production in an economy can be insightful in terms of relationships among various industrial groups. A technique known as input-output modeling accounts for the interdependence of production activities for the many different industries comprising an economy. An input-output model is a representation of the flows of economic activity among sectors within a region. The model captures what each business or sector must purchase from every other sector to produce a dollar's worth of goods or services.

The interdependence captured in the model arises because each industry employs the outputs of other industries as its raw materials. In addition, other producers or industries may use its output as a factor of production. To illustrate these economic linkages and interdependencies, consider corn production. Some output from this production activity is input into dry and wet corn milling. Some co-product output from milling is input into livestock feed (e.g. corn gluten feed), as is some output directly from corn production. Moving closer to the consumer level in the supply chain, some output from the milling industry is high-fructose corn syrup (HFCS) which in turn is input into the soft drink manufacturing industry.

Measuring these interdependencies and linkages can reveal how much of each industry's output is consumed by other industries and how much is available for final consumption. OHFOOD is constructed so as to define the supply chain of the food and related agricultural cluster of the economy as consisting of five major sectors or components, all vertically linked and interdependent in an economic sense. The five major components comprising the cluster are *farm inputs and machinery, farm production, processing of food and forestry products, wholesaling and retailing of food and forestry products*, and ultimately the *food service sector*.

A diagram of the simplified economic linkages among the five food and agriculture-related components of the cluster is provided in Figure 1. The four elliptical shapes of the diagram represent final demand components for the output of the other five stages. The arrows indicate primary or secondary economic flows, in terms of dollars of output, from one sector that becomes input to another sector.[1]

For each industry or sector of the economy, estimates of the amount of direct purchases per dollar of output are obtained from the interindustry model. In addition, other economic measures of interest derived for each sector of the

[1] For an excellent illustration of vertical linkages among the food processing, wholesaling and retailing, and food service sectors for the economy, see an article by John Siebert, cited in the references.

economy from the input-output model include total employment, income, contribution to gross state product, and the total dollar value of output. Each of these economic indicators measures different, yet related, linkages among the various sectors of the economy. For purposes of the model, income here is the money earned within the region from production and sales. Thus, income includes personal income (wage and salary income) as well as income of sole proprietor's profits and rents. It is not just wage income for the region.

Another useful indicator from input-output models is the "multiplier." Input-output models are driven by final consumption or final demand. Industries respond to meet demands directly or indirectly (by supplying goods and services to industries responding directly). Each industry that produces goods and services generates demands for other goods and services. These other producers, in turn, purchase goods and services. These "indirect" purchases (indirect effects) continue until "leakage" from the region (such as imports, wages, or profits) stop the cycle. Multipliers describe these iterations.

An output multiplier for a sector, for example, measures the additional value of production from all sectors of the economy when expansion or contraction of output occurs within a sector by addition of firms or from firms exiting a geographic location. Output multipliers can be the basis for analyzing the importance of each industry in terms of its overall influence on the economy.

Other multipliers include income and employment. An income multiplier is a measure of the intuitive notion that income earned by one individual or industry is spent and becomes income to a second individual or industry. In turn, the second individual spends a portion of that income so that it becomes income to yet another individual. The income multiplier relates an increment in the income of one sector to an increment of income of other sectors. In essence, when expenditures from one sector increase, the income of other sectors will increase in some multiple of the original increment. Employment multipliers are derived from output multipliers simply by converting from an output to employment base.

An Ohio Model: OHFOOD

Sector Definition

An input-output model of the state's economy captures interindustry economic relationships and provides information on the relative importance of various sectors of the economy. **OHFOOD**, an acronym for **Ohio Food**, is an input-output model composed of 43 sectors defined in a manner to emphasize agriculture and processed food and forestry products, distribution and retailing of food and forestry products, and food consumption. Many of the 43 sectors are defined based upon the aggregation of similar industries. For example, the "Nursery and Horticulture" sector of **OHFOOD** is defined to include the grass seeds industry, the greenhouse and nursery

products industry, and the landscape and horticultural services industry.

The specific definition of sectors within **OHFOOD** was accomplished by maintaining substantial detail among the agricultural production and food-forestry processing/distribution sectors, but aggregating many other non-food industries into relatively large composite sectors. The specific food and related agricultural sectors of **OHFOOD** are farm inputs and machinery production; dairy farms; poultry and egg production; cattle feeding; miscellaneous livestock (including sheep, goats, horses, and other livestock); swine production; food grain production; feed grain production; miscellaneous crops including hay, sugar, and nut crop production; fruits and vegetables; oil bearing crops, primarily soybeans; forestry and fishing production; nursery and horticulture production; meat, fish, and egg processing; dairy processing; processed food and kindred products; wood processing and paper production and wood furniture manufacturing; grain milling and flour production; beverage processing (mostly soft drink and liquor production); fats and oils production; food and forestry wholesaling and retailing; and finally away-from-home food service (restaurants; institutions such as schools, hospitals and prisons; and other retail food service; but excluding hotel and motel food service).

OHFOOD is comprised of 22 sectors related to food and agriculture and 21 sectors that are based on the general manufacturing and service sectors of the entire economy. The precise and detailed four-digit 2000 Standard Industrial Classification (SIC) definition of each sector defined within **OHFOOD** is provided in Appendix Table A-2.

Methods

The **OHFOOD** model is based on *IMPLAN*, an input-output algorithm for the national economy using non-survey based data (University of Minnesota). *IMPLAN* is based on a procedure developed by the U.S. Forest Service for estimating input-output models for the United States or subregions (Alward).

Estimates of sectoral activity for final demand, final payments, industry output, and employment for the Ohio economy are based on the latest data available aggregating the detail for 528 industries of the United States economy. All information within this Version 6.0 model is for the calendar year 2000 and is in 2000 dollars.

The **OHFOOD** estimates of economic activity by sector in Ohio are based on information and/or data from each of the following sources:

- US Bureau of Economic Analysis Benchmark I/O Accounts of the US
- US Bureau of Economic Analysis Output Estimates
- US Bureau of Economic Analysis REIS Program
- US Bureau of Labor Statistics ES202 Program
- US Bureau of Labor Statistics Consumer Expenditure Survey
- US Census Bureau County Business Patterns

- US Census Bureau Decennial Census and Population Surveys
- US Census Bureau Economic Censuses and Surveys
- US Department of Agriculture
- US Geological Survey

Each sector defined in the **OHFOOD** model is a grouping of industries that produce similar products or services. This is the last OHFOOD model that is based on sector definitions using the Standard Industrial Classification code (SIC code). The next major version of OHFOOD (version7.0) will use definitions based on the new North American Industrial Classification System (NAICS).

Detail of the methods of input-output modeling for an economy and the methods used for calculations of multipliers may be found in Miller and Blair. There are many other sources of information on the input-output modeling technique.

Analysis of the Ohio Economy

Basic Economic Linkages

An overview of the Ohio economy in 2000 is shown by the total output, gross state product, income and employment for each of 43 sectors, Table 1. The total economic output for Ohio in 2000 was $687.8 billion, with total employment of nearly 6.9 million persons. The 2000 Ohio economy generated a gross state product (GSP) of $372.6 billion, and the food and agricultural share of this GSP was $36.5 billion. This means that the food and agricultural components of the Ohio economy generate approximately $9.80 of each $100 in Ohio GSP.

The output of food and related agricultural sectors was $79.6 billion, or about 12 percent of Ohio's total economy, Figure 2. The $79.6 billion represents about $1 of every $8 in output for the entire Ohio economy. The total output of $79.6 billion may be divided among the five basic components of the food and related agriculture cluster, Figure 2. The largest component is processed food and processed forestry products, accounting for $32.5 billion of this output, or about 41 percent of the total $79.6 billion food and agricultural output. This $32.5 billion is composed of $18.9 billion from food processing and another $13.6 billion from value added forestry processing which includes wood processing, paper, and wood furniture manufacturing. Thus, food processing accounts for about 58 cents of every $1 in output from the total food and forestry-processing sector.

Agricultural production adds about $6.5 billion in output or just over 8 percent of the total output from the food and related agricultural cluster of the Ohio economy. The largest component within the agricultural production sector is the nursery and horticultural industries, accounting for nearly $1.9 billion in output, or nearly $1 of every $3 in output generated by the farming sector. However, feed grains and oil bearing crops, primarily corn and soybeans, together account for nearly $1.8 billion in sector output.

The Ohio livestock sectors combined account for nearly $1.8 billion in output, or around 28 percent of the $6.2 billion

total agricultural production output, excluding forestry production and fishing, Figure 3. Crop and horticultural industries account for 72 percent of the total output from the primary agricultural production sectors of livestock, crops, and horticulture, or some $4.4 billion in output, Figure 4. The largest component of the field crop sectors is feed grains at nearly $931.7 million in output. However, the oil bearing crops sector, primarily soybeans, also contributes $831.7 million in output.

Gross state product is another significant measure of economic activity and is a useful measure in comparison of the relative importance of one sector to another. Gross state product for the total economy is similar in concept to the measure called gross domestic product (GDP) for a nation. The 2000 Ohio economy generated a gross domestic product (GSP) of $372.6 billion, and the food and agricultural share of this GSP was $36.5 billion, Table 1. This means that the food and related agricultural cluster of the Ohio economy generated approximately $9.80 of each $100 in Ohio GSP. Of the $36.5 billion gross state product contributed by the food and related agricultural cluster, 28 percent is attributable to the total food and forestry-processing sector. The largest of the five components of the cluster in terms of gross state product is the wholesaling and retailing of food and forestry products sector, accounting for $13.4 billion, nearly 37 percent of the entire gross state product by the food and related agricultural cluster combined, Figure 5. Food service accounts for another $7.3 billion in gross state product. Finally, the farming sector and the farm inputs and machinery sector account for another 7 percent and 8 percent, respectively, of the gross state product. Farm production accounts for over $2.5 billion in gross state product while the farm inputs and machinery industries account for $3.0 billion in gross state product.

The food and related agricultural component of the state's economy contributes over one million jobs or nearly 1 in every 7 employed in Ohio, Figure 6. The wholesaling and retailing component of the food and related agriculture cluster combined with the food service sector account for 7 of every 10 jobs in the cluster, or approximately 719.7 thousand jobs in total. The food and value added forestry processing sectors account for nearly 143.1 thousand jobs, or nearly 14 percent of the total food and related agricultural cluster employment. Farm production accounts for over 147 thousand jobs or about 1 of every 7 persons employed in the food and related agricultural cluster. The smallest sector in terms of employment within the food and related agricultural cluster is farm inputs and machinery, yet this sector employs over 27 thousand people in Ohio, Table 1.

The food and related agricultural cluster accounts for about 10 percent of total income in the entire state's economy, Figure 7. The food and forestry product processing sector accounts for about $9.8 billion of a total food and related agricultural cluster income of $31.7 billion, or roughly 31 percent of the cluster's income. Food and forestry wholesaling and retailing income is larger

and accounts for $10.5 billion, while farm production income is $2.3 billion, Table 1.

Ohio livestock sectors combined account for $370 million in income, or approximately one-sixth of the $2.2 billion total farming income, Figure 8. Dairy farms account for 45 percent of total livestock sector income, while poultry and egg production and cattle feeding each account for an additional 19 percent of total income from the livestock sector. Swine production accounts for another 13 percent of the total livestock sector income in Ohio.

Of the total Ohio livestock, crop and horticultural income of $2.2 billion for 2000, crops and horticulture account for nearly 83 cents of each dollar of income, Figure 9. Nursery and horticulture accounts for over 54 percent of the total crops and horticulture income. The feed grains and oil bearing crop industries combine to account for about one-third of the total crops and horticulture income.

Food Cluster Exports

Another significant aspect of the food and agricultural component of Ohio's economy is its contribution to exports. **OHFOOD** tracks exports to other states separately from exports to foreign countries, Table 2. Total food and related agricultural cluster exports from Ohio to other states were $32.3 billion in 2000, or over 22 cents of every dollar of domestic exports from the entire Ohio economy. The food and related agricultural cluster enjoyed total exports of $37.8 billion in 2000. Of this total, about $32.3 billion was domestic exports and the remaining $5.5 billion was exports outside the United States. Thus, over 85 cents of each dollar exported outside Ohio by the food and related agricultural cluster was accounted for by domestic exports; staying within the United States but shipped outside Ohio.

Scrutiny of the food and related agricultural cluster's exports to other states reveals that the food processing sector exports $10.1 billion while Ohio's food wholesaling and retailing sector exports an additional $8.1 billion to other states, Figure 10.

Combining the processing sector's domestic exports of $11.6 billion with the sector's $1.8 billion in exports to foreign countries produces total processing sector exports of more than $13.4 billion. This represents over one-third of all exports by the food and related agricultural cluster.

Farm production exports around $2.4 billion to other states, or about 7 percent of the domestic export total. In addition, the agriculture production sector exports $751 million to foreign countries, Figure 11.

The farm inputs and machinery sector exported $7.5 billion to other states and another $2.2 billion to international destinations. Total exports from this sector represent about one-fourth of the total exports of the cluster.

The Impact Multipliers

Impact coefficients or multipliers are quantitative and summary measures of the total effects that a change in the final demand for a particular sector of the Ohio economy has on the output, income, employment, or value added. All multipliers reported here, Table 3, are Type II multipliers. A Type II multiplier measures the direct and indirect effects and also takes into account the income and expenditures of households employed in both the direct and indirect businesses within the Ohio economy (i.e. induced effect). The induced effect is based on changes in the associated value added component, such as employee compensation.

The output multiplier of a particular sector measures the total change in output generated by a $1.00 change in final demand for the product of a particular sector, Table 3.

Other multipliers are calculated for income, employment, and gross state product. For example, a $1.00 change in final demand for feed grain products generates total economy-wide income of $1.9016, Table 3. Similarly, the employment multiplier for the feed grains sector is 1.1995. Thus, the total employment effect for a $1 million change in final demand is just under 1.2 person-years.

All multipliers are interpreted in a similar fashion. An example of interpretation for the dairy production sector is provided in this paragraph. In Table 3, the dairy production income multiplier is 1.7016. It means that each $1.00 of income from dairy farms resulting from a change in final demand generates about $1.70 in total economy-wide Ohio income. The employment multiplier of 1.5401 means that each $1 million change in Ohio dairy farm output resulting from a change in final demand generates approximately 1.5 person-years change in total employment in Ohio.

Conclusions

OHFOOD, an acronym for **Oh**io **food**, is a sophisticated input-output model. The model is designed specifically to capture the inter-dependencies and linkages among various sectors and industries composing the complex economy of Ohio. The input-output model of Ohio's economy also maintains substantial detail on the food and agricultural sectors. The interindustry model describes the linkages among various sectors of the economy and is specifically designed to provide estimates of the economic importance of the food and agriculture-related cluster, along with the general manufacturing and service sectors, of the economy.

Also, **OHFOOD** provides several types of economic multipliers for detailed food and agriculture-related sectors of the economy. These multipliers may be useful in investigating the statewide economic influence of induced changes in output or employment in a particular sector.

This documentation provides a succinct analysis of the importance of food and agriculture to the state's economy, based on the interindustry model. The analysis indicates that for 2000 the food

and agricultural cluster of Ohio's economy contributed approximately 12 percent of the output, added 10 percent to Ohio's gross state product, accounted for 15 percent of the total employment, and contributed 10 percent of total income. In 2000, the Ohio economy generated a gross state product (GSP) of $372.6 billion. The food and agricultural cluster's share of this GSP was $36.5 billion, or $9.80 of each $100 of Ohio GSP.

Of the 5 major components comprising the food and agricultural-related cluster, the processing sectors of food and forestry-related products are the largest in terms of output, contributing $10.4 billion to Ohio's GSP in 2000, or just over 28 percent of the total contribution to GSP of $36.5 billion by the entire food and agriculture cluster. Food and forestry wholesaling and retailing sectors within the food and agriculture cluster are notable for their contribution to employment. These sectors combine to account for nearly 720,000 jobs, or nearly seven of every ten jobs accounted for by the food and agriculture cluster. The entire food and agriculture complex accounted for over one million jobs in Ohio in 2000, or about one of every seven jobs (15 percent).

Table 1. Ohio: Output, Gross State Product, Income, and Employment, 2000.

	Total Output	Gross State Product (GSP)	Income	Employment
	$ Millions	*$ Millions*	*$ Millions*	*Person Years*
Food & Related Agricultural Cluster				
Farm Inputs & Machinery	**9,056.4**	**2,978.9**	**2.783.1**	**27,082**
Farming	**6,488.4**	**2,522.6**	**2,341.9**	**147,133**
Dairy Farms	558.9	169.2	165.4	4,386
Poultry & Eggs	505.5	73.8	71.4	2,486
Cattle Feeding	302.1	77.1	71.1	4,843
Swine	330.1	52.0	46.4	4,798
Miscellaneous Livestock[a]	59.9	16.4	15.6	3,430
Food Grains	151.5	48.0	43.0	4,320
Feed Grains	931.7	334.1	294.0	16,777
Nursery & Horticulture	1,917.4	1,051.2	998.8	47,387
Fruits & Vegetables	175.8	62.8	59.8	2,280
Oil Bearing Crops	831.7	339.5	304.2	19,869
Misc Crops/Hay/Sugar/Tobacco/Nuts	434.8	152.6	136.6	26,320
Forestry, Fishing, Ag Services	289.0	145.9	135.8	10,237
Processing	**32,541.2**	**10,386.6**	**9,794.9**	**143,111**
Food Processing	18,899.8	5,581.9	5,191.8	61,431
Processed Meat, Fish & Eggs	2,148.5	377.6	356.1	9,205
Dairy Processing	3,992.8	1,109.3	1,057.1	8,744
Processed Food & Kindred Products	8,235.6	2,761.0	2,656.2	32,428
Grain Milling & Flour	1,241.1	266.3	253.3	2,550
Fats & Oils	594.1	83.7	77.5	847
Beverage Processing	2,687.8	984.0	791.6	7,657
Wood/Paper/Furniture Manufacturing	13,641.5	4,804.7	4,603.1	81,680
Food & Forestry Wholesale/Retail	**17,720.7**	**13,361.9**	**10,511.1**	**323,961**
Food Services[b]	**13,786.7**	**7,256.1**	**6,270.6**	**395,717**
Total Food & Ag Cluster	**79,593.4**	**36,506.1**	**31,701.7**	**1,037,004**
General Manufacturing & Service Sectors				
Mining	4,268.4	1,741.6	1,521.3	22,054
Construction	45,855.2	18,218.7	17,645.6	412,450
Apparel, Accessories, Yarn & Leather	3,155.1	1,172.0	1,123.7	25,711
Motor Vehicle Equipment	50,703.6	15,316.3	14,801.2	140,941
Metal Industries	47,104.0	17,230.4	16,464.0	226,710
Chemical & Petroleum	42,937.1	15,917.8	15,224.8	155,501
Publishing	10,157.3	4,458.6	4,269.9	76,543
Stone, Clay & Glass	7,219.0	3,506.6	3,354.5	45,996
Machinery & Equipment	31,542.2	12,023.9	11,549.4	180,295
Technology Industries	14,485.8	5,043.8	4,844.4	67,688
Business and Personal Services[c]	50,027.0	30,243.3	28,660.2	864,235
Transportation & Communication	33,602.4	17,399.2	15,960.0	253,422
Electrical, Gas & Sanitary	11,201.9	6,597.0	5,392.0	28,235
Wholesale & Retail Trade	56,424.4	42,545.7	10,568.1	812,746
Financial & Legal	50,984.1	33,659.2	31,792.1	475,047
Real Estate & Development	46,981.3	35,233.8	28,824.2	136,021
Recreation & Amusement	5,278.3	2,815.1	2,529.4	128,356
Health Services	37,641.0	25,058.6	24,268.1	593,591
Education Services	5,398.6	3,101.3	3,013.4	152,240
Government & Non-Profit	52,855.7	44,736.4	44,045.6	1,021,447
Others	397.8	114.6	107.6	35,000
Total of Mfg & Service Sectors	**608,220.1**	**336,133.9**	**285,959.5**	**5,854,229**
Total Economy	**687,813.6**	**372,640.0**	**317,661.2**	**6,891,233**

Note: Each sector's output, gross state product, income, and employment are provided through U. S. Census of Manufacturing information. The wholesaling and retailing sector is treated as one sector for purposes of the input-output model definition, but this sector is disaggregated for purposes of Table 1. The procedure used to estimate the percentage of all wholesale/retail payroll and employment that is food- and agriculture-related is based on data published by *County Business Patterns,* 2000. The percentage of payroll (23.9%) is used to estimate the proportion of food- and agriculture-related output, gross state product, and income. The percentage of employment (28.5%) is used to allocate employment in a similar fashion.

[a] Sheep, goats, horses, and miscellaneous livestock.

[b] Excludes hotel/motel food service.

[c] Includes diverse service items such as advertising, cleaning, barber and beauty shops, and funerals.

Source: Computed

Table 2.
Contributions of the Food and Related Agricultural Cluster to Exports, Domestic and Foreign, Ohio, 2000

SECTOR	Total Exports=	Domestic Exports +	Foreign Exports	Domestic Exports as Share of Total Sector Exports	Sector Total Exports as Share of Food & Ag Cluster Total Exports
	$ Millions	$ Millions	$ Millions		
Farm Inputs and Machinery	**9,729**	**7,535**	**2,194**	**77.4%**	**25.7%**
Farming	**3,120**	**2,369**	**751**	**75.9%**	**8.3%**
Dairy Farms	1	0	1	0.0%	0.0%
Poultry & Egg	143	137	6	95.8%	0.4%
Cattle Feeding	2	0	2	0.0%	0.0%
Swine	121	120	1	99.2%	0.3%
Miscellaneous Livestock	8	0	8	0.0%	0.0%
Food Grains	143	39	104	27.3%	0.4%
Feed Grains	769	576	193	74.9%	2.0%
Nursery & Horticulture	797	790	7	99.1%	2.1%
Fruits & Vegetables	48	22	26	45.8%	0.1%
Oil Bearing Crops	570	220	350	38.6%	1.5%
Misc Crops/Hay/Sugar/Tobacco/Nut	454	413	41	91.0%	1.2%
Forestry/Fishing/Ag Services	64	52	12	81.3%	0.2%
Processing	**13,434**	**11,639**	**1,795**	**86.6%**	**35.5%**
	11,004	**10,114**	**890**	**91.9%**	**29.1%**
Processed Meat, Fish, & Eggs	134	0	134	0.0%	0.4%
Dairy Processing	1,656	1,485	171	89.7%	4.4%
Processed Food & Kindred Products	5,675	5,334	341	94.0%	15.0%
Grain Milling & Flour Milling	1,104	1,037	67	93.9%	2.9%
Fats & Oils Processing	119	5	114	4.2%	0.3%
Beverage Processing	2,316	2,253	63	97.3%	6.1%
	2,430	**1,525**	**905**	**62.8%**	**6.4%**
Food & Forestry Wholesaling & Retailing	**8,869**	**8,084**	**785**	**91.1%**	**23.5%**
Food Service[a]	**2,656**	**2,631**	**25**	**99.1%**	**7.0%**
Total Food and Ag Cluster	**37,808**	**32,258**	**5,550**	**85.3%**	**100.0%**
Total Economy	**410,948**	**151,796**	**259,152**	**36.9%**	

a Excludes hotel/motel food service
Source: Computed

Table 3. Ohio Economic Multipliers: Output, Income, Employment, and Value Added, 2000.

	Output	Income	Employment	Value Added
Food & Related Agricultural Cluster				
Farm Inputs & Machinery	1.5875	2.0929	2.1360	2.0338
Farming				
Dairy Farms	1.5772	1.7016	1.5401	2.0671
Poultry & Eggs	1.6756	2.7595	1.9587	3.2817
Cattle Feeding	1.6268	1.9055	1.3179	2.3001
Swine	1.7462	2.6510	1.5049	3.2100
Miscellaneous Livestock	1.6594	1.9097	1.0906	2.2620
Food Grains	1.6947	2.2103	1.1361	2.3106
Feed Grains	1.5913	1.9016	1.1995	1.9893
Nursery & Horticulture	1.7266	1.7743	1.1985	1.7841
Fruits & Vegetables	1.7015	1.8769	1.3572	2.1143
Oil Bearing Crops	1.6978	1.8577	1.1941	2.0309
Misc Crops/Hay/Sugar/Tobacco/Nuts	1.6148	1.8865	1.0624	2.0427
Forestry, Fishing, Ag Services	1.6229	1.7201	1.1010	1.7062
Processing				
Food Processing				
Processed Meat, Fish & Eggs	1.9427	2.8406	2.8823	3.2133
Dairy Processing	1.7848	3.0734	3.2746	2.3758
Processed Food & Kindred Products	1.7690	2.6325	2.3851	2.2499
Grain Milling & Flour	1.7522	3.3956	4.1955	3.0114
Fats & Oils	2.1301	5.7016	9.4879	4.8739
Beverage Processing	1.6115	2.5137	2.4611	1.9472
Wood/Paper/Furniture Manufacturing	1.9366	2.2582	1.8771	2.4080
Food & Forestry Wholesale/Retail	1.6505	1.5345	1.1716	1.5231
Food Services	1.7549	1.7125	1.1385	1.8318
General Manufacturing & Service Sectors				
Mining	1.6524	2.0088	1.6021	1.9153
Construction	1.8226	1.8570	1.4975	2.1874
Apparel, Accessories, Yarn & Leather	1.6785	1.9130	1.4776	2.0280
Motor Vehicle Equipment	1.6101	2.0404	2.0998	2.0825
Metal Industries	1.6092	1.8402	1.6525	1.9656
Chemical & Petroleum	1.6853	2.0584	1.9241	2.0046
Publishing	1.8796	1.9652	1.6302	2.1151
Stone, Clay & Glass	1.7107	1.7806	1.5213	1.8416
Machinery & Equipment	1.6864	1.8425	1.6010	2.0219
Technology Industries	1.7335	1.9802	1.7878	2.1430
Business and Personal Services	1.8245	1.6387	1.2322	1.8208
Transportation & Communication	1.7982	1.8900	1.5893	1.8858
Electrical, Gas & Sanitary	1.5006	2.0062	1.9593	1.4754
Wholesale & Retail Trade	1.6505	1.5345	1.1716	1.5231
Financial & Legal	1.6956	1.6788	1.3529	1.6560
Real Estate & Development	1.3505	3.1353	1.8533	1.2820
Recreation & Amusement	1.8907	1.8121	1.2826	1.9984
Health Services	1.8473	1.5240	1.2030	1.7673
Education Services	1.9429	1.6504	1.1659	1.9969
Government & Non-Profit	1.7675	1.3804	1.0760	1.5475
Others	2.5189	1.5017	1.0613	4.1227

Source: Computed

Figure 1: Major Linkages in Food and Agriculture-Related Cluster:
Economic Transaction Flows among Five Sectors of the Cluster

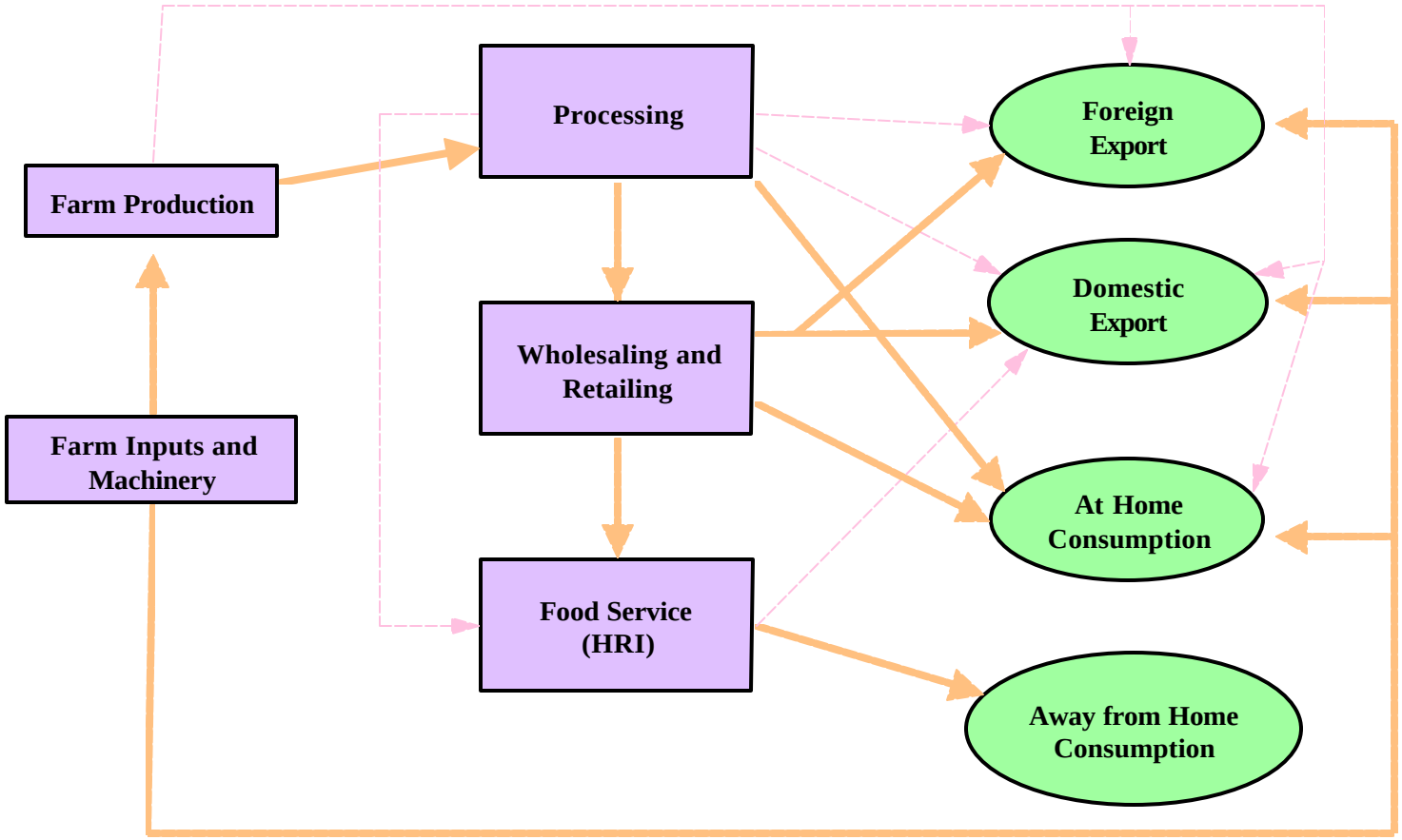
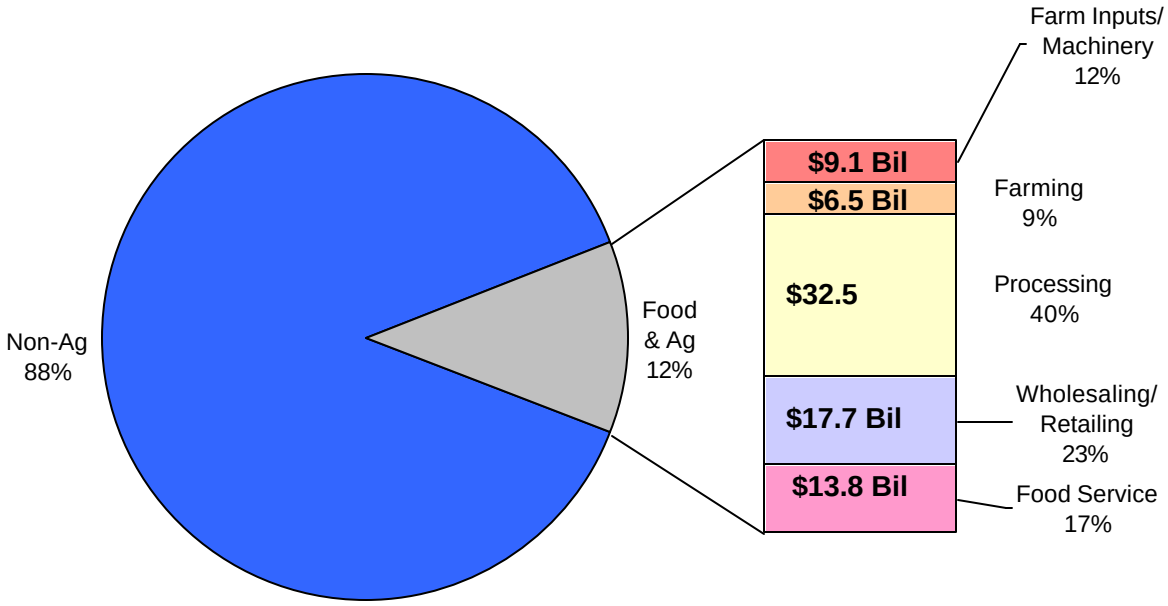


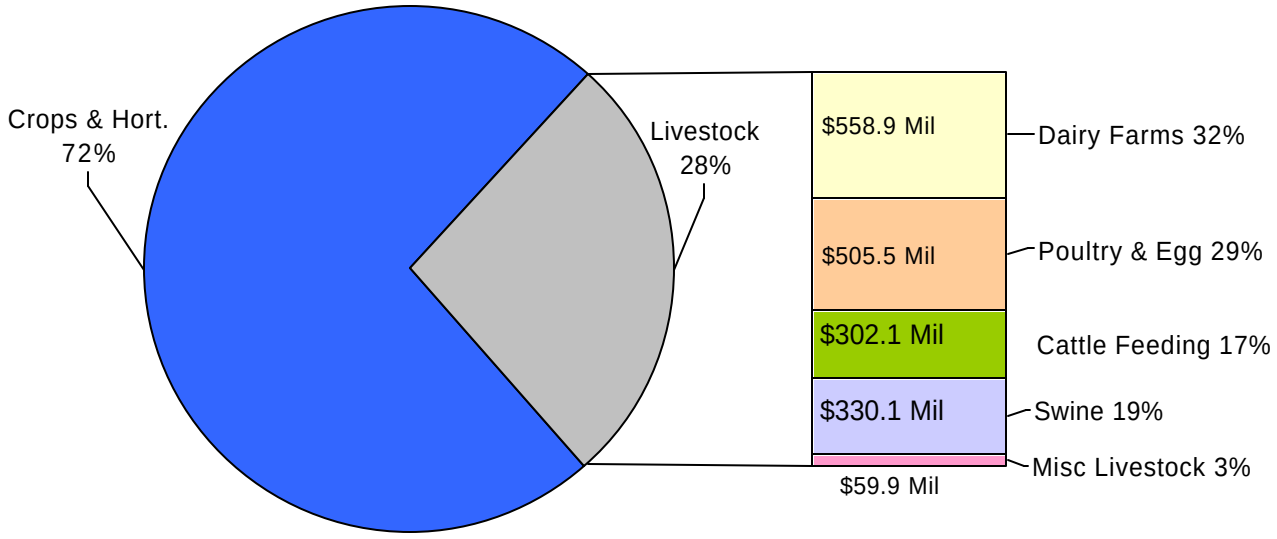
Figure 2: Ohio Economic Output
Food & Agriculture Cluster, 2000



Total Output: $687.8 Bil

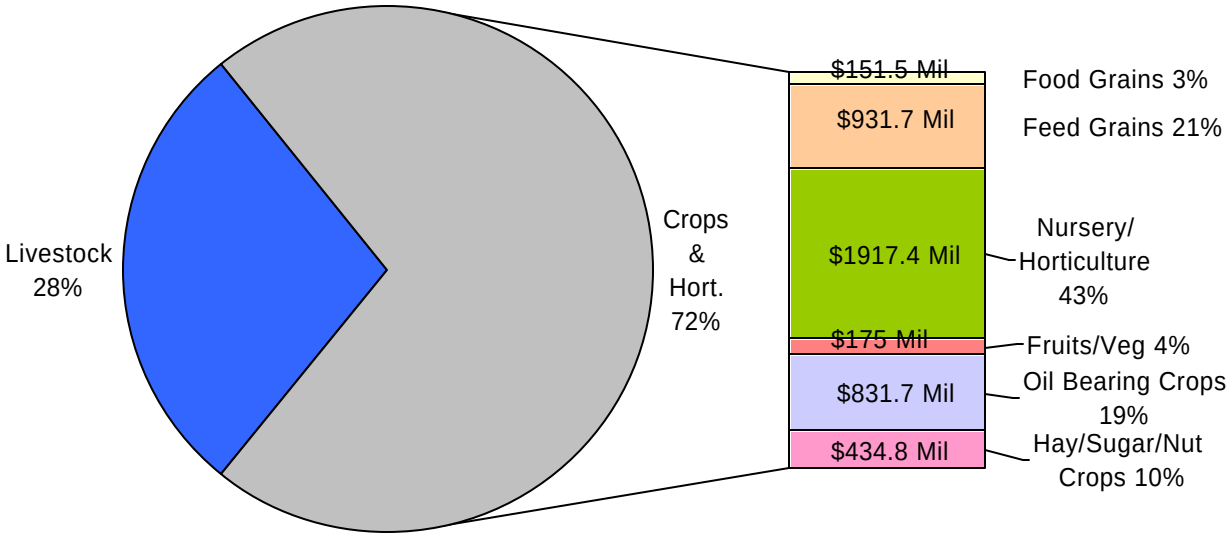
Food & Ag Sectors: $79.6 Bil

Figure 3. Ohio Agricultural Output
Livestock Sectors, 2000



Total Livestock, Crops, & Hort: $6.2 Bil Livestock Sectors: $1.8 Bil

Figure 4: Ohio Agricultural Output
Crops & Horticulture Sectors, 2000



Total Livestock, Crops, & Hort: $6.2 Bil

Crops & Hort. Sectors: $4.4 Bil

Figure 5: Ohio Gross State Product
Food & Agriculture Cluster, 2000

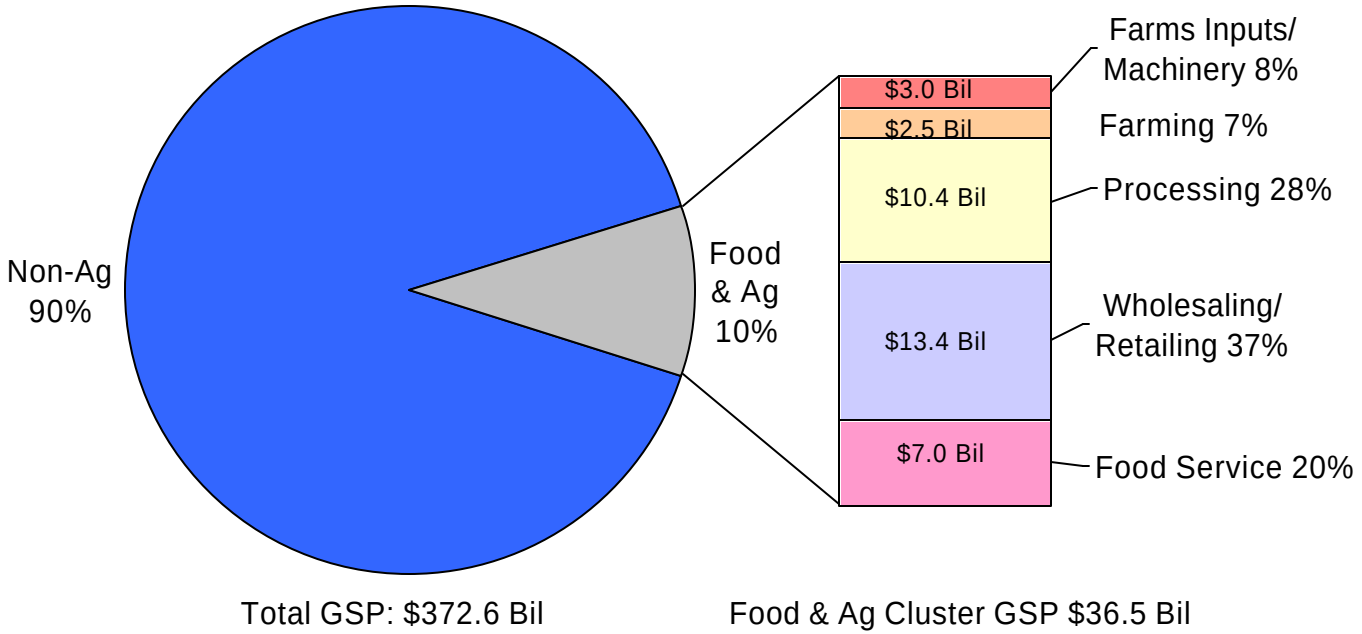
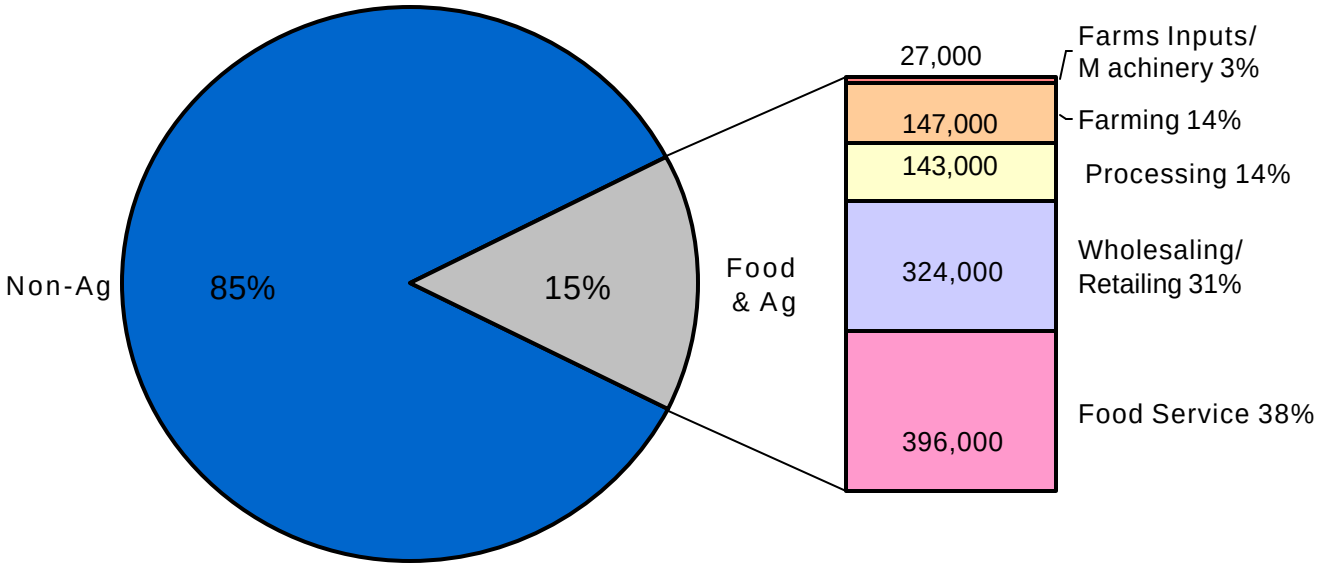


Figure 6: Ohio Employment
Food & Agriculture Cluster, 2000



Total Employment: 6.9 Mil

Food & Ag Sectors: 1.0 Mil

Figure 7: Ohio Income
Food & Agriculture Cluster, 2000

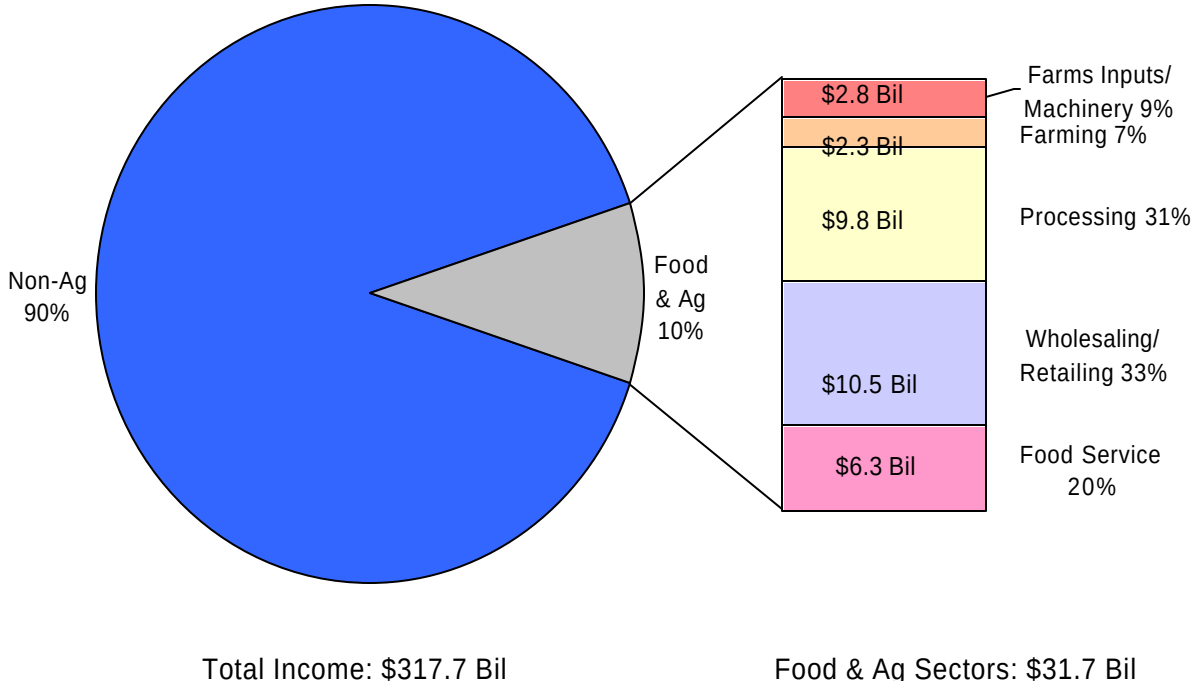
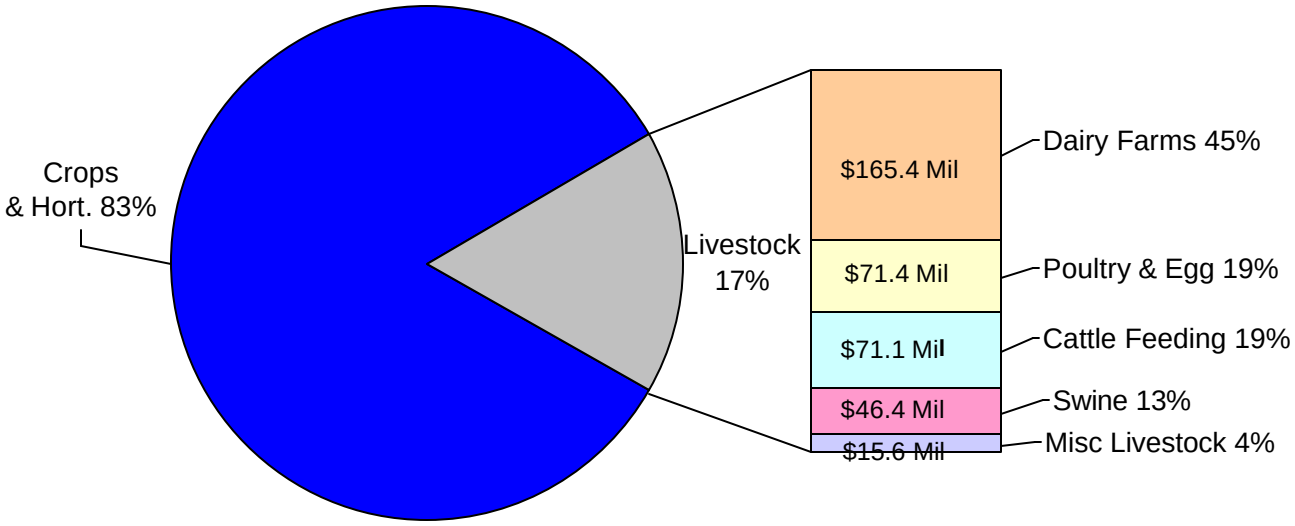


Figure 8: Ohio Agricultural Income
Livestock Sectors, 2000



Total Livestock, Crops, & Hort: $2.2 Bil

Livestock Sectors: $370.0 Mil

Figure 9: Ohio Agricultural Income
Crops & Horticulture Sectors, 2000

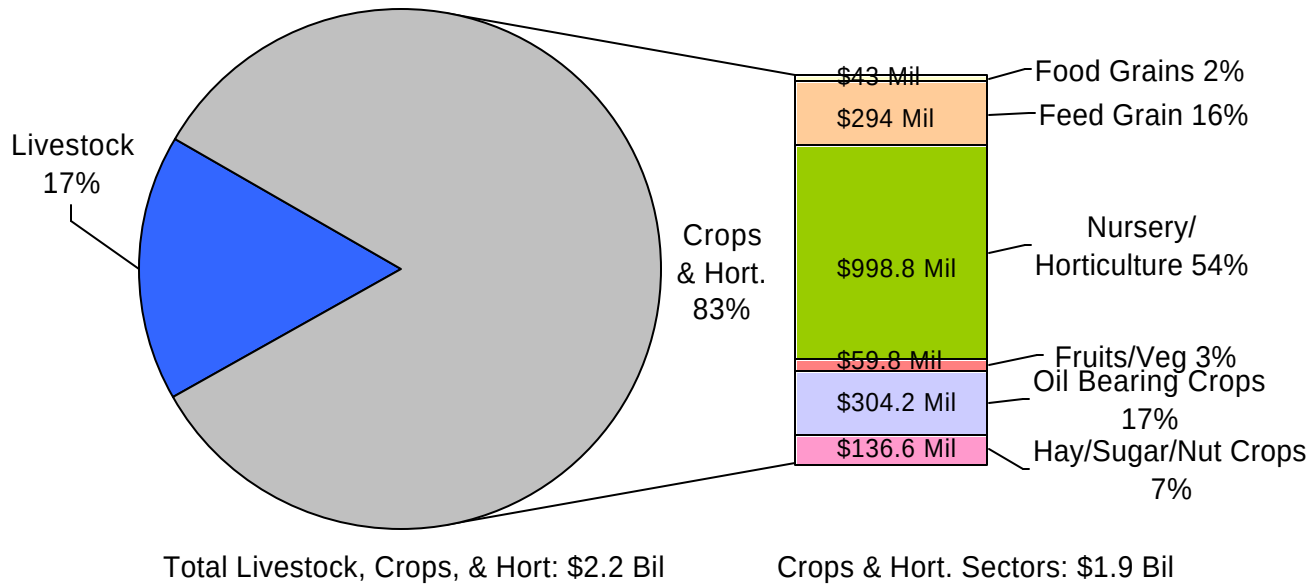
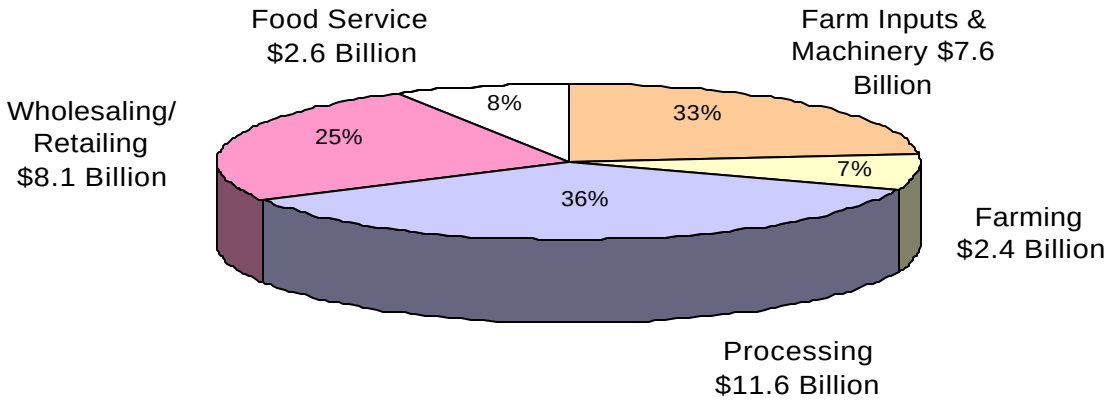
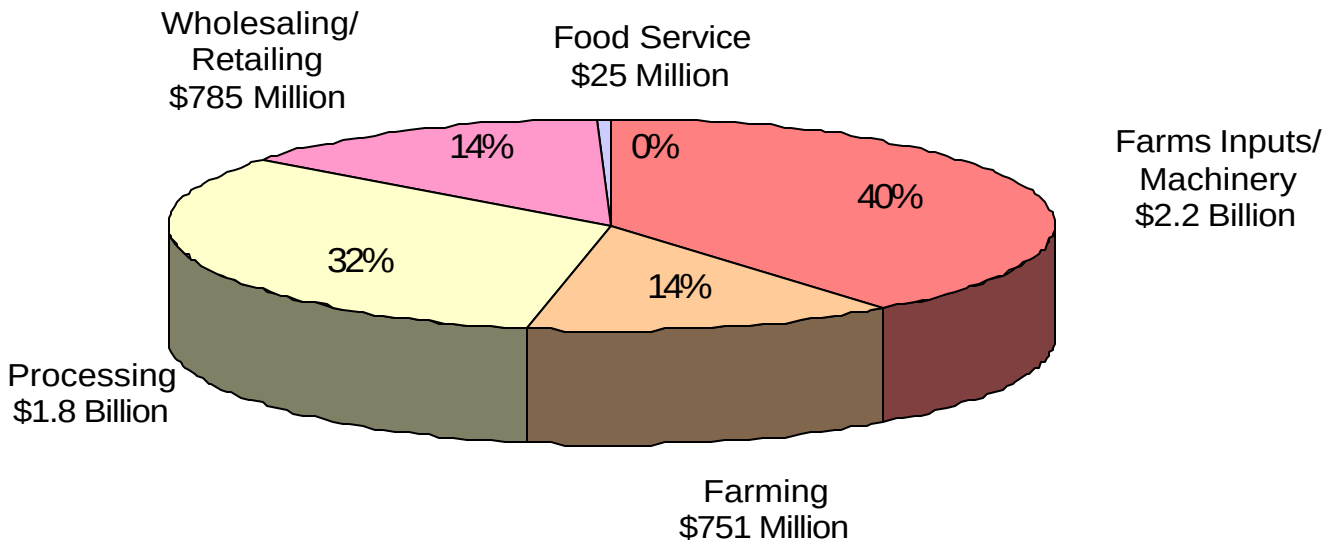


Figure 10: Ohio Domestic Exports
Food & Agriculture Cluster, 2000



Total: $32.3 Billion

Figure 11: Ohio Foreign Exports
Food & Agriculture Cluster, 2000



Total: $5.6 Billion

References

Alward, G.S. *IMPLAN Version 2.0: Methods Used to Construct the 1982 Regional Economic Data Base*. U.S. Department of Agriculture, General Technical Report R-000. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado, 1987.

Miller, R. and P. Blair. *Input-Output Analysis: Foundations and Extensions*. Englewood, New Jersey: Prentice-Hall, Inc. 1985

Minnesota IMPLAN Group. *IMPLAN Software Manual*. Stillwater, Minnesota, February 1997.

Richardson, H.W. 1972. *Input-Output and Regional Economics*. New York: Halstead, 1972.

Siebert, John W. "Pizza: A Delivery Vehicle to Illustrate the Role of Food and Non-Food Suppliers Serving the FAFH Industry," *Agribusiness: An International Journal*. Volume 13, No. 1, January/February 1997, pp. 85-92.

U.S. Department of Commerce, Bureau of the Census, 1992, *Census of Manufactures*, U.S. Government Printing Office, Washington, D.C.

U.S. Department of Commerce, Bureau of the Census, 1994, *County Business Patterns*, U.S. Government Printing Office, Washington, D.C.

U.S. Department of Commerce, Bureau of the Census, *Numerical List of Manufactured and Mineral Products Reference Series*, 1992 Census of Manufactures and Census of Mineral Industries, MC 92-R-1, Washington DC, May 1983.

U.S. Office of Management and Budget, *Standard Industrial Classification Manual*, 1987, National Technical Information Service, Washington DC, 1988.

This research was partially funded by the Farm Income Enhancement Program, Department of Agricultural, Environmental, and Development Economics, The Ohio State University. Income Enhancement Study. OHFOOD Version 6.0, June 2003 supersedes OHFOOD Version 5.0, October 1999.

Appendix A-1

STANDARD INDUSTRIAL CLASSIFICATION CODES
A Brief Explanation

The Standard Industrial Classification, or SIC, code is a commonly accepted means of classifying industries and is a federal government classification scheme. The SIC codes were developed under the direction of the Office of Management and Budget by the Technical Committee on Industrial Classification. The SIC code classifies establishments to the four-digit industry level by their primary type of activity. An additional four digits in the code narrows the classification down to a type of product. For example, in Sector 16 of Table A-1, processed food and kindred products, an eight-digit SIC code identifies the industry group, industry, product class, and product. This is illustrated as follows:

SIC Code	Level	Description
20	Major Group	Food & Kindred Products
203	Industry Group	Canned, Frozen & Preserved Fruits & Vegetables, & Food Specialties
2032	Industry	Canned Food Specialties
203202	Product Class	Ethnic foods, canned & jarred
203202 12	Product	Tamales, packed in cans, jars

This study aggregates industries based on their two- and four-digit SIC definitions. Searching by its first four digits can identify a particular industry's location in the aggregation scheme. The Standard Industrial Classification Manual that provides the complete detail of the classification scheme on which OHFOOD is based can be found in any major library or is available online from the Occupational Safety and Health Administration's Web site at: http://www.osha.gov/oshstats/sicser.html.

Appendix A-2

OHFOOD SECTOR DEFINITIONS
Using Standard Industrial Classification (SIC) Codes

Appendix Table A-1. Concordance between the OHFOOD Sectors and the Standard Industrial Classification (SIC) System, Version 6, Year 2000

OHFOOD Sector	Industry Level (Four Digit) Standard Industrial Classification (SIC) Included
Farm Inputs & Machinery	2812, 2813, 2816, 2819, 2865, 2869, 2873, 2874, 2875, 2879, 3523, 3524, 3535, 3556
Dairy Farms	0241; parts of: 0191, 0259, 0291
Poultry & Eggs	0251, 0252, 253, parts of: 0191, 0219, 0259, 0291
Cattle Feeding	0211, parts of: 0191, 0212, 0219, 0259, 0291
Swine	0213, parts of: 0191, 0219, 0259, 0291
Miscellaneous Livestock	0214, 0271, 0272, parts of: 0191, 0219, 0259, 0273, 0279, 0291
Food Grains	0111, 0112, parts of: 0191, 0219, 0259, 0291
Feed Grains	0115, parts of: 0139, 0191, 0219, 0259, 0291
Nursery and Horticulture	0182, 0189, 0780, parts of: 0139, 0191, 0219, 0259, 0291
Fruits and Vegetables	0134, 0161, 0171, 0172, 0174, 0175, parts of: 0119, 0139, 0179, 0191, 0219, 0259, 0291
Oil Bearing Crops	0116, parts of: 0119, 0139, 0173, 0219, 0259, 0291
Miscellaneous Crops, and Hay, Sugar, Tobacco, and Nut Crops	0131, 0132, 0133, parts of: 0119, 0139, 0173, 1079, 0191, 0219, 0259, 0291
Forestry, Fishing, Ag Services	0710, 0720, 0750, 0760, 0254, 0810, 0830, 0850, 0910, 0920, 0970, parts of: 0279
Processed Meat, Fish, and Eggs	2011, 2013, 2015, 2092
Dairy Processing	2021, 2022, 2023, 2024, 2026
Processed Food and Kindred Products	2032, 2033, 2034, 2035, 2037, 2038, 2047, 2048, 2051, 2052, 2061, 2062, 2063, 2065, 2066, 2067, 2068, 2087, 2091, 2095, 2097, 2098, 2099, 2110-2140
Grain Milling & Flour	2041, 2043, 2045, 2046
Fats & Oils	2074, 2075, 2076, 2077, 2079
Beverage Processing	2082, 2083, 2084, 2085, 2086
Wood, Paper, and Furniture Manufacturing	2410, 2421, 2426, 2429, 2431, 2434, 2435, 2436, 2439, 2441, 2448, 2449, 2452, 2491, 2493, 2499, 2511, 2512, 2517, 2519, 2521, 2530, 2541, 2610-2630, 2650, 2671, 2672, 2674, 2675, 2676, 2677, 2678, 2679
Food and Forestry Wholesaling and Retailing	4450, 4442, 4529, 4213, 4224, 4225, parts of 4461, 4229, 4218, 4213
Food Services	5800

Mining	1010-1030, 1041, 1044, 1060, 1080, 1094, 1099, 1200, 1310, 1320, 1410, 1420, 1440, 1450, 1474, 1475, 1479, 1480, 1490
Construction	1380, parts of: 15, 16, 17
Apparel, Accessories, Yarn and Leather	2410, 2421, 2426, 2429, 2431, 2434, 2435, 2436, 2439, 2441, 2448, 2449, 2452, 2491, 2493, 2499, 2511, 2512, 2514, 2515, 2517, 2519, 2521, 2522, 2530, 2541, 2542, 2591, 2599, 2610-2630, 2650, 2710, 2720, 2731, 2732, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2740-2770, 2782, 2789, 2791, 2796
Motor Vehicle Equipment	2451, 3711, 3713-3716, 3721, 3724, 3728, 3731, 3732, 3740, 3750, 3764, 3769, 3792, 3799
Metal Industries	2514, 2515, 2522, 2542-2599, 3312, 3313, 3315, 3316, 3317, 3320, 3331, 3334, 3339, 3340, 3261, 3353, 3354, 3355, 3356, 3357, 3363, 3364, 3365, 3366, 3369, 3398, 3399, 3411, 3412, 3421, 3423, 3425, 3429, 3431, 3432, 3433, 3441, 3442, 3443, 3444, 3446, 3448, 3449, 3450, 3462, 3463, 3464, 3465, 3466, 3469, 3471, 3479, 3482, 3483, 3484, 3489, 3491, 3492, 3493, 3494, 3498, 3495, 3496, 3497, 3499, 3761, 3795
Chemical & Petroleum	2673, 2821, 2822, 2823, 2824, 2830, 2841, 2842, 2843, 2844, 2850, 2861, 2891, 2892, 2893, 2895, 2899, 2910, 2951, 2952, 2992, 2999, 3010-3030, 3052, 3053, 3080
Publishing	2410, 2421, 2426, 2429, 2431, 2434, 2435, 2436, 2439, 2441, 2448, 2449, 2452, 2491, 2493, 2499, 2511, 2512, 2514, 2515, 2517, 2519, 2521, 2522, 2530, 2541, 2542, 2591, 2599, 2610-2630, 2650, 2710, 2720, 2731, 2732, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2740-2770, 2782, 2789, 2791, 2796
Stone, Clay, and Glass	3210, 3221, 3229, 3230, 3240, 3251, 3253, 3255, 3259, 3261, 3262, 3263, 3264, 3269, 3271, 3272, 3273, 3274, 3275, 3280, 3291, 3292, 3293, 3295, 3296, 3297, 3299
Machinery and Equipment	3511, 3519, 3531, 3532, 3533, 3534, 3536, 3537, 3541, 3542, 3543, 3544, 3545, 3546, 3547, 3548, 3549, 3552, 3553, 3554, 3555, 3559, 3561, 3562, 3563, 3564, 3565, 3566, 3567, 3568, 3569, 3581, 3582, 3585, 3586, 3589, 3592, 3599, 3612, 3613, 3621, 3625, 3629, 3631, 3632, 3633, 3634, 3635, 3639, 3641, 3643, 3644, 3645, 3646, 3647, 3648, 3825
Technology Industries	3571, 3572, 3575, 3577, 3578, 3579, 3596, 3593, 3594, 3651, 3652, 3661, 3663, 3669, 3671, 3672, 3673, 3674, 3675, 3676, 3677, 3678, 3679, 3691, 3692, 3693, 3694, 3699, 3812, 3821, 3822, 3823, 3824, 3825, 3826, 3827, 3829, 3830, 3841, 3842, 3843, 3844, 3845, 3850-3870, 3911, 3914, 3915, 3930, 3942, 3944, 3949, 3951, 3952, 3953, 3955, 3961
Business and Personal Services	3993, 3995, 7000, 7210-7260, 7290, 7310-7320, 7331, 7334, 7335, 7336, 7338, 7381, 7382, 7383, 7389, 7340-7370, 7620-7640, 7690, 7510, 8710, 8730, 8740
Transportation and Communication	4010, 4040, 4100, 4200, 4400, 4500, 4720, 4730, 4783, 4785, 4810-4840, 4890, 7520, 7530, 7542, 7549, parts of: 4789
Electrical, Gas and Sanitary	4600, 4910, 4920, 4940, 4952, 4953, 4959, 4960, 4970, parts of: 493
Wholesale and Retail Trade	4600, 4910, 4920, 4940, 4952, 4953, 4959, 4960, 4970, parts of 4930

Financial and Legal	6000, 6100-6400, 6710, 6720, 6733, 6790, 8110, 8720, 8910, 8930, 8990
Real Estate and Development	6500
Recreation and Amusement	7800, 7910-7930, 7941, 7948, 7992, 7993, 7996, 7997, 7999
Health Services	0740, 8010-8090, 8360
Education Services	8210-8240, 8290, 8230, 8350
Government and Non-Profit	4311, 6732, 8320, 8390, 8400, 8610-8660, 8690, 8922, parts of 4100, 4190
Others	8800