Multiplier Analysis for Agriculture and Other Industries

Booyong Song
Assistant Researcher

Mike D. Woods
Professor and Extension Economist

Gerald A. Doeksen
Regents Professor and Extension Economist

Dean Schreiner
Professor

Regional impact analysis of state or local government policies often focus on accounting exercises examining differences in tax collections and direct expenditures made in various regions of a regional economy (regional balance sheets). Balance sheet approaches treat regional effects of policies as if net benefits sum to zero. They only capture the cash component of transactions between regions rather than wider impacts on regional welfare. They ignore indirect or multiplier effects of proposed policies.

What is an alternative approach to the evaluation of regional effects of policies which avoids most of these problems? What will be the economic impact of a proposed project? What will be the total regional impact on income and employment resulting from the establishment of a new plant? What type of industry, if established, will create the most economic activity? These are questions which are difficult to answer, but leaders in business and government require such information for purposes of evaluating how various projects and programs will effect the economic activity in a region.

Leaders are asking for information on the different abilities of various industries to generate new jobs. Decision makers need to know how the available resources in a region can be utilized for further development and economic growth.

Before expanding their facilities, businessmen attempt to evaluate the demand for increased production of goods and services. Others in the region are interested in the impact that new or expanded industries will have on their businesses. Those who finance a new plant in an area want to know the impact the new facility will have on the economic activity of the area.

Information is needed to measure a decline in economic activity as well as an increase. For example, what will be the effect on the economy if a plant or army base were to close its door? Employment and income would directly decline by the size of the employed labor force and payroll of the closed plant. Other businesses in the region, however, would also feel the effects as lesser amounts of their goods and services would be demanded.

A measure is needed that yields the effects created by an increase or decrease in economic activity. In economics, the measure that yields this information is called the multiplier effect. Before discussing the multiplier effect, it is helpful to review some basic concepts.

Basic Concepts of Community Economics

Industries or businesses that produce goods primar-

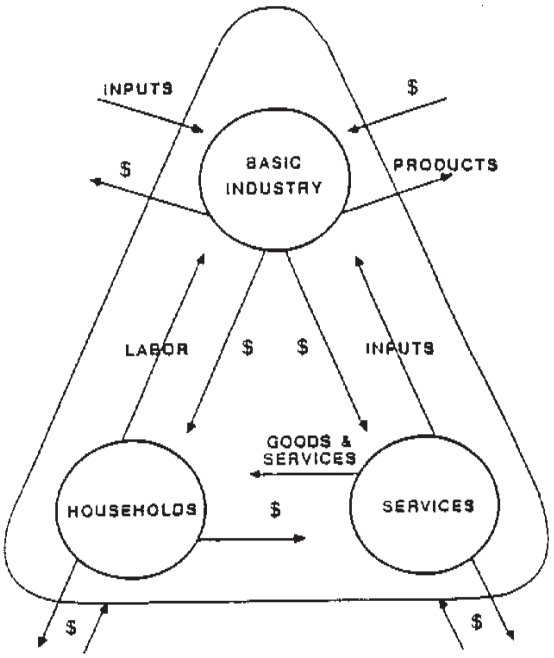

Figure 1.

ily for sale outside the economy are called basic industries. They are important components of all economic systems. Two other major components of economic systems are service firms and households. Figure I illustrates the major flows of these sectors within any economy.

Basic industries purchase labor from households and reimburse them with dollars. Other inputs used by basic industries are purchased from local service firms and service from outside the area. Local service firms also provide goods and services to households (consumers). Each of these three components of an economy purchase goods and services from outside the economy. Local transactions determine the relationships that exist among the various firms in an economy.

For example, consider what the impact of a proposed recreational lake would have on the economy of a county. The lake could be considered a basic industry if it draws visitors from outside the county. Visitors would purchase goods and services from the service sectors including food, gasoline, hotel rooms, and other items. As income is generated in these businesses, they would hire additional employees and buy more inputs from other businesses.

The total impact of any basic industry on an economy consists of direct, indirect, and induced impacts. Direct impacts are the immediate effects of the impacting industry; for example, the jobs created to fill certain positions within the firm and the payroll to pay those new employees. Indirect impacts are the effects that occur in the sectors as a result of the input purchases made by the impacting industry. Induced effects are the changes in other sectors brought about by the increased consumer spending due to the initial direct and the following indirect effects. In brief, the initial jobs are created and income is spent in ways that tend to create further employment and income in other sectors of the local economy.

The above discussion indicates how basic industries serve as the foundation of an economy and how households and service firms are necessary to make the economy function. Service industries account for a substantial part of the outputs of most economies. But, as Figure I shows, much of the service industries' output supports the local basic industries and households. Mathematical techniques can be used to measure the relationships between basic industries, households, and services.

Type I and Type III multipliers are used for this study. The Type I multipliers take into account only the direct and indirect changes in output, income, or employment resulting from the proposed project. The Type III multipliers compare direct, indirect and induced effects to the direct effects generated by a change in final demand. A Type III retail sales multiplier of 1.5 indicates that if one dollar is generated by tourist activity, then an additional 50 cents will be generated due to business (indirect) and household (induced) spending. The following section describes the source of the multiplier estimates utilized in this fact sheet.

Multiplier Effect

The most frequently used types of multipliers are those that estimate the effects of (1) outside changes in output of the sectors in the economy, (2) income earned by households because of the new outputs, (3) value-added generated from the production of new output, and (4) employment that is expected to be generated because of the new outputs. Value added includes employee compensation, proprietary income, other property type income, and indirect business tax. Employment is generally measured in terms of the number of jobs.

The multiplier effect indicates the relationship between some observed change in the economy and the amount of economic activity that this change creates throughout the economy. The income multiplier measures the change in income that is created by some increase or decrease in the economy. For example, suppose the region has an income multiplier of 2.8 and a new plant puts $1,000,000 worth of income into the hands of those operating and those employed by the firm. The multiplier effect indicates that this initial increase in income will swell to $2,800,000 worth of income as the secondary repercussions are felt throughout the region's economy. These secondary repercussions are measured by the indirect and induced impacts discussed above. Similarly, if employment is increased or decreased, the employment multiplier indicates how this change will affect the rest of the economy. Suppose the region has an employment multiplier of 2.4 in the manufacturing sector. If a manufacturing plant which would employ 1000 labor workers is built in this region, the total employment impact for the region will be 2400 jobs including the new plant's labor force.

Multipliers for various types of industrial activities are expected to differ. The industrial activity of an area can be classified into three broad categories. First are the basic industries such as livestock, farming, mining, and forestry. These industries depend and are directly related to the natural resources of the region. Second are the industries which process the raw materials of the basic industries. Industries in this manufacturing category include food products, flour mills, oil refining, livestock processing, etc. The third stage industries arise to meet the needs of the other industries and include businesses such as wholesale and retail stores, transportation, communication, etc.

The multipliers for this study were derived for the state as well as for each sub-state planning district within the state using IMPLAN (Impact Analysis for Planning) input-output data. IMPLAN input-output data was available in micro computer software form. This

study used micro IMPLAN release 91-03 developed by the U.S.D.A. Forest Service. IMPLAN performs impact analysis for any region of the United States. The data base was for the year 1985 and industry structure was based on 1977.

Micro IMPLAN contains data for 528 economic sectors specified under the SICs (Standard Industrial Codes). Based on homogeneity in the nature of industries, the 528 sectors were aggregated into 20 sectors.

IMPLAN produces four kinds of multipliers: output, income, value-added, and employment. For each multiplier IMPLAN generates direct, indirect,and induced effects,along with Type I and Type III multipliers. Type II multipliers are not provided by IMPLAN. Hereafter, when this report refers to multipliers, it is referring to the Type III multipliers unless otherwise noted.

Input-output analysis is a methodology frequently used to estimate multipliers. A critical assumption of input-output analysis is that technology is constant and industries use a fixed combination of input purchases to produce their output. The interested reader can refer to the text by Miller and Blair cited in the references to learn more about input-output analysis.

The State Analysis

The analysis conducted on the Oklahoma economy consisted of dividing the economic activity into 20 sectors. These included three primary resource sectors, eight manufacturing sectors, and nine service sectors (Table 1).

1. Income multipliers

Income multipliers for the State are presented in Table I. The income multiplier measures the total change in personal income resulting throughout the economy from a one dollar change in income in a sector. For example, the Type I income multiplier in the petroleum products sector for the State is 5.28 and the Type III multiplier is 5.95.

The Type III income multiplier for the livestock sector is 2.72, for the crop sector is 2.51, and for mining is 1.34. In the manufacturing sectors the petroleum products sector has the largest multipliers, and the food products sector is second in size. The multipliers for the other manufacturing sectors ranges from 1.49 to 1.99. The range in income multipliers for the service sectors is from 1.19 to 2.01.

2. Employment Multipliers

Employment multipliers for the State are also presented in Table 1. The employment multiplier is defined as the total change in employment due to a one unit change in the labor force in a specific sector. As an example, the Type III employment multiplier for food products for the State is 3.00. This means that if a new food products manufacturing plant is established in Oklahoma employing 1,000, the total employment impact for the State will be 3,000 including the new plant's labor force. The employment multiplier of 3.00 includes the direct, indirect, and induced employment effects from the direct employment due to plant production. The total employment impact assumes new additional output for all interdependent sectors. If the new plant processes agricultural products already produced in the State, the total employment impact will be somewhat less than 3.00.

The employment multipliers in agriculture are 2.02 and 1.69 for the livestock and crop sectors, respectively. Mining has a multiplier of 1.62. In the manufacturing sectors, petroleum products and food products have the highest multipliers of 9.21 and 3.00, respectively. Employment multipliers range from 1.47 to less than 1.95 for the other manufacturing sectors. The range of the employment multipliers in the service sectors is from 1.25 for Federal government service to 2.20 for the communication sector.

Multipliers should be used with care. It is important to note that multipliers should not be used alone to analyze a region. Factors such as probability of individual firm success, local resource constraints, and social or environmental concerns should also be included in the analysis. These factors should be accounted for whether the analysis occurs at the state or substate level.

An Analysis by Substate Planning Districts

The income and employment multipliers presented above apply to the entire state and are useful for state analysis. However, many people are concerned about the effect of industrialization on a substate or regional basis. Since Substate Planning Districts were classified as the regional delineation scheme for rural development, multiplier analysis according to planning districts can be more important for the rural Oklahoma economy and its development. As a part of this study, employment and income multipliers were derived for the 11 Substate Planning Districts in Oklahoma. Figure 2 delineates the boundaries of each planning district.

1. District Income Multipliers

Income multipliers for each planning district are presented in Table 2. Each multiplier indicates the amount of income generated in that district from a one dollar increase in direct income for a given sector. When one compares the multipliers for the State with those of the planning districts, the State multipliers are larger than those of substate region in general. This is because the State has fewer leakages from the economic system than the planning districts. Leakages would result from purchases from outside the region of interest. Some planning districts frequently supply certain of the required inputs from other planning districts, thus reducing the local impact of a change in sector output. For the State,

TABLE 1. INCOME AND EMPLOYMENT MULTIPLIERS BY SECTOR IN OKLAHOMA, 1985.

Sectors in Oklahoma Economy	Income Multiplier		Employment Multiplier	
	Type I	Type III	Type I	Type III
Primary Resource Sectors				
1. Livestock and Products	1.98	2.72	1.63	2.02
2. Crops and Forestry	1.83	2.51	1.36	1.69
3. Mining	1.19	1.34	1.31	1.62
Manufacturing				
4. Food products	2.61	2.61	2.42	3.00
5. Textiles and Apparel	1.35	1.99	1.18	1.47
6. Lumber, Wood and Furniture	1.45	1.93	1.35	1.68
7. Printing and Publishing	1.30	1.63	1.30	1.61
8. Petroleum Products	5.28	5.95	7.43	9.21
9. Machinery	1.24	1.49	1.30	1.61
10. Transportation Equipment	1.39	1.66	1.58	1.95
11. Other Manufacturing	1.45	1.76	1.47	1.82
Services				
12. Construction	1.39	1.80	1.38	1.71
13. Transportation and Warehousing	1.34	1.60	1.37	1.70
14. Communication and Utilities	1.55	1.74	1.77	2.20
15. Wholesale and Retail Trade	1.28	1.66	1.22	1.51
16. Finance, Insurance and Real Estate	1.23	1.42	1.35	1.67
17. Business and Personal Services	1.27	1.74	1.17	1.45
18. Medical and Professional Services	1.25	1.65	1.16	1.44
19. Federal Government Enterprises	1.01	1.19	1.01	1.25
20. State and Local Government Enterprise	1.44	2.01	1.19	1.48

Source of the Aggregation Scheme: Dean F. Schreiner and James C. Chang. Structure and Analysis of the Economies of Substate Planning Districts in Oklahoma, Ozarks Regional Commission Publication, May 1975

Figure 2 **Substate Planning Districts in Oklahoma**

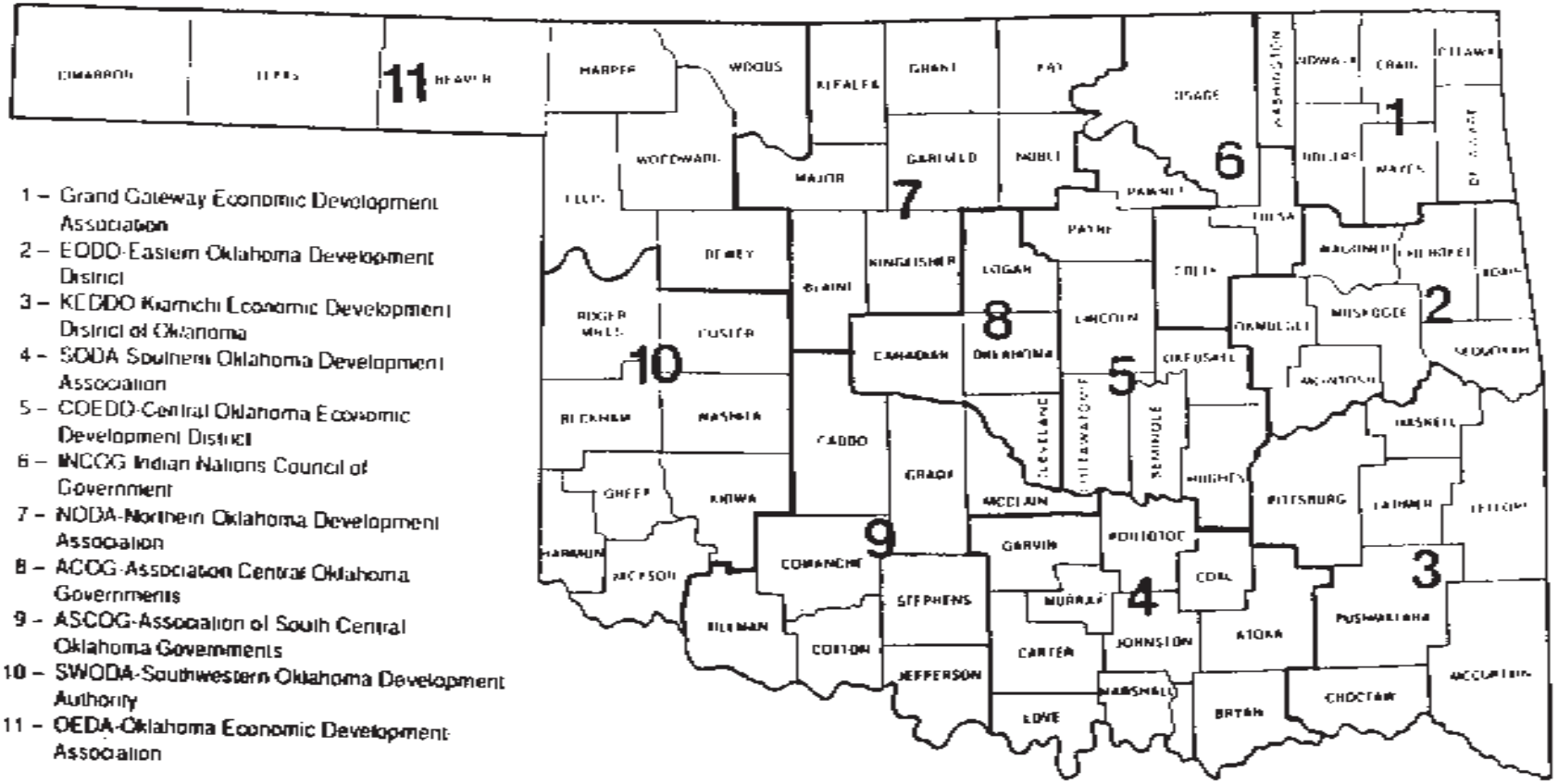

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TABLE 2. INCOME MULTIPLIERS BY SECTOR AND PLANNING DISTRICT IN OKLAHOMA, 1985.(1)

SECTOR	1 GGEDA	2 EODD	3 KEDDO	4 SODA	5 COEDD	6 INCOG	7 NODA	8 ACOG	9 ASCOG	10 SWODA	11 OEDA
LIVESTOCK & PRODUCTS	2.18	2.05	2.04	2.24	2.13	2.38	2.23	2.34	2.08	2.18	2.20
CROPS AND FORESTRY	2.00	1.86	1.72	2.05	1.87	2.05	1.99	1.98	1.88	1.97	1.89
MINING	1.29	1.23	1.26	1.23	1.20	1.31	1.25	1.28	1.23	1.26	1.22
FOOD PRODUCT	3.50	2.22	2.49	2.03	2.13	1.93	1.93	2.05	1.60	2.55	3.14
TEXTILES & APPAREL	1.85	1.69	1.65	1.75	1.70	1.87	1.77	1.81	1.61	1.70	1.62
LUMBER, WOOD, & FURNITURE	1.67	1.61	1.86	1.70	1.64	1.63	1.64	1.70	1.54	1.58	—
PRINTING & PUBLISHING	1.39	1.42	1.38	1.44	1.35	1.67	1.41	1.52	1.43	1.45	1.42
PETROLEUM PRODUCTS	1.62	—	1.56	4.19	1.94	6.39	2.86	2.69	—	—	—
MACHINERY	1.35	1.34	1.27	1.28	1.42	1.46	1.34	1.42	1.26	1.32	1.34
TRANSPORTATION EQUIPMENT	1.56	1.53	—	1.49	1.55	1.49	1.54	1.65	1.50	1.52	—
OTHER MANUFACTURING	1.58	1.51	1.50	1.44	1.54	1.68	1.58	1.66	1.41	1.46	1.87
CONSTRUCTION	1.53	1.37	1.37	1.42	1.45	1.69	1.43	1.65	1.35	1.47	1.35
TRANSPORTATION & WAREHOUSING	1.43	1.39	1.36	1.40	1.39	1.57	1.37	1.53	1.37	1.39	1.38
COMMUNICATION & UTILITIES	1.53	1.44	1.42	1.57	1.59	1.82	1.60	1.56	1.46	1.73	1.86
WHOLESALE & RETAIL TRADE	1.50	1.43	1.40	1.44	1.43	1.60	1.42	1.57	1.43	1.47	1.44
FINANCE, INSURANCE & REAL ESTATE	1.34	1.37	1.34	1.33	1.34	1.44	1.31	1.50	1.35	1.31	1.33
BUSINESS & PERSONAL SERVICES	1.58	1.54	1.46	1.50	1.51	1.66	1.52	1.63	1.46	1.49	1.47
MEDICAL & PROFESSIONAL SERVICE	1.47	1.42	1.37	1.42	1.41	1.62	1.41	1.55	1.38	1.42	1.34
FEDERAL GOVERNMENT SERVICE	1.15	1.13	1.11	1.13	1.11	1.17	1.13	1.15	1.12	1.13	1.12
STATE & LOCAL GOVERNMENT	1.90	1.81	1.67	1.87	1.89	1.82	1.89	1.76	1.62	1.76	1.83

Source of the Aggregation Scheme: Dean F. Schreiner and James C. Chang, Structure and Analysis of the Economies of Substate Planning Districts in Oklahoma, Ozarks Regional Commission Publication, May, 1975.

(1)Multipliers are Type III.

*)Dash indicates there is no economic activity occurring in that sector in that region.

TABLE 3. EMPLOYMENT MULTIPLIERS BY SECTOR AND PLANNING DISTRICT IN OKLAHOMA, 1985.(1)

SECTOR	1 GGEDA	2 EODD	3 KEDDO	4 SODA	5 COEDD	6 INCOG	7 NODA	8 ACOG	9 ASCOG	10 SWODA	11 OEDA
LIVESTOCK & PRODUCTS	1.80	1.77	1.77	1.83	1.80	1.82	1.77	1.84	1.73	1.80	1.79
CROPS AND FORESTRY	1.55	1.51	1.44	1.54	1.49	1.44	1.51	1.45	1.50	1.56	1.49
MINING	1.57	1.50	1.49	1.45	1.44	1.61	1.44	1.58	1.44	1.48	1.40
FOOD PRODUCT	4.49	2.43	2.80	2.45	2.97	2.04	2.78	2.36	1.80	2.97	3.20
TEXTILES & APPAREL	1.45	1.36	1.36	1.37	1.38	1.39	1.39	1.38	1.37	1.39	1.27
LUMBER, WOOD, & FURNITURE	1.45	1.48	1.76	1.48	1.45	1.54	1.37	1.50	1.41	1.39	—
PRINTING & PUBLISHING	1.46	1.43	1.39	1.43	1.44	1.67	1.38	1.54	1.42	1.44	1.40
PETROLEUM PRODUCTS	2.21	—	2.16	6.35	2.90	9.92	4.32	3.94	—	—	—
MACHINERY	1.48	1.43	1.40	1.41	1.54	1.58	1.45	1.54	1.41	1.39	1.42
TRANSPORTATION EQUIPMENT	1.64	1.69	—	1.45	1.64	1.69	1.53	2.08	1.52	1.62	—
OTHER MANUFACTURING	1.76	1.67	1.72	1.52	1.56	1.74	1.65	1.74	1.47	1.59	2.39
CONSTRUCTION	1.53	1.39	1.39	1.40	1.47	1.63	1.40	1.62	1.33	1.47	1.33
TRANSPORTATION & WAREHOUSING	1.52	1.43	1.46	1.50	1.51	1.77	1.55	1.57	1.45	1.44	1.40
COMMUNICATION & UTILITIES	1.96	1.86	1.84	1.94	2.00	2.26	1.98	1.95	1.83	2.16	2.25
WHOLESALE & RETAIL TRADE	1.42	1.38	1.36	1.37	1.38	1.49	1.34	1.48	1.34	1.38	1.36
FINANCE, INSURANCE & REAL ESTATE	1.50	1.47	1.43	1.45	1.46	1.60	1.41	1.63	1.46	1.45	1.42
BUSINESS & PERSONAL SERVICES	1.38	1.36	1.33	1.34	1.34	1.42	1.31	1.41	1.31	1.35	1.31
MEDICAL & PROFESSIONAL SERVICE	1.38	1.32	1.27	1.30	1.30	1.43	1.30	1.43	1.30	1.32	1.30
FEDERAL GOVERNMENT SERVICE	1.24	1.23	1.20	1.20	1.19	1.24	1.19	1.22	1.18	1.21	1.18
STATE & LOCAL GOVERNMENT	1.51	1.47	1.38	1.48	1.58	1.35	1.46	1.36	1.30	1.42	1.42

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(1)Multipliers are Type III.

*) Dash indicates there is no economic activity occurring in that sector in that region

trade among planning districts is netted out and does not appear as a leakage in the multiplier. However, some regional or substate multipliers are larger than those of the State. For example, in Table 2, the income multiplier in petroleum products in district INCOG is 6.39, which is larger than that of the State (5.95). A reason can be found from the assumption of the regional input-output model used to derive multipliers. The assumption is that the technology of production in each sector in a substate is the same as in the State as a whole. If the proportions of inputs required from sectors that would be expected to come from within the substate are always less than one, then the State multipliers are always larger than the substate's multiplier. If not, some substate multipliers for some sectors could be larger than the State's multipliers.

2. District Employment Multipliers.

Employment multipliers for the 11 planning districts are presented in Table 3. Again the district multipliers are in general smaller than the State multipliers due to leakages between districts. However, as one can see in Table 3, the employment multiplier for food product in GGEDA is 4.49, which is larger than that of the State (3.00).

Summary

Multiplier analysis is useful to determine the total impact on an economy (State or substate region), of some change caused by an external force or decision such as location of a new business or government facility. The analysis does not determine whether location of the facility is profitable to the investors nor whether the impact of the facility is beneficial to the local community. Additional analysis is needed to determine tax benefits and detailed impacts in the public or private sectors (see OSU Bulletin B-793). Care should be taken when using multiplier analysis to understand the assumptions and data the analysis is based upon. It is hoped this report will be useful to local leaders and policy makers pursuing economic development options.

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