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**OHFOOD:
An Ohio Food Industries
Input-Output Model
Version 8.1**

**The Ohio State University
AED Economics Department
July 2005**



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OHFOOD

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Version 8.1

July 2005

by

Thomas L. Sporleder

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**OHFOOD: An Ohio Food Industries
Input-Output Model
(Version 8.1, July 2005)**

by
Thomas L. Sporleder¹

Abstract

OHFOOD, an acronym for **Ohio 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.

This is the first OHFOOD model that is based solely on the North American Industrial Classification System (NAICS). The results provided in this report are not comparable to any previous OHFOOD results because of this change in the classification system.

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 2002 the food and agricultural cluster of Ohio's economy contributed 11 percent of the output, added 9 percent to Ohio's gross state product, accounted for 15 percent of the total employment, and contributed 9 percent of total income.

In 2002, the Ohio economy generated a gross state product (GSP) of \$388.2 billion. The food and agricultural cluster's share of this GSP was \$36.0 billion, or \$9.27 of each \$100 of Ohio GSP. For 2002 the contribution to GSP for the five components of the cluster are \$1.6 billion for farm inputs, machinery, and professional services; another \$2.3 billion from agricultural production; about \$11.8 billion from processing; an additional \$13.3 from food wholesaling and retailing; and another \$6.9 billion in food services.

Of these 5 major components comprising the food and agriculture-related cluster, the food wholesaling and retailing sectors are the largest in terms of contribution to GSP, contributing 37 percent of the total contribution to GSP of \$36.0 billion by the entire food and agriculture cluster. The food and forestry-related products are the next largest in terms of GSP, contributing nearly 33 percent of the total GSP of \$36.0 billion by the entire food and agriculture cluster. The food service sector is notable for its contribution to employment. This sector accounts for nearly 449,000 jobs, or nearly 45 of every 100 jobs accounted for by the food and agriculture cluster. The entire food and agriculture complex accounted for over one million jobs in Ohio in 2002, or about one of every seven jobs (15 percent) in Ohio.

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. The complete study may be printed from a downloadable pdf file available from the AED Economics Department of The Ohio State University at: <http://aede.osu.edu/resources/docs/display.php?cat=21>.

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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

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.

interest derived for each sector of the economy from the input-output model include total employment, income, contribution to gross state product (GSP), and the total dollar value of output. Each of these economic indicators measures different, yet related, linkages among sectors within 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 among all other sectors. Thus, the multiplier is a measure of the idea that when income from one sector increases the income of other sectors will increase as a result, and the total influence on income economy-wide is 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 38 aggregated 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 38 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, machinery production and professional services (such as veterinary medicine); cattle and dairy production; poultry and egg production; hogs and miscellaneous livestock (including sheep, goats, horses, and other livestock); grain production; miscellaneous crops including hay, sugar, and nut crop production; fruits and vegetables; oil bearing crops, primarily soybeans; forestry, hunting and fishing; nursery and horticulture production; meat, fish, poultry and egg processing; dairy processing; processed food and kindred products; wood processing, 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 19 sectors related to food and agriculture and 19 sectors that are based on the general manufacturing and service sectors of the entire economy. The precise and detailed five-digit 2002 North American Industrial Classification System (NAICS) definition of each sector defined within **OHFOOD** is provided in Appendix Table A-1.

Methods

The **OHFOOD** model is based on *IMPLAN*, an input-output algorithm for the national economy using non-survey based data. *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 509 industries of the United States economy. All information within this Version 8.0 model is for the calendar year 2002 and is in 2002 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 first OHFOOD model that is based solely on the North American Industrial Classification System (NAICS). The results provided in this report are not comparable to any previous OHFOOD results because of this change in the classification system.*

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 2002 is shown by the total output, gross state product, income and employment for each of 38 sectors, Table 1. The total economic output for Ohio in 2002 was \$704.6 billion, with total employment of nearly 6.7 million persons. The 2002 Ohio economy generated a gross state product (GSP) of \$388.2 billion, and the food and agricultural share of this GSP was \$36.0 billion. This means that the food and agricultural components of the Ohio economy generate approximately \$9.27 of each \$100 in Ohio GSP.

The output of food and related agricultural sectors was \$77.5 billion, or about 11 percent of Ohio's total economy, Figure 2. The \$77.5 billion represents about \$1 of every \$9 in output for the entire Ohio economy. The

total output of \$77.5 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 \$33.4 billion of this output, or about 43 percent of the total \$77.5 billion food and agricultural output. This \$33.4 billion is composed of \$20.5 billion from food processing and another \$12.9 billion from value added forestry processing which includes wood processing, paper, and wood furniture manufacturing. Thus, food processing accounts for about 61 cents of every \$1 in output from the total food and forestry-processing sector.

Agricultural production adds about \$5.3 billion in output or nearly 7 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 food and feed grain industries, accounting for nearly \$1.1 billion in output, or nearly \$1 of every \$5 in output generated by the farming sector. However, oil bearing crops, primarily soybeans, account for nearly \$815.6 million in sector output.

The Ohio livestock sectors combined account for over \$1.6 billion in output, or around 34 percent of the \$4.7 billion total agricultural production output, excluding forestry, hunting, and fishing, Figure 3. Crop and horticultural industries account for 66 percent of the total output from the primary agricultural production sectors of livestock, crops, and horticulture, or some \$3.1 billion in output, Figure 4. The largest component of the field crop sectors is food and feed grains at nearly \$1.1 billion in output. However, the oil bearing crops sector,

primarily soybeans, also contributes \$815.6 million in output.

Gross state product is another significant measure of economic activity and is a useful measure for comparing the relative importance of various sectors. Gross state product for the total economy is similar in concept to the measure called gross domestic product (GDP) for a nation. The 2002 Ohio economy generated a gross domestic product (GSP) of \$388.2 billion, and the food and agricultural share of this GSP was \$36.0 billion, Table 1. This means that the food and related agricultural cluster of the Ohio economy generated approximately \$9.27 of each \$100 in Ohio GSP. Of the \$36.0 billion gross state product contributed by the food and related agricultural cluster, about one-third is attributable to the 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 \$13.3 billion, or 37 percent of the entire gross state product by the food and related agricultural cluster combined, Figure 5. Food service accounts for another \$6.9 billion in gross state product. Finally, the farm production and the farm inputs and machinery sector account for about another 7 percent and 5 percent, respectively, of the gross state product. Farm production accounts for over \$2.3 billion in gross state product while the farm inputs and machinery industries account for \$1.6 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 727.3 thousand jobs in total. The food and value added forestry processing sectors account for nearly 137.2 thousand jobs, or nearly 14 percent of the total food and related agricultural cluster employment. Farm production accounts for over 104 thousand jobs or about 1 of every 10 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 nearly 34 thousand jobs in Ohio, Table 1.

The food and related agricultural cluster accounts for about 9 percent of total income in the entire state's economy, Figure 7. The food and forestry product processing sector accounts for about \$11.1 billion of a total food and related agricultural cluster income of \$31.6 billion, or roughly 35 percent of the cluster's income. Food and forestry wholesaling and retailing income is larger and accounts for \$10.4 billion, while farm production income is \$2.2 billion, Table 1.

Ohio livestock sectors combined account for \$366 million in income, or approximately one-sixth of the \$2.2 billion total farming income, Figure 8. Cattle and dairy production account for 39 percent of total livestock sector income, while poultry and egg production accounts for an additional 48 percent of total income from the livestock sector. Hogs and miscellaneous livestock accounts for another 13 percent of the total livestock sector income in Ohio.

Of the total Ohio livestock, crop and horticultural income of \$2.0 billion for 2002, crops and horticulture account for nearly 81 cents of each dollar of income, Figure 9. Nursery and horticulture accounts for 31 percent of the total crops and horticulture income. The grains and oil bearing crop industries combine to account for about one-half 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 \$10.4 billion in 2002. The food and related agricultural cluster enjoyed total exports of \$39.8 billion in 2002. Of this total, about \$29.4 billion was exported outside the United States and the remaining \$10.4 billion was exported to other states. Thus, over 26 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 and forestry processing sector exports \$2.0 billion while Ohio's food wholesaling and retailing sector exports an additional \$6.8 billion to other states, Figure 10.

Combining the processing sector's domestic exports of \$2.0 billion with the sector's \$20.8 billion in exports to foreign countries produces total processing sector exports of more than

\$22.9 billion. This represents over one-half of all exports by the food and related agricultural cluster.

Farm production exports around \$902.4 million to other states, or a 8.6 percent of the domestic export total. In addition, the agriculture production sector exports \$1.4 billion to foreign countries, Figure 11.

The farm inputs and machinery sector exported \$670.4 million to other states and another \$2.6 billion to international destinations. Total exports from this sector represent about 8 percent 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 grain products generates total economy-wide income of \$8.9552, Table 3. Similarly, the employment multiplier for the grains sector is 1.2658. Thus, the total employment effect for a \$1 million change in final demand is just over 1.2 person-years.

All multipliers are interpreted in a similar fashion. An example of interpretation for the cattle and dairy production sector is provided in this paragraph. In Table 3, the cattle and dairy production income multiplier is 1.8671. It means that each \$1.00 of income from cattle and dairy production resulting from a change in final demand generates about \$1.87 in total economy-wide Ohio income. The employment multiplier of 1.6163 means that each \$1 million change in Ohio cattle and dairy production output resulting from a change in final demand generates approximately 1.6 person-years change in total employment in Ohio.

Regional Purchase Coefficients

Often it is useful to understand the differences in procurement patterns across various sectors of the economy. For example, if a new egg production facility is built in a particular community, questions often surface about how much input a production facility such as that might purchase from the local community compared to importing from other geographic areas. The measure of local procurement compared to importing input from other geographic areas is known as a regional purchase coefficient (RPC).

In the context of an input-output model, gross regional trade flows (gross exports

and gross imports) of commodities are estimated by developing regional purchase coefficients. A RPC represents the proportion of the total supply of a good or service used to fulfill the demands of a region that is supplied by the region to itself. For example, a RPC value of 0.8 for the commodity "fish" indicates that 80 cents of each \$1 of input demanded by fish processors, fish wholesalers, foreign exports, and all other demands for fish are met by local producers. Local for OHFOOD is defined as the state of Ohio. Of course, a RPC of 80% also means that 20% (1.0-RPC) of the demand is imported and therefore is not met by local producers.

The RPCs for various sectors within the food and agriculture cluster have been calculated for 2002 from the OHFOOD model. Results of the RPC estimates are provided for the livestock sectors in Figure 12, for crop sectors in Figure 13, and for food and beverage processing sectors in Figure 14. The interpretation of the RPC is similar in all cases. It provides the percent of each \$1 of input that is purchased within Ohio, while 1.0 - RPC provides an estimate of what percentage of each \$1 of input is imported from outside Ohio.

For the livestock sectors, hogs, poultry and egg production, and miscellaneous livestock (i.e. goats, sheep, horses, etc.) purchase just over 75% of their inputs from Ohio, Figure 12. Beef and dairy cattle production purchases about 47% of their inputs from Ohio.

The crop sectors range from fruits and vegetables with a low of about 16% to a high of just over 55% for nursery and horticulture crops, Figure 13. Oil

bearing and feed and food grains are similar at around 30% of all input.

Finally, the food and beverage processing sectors range from a low of only 6% for fats and oils to a high of over 85% for dairy processing, Figure 14. Processed foods purchase about 46% of their inputs from Ohio while beverage processing purchases less than 20% from Ohio.

Conclusions

OHFOOD, an acronym for **Ohio 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 2002 the food

and agricultural cluster of Ohio's economy contributed approximately 11 percent of the output, added 9 percent to Ohio's gross state product, accounted for 15 percent of the total employment, and contributed 9 percent of total income. In 2002, the Ohio economy generated a gross state product (GSP) of \$388.2 billion. The food and agricultural cluster's share of this GSP was \$35.9 billion, or \$9.27 of each \$100 of Ohio GSP.

Of these 5 major components comprising the food and agricultural-related cluster, the food wholesaling and retailing sectors are the largest in terms of contribution to GSP, contributing 37 percent of the total contribution to GSP of \$36.0 billion by the entire food and agriculture cluster. The food and forestry-related products are the next largest in terms of GSP, contributing nearly 33 percent of the total GSP of \$36.0 billion by the entire food and agriculture cluster. The food service sector is notable for its contribution to employment. This sector accounts for nearly 449,000 jobs, or nearly 45 of every 100 jobs accounted for by the food and agriculture cluster. The entire food and agriculture complex accounted for over one million jobs in Ohio in 2002, or about one of every seven jobs (15 percent) in Ohio.

Table 1. Ohio: Output, Gross State Product, Income, and Employment, 2002.

	Gross State			
	Total Output	Product (GSP)	Income	Employment
	<i>\$ Millions</i>	<i>\$ Millions</i>	<i>\$ Millions</i>	<i>Person Years</i>
<u>Food & Related Agricultural Cluster</u>				
Farm Inputs & Machinery	4,282.1	1,610.3	1,535.4	33,655
Farming	5,318.9	2,338.9	2,177.7	104,042
Cattle & Dairy Production	852.2	173.3	143.6	13,560
Poultry & Eggs	461.9	181.4	176.2	1,856
Hogs & Miscellaneous Livestock	316.8	54.8	46.6	13,932
Grains	1,058.4	441.2	405.6	34,904
Oil Bearing Crops	815.6	345.8	313.7	17,771
Misc Crops, Hay, Sugar, Tobacco & Nuts	419.5	237.0	221.1	4,942
Fruits & Vegetables	234.7	170.0	163.2	3,180
Nursery & Horticulture	584.8	507.9	491.0	10,534
Forestry, Hunting & Fishing	575.0	227.5	216.7	3,363
Processing	33,425.6	11,788.8	11,131.9	137,357
Food Processing	20,489.6	6,870.5	6,395.0	64,454
Processed Meat, Fish, Poultry & Eggs	2,450.1	517.6	484.3	9,941
Dairy Processing	4,045.6	1,169.1	1,111.7	8,056
Processed Food & Kindred Products	10,285.1	3,850.3	3,695.3	37,634
Grain Milling & Flour	495.8	106.8	100.6	823
Fats & Oils	542.2	52.2	45.6	439
Beverage Processing	2,670.8	1,174.5	957.5	7,561
Wood/Paper/Furniture Manufacturing	12,936.0	4,918.3	4,736.9	72,903
Food & Forestry Wholesale/Retail	17,802.4	13,331.3	10,419.0	278,404
Food Services^b	16,676.6	6,918.6	6,359.5	448,929
Total Food & Ag Cluster	77,505.6	35,987.9	31,623.5	1,002,387.0
<u>General Manufacturing & Service Sectors</u>				
Mining	567.7	274.4	215.3	2,585
Stone, Clay & Glass	7,106.1	3,719.7	3,572.0	40,650
Metal Industries	33,660.3	13,031.0	12,516.4	158,954
Chemicals, Plastics & Petroleum	40,662.3	12,557.0	11,899.8	129,224
Construction	38,665.2	16,471.5	16,019.2	370,122
Textiles, Apparel, Accessories, Yarn	3,997.5	1,540.8	1,492.3	28,431
Machinery & Equipment	28,305.2	11,508.3	11,114.8	165,088
Motor Vehicles & Equipment	64,125.9	19,320.3	18,593.5	241,876
Transportation & Communication	23,586.9	11,338.8	10,807.4	179,939
Computer & Electronic Products	9,073.4	3,998.8	3,844.9	56,158
Publishing & Information Industries	13,012.1	5,846.8	5,659.8	84,271
Wholesale & Retail Trade	56,684.6	42,448.0	33,175.1	751,196
Business and Personal Services ^c	56,184.1	37,371.1	36,166.4	776,334
Financial, Legal & Real Estate	78,538.3	49,874.5	45,201.9	554,576
Travel, Recreation & Entertainment	21,460.8	12,503.9	10,735.8	237,089
Health Care & Social Assistance	53,342.3	31,164.2	30,262.7	712,328
Electricity, Gas & Sanitary	15,935.7	9,620.4	8,303.1	47,026
Education Services	32,684.1	31,218.2	30,697.3	805,181
Government, Military & Non-Profit	20,390.8	14,681.5	14,446.3	273,981
Others	29,120.0	23,747.9	19,536.1	53,312
Total of Mfg & Service Sectors	627,103.3	352,237.1	324,260.0	5,668,321
Total Economy	704,608.9	388,225.0	355,883.5	6,670,708

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, 2002

FOOD & AGRICULTURAL CLUSTER	Total Exports =	Foreign Exports	Domestic 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, Equipment & Professional Services	3,258.6	2,588.2	670.4	79.4%	8.2%
Farming	2,315.1	1,412.7	902.4	61.0%	5.8%
Cattle & Dairy Production	2.9	0.0	2.9	0.0%	0.0%
Poultry & Egg	100.1	94.9	5.2	94.8%	0.3%
Hogs & Misc Livestock	55.0	39.4	15.6	71.6%	0.1%
Grains	909.4	519.5	389.9	57.1%	2.3%
Oil Bearing Crops	734.6	359.5	375.1	48.9%	1.8%
Misc. Crops, Hay, Sugar, Tobacco & Nuts	203.4	173.4	30.0	85.2%	0.5%
Fruits & Vegetables	32.0	0.0	32.0	0.0%	0.1%
Nursery & Horticulture	239.9	226.0	13.9	94.2%	0.6%
Forestry, Hunting & Fishing	37.8	0.0	37.8	0.0%	0.1%
Processing	22,857.6	20,841.2	2,016.4	91.2%	57.4%
Food Processing	10,571.2	9,495.3	1,075.9	89.8%	26.6%
Processed Meat, Fish, Poultry & Eggs	191.2	0.0	191.2	0.0%	0.5%
Dairy Processing	1,564.6	1,393.7	170.9	89.1%	3.9%
Processed Food & Kindred Products	5,886.8	5,380.6	506.2	91.4%	14.8%
Grain Milling & Flour	415.8	360.1	55.7	86.6%	1.0%
Fats & Oils	490.0	405.2	84.9	82.7%	1.2%
Beverage Processing	2,022.7	1,955.7	67.0	96.7%	5.1%
Wood, Paper, & Wood Furniture Mfg	12,286.4	11,345.9	940.5	92.3%	30.9%
Food & Forestry Wholesaling & Retailing	7,581.9	742.6	6,839.3	9.8%	19.0%
Food Services	3,798.7	3,780.2	18.5	99.5%	9.5%
Total Food & Ag Cluster	39,811.8	29,364.9	10,447.0	73.8%	100.0%
Total Economy	274,961.1	48,109.8	226,851.3	17.5%	

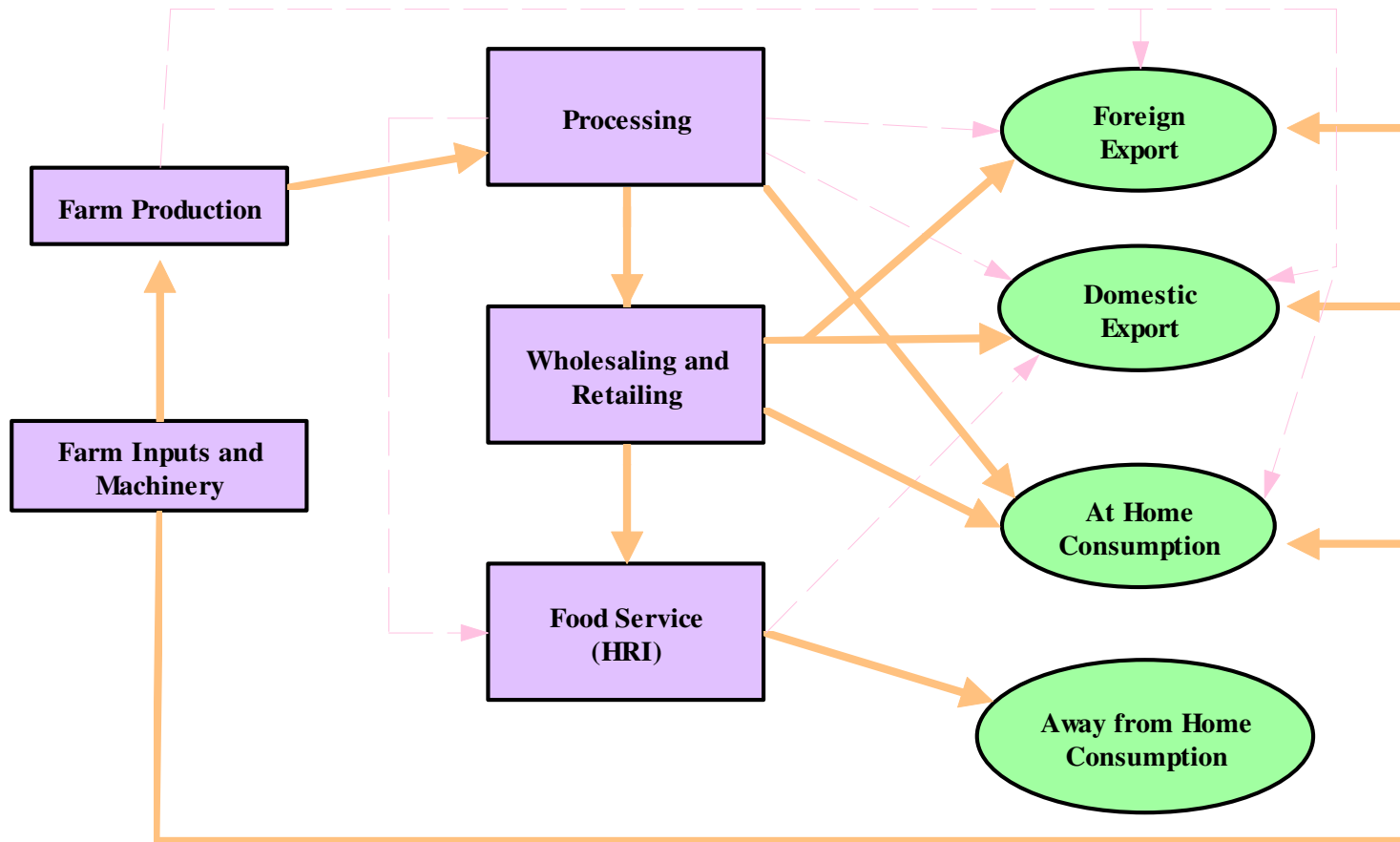
Table 3. Ohio Economic Multipliers: Output, Income, Employment, and GSP, 2002.

	Output	Income	Employment	Gross State Product
<u>Food & Related Agricultural Cluster</u>				
Farm Inputs, Equipment & Prof Services	1.5875	2.0929	2.1360	2.0338
Farming				
Cattle & Dairy Production	1.4731	1.8671	1.6163	2.1344
Poultry & Eggs	1.3198	2.8159	2.9293	1.3994
Hogs & Misc. Livestock	1.4594	2.3329	1.2181	2.3411
Grains	1.3744	N/A*	1.2658	1.4776
Nursery & Horticulture	1.1073	1.1774	1.5002	1.0681
Fruits & Vegetables	1.1680	1.6190	1.6198	1.1242
Oil Bearing Crops	1.4139	N/A*	1.4268	1.5400
Misc. Crops/Hay/Sugar/Tobacco/Nut	1.2876	2.7005	1.7384	1.2713
Forestry, Hunting & Fishing	1.3204	1.4234	2.4051	1.3692
Processing				
Food Processing				
Processed Meat, Fish, Poultry & Eggs	1.6421	1.8400	4.3318	2.2465
Dairy Processing	1.5757	2.1456	N/A*	1.8222
Processed Food & Kindred Products	1.4102	1.8170	3.7665	1.6085
Grain Milling & Flour	1.4569	2.4132	N/A*	2.2199
Fats & Oils	1.4413	3.2280	N/A*	3.4811
Beverage Processing	1.3289	1.6412	4.3863	1.4196
Wood, Paper & Wood Furniture Mfg.	1.3270	1.3976	2.5704	1.4577
Food & Forestry Wholesale/Retail	1.2122	1.1933	1.9066	1.1725
Food Services	1.4571	1.3892	1.4299	1.5771
<u>General Manufacturing & Service Sectors</u>				
Mining	1.3550	1.4195	3.3169	1.3896
Construction	1.3552	1.3352	2.1192	1.4734
Textiles, Apparel, Accessories	1.3814	1.4043	2.3418	1.4988
Motor Vehicles & Equipment	1.3054	1.4784	3.0851	1.5466
Metal Industries	1.2959	1.3592	2.8213	1.4401
Chemicals, Plastics, Petroleum	1.8247	2.1660	4.7646	2.1427
Publishing & Information Industries	1.3543	1.4228	2.6880	1.4664
Stone, Clay & Glass	1.3318	1.3549	2.7824	1.3414
Machinery & Equipment	1.3096	1.3643	2.6107	1.4270
Computers & Electronic Products	1.3149	1.3075	2.6661	1.4159
Business & Personal Services	1.2689	1.1957	1.8902	1.2432
Transportation & Communication	1.4140	1.4102	2.5200	1.4680
Electrical, Gas & Sanitary	1.3970	1.5624	4.6639	1.3030
Wholesale & Retail Trade	1.2122	1.1933	1.9066	1.1725
Financial, Legal & Real Estate	1.3062	1.3578	2.6097	1.2974
Travel, Recreation & Entertainment	1.3340	1.3634	2.1127	1.3433
Health Care & Social Assistance	1.3662	1.2732	1.9756	1.3634
Education Services	1.0486	1.0196	1.5065	1.0308
Government, Military & Non Profit	1.2414	1.1555	1.8833	1.1900

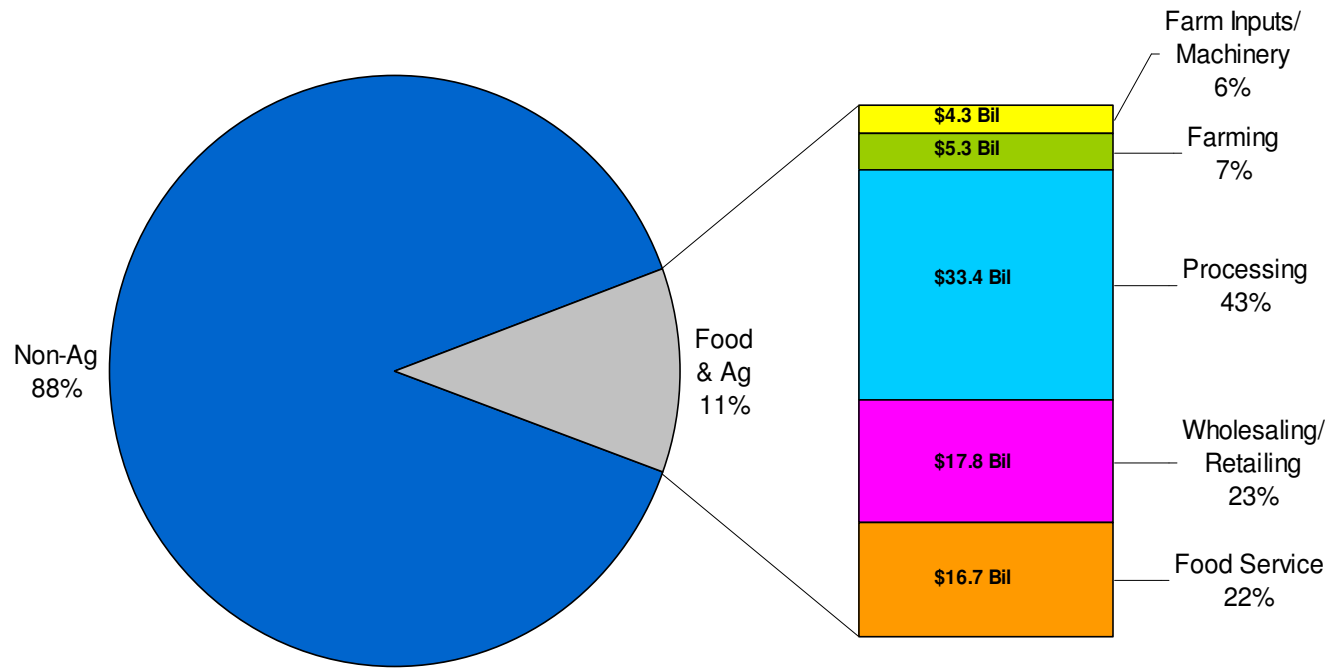
Source: Computed

* N/A = Not available

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

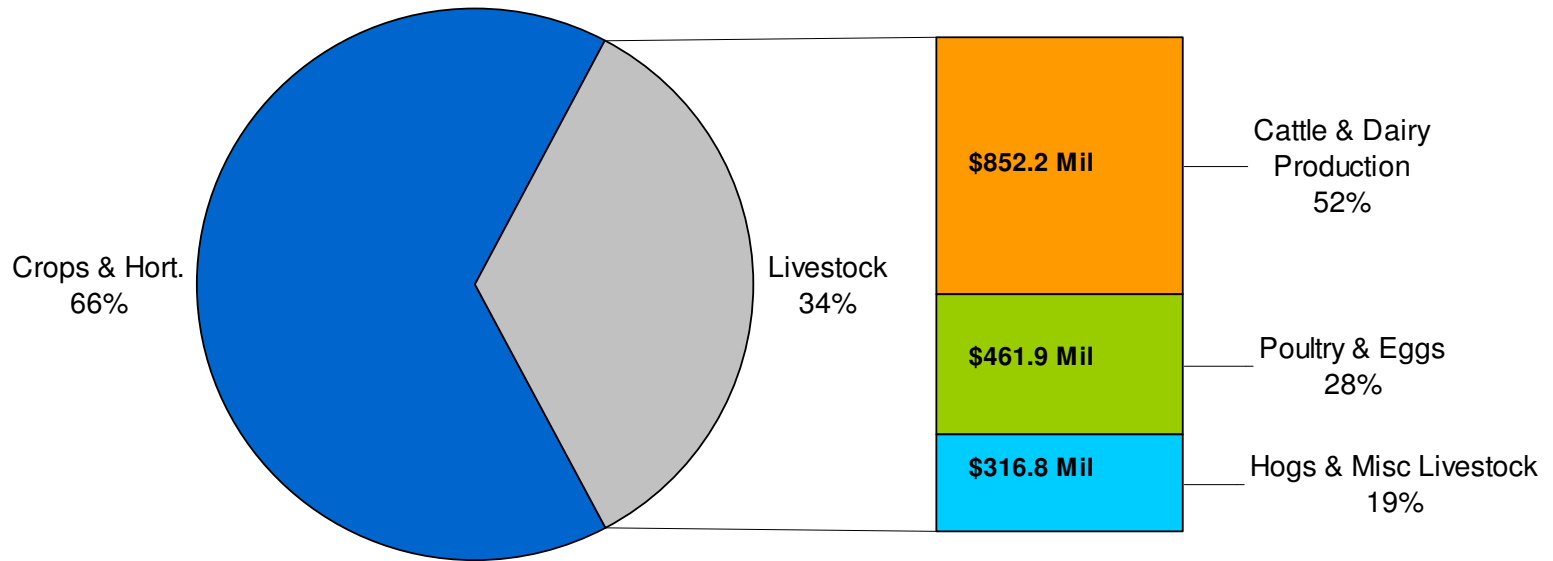


**Figure 2: Ohio Economic Output
Food & Agriculture Cluster, 2002**



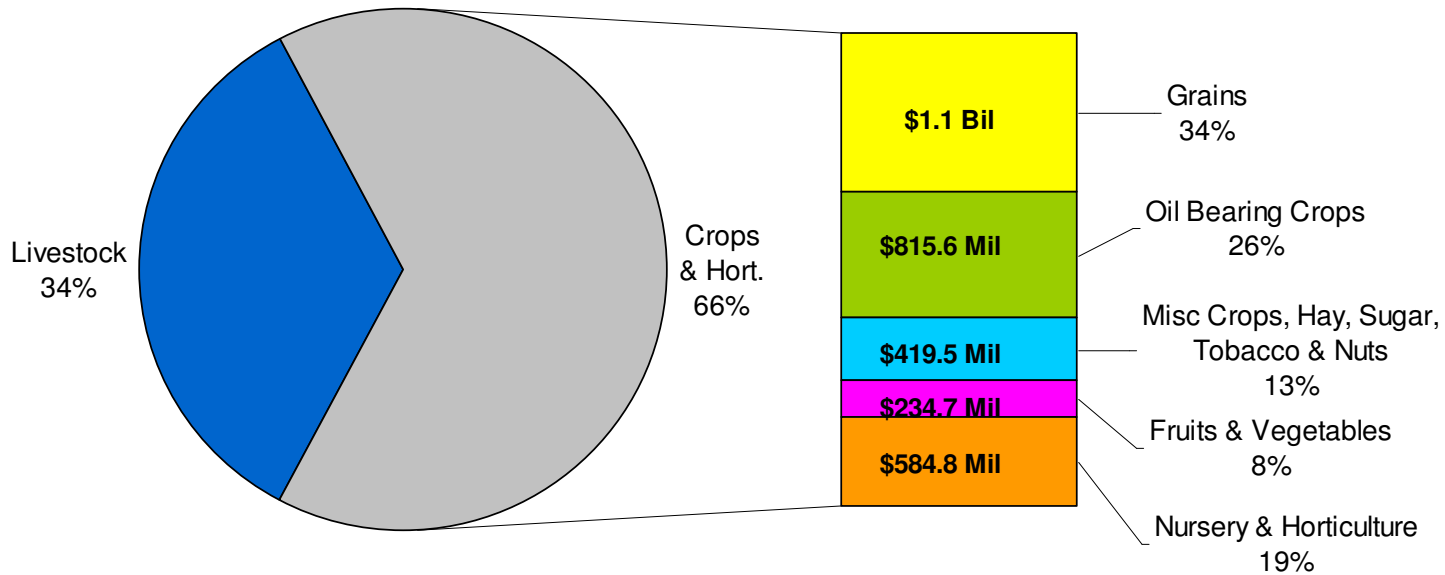
Total Output: \$704.6 Billion Food & Ag Sectors: \$77.5 Billion

**Figure 3. Ohio Agricultural Output
Livestock Sectors, 2002**



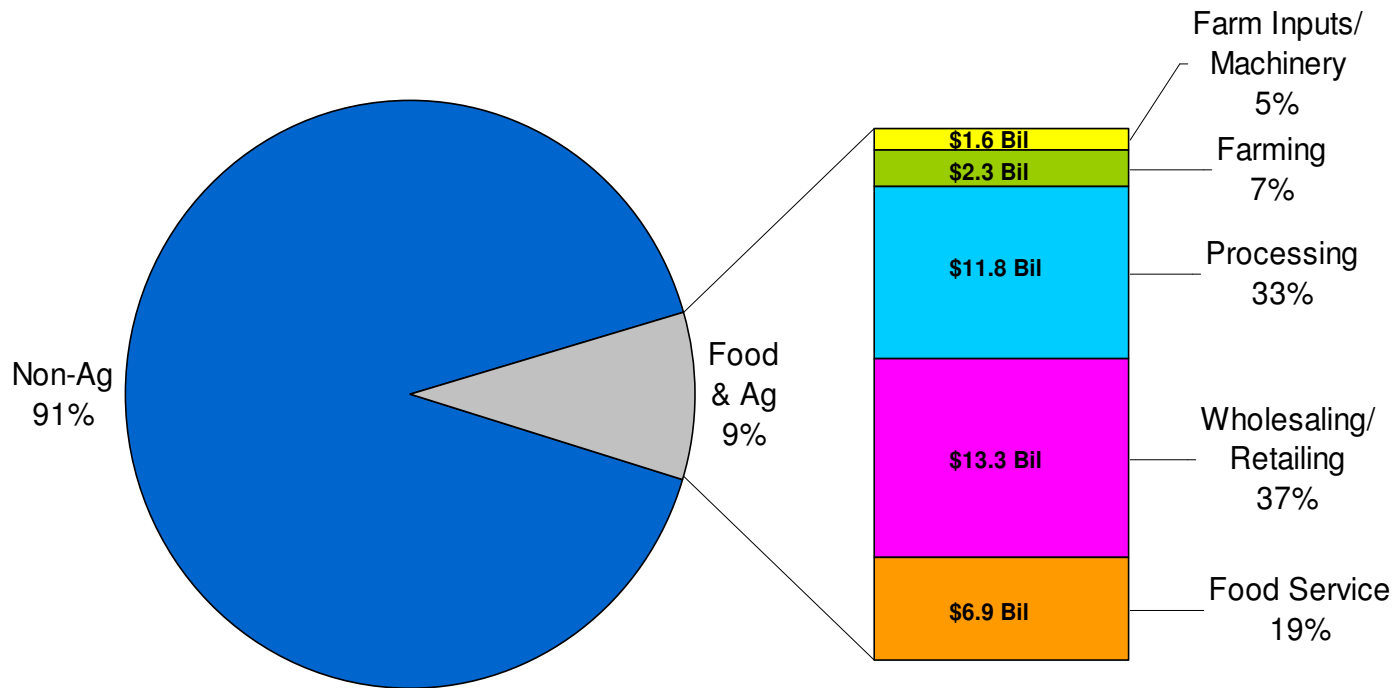
Total Livestock, Crops, & Hort: \$4.7 Bil Livestock Sectors: \$1.6 Bil

**Figure 4: Ohio Agricultural Output
Crops & Horticulture Sectors, 2002**



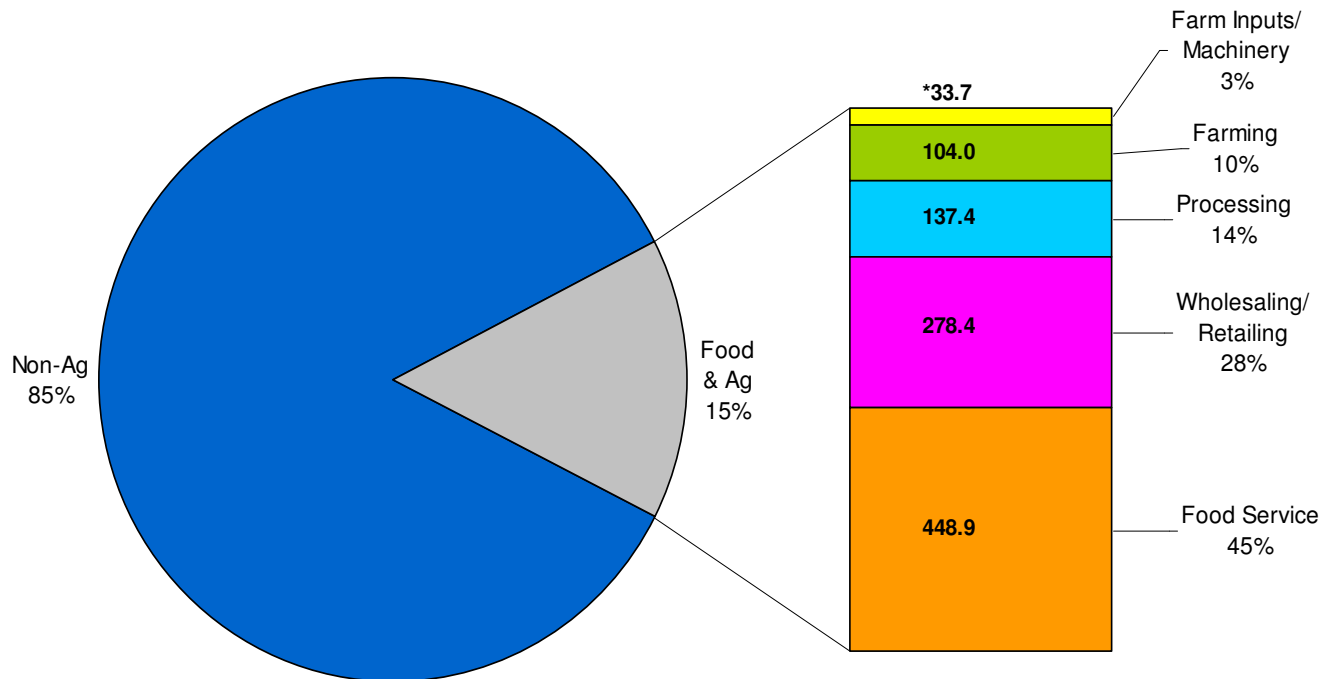
Total Livestock, Crops, & Hort: \$4.7 Billion Crops & Hort Sectors: \$3.1 Billion

**Figure 5: Ohio Gross State Product
Food & Agriculture Cluster, 2002**



Total Gross State Product: \$388.2 Billion Food & Ag Sectors: \$36.0 Billion

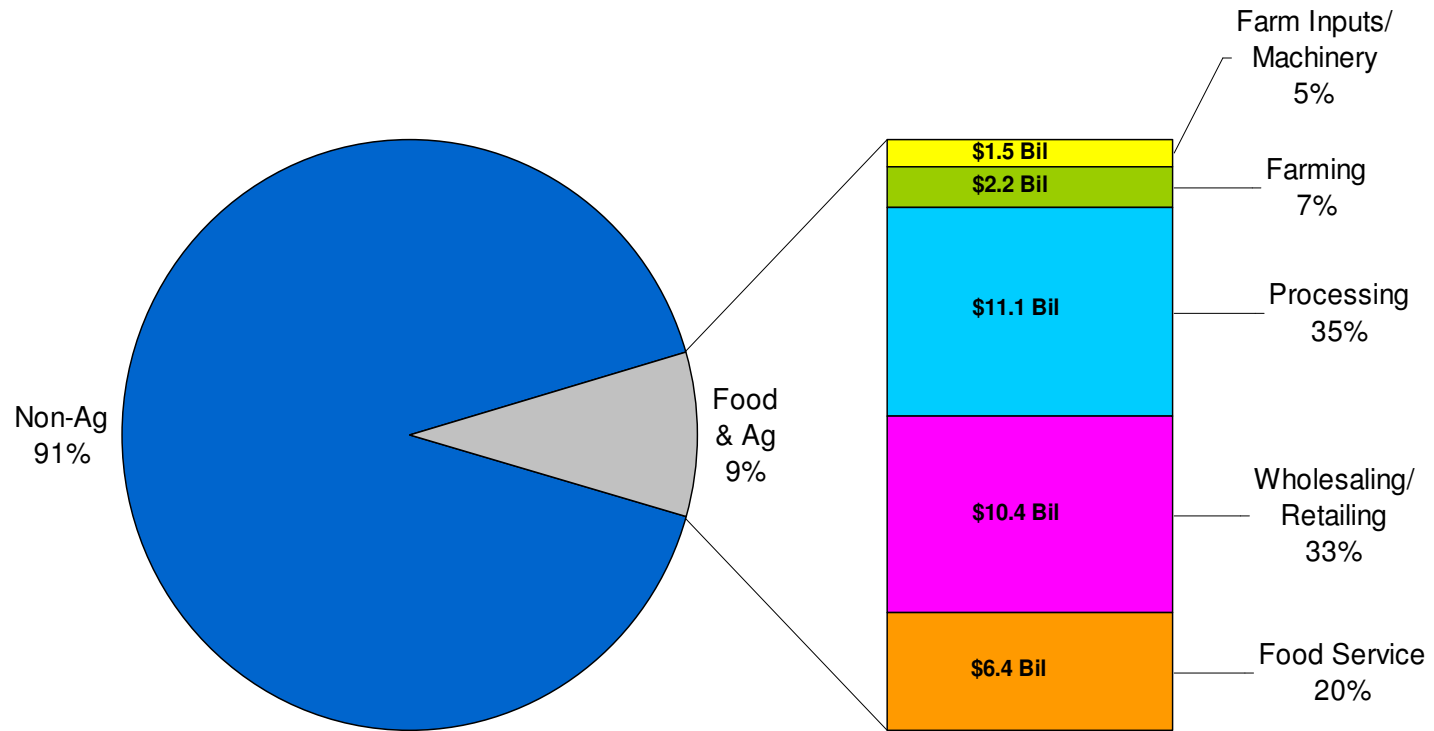
Figure 6: Ohio Employment Food & Agriculture Cluster, 2002



Total Employment: 6.7 Million Food & Ag Secotrs: 1.0 Million

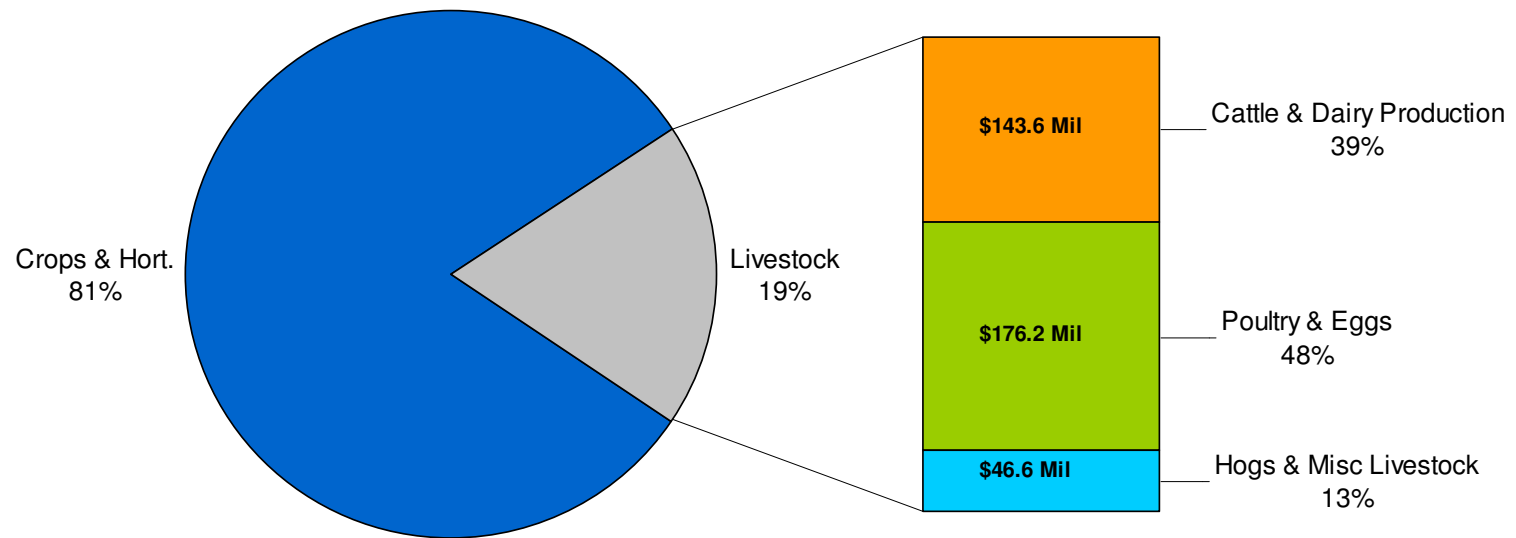
*numbers are in thousands of persons-years

**Figure 7: Ohio Income
Food & Agriculture Cluster, 2002**



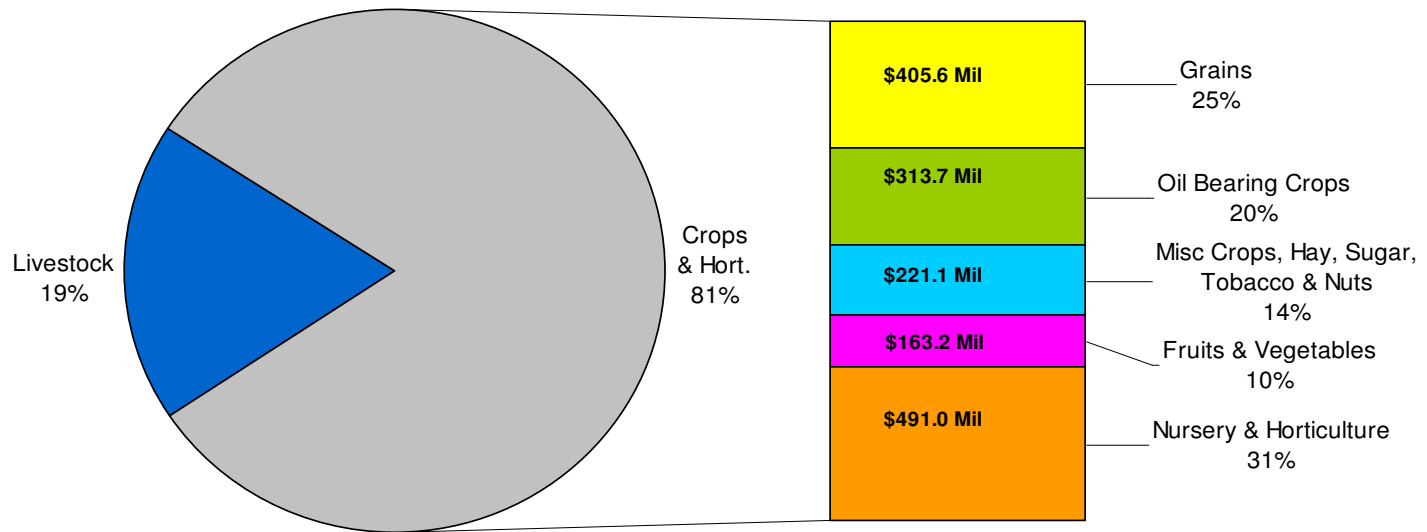
Total Income: \$355.9 Billion Food & Ag Sectors: \$31.6 Billion

**Figure 8: Ohio Agricultural Income
Livestock Sectors, 2002**



Total Livestock, Crops, & Hort: \$2.0 Billion Livestock Sectors: \$366.4 Million

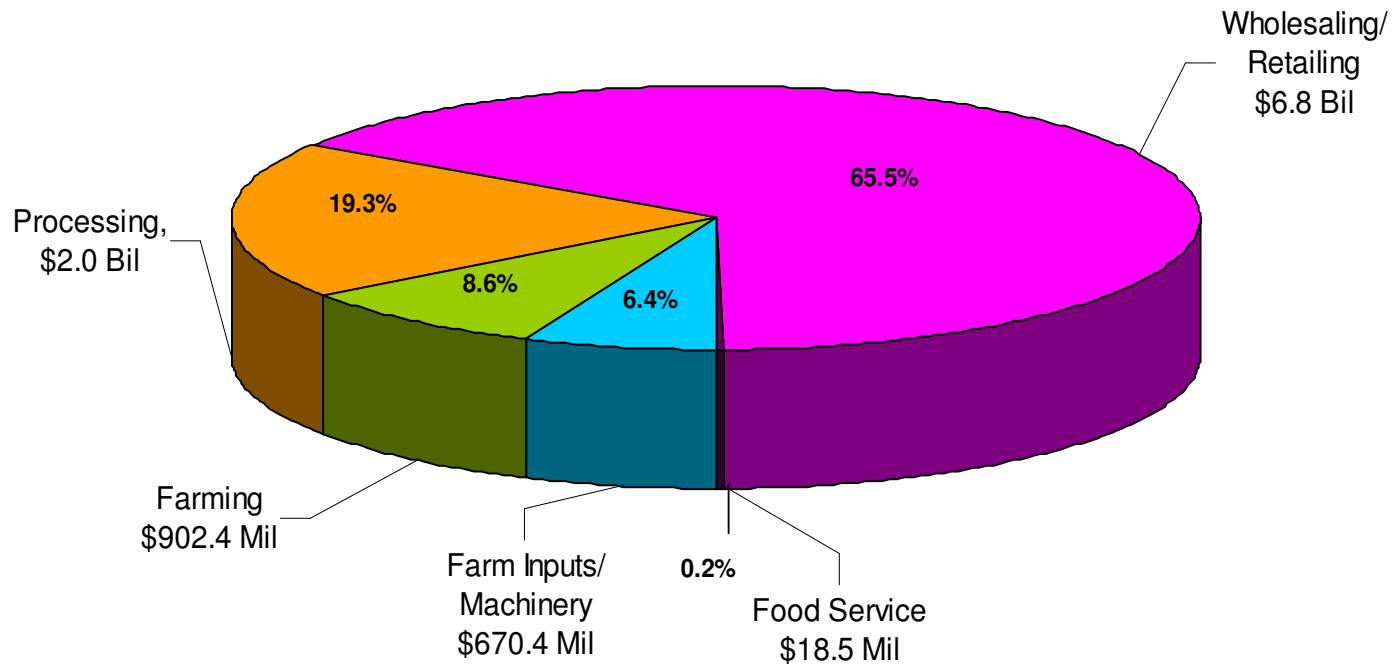
**Figure 9: Ohio Agricultural Income
Crops & Horticulture Sectors, 2002**



Total Livestock, Crops, & Hort: \$2.0 Billion

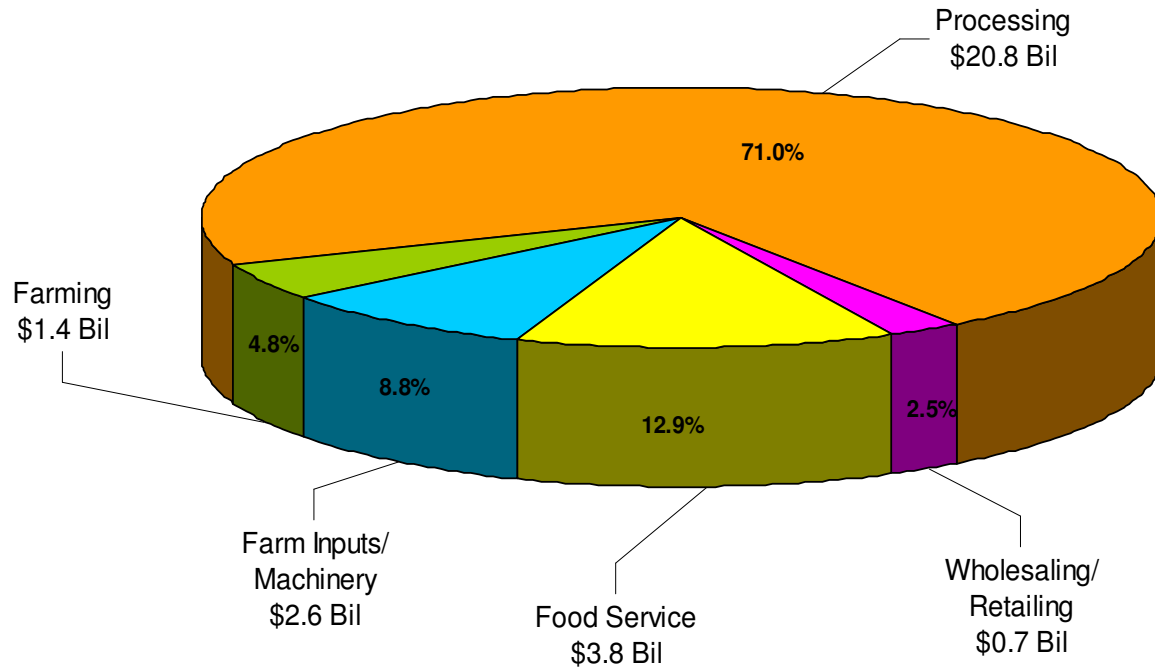
Crops & Hort. Sectors: \$1.6 Billion

**Figure 10: Ohio Domestic Exports
Food & Agriculture Cluster, 2002**



Total Domestic Exports: \$226.9 Billion Food & Ag Sectors: \$10.4 Billion

**Figure 11: Ohio Foreign Exports
Food & Agriculture Cluster, 2002**



Total Foreign Exports: \$48.1 Billion

Food & Ag Sectors: \$29.4 Billion

Figure 12: Regional Purchase Coefficients for the Livestock Sectors, Ohio, 2002

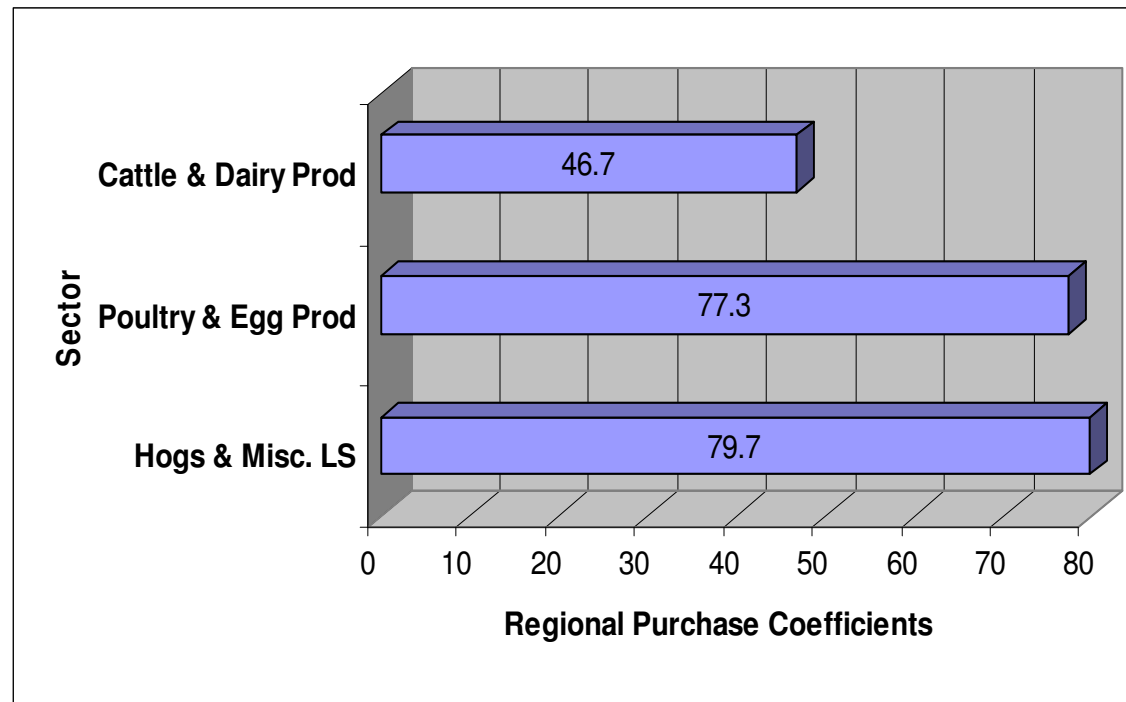


Figure 13: Regional Purchase Coefficients for the Crop Sectors, Ohio, 2002

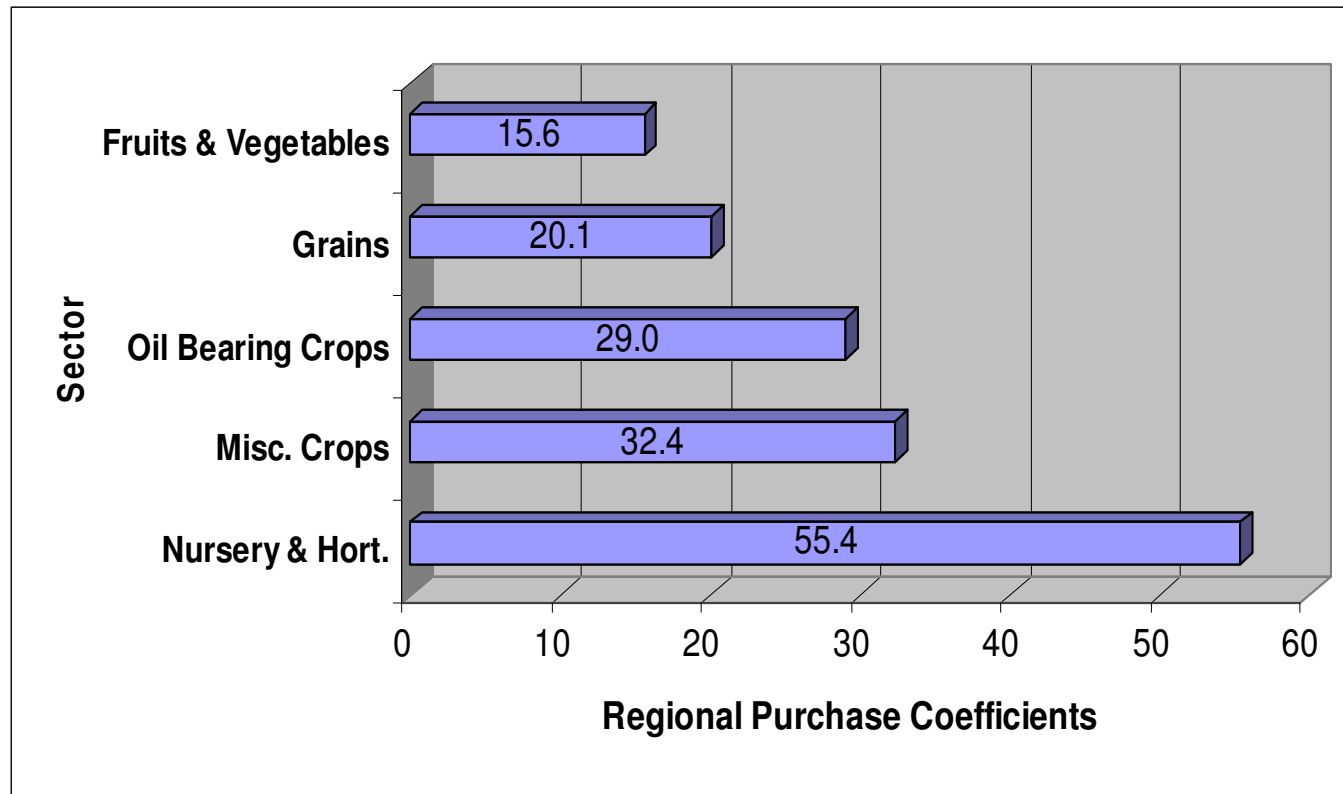
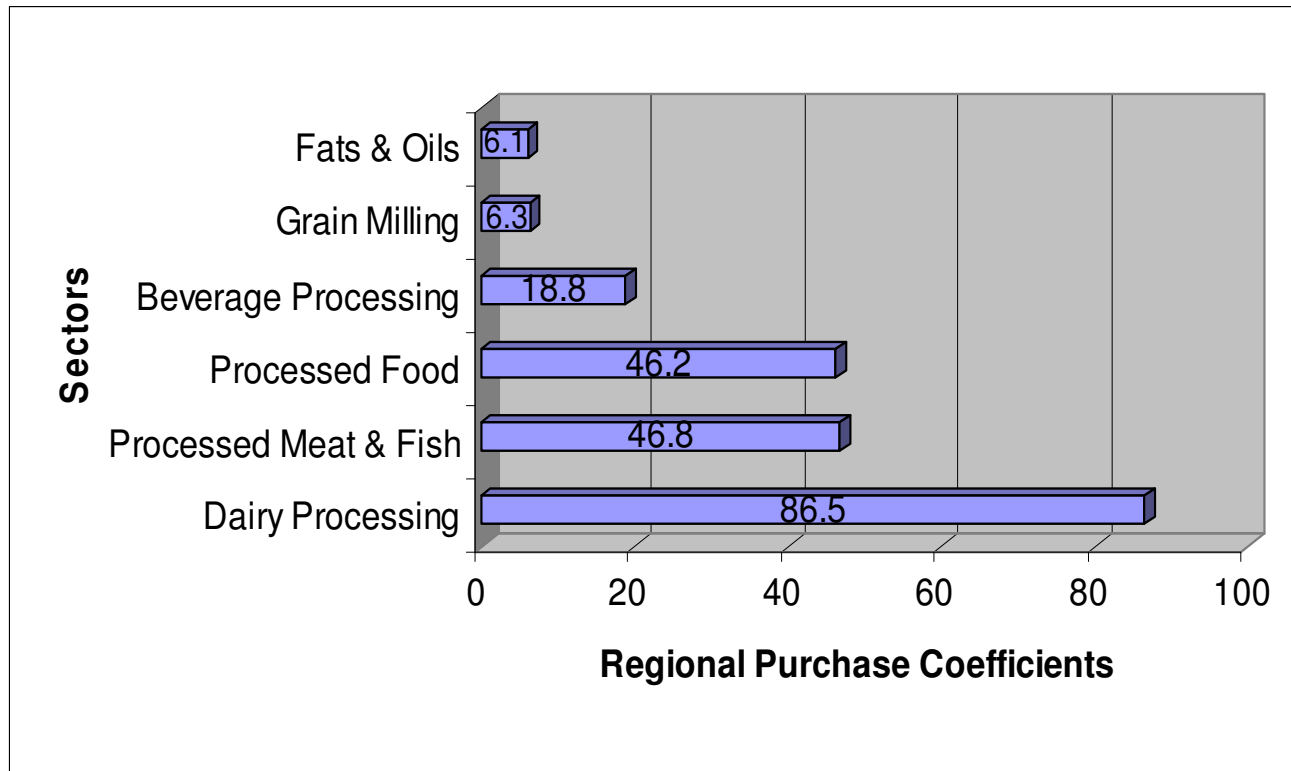


Figure 14: Regional Purchase Coefficients for selected Food Processing Sectors, Ohio, 2002



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Appendix A-1

OHFOOD SECTOR DEFINITIONS
Using North American Industry Classification (NAIC) Codes

Appendix Table A-1. Concordance between the OHFOOD Sectors and the North American Industrial Classification System (NAICS) for Version 8.0, Data Year 2002.

OHFOOD Sector	NAICS
Farm Inputs, Equip. & Prof Services	11500, 21239, 23000, 32532, 32741, 54162, 54169, 54194, 311119, 325311, 325312, 325314, 333111, 333112
Poultry & Eggs	11230
Cattle & Dairy Production	11211, 11212, 11213
Hogs & Misc. Livestock	11220, 11240, 11250, 11290
Grains	11113, 11114, 11115, 11116, 11119
Nursery and Horticulture	11140
Fruits and Vegetables	11120, 11131, 11132, 11133
Oil Bearing Crops	11111, 11112, 311223
Miscellaneous Crops, and Hay, Sugar, Tobacco, and Nut Crops	11191-11194, 31131, 31221, 111335, 111991, 111992, 111998, 312221, 312229
Forestry, Fishing, Ag Services	11310, 11320, 11330, 11410, 11420
Processed Meat, Fish, Poultry & Eggs	31170, 311611, 311612, 311613
Dairy Processing	311511, 311512, 311513, 311514
Processed Food and Kindred Products	31123, 31132, 31133, 31134, 31141, 31152, 31183, 31192, 31193, 31199, 311111, 311213, 311221, 311222, 311420, 311811, 311812, 311813, 311821, 311822, 311823, 311911, 311919, 311941, 311942
Grain Milling & Flour	311211, 311212
Fats & Oils	311225
Beverage Processing	312110, 312120, 312130, 312140
Wood / Paper/ Furniture Manufacturing	322110, 322120, 322130, 322210, 333210, 337110, 321113, 321114, 321192, 321211, 321212, 321213, 321214, 321219, 321911, 321912, 321918, 321999, 322221, 322222, 322223, 322224, 322226, 322231, 322232, 322233, 322291, 322299, 323116, 333291, 337121, 337122, 337124, 337125, 337127, 337129, 337211, 337212, 337214, 337215
Food Services	721110, 721120, 721190, 72120, 72130, 72200
Mining	21210, 212210, 212220, 212230, 212290
Construction	23000, 321991, 321992, 327420
Textiles, Apparel, Accessories, Yarn & Leather	31310, 313210, 313220, 313230, 313240, 313310, 313320, 314110, 314120, 314910, 315190, 31520, 31590, 31610, 31620, 31690, 337910, 337920, 339910, 339950, 314991, 314992, 314999, 315111, 315119, 333292, 339991, 339992, 339993, 339999

Motor Vehicles & Equipment	336110, 336120, 33630, 53210, 811110, 811120, 336211, 336212, 336213, 336214, 811191, 811192, 811198
Metal Industries	331210, 331510, 332410, 332420, 332430, 332500, 332600, 332720, 332910, 322225, 331111, 331112, 331221, 331222, 331311, 331312, 331314, 331315, 331316, 331319, 331411, 331419, 331421, 331422, 331423, 331491, 331492, 331521, 331522, 331524, 331525, 331528, 332111, 332112, 332114, 332115, 332116, 332117, 332211, 332212, 332213, 332214, 332311, 332312, 332313, 332321, 332322, 332323, 332811, 332812, 332813, 332991, 331992, 332993, 332994, 332995, 332996, 332997, 332998, 332999
Chemicals, Plastics & Petroleum	211000, 324110, 325110, 325130, 325180, 325190, 325510, 325520, 325920, 326110, 326120, 326130, 326140, 326150, 326160, 326210, 326220, 326290, 333220, 213111, 213112, 213113, 213113, 213114, 213114, 213115, 324121, 324122, 314191, 324199, 324221, 325211, 325212, 323222, 325991, 325992, 325998, 326191, 326192, 326199
Publishing & Information Industries	325910, 511110, 511120, 511130, 511140, 511190, 511200, 512100, 512200, 513100, 513200, 513300, 514100, 514200, 323111, 323112, 323113, 323114, 323115, 323117, 323118, 323119, 323121, 323122, 333293
Stone, Clay & Glass	212310, 212320, 327310, 327320, 327390, 327910, 327111, 327112, 327113, 327121, 327122, 327123, 32714, 327125, 327211, 327212, 327213, 327215, 327331, 327332, 327991, 327992, 327993, 327999
Machinery and Equipment	332710, 333120, 811200, 811300, 811400, 333131, 333132, 333294, 333295, 333298, 333311, 333312, 333314, 333315, 333319, 333411, 333412, 333414, 333415, 333511, 333512, 333513, 333514, 333515, 333516, 333518, 333611, 333612, 333613, 333618, 333911, 333912, 333913, 333921, 333922, 333923, 333924, 333991, 333992, 333993, 333994, 333995, 333996, 333997, 333999, 335212, 335221, 335222, 335224, 335228
Technology Industries	334210, 334220, 334290, 334300, 334111, 334112, 334113, 334119, 334411-334419, 334510-334514, 334516, 334517, 334518, 334519, 334611, 334612, 334613
Business and Personal Services	339940, 532400, 531300, 531400, 541610, 541700, 541800, 541910, 541920, 541930, 541990, 55000, 56110, 56120, 56130, 56140, 56150, 56160, 56170, 56190, 81210, 81220, 81230, 81290, 339995, 541511, 541512, 541513, 541519
Transportation and Communication	33650, 48100, 48200, 48300, 48400, 48500, 48600, 48700, 48800, 49200, 53221, 53222, 53223, 53230, 335411, 335413, 335419, 336412, 336414, 336415, 336611, 336612, 336991, 336992, 336999
Electrical, Gas and Sanitary	22110, 22120, 22130, 325120, 325620, 335110, 335120, 335930, 56200, 325611, 325612, 325613, 334515, 335311, 335312, 335313, 335314, 335911, 335912, 335921, 335929, 335991, 335999, 339994
Wholesale and Retail Trade	42000, 44100, 44200, 44300, 44400, 44500, 44600, 44700, 44800, 45100, 45200, 45300, 45400, 49300
Financial, Legal & Real Estate	52100, 52210, 52220, 52230, 52300, 52410, 52420, 52500, 53100, 53300, 54110, 54120
Travel, Recreation & Entertainment	339920, 339930, 71110, 71120, 71130, 71140, 71150, 71200, 71310, 71320, 713910, 713920, 713930, 713940, 713950, 713990

Health Care & Social Assistance	325410, 62110, 62120, 62130, 62140, 62150, 62160, 62190, 62200, 62300, 62410, 62420, 62430, 62440, 339111, 339112, 339113, 339114, 339115, 339116
Education Services	61110, 61120, 61130, 61140, 61150, 61160, 61170
Government, Military & Non-Profit	81310, 81320, 81330, 81340, 81390, 491110