AN ANALYSIS OF OKLAHOMA'S ECONOMY BY DISTRICTS USING INPUT-OUTPUT TECHNIQUES

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In order to adequately appraise a district's potential for economic growth and development, it is important to know as much as possible about the economic structure of the particular district under analysis. Recent input-output analysis research conducted for the state of Oklahoma provided an examination of the economic base of the state, but this examination proved inadequate when considering the economic structure of the districts within the state.[1]

The Oklahoma model provided an "average" or "aggregate" description of the various economic structures found in the state.[1]

To assist in planning for economic growth and development for the districts in Oklahoma, it was necessary to examine the economic structure of these districts, thus, Oklahoma was divided into three relatively homogenous districts. One district has a well-developed urban and industrial base; whereas, the economies of the other two districts are based predominately on agriculture. Of the two agricultural districts, one is well-developed with large scale ranches and farms and the other is characterized by small diversified units. In general, the latter district is economically depressed. In order to examine each of these districts separately, the state model was disaggregated into three district input-output models.

The empirical results illustrate the need for separate district models. Specifically, the results illustrate the need for different actions for economic growth in each district.

OBJECTIVES OF THE STUDY

To formulate policies for economic growth and development, economic differences of districts have to be taken into account. The main objective of the study for Oklahoma was to develop input-output models to be used to examine the economic interrelationships in each district. A major consideration in the development of the district models was to obtain information for assessing conditions in the economically depressed district in Oklahoma and for pointing out possible corrective actions. The information needed could not be obtained from the state model in its aggregated form.

The specific objectives of this paper are: (1) to describe the three economic districts in Oklahoma, (2) to show how the input-output model for Oklahoma was disaggregated into district models and (3) to illustrate the information available from the district models by comparing the empirical results by districts. Included in the empirical results are estimates of the leakage coefficients which measure the leakage of output and income from a district due to imports. Leakage becomes very important when examining small districts as those in Oklahoma, which are not self-sufficient and must import goods and services from outside the district.

ECONOMIC DISTRICTS

The state was divided into three economic districts, mainly on the basis of family income and unemployment data [6]. These economic districts are outlined

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[1] For a discussion of the state model, see [7].

in Figure 1. District I consists of counties with a median family income of below \$3,000. District III is characterized by a sparse settlement pattern. The average median family income in District III was \$4,468 in this district in 1960. District II contains the counties where most of the trade centers of 5,000 or more population in the state are located. The predominance of trade centers is the major reason the district is considered a unit. Average median family income in District II was \$4,133 in 1960. Seventy-two percent of the people in District II are classified as urban, compared to 31 and 32 percent for Districts I and III, respectively. In District I, 50 percent of the population are classified as nonfarm rural population compared to 20 and 38 percent, respectively, for Districts II and III. District III has 30 percent of its population classified as rural farm population compared to Districts I and II which had 19 and 8 percent, respectively [12].

Agricultural activity varies across the state. Agriculture is the predominate industry in Districts I and III. However, value of sales of agricultural products per farm were \$11,110 in District III compared to \$3,505 in District I in 1964. About half of total value of sales was from crops in District III, while District I received the majority of its value of sales from livestock products. District III consists of mostly large farms and ranches, while farms in District I are rather small with more diversification of operations.

In District II, the metropolitan centers of Tulsa and Oklahoma City, contain most of the manufacturing firms in the state. The urban complexes in this district offer the transportation facilities, distribution facilities, public utilities, and other services demanded by manufacturers. According to Census data, 82.7 percent of the value added for manufactured goods for the state was in District II. This was compared to 5.6 percent in District I, 8.9 percent in District III [10].

The mining sector has an important role in the economic activity in Oklahoma. The resources from the mining sector provide the base for much of the industrial activity of the state. In District II, 85.3 percent of the total value of mineral production for the state was mined in 1959. District I had 5.2 percent, District III had 8.6 percent [11].

DISTRICT MODELS

These above descriptions indicate some of the differences in the economic structure of the three districts. The design of the input-output model for each district is the same as that for the state model reported in [7]. The data were for 1959, because available secondary data were most complete for this year.[2] Nine endogenous and seven exogenous sectors were considered. The sectors are:

Endogenous Sectors

Livestock and Livestock Products
Crops
Agricultural Processing
Manufacturing
Transportation, Communication and Public Utilities
Real Estate, Finance and Insurance
Services
Wholesale and Retail
Mining

Exogenous Sectors

Maintenance Construction
New Construction
Federal Government
State and Local Governments
Household
Exports
Imports

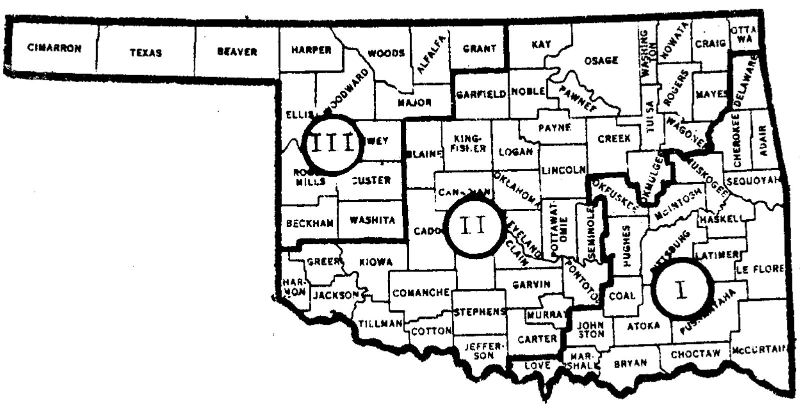

FIGURE 1. GENERAL ECONOMIC DISTRICTS IN OKLAHOMA

2 For a detailed explanation of the secondary data used in the state model and the sources of data, see [2, pp. 67-114].

In constructing the three district models, the state model was divided into three models to represent the economy of each district. It was necessary to begin with the state model unadjusted for imports. Three major steps were needed to convert the state model (unadjusted for imports) to represent each district. First, an adjustment was made for the production in each district. Census data provided most of the information needed to estimate total output or production for each sector in each district. As a first approximation of the district models, it was assumed that each district required inputs in direct proportion to their production. For example, District I produced 19 percent of the livestock and livestock products produced in the state and, thus, required 19 percent of the state inputs for livestock production.

The second step consisted of an adjustment for difference in technology among the districts. Wage and salary data were used to adjust for technological differences [9]. As a district adopts new technology, several changes in wages and salary per unit of output are expected. In the primary and manufacturing sectors, capital substitutes for labor and the amount spent for wages and salaries per dollar of output becomes smaller. Also as an economy develops, the service-type sectors become more important, and in general provide personal services often not found in less developed districts. The result is that a high proportion of the inputs for service type sectors consists of wages and salaries. The adjustment was accomplished by entering wage and salary data for each district into the three district models. Each column of each table was then adjusted percentage-wise upward or downward depending upon whether the sector paid more or less than the state average for wages and salaries.

The third step consisted of allowing for the effects of imports and exports. Export and import data were computed by determining the total demand of each sector and the amount of the product demanded for final consumption within each district. The amount produced above these demands was the amount exported. The excess of demands above that which was produced within the district was imported. The amount imported by each sector was determined by assuming its share of the total imports was equal to the proportion it used of the total demand in the district. Therefore, each sector had an import entry. By computing the requirements in this manner, the resulting export and import entries are net figures. The final input-output models consisted of three district input-output models corrected for production, technology and net imports and exports.

From all indications, the models derived with these adjustments represent the economic structure of the districts. One place to check for reasonableness is in the export column of the inter-industry flow tables.[3] The export columns of the inter-industry flow tables reflect some of the economic characteristics which exist in the districts. These adjustments indicate that District I has a very small export base compared to the other two districts. The structure of the economy and the adjusted district model for District I indicate that livestock and livestock products and mineral resources are exported. District II exports goods and services from all sectors except from the manufacturing sector. It must be remembered that these are net figures, and even though District II produces most of the manufactured products of the state, it requires a large percentage of the state's demand for them and, thus, is a net importer of manufactured goods. Many of the service-type requirements for District I and III are produced in the urban centers in District II. The adjusted models also indicate this as District II is a net exporter of service-type products. The structure of District III indicates that this area is characterized by large farms and ranches. This district also has a mining sector and a small demand for mineral products. Thus, the structure supports the findings of the model as derived by the adjustment process for District III.

The ability of the predictive devices to represent the economy of each district depends on the reliability of the data and the adjustment technique. All checks on the district models demonstrate that the input-output tables obtained reasonably reflect the economic structure of the districts. For each district model, three tables were constructed: an inter-industry flow table, a table of technical coefficients, and a table of interdependence coefficients. The inter-industry flow table provides the base of the input-output model as the technical and interdependence coefficients are derived directly from it. From the interdependence coefficients are derived the empirical predictive devices.

EMPIRICAL PREDICTIVE DEVICES

The input-output multipliers are used to predict the total change in sector output and income due to a change in demand for goods and services of a sector. If the economic base of a district is small, generally the effect of an economic change within a district will be reduced as a result of importing goods and services into the district. The effect that imports have on a multiplier is referred to as leakage. To compute the leakage coefficients, multipliers for each sector for each district are computed under the assumption that each district produces all of the products demanded by the producing and final demand sectors. In other words, no goods and services are imported from the other districts in the state or outside the state. The difference

[3] For the inter-industry flow tables, see [3].

between these multipliers and those computed from the original model with imports is the leakage coefficient associated with each multiplier [8].

There is considerable trading among the three districts in Oklahoma, and, thus, leakage would be expected. For this reason, some measure of leakage is essential when attempting to induce economic growth and development. The leakage coefficient was estimated for the output and income multipliers in each district.

Output Multipliers

Output multipliers measure the amount of output generated by a dollar change in final demand for products of a particular sector.[4] Output multipliers and the associated leakage coefficients for each sector in each district are listed in Table 1. Leakage is the net amount of a change in total output as a result of a one dollar change in final demand that is not realized within the district due to imports.

The multipliers for District II are larger than those for either District I or III. The greater industrial activity as well as the large number of urban centers in District II may account for most of the differences. The multipliers for Districts I and III are very similar except for three sectors: livestock and livestock products, agricultural processing, and manufacturing. For each of these sectors, the multipliers are larger in District III. This is probably because there is more interaction of these sectors with the other sectors within the district.

The agricultural processing sector exhibits a relatively large multiplier in all three districts, especially in District II. If demand for products in this sector changes by one dollar, output will change by $1.76 in District I, $2.58 in District II and $1.96 in District III. The size of the multiplier indicates the large interaction of this sector with the other sectors, especially the two basic agricultural sectors. Leakage for this sector is large for Districts I and III compared to District II due to the large amount of manufactured goods and services imported from outside each district The multipliers of the livestock and livestock products sector are also relatively large in all three districts. Again, leakage is greatest in Districts I and III. Even with leakage, an expansion of economic activity in either the agricultural processing or the livestock and livestock products sector will generate more economic activity in each district than a similar change in any other sector, given the current economic structure of the district. Expansion, of course, depends on the availability of resources in the districts. The greatest potential for expansion at the present time for these two sectors most likely exists in Districts II and III, because they have more available basic resources.

The multiplier for the manufacturing sector is larger in District II than in I and III, because the services demanded by the manufacturing sector are provided by the large urban centers in District II. Thus, a change in manufacturing activity in District II generates considerable activity in the service-type industries located within that district. Districts I and III have less service-type industries, and as a result, a large part of any increase in demand for service outputs is met by industries outside the districts. This explains the smaller multipliers and the large leakage coefficients for the two districts. Future expansion in manufacturing would most likely occur in District II due to the established industrial base.

The output multipliers of the crop and mining sectors appear somewhat small. An increase in demand for products in these sectors is met by more intensive use of existing inputs and, thus, a small increase in the demand for new inputs from other sectors. The result is a weaker degree of interdependence between the crop and mining sectors and all the other sectors. This condition is reflected in the input-output model in terms of small technical coefficients and small multipliers.

The remaining service-type sectors are similar in nature. The multipliers for these sectors are generally smaller than those of the primary and industrial sectors, principally because these sectors are rather labor intensive and purchase relatively few goods from the primary sectors. The economic activity of these sectors in a district depends on the industrial base of the district. The large industrial base in District II accounts for the larger multipliers for the service-type sectors in that district as compared to Districts I and III. The multipliers for the service-type sectors are slightly larger in District I than in III, due to a larger base of service activities in I. The larger loss from leakage of service activities may be because of the smaller nonfarm population in District III.

Income Multipliers

The income multiplier is defined as the total change in income in the economy resulting from a one dollar change in income in a sector.[5] Income multipliers and the associated leakage coefficients for the three districts are listed in Table 2. Leakage is defined as the net amount of new income which is not generated

[4] For a calculation procedure, see [4].

[5] For a computational procedure of the income multiplier, see [5].

TABLE 1. OUTPUT MULTIPLIERS AND LEAKAGE OF THE SECTORS FOR THE THREE DISTRICTS OF OKLAHOMA

	District I			District II			District III		
	Multiplier		Leakage	Multiplier		Leakage	Multiplier		Leakage
	Size	Rank		Size	Rank		Size	Rank	
Livestock and Livestock Products	1.80	1	.50	2.28	2	.10	1.88	2	.66
Crops	1.25	8	.45	1.63	6	.15	1.25	7	.64
Agricultural Processing	1.76	2	.76	2.58	1	.18	1.96	1	1.16
Manufacturing	1.47	3	.64	2.28	3	.29	1.62	3	1.25
Transportation, Communication and Public Utilities	1.33	5	.41	1.48	9	.09	1.30	5	.56
Real Estate, Finance and Insurance	1.27	6	.47	1.58	7	.13	1.24	8	.64
Services	1.28	7	.71	1.87	4	.24	1.25	6	.99
Wholesale and Retail	1.20	9	.46	1.50	8	.11	1.19	9	.65
Mining	1.36	4	.65	1.69	5	.15	1.37	4	.96

TABLE 2. INCOME MULTIPLIERS AND LEAKAGES OF THE SECTORS FOR THE THREE DISTRICTS IN OKLAHOMA

	District I			District II			District III		
	Income Multiplier		Leakage Coefficient	Income Multiplier		Leakage Coefficient	Income Multiplier		Leakage Coefficient
	Size	Rank		Size	Rank		Size	Rank	
Livestock and Livestock Products	2.10	2	.63	2.73	3	.11	2.26	3	.64
Crops	1.20	8	.34	1.46	7	.09	1.20	7	.33
Agricultural Processing	2.22	1	1.17	4.16	1	.29	4.42	1	3.03
Manufacturing	1.47	3	.67	3.76	2	.49	2.28	2	2.02
Transportation, Communication and Public Utilities	1.44	4	.65	1.43	8	.07	1.37	5	.60
Real Estate, Finance and Insurance	1.28	6	,47	1.49	6	.09	1.24	6	.44
Services	1.22	7	.59	1.66	4	.15	1.18	8	.56
Retail and Wholesale	1.14	9	.32	1.30	9	.05	1.13	9	.32
Mining	1.42	5	.75	1.56	5	.10	1.47	4	.95

within the district as a result of a one dollar increase in income because of imports into the district.

The agricultural processing sector has the largest income multiplier in each district. They indicate that if income from the agricultural processing sector increases by one dollar in each district, $2.22 income will be generated in District I, $4.16 in District II and $4.42 in District III. The smaller coefficient in District I can be explained by the larger percent of total inputs obtained from the household sector. This fact means that a smaller percent of expenditures go directly to the production sectors and, thus, reduce the interaction among the endogenous sectors.

The leakage for the agricultural processing sector is small in District II, but rather large in Districts I and III. More goods and services are imported by agricultural processing firms in Districts I and III than in District II. The large multipliers for the agricultural processing sector indicate that this sector offers the best prospects for expanding regional incomes, especially in Districts II and III if the economic structure does not change, if there is an increase in demand and if resources are available.

The second largest income multiplier for District I is in the livestock and livestock products sector. The magnitude of the multiplier indicates that this sector has an impact on income almost equal to that of the agricultural processing sector and much higher than that of the manufacturing sector indicating that District I is a predominately agriculturally based economy. In Districts II and III, the manufacturing sector has the second largest income multiplier. The multiplier for the manufacturing sector of District II is clearly larger than that of the livestock sector. However, for District III, the multipliers for the livestock sector and the manufacturing sector are about the same, reflecting similar income effects. Leakages due to imports is particularly large for the manufacturing sector in District III.

The income multipliers for the mining sector are similar in all three districts. The leakage coefficients are larger for Districts I and III, indicating that many of the goods and services needed by the mining sector in these districts are imported. Multipliers for the service-type sectors in District II are larger than in either I or III, again reflecting concentration of service industries in the urban centers in District II. The multipliers for these sectors are slightly larger in I than those in III.

Prediction and Policy Implications

For those advocating methods to improve the income situation in a poverty district, questions are constantly arising which require prediction of future economic conditions. The policy maker has a future goal specified. To devise policy, he must first know what change can be expected with existing conditions and then how these can be altered to obtain his goal. The usefulness of the district input-output model for prediction purposes is well illustrated by considering the low income situation in District I relative to District II. The main question is whether the relative income situation for District I will improve in the future assuming no change in the economic structure of the district, say by 1975.

To use the input-output model for prediction problems of this nature, primary resource coefficients and estimates of final demand are needed. Primary resources are those resources supplied by the exogenous sectors. For the three district models, the primary resources were aggregated into four sectors: construction, government, households and imports. The coefficients are calculated by multiplying the direct coefficients of the primary resource sectors times the matrices of interdependence coefficients.[6] An estimate of final demand for 1975 by sectors is also needed. This estimate was obtained by allocating the final demand estimate for the state model to the district models [7]. This allocation was obtained by assuming the proportion of each district total to the state total of final demand will be the same in 1975 as it is in the models used in this analysis. The result is only an approximation of final demand by sectors, and assumes no significant structural changes in the economy.

Multiplying the matrix of primary resource coefficients times the estimated final demand vectors yields estimates of the amount of inputs from the construction, government, households, and import sectors needed to meet the final demand. These estimates are shown in Table 3. For the households sector, the estimates can also be interpreted as the level of income generated by the expected final demand. With the projected final demand, households in District I could expect $582,956,000 worth of income, and households in District II could expect $4,379,680,000 worth of income in 1975. This amount includes wages and salaries, proprietor income, and rent income. Dividing this by the population estimate[7] for 1975 yielded per capita incomes of $1,352 and $2,081 for Districts I and II, respectively.

[6] For a calculation procedure, see [1, pp. 68-70] and for the primary resource coefficients of the three districts in Oklahoma, see [3].

[7] The population estimates were calculated by deriving the annual change in population from 1960 to 1966 for these two districts. This percentage change was assumed to be the percentage in population from 1966 to 1975.

Multiplying the per capita income amounts times the family size[8] yielded family incomes of $4,732 and $7,283 for Districts I and II, respectively.

At first glance, these income projections seem large. However, past data on income trends, which show that median family income almost from 1950 to 1960 for Districts I and II, support the projected estimates [6, p. 34]. The important consideration is not the magnitude of these estimates, but the relative size of the family income of District I as compared to District II. In 1960, the median family income of District I was 62 percent as large as that of District II [6, p. 34]. The predictions for 1975 show the family income in District I as 65 percent as large as that of District II, indicating only a slight change in the relative income situation.

To the policy maker, the results indicate that the projected conditions will not eliminate the depressed income situation in District I. Different policies have to be advocated. Two alternatives are available: (1) increase income by increasing final demand in District I, and (2) change the structure of the economy.

The first alternative could include either an equal increase in demand in all sectors or an increase in one or several factors. Suppose an equal increase in final demand in all sectors is suggested to make family income in District I equal to that in District II. Total income in District I would have to be $896,911,000 in 1975. In order to obtain this income, final sector demands would have to be 54 percent larger than the estimated 1975 demands. If demand is increased in only a few of the sectors, the percentage increases would be even larger. The second alternative is to change the structure of the economy. This is the more realistic alternative, particularly if considered in conjunction with an increase in final demand. Structural changes are reflected by changes in the interdependence coefficients and the primary technical coefficients. The new coefficients can be used to project future input requirements and expected income.

The projection of family income illustrates but one application of the district input-output models. In addition, an estimate of the amount of required government expenditures for 1975 can be obtained. An estimate of future import and construction needs for the district can be obtained. For example, if family incomes in 1975 in District I were raised to the level in District II with no structural changes, government expenditures would have to be $150,413,000, construction demands would be $67,306,000, and $435,526,000 of goods and services would have to be imported. To those concerned with area development, the questions are: Will this level of government expenditures be available? Can the import and construction demands be met? Estimates of this nature are useful in determining future tax structures and needed public investments. They can also be used to estimate a capacity in the construction industry which would be needed for expansion. In addition, they provide information about possible bottlenecks to economic development in meeting the import requirements.

SUMMARY AND IMPLICATIONS

The general objective of this paper was to report on a district input-output analysis for Oklahoma. The state was divided into three separate districts, and models for each district were derived from an input-output model for the state. The district models were needed, because the state model was not fully representative of any one district. It could not be used to estimate the full extent of an economic change in a district.

It was determined that three models were necessary to analyze the districts within the state. Separate models for each district were obtained by adjusting the state model for differences in total production, levels of technology and imports. The empirical results varied greatly among the districts. The major conclusions are (1) that district input-output models can be constructed from available data; (2) that input-output models designed for a relatively homogenous district within a state produce valuable information not obtainable from more aggregate models; and (3) that district input-output models can provide useful information to assist in answering policy questions.

[8] For illustration purposes, a family size of 3.5 was assumed. This was the family size in both districts in 1960 [5, p. 17].

TABLE 3. ESTIMATED REQUIREMENTS OF PRIMARY INPUTS FOR THE THREE DISTRICTS IN OKLAHOMA FOR 1975

	District I	District II	District III
		(Thousands of Dollars)	
Construction	43,705	277,987	31,081
Government	97,671	634,415	72,593
Households	582,956	4,379,680	340,812
Imports	282,809	433,478	235,326

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