AN ECONOMIC ANALYSIS OF PLANT LOCATION BY COMMUNITY SIZE IN OKLAHOMA

By

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PREFACE

This study is concerned with the analysis of jobs created by new manufacturing plants and plant expansions in Oklahoma during the period 1963 to 1971. All communities in the state are divided into seven community size intervals. Each interval is examined to determine the types of manufacturers the interval attracted during the study period. Regression analysis is applied to seven community size intervals and eight types of manufacturing industries to determine the characteristics significant to different community sizes and manufacturing industries.

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CHAPTER I

INTRODUCTION

Statement of the Problem and Needs

In Oklahoma, as in other parts of the United States, rural residents continue to move to urban centers. In 1960, 37 percent of Oklahoma's population resided in rural areas (rural defined to encompass all persons living in open country and towns of 2,500 or less). In 1970, rural areas accounted for only 32 percent of the state's population.[1] Many that move to urban areas may prefer to live in rural communities. But new industrially based employment opportunities in rural communities have not expanded sufficiently to offset reduced labor requirements of agriculture and other basic industries and the natural increase in the rural work force.

Enticing more new industries to locate in nonmetropolitan areas is seen by many rural leaders as a means of reducing the trek of rural people to cities and as a means of increasing the economic development and growth of the rural community. The increased congestion in urban centers and expanded problems of pollution, travelling times, crime, etc., have increased the interest in the development of rural communities of national and state leaders as well as rural leaders and industry itself.

Knowledge of locational patterns of manufacturing establishments is essential if regional growth is to be understood and planned. This study is designed to provide information that will help uncover these locational patterns. The study investigates locational trends of manufacturing plants which began operations or expanded existing operations in Oklahoma during the period from 1963 through 1971.

This study is intended to provide useful data for local development planners in their efforts to persuade new industries to locate in their areas. For them and others who are interested in the development of rural areas, it is useful to understand how the market economy has been operating in the past. What types of plants have been locating in various community sizes and knowledge of capital or labor intensities of these plants are important aspects that need to be comprehended by local policy-makers. This analysis of past industry location should provide assistance to local development planners in evaluating the prospects for their areas to acquire additional employment in specific manufacturing industries.

Objectives of the Study

The general objective of this study is to analyze the geographical pattern and economic implications of the number of jobs created by new plant locations and expansions in Oklahoma from 1963 through 1971. More specifically, this study has two main sections with specific objectives associated with each section. These include:

I. A descriptive analysis of plant location in Oklahoma from 1963 through 1971.

   1. To determine the number of jobs created by new plants and plant expansions by community size;

   2. To ascertain the number of jobs created by industry type;

3. To ascertain the number of jobs created by districts in Oklahoma and which community sizes are most important within each district.
4. To evaluate which types of industries locating in Oklahoma are capital or labor intensive; and
5. To determine the community size intervals where different capital or labor intensive firms are locating.

II. An empirical analysis of plant location in Oklahoma.

1. To determine those factors associated with plant location for each community size; and
2. To predict a community's prospects of acquiring additional employment in specific manufacturing industries.

Previous Research

The variety of methodological approaches involved in measuring the relative significance of various factors on industrial location has resulted in a voluminous literature. Many authors use a technique that is mostly a description of observed or secondary data. One method widely used in descriptive studies is to survey those business executives who make location decisions for their respective firms. Surveys based on a questionnaire method usually include a predetermined list of location factors that business executives responsible for location decision-making are asked to rank or rate in order of importance in selecting a business or plant site. Other studies of a descriptive nature obtain most of their data pertaining to employment and investment of manufacturing firms from secondary data. Another technique used in a limited number of studies to analyze the significant or relevant forces of location for plant sites from empirical data is the multiple regression technique or sometimes referred to as regression analysis.

The following discussion of previous industrial location research is grouped into two major categories. The first group of studies is descriptive in nature and relate some past trends in manufacturing employment and investment. A second group of industrial studies uses quantitative methods, mainly regression analysis, to determine those significant factors which caused plants to locate at their present respective sites.

Descriptive Studies

There are many descriptive studies that have been undertaken during the past quarter century covering all sections of the nation. Below are summarized only a few of the major industrial location surveys based on the questionnaire method and those based on secondary publications. An annotated bibliography has been completed by Benjamin Stevens and Carolyn Brackett and should be referred to for a comprehensive review of descriptive studies on industrial location.[2]

Studies Using Survey Method. A Florida survey, directed by Melvin L. Greenhut was based on replies of 752 firms to a questionnaire sent to plant personnel locating in Florida in 1956 and 1957.[3] Decision makers were asked to select from 23 factors listed in the questionnaire, those first, second, and third factors which induced them to locate in Florida. Greenhut's study revealed that 488 of 752 decision makers cited "access to markets" or "anticipation of growth of markets" as the primary location factor. "Community attitudes and aid," which would include subsidies, were factors mentioned least.

In a study directed by the Bureau of Business Research at the University of Colorado, questionnaires were sent to 693 manufacturers who established plants in Colorado between 1948 and 1957.[4] Executives responsible for site selection for these firms were asked to indicate which of 30 selected factors had "strongly influenced," "some influence," or "no influence" in the choice of their plant site. Of 693 questionnaires sent out, only 36.5 percent were returned in exploitable form. The majority of respondents indicated that market orientation was the primary reason for location in Colorado. Factors listed as most important by firm executives were "availability of markets," "availability of future markets," and "overall growth of the state or area." None of those firms which located in Colorado during the given period placed primary importance upon subsidies.

The Oklahoma Bureau of Business Research undertook a study which included manufacturers who located plants in a six-state area: Oklahoma, Texas, Louisiana, Arkansas, Kansas, and Mississippi.[5] All firms chosen for the survey began operations after World War II in their respective states. Results of the survey were tabulated separately for large and small firms. Of 34 selected location factors listed on the questionnaire, "availability of product markets," "wages and salaries," and "abundance of general labor supply" were considered to be most important by the large and small firms surveyed. "Subsidies or other incentives by state or local groups" was rated last by both groups of firms.

To appraise the relative importance of various possible location factors in Ohio, 545 manufacturing company personnel who had located in that state since 1939 were surveyed.[6] Information was gained in two ways. Personal interviews were held with responsible representatives of 396 companies; questionnaires were sent to an additional 375 companies, of which 149 returned questionnaires proved to be useful. The 18 different location factors mentioned by 545 participating firms were ranked on the basis of the number of times they were mentioned whether as the "only factor," "the principal factor," or "a secondary or tertiary factor." Five principal factors deemed most important by national organizations which located branch plants in Ohio were market accessibility, labor and raw materials accessibility. Factors specifically of interest to relatively smaller operations were local ownership or residence of the owner, and available building and/or sites. Overall, market accessibility was the most frequently mentioned factor in this study with 41 percent of 545 industrialists mentioning it.

Industrial organizations providing the basis for a West Virginia study were manufacturing plants which were established in the state during the period between January 1945 and April 1956.[7] Data were obtained from a questionnaire survey made by the Bureau of Business Research of West Virginia University. Questionnaires were also sent to plant managers of 185 firms. Usable returns were received from 93, or 50 percent of the total number who received questionnaires. Attention was given to reasons that motivated managers to be interested in the question of plant location and to elements that exerted favorable influence on managers toward selecting their present sites in the state. Respondents were asked to indicate if they were "strongly influenced" by each factor, if it "had some influence," or "did not enter into the choice." Factors cited most frequently as influencing the choice of plant location by firms locating plants in West Virginia were adequacy of labor supply, transportation facilities, location with regard to materials, location with regard to markets, and labor costs.

<u>Studies Using Secondary Data Method</u>. Theodore Fuller conducted a study in Pennsylvania which evaluated changes in employment base rather than uncovering those factors leading to or causing the employment base change.[8] The study describes changes in manufacturing employment during 1960 and 1966 among 169 small centers. Small centers used in the study were under 25,000 population and were located outside the immediate vicinity of any large urban centers in Pennsylvania. Sources of his data were mainly from the Pennsylvania Industrial Directory and from County Industry Reports provided by the Pennsylvania Department of Internal Affairs, Division of Documents and Bureau of Statistics. The report describes changes in the amount and composition of manufacturing among small centers grouped by size and regional location. Fuller's conclusions indicated that industry in small centers outside the immediate vicinity of large urban places has been growing at a more rapid rate than in urban areas.

<u>Studies Using Quantitative Techniques</u>

Several studies applied quantitative techniques to analyze firm location. Two quantitative techniques used are multiple regression and discriminant analysis. More attention will be given to studies using multiple regression analysis since this technique was chosen for this study.

Of those studies using multiple regression, the most complete study was done by Spiegelman.[9] He used multiple regression techniques to explain changes in manufacturing employment from 1947 to 1958. His study was aimed at determining those forces associated with the location of individual manufacturing industries by state economic districts in the U.S. This technique was applied to disaggregated data which consisted of employment in manufacturing industries that were classified by the four-digit Standard Industrial Classification code. Fifty-three industries thus classified were studies on a geographic guide to determine significant area characteristics or variables influencing area performances of various industries.

Fuchs analyzed differential rates of growth of manufacturing in various parts of the United States during the period 1929 through 1954.[10] Data were obtained from the Bureau of Census. The basic method of analysis was the comparison of actual values for each state in 1954 with hypothetical figures showing values each state would have had if it had changed at the same rate as the nation between 1929 and 1954. Multiple regression was used in two phases of Fuchs' study. It was first used to estimate comparative growth of manufacturing (percent), adjusted, using state measures of various location factors in the independent variable. Multiple regression was again used to estimate plant mobility having various combinations of other industry characteristics as independent variables. Results of that study showed the South and the West growing much more rapidly than the nation as a whole; the North Central region just holding its own, and the Northeast having a large comparative loss.

Thompson and Mattila undertook a study to explore the nature of state industrial development with special emphasis on some first approximations to estimating equations with which employment growth trends might be predicted.[11] Employment growth was estimated by fitting a least squares trend line to annual employment data drawn from the 1947 and 1954 Census of Manufacturing and the 1949 to 1953 Annual Survey of Manufacturers. The analysis was concentrated on 20 variables of manufacturing industry groups with states being chosen as appropriate units of areal sub-division.

A study by Ben Zvi divided 200 plants which located in Oklahoma between 1920 and 1970 into three groups: those which indicated their reasons for specific location as to labor factors, operating cost factors or market factors.[12] The information for categorizing these plants into three groups was obtained through a questionnaire or personal interviews of both. After grouping plants he applied discriminant analysis to predict the adaptability of a specific firm to the state. This type of analysis was chosen because it reveals what locational factors are important as viewed by firms which build and operate their plants in an area. Ben Zvi's study showed that those factors attracting out-of-state firms to locate, in order of preference, were: labor supply, markets, labor and communities' attitude and expected future markets.

FOOTNOTES

[1] Luther Tweeten, "Elements of Economic Growth in Rural Areas," Research Application in Rural Economic Development and Planning, Research Report P-665, Oklahoma State University, Agriculture Experiment Station, July, 1972.

[2] Benjamin H. Stevens and Carolyn A. Bracket, Industrial Location: A Review and Annotated Bibliography of Theoretical, Empirical and Case Studies, Bibliography Series Number 3, Regional Science Research Institute, 1967.

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[4] L. J. Crompton and Paul W. DeGood, Industrial Location Survey, (Boulder, Colorado, Bureau of Business Research, University of Colorado, 1957).

[5] Francis R. Cella, et al., Factors Affecting Industrial Location in the Southwest (Norman, Oklahoma, Bureau of Business Research, University of Oklahoma, 1954).

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[7] James H. Thompson and Thomas S. Isack, Factors Influencing Plant Location in West Virginia, 1945-56, West Virginia University Bulletin Series 56, No. 12-4, June, 1956.

[8] Theodore E. Fuller, Trends in Manufacturing Among Small Centers of Pennsylvania, Pennsylvania State University, Agricultural Experiment Station Bulletin 788, December, 1971.

[9] Robert G. Spiegelman, A Study of Industry Location Using Multiple Regression Techniques, Agricultural Economics No. 140, ERS, USDA, August, 1968.

[10] Victor R. Fuchs, Changes in the Location of Manufacturing in the United States Since 1929 (New Haven and London, Yale University Press, 1962).

[11] Wilbur R. Thompson and John M. Mattila, An Econometric Model of Postwar State Industrial Development (Detroit, Wayne State University Press, 1959).

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CHAPTER II

PLANT LOCATION BY COMMUNITY SIZE IN OKLAHOMA

If local policy makers are to successfully compete for additional employment in specific manufacturing industries, it should be helpful for them to know how the market economy has been operating in the past. The fundamental importance of manufacturing industries in providing employment to both metropolitan and non-metropolitan areas makes them a key element in helping to explain past economy actions. Descriptive material denoting a manufacturing industry's actions from 1963 through 1971 should aid local development planners in evaluating the prospects for their areas to acquire additional employment.

Data Source and Classification

Data used in this descriptive analysis were obtained from the Bureau of Business Research, College of Business Administration, University of Oklahoma, Norman, Oklahoma. Data were collected by the Bureau from clues provided to them by major utility companies on the basis of new gas and electricity connections and by the Chamber of Commerce in each community as to new plants and plant expansions. Data were originally listed by new manufacturing plants and manufacturing plant expansions by communities in Oklahoma. In each instance information was carefully checked by the Bureau with a responsible officer of the firm so that every listing was a bona fide manufacturing plant which was actually in production.[1] If needed, the Bureau would follow up with a request for more pertinent information from the firm itself.

Information available concerning each listing included the Standard Industrial Classification Code (SIC),[2] when operations or expansions began, market served, total employment, and total capital investment. Each plant was assigned an industrial code (SIC) on the basis of its major activity, which was determined by the product or group of products produced or handled, or service rendered.

Data gathered by the Bureau of Business Research estimated the initial number of jobs created when operations were first begun by new plants and expansions to have been roughly 59,000 between 1963 and 1971. The Oklahoma Employment Security Commission supports this figure by reporting that of the jobs created from 1963 to 1971, the number still in existence is approximately 40,000.[3] This leaves roughly 19,000 jobs to have been annihilated by firms closing down operations, which is a reasonable figure for the time period in consideration.

Data for the 1960's indicate that manufacturing employment grew at greater rates in non-metropolitan than metropolitan areas in all regions of the nation except the Western United States.[4] This indicates that at least some segments of manufacturing are undergoing relative shifts from metropolitan to non-metropolitan areas. Therefore, the emphasis of this study was toward communities that conformed more to smaller size population intervals.

For study purposes all communities in Oklahoma were partitioned into seven intervals according to population.[4] These intervals are: 0-2,499; 2,500-4,999; 5,000-9,999; 10,000-14,999; 15,000-29,999;

30,000-99,999; and 100,000+. Each community's population was based on population counts taken in 1970. Smaller intervals were formed for lower populated areas because of the wider range of characteristics shared by communities in these intervals. Generally, as the community size increased, the disparity in characteristics decreased, therefore, the magnitude of those intervals were increased. Also, another reason for forming smaller intervals for lower populated areas was because the study was mainly interested in rural areas and a more detailed analysis could be completed on these smaller intervals. Even though these smaller communities were divided into smaller intervals, the total population of each interval was fairly uniform. The interval, 10,000-14,999, represented the fewest number of people. It contained 105,562. Other intervals contained roughly 240,000 each except the interval containing Oklahoma City and Tulsa which contained 698,119.

Jobs Created by Industry Type and Community Size

A perspective on manufacturing trends in Oklahoma can be secured by determining the number of jobs generated by new plants and expansions of existing plants in the state. From 1963 through 1971 there were 58,693 new manufacturing jobs created in Oklahoma. Of these 58,693 jobs, new manufacturing plants provided 49.7 percent and expansions added the remaining 50.3 percent. Job creation from new plants and expansions of existing plants are almost of equal importance to Oklahoma in terms of providing new manufacturing employment.

Number of Jobs Created by New Plants

The number of jobs created by new manufacturing plants which located in Oklahoma from 1963 through 1971 was 29,172 (Table I). This total was spread sporadically throughout all community size intervals. The interval containing communities with a population of over 100,000 was most conducive to new plant location. In fact, 26.6 percent of the jobs created by new plants during the period were in this interval. It should be noted that this interval is composed entirely of Oklahoma City and Tulsa.[6]

The 5,000-9,999 interval received 7,306 jobs, which represented 25 percent of the jobs created by new plants in Oklahoma from 1963 through 1971 (Table I). During 1970 and 1971, there were more jobs created in this interval than any other community size interval. This data indicates that in recent years smaller communities were more attractive to plant location than large metropolitan centers. Intervals 0-2,499 and 15,000-29,999 supported another 15.5 and 11.9 percent, respectively, of the jobs created by new manufacturing plants. Jobs created in these intervals indicate that manufacturing employment in small centers is a significant part of the state's total amount of new employment.

Data from Table I suggests that 47 percent of those jobs created by new manufacturing plants existed in communities with a population of less than 10,000 people. If all communities with a population of less than 30,000 are included, then 66.1 percent of all jobs created is encompassed. Data on firms creating jobs in metropolitan versus nonmetropolitan manufacturing support trends previously cited. The difference in jobs created in large urban areas and small centers suggests

TABLE I

NUMBER OF JOBS CREATED BY NEW MANUFACTURING PLANTS
LOCATING IN OKLAHOMA FROM 1963 THROUGH 1971
CLASSIFIED BY COMMUNITY SIZE

Community Size	1963	1964	1965	1966	1967	1968	1969	1970	1971	Total	Percent
0-2,499	282	291	8	323	655	760	910	821	462	4,512	15.5
2,500-4,999	80	12	109	86	34	476	609	385	105	1,896	6.5
5,000-9,999	248	35	287	1,299	817	677	1,239	1,118	1,586	7,306	25.1
10,000-14,999	77	8	158	119	273	256	413	150	655	2,109	7.2
15,000-29,999	125	31	209	414	310	802	1,490	50	47	3,478	11.9
30,000-99,999		155	73	153	375	397	403	500	51	2,107	7.2
100,000+	2,809	460	307	463	703	238	1,237	482	1,065	7,764	26.6
Total	3,621	992	1,151	2,857	3,167	3,606	6,301	3,506	3,963	29,172	100.0
Percent	12.4	3.4	3.9	9.8	10.9	12.4	21.6	12.0	13.6	100.0	

a relative shift of employment away from large metropolitan agglomerations.

The number of jobs created in the state by new manufacturing plants increased steadily throughout the period 1963 through 1971. During years 1963 through 1965, 33.2 percent of the jobs were created; whereas during the last three years, 1969 through 1971, almost half, or 47.2 percent, of the jobs were created.

Number of Jobs Created by Plant Expansions

Expansions of existing plants provided the state of Oklahoma with 29,521 jobs between 1963 through 1971 (Table II). This represented 50.7 percent of all jobs created in the state by both new plants and expansions of existing plants. It appears that the number and size of existing plants were definitely a stabilizing and growth factor in the state. Of those 29,521 jobs, 59.1 percent were created in communities with a population of over 100,000. Combining the number of jobs created by plant expansions with jobs created by new plants in the 100,000+ interval, roughly 43 percent of all jobs created from 1963 through 1971 are included. This means that 43 percent of the new manufacturing employment in the state was created in Oklahoma City and Tulsa.

Other communities that prospered substantially from expansions of existing plants were those in intervals 5,000-9,999; 10,000-14,999 and 15,000-29,999. The group of communities which constituted the 5,000-9,999 interval provided a base for 3,899 jobs or 13.2 percent of all jobs created by expansion (Table II). The interval consisting of the group of communities with a population between 10,000-14,999 provided

TABLE II

NUMBER OF JOBS CREATED BY EXPANSIONS OF EXISTING PLANTS
IN OKLAHOMA FROM 1963 THROUGH 1971
CLASSIFIED BY COMMUNITY SIZE

Community Size	1963	1964	1965	1966	1967	1968	1969	1970	1971	Total	Percent
0-2,499	103	3	20	186	224	200	124	401	294	1,555	5.3
2,500-4,999		35	88	92	67	80	120	95	76	653	2.2
5,000-9,999	315	529	190	575	556	525	184	524	561	3,899	13.2
10,000-14,999	333	123	580	203	67	70	125	550	120	2,171	7.4
15,000-29,999	390	113	388	876	73	136	262		310	2,548	8.6
30,000-99,999		80	45	76	523	25	300	144	67	1,260	4.3
100,000+	188	4,459	232	2,963	1,399	2,444	2,807	2,502	441	17,435	59.0
Total	1,329	5,342	1,543	4,911	2,909	3,480	3,922	4,216	1,869	29,521	100.0
Percent	4.5	18.1	5.2	16.6	9.9	11.8	13.3	14.3	6.3	100.0	

for 7.4 percent of those jobs created by expansions while the interval 15,000-29,999 provided for another 8.6 percent.

Expansions of existing plants were least active in the group of communities which conformed to the population interval 2,500-4,999. Only 653 jobs or 2.2 percent of those jobs created by expansions were represented in this group (Table II). This same group of communities was also lacking in promotional skills in the enticement of new plants (Table I). Throughout the state this interval accounted for only 4.3 percent of all new jobs created which was the least amount for any community size interval.

The years with greatest plant expansion were somewhat different than the years with greatest new plant location. The year most favorable for expansions of existing plants was 1964 (Table II). A total of 5,342 jobs were created by expansions in 1964. There were 4,911 additional jobs created in the year 1966.

Jobs Created by New Plants by Industry Type

Wide variation existed in the types of manufacturing plants that chose to locate in Oklahoma from 1963 through 1971. The type of new plants which created more jobs than any other was those manufacturers engaged in the production of apparel and related products (SIC code 23). Manufacturers of apparel and related products generated 4,670 jobs or 16 percent of all jobs created in Oklahoma by new manufacturing plants from 1963 through 1971 (Table III). Of the 4,670 jobs created by manufacturers of apparel and related products, roughly 69 percent were created in non-metropolitan centers with a population of less than 30,000. Thus, the apparel and related products industry not only

TABLE III

NUMBER OF JOBS CREATED BY NEW MANUFACTURING PLANTS LOCATING IN OKLAHOMA FROM 1963 THROUGH 1971 CLASSIFIED BY INDUSTRY TYPE AND COMMUNITY SIZE

SIC Code	Industry Group	0-2,499	2,500-4,999	5,000-9,999	10,000-14,999	15,000-29,999	30,000-99,999	100,000+	Total	Percent
19	Ordnance and Accessories	0	0	0	0	0	6	0	6	0.0
20	Food and Kindred Products	49	42	584	14	26	189	295	1,999	4.1
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	691	257	311	430	82	0	0	1,771	6.1
23	Apparel and Related Products	250	455	1,797	125	608	362	1,073	4,670	16.0
24	Lumber and Wood Products	108	143	485	0	40	25	13	814	2.8
25	Furniture and Fixtures	510	31	1,424	320	0	5	45	2,335	8.0
26	Paper and Allied Products	706	0	35	0	7	0	73	821	2.8
27	Printing, Publishing and Allied Products	0	0	0	0	10	3	281	294	1.0
28	Chemicals and Allied Products	187	109	186	25	0	0	216	723	2.5
29	Petroleum and Coal Products	96	10	128	0	20	0	127	381	1.3
30	Rubber and Plastic Products	0	65	10	4	1,443	350	1,406	3,278	11.2
31	Leather and Leather Products	40	0	0	3	0	0	27	70	0.2
32	Stone, Clay and Glass Products	387	95	229	7	135	21	220	1,094	3.8
33	Primary Metals	339	78	770	28	0	125	243	1,583	5.4
34	Fabricated Metals	128	122	65	146	432	90	413	1,396	4.8
35	Machinery Except Electrical	75	230	377	100	138	500	349	1,769	6.1
36	Electrical Machinery	264	31	186	12	86	0	2,654	3,233	11.1
37	Transportation Equipment	621	185	511	778	401	431	252	3,179	10.9
38	Instruments and Related Products	0	9	100	0	43	0	4	156	0.5
39	Miscellaneous Manufacturing	61	34	108	117	7	0	73	400	1.4
	Total	4,512	1,896	7,306	2,109	3,476	2,107	7,764	29,172	100.0
	Percent	15.5	6.5	25.1	7.2	11.9	7.2	26.6	100.00	

created more jobs than any other industry, but was also attracted to non-metropolitan areas.

The state was also popular with other types on industry. Those industries which produced rubber and plastic products (SIC code 30), electrical machinery (SIC code 36), and transportation equipment (SIC code 37) generated 3,278, 3,233, and 3,179 jobs, respectively (Table III). Jobs in each of these industries represented approximately 11 percent of the total number of jobs created by new plants. Of those jobs created in the transportation equipment industry, 78.5 percent were created in communities with a population of less than 30,000. Manufacturers of rubber and plastic products created only 46.4 percent of their jobs in communities with less than 30,000 population. Most jobs created by manufacturers of electrical machinery were in metropolitan centers with a population of over 30,000 (Table III). Only 17.9 percent of those jobs created by this type of industry was created in communities with a population of less than 30,000. This suggests that manufacturers in this category preferred the larger-sized communities for the location of their new plants. Some possibilities for this preference could be that this type of industry gravitates to larger centers, or that this industry requires large-sized plants and due to physical layout or workforce, these plants are more adapted to large centers.

Other types of industries which located new plants in the state and also created a substantial amount of jobs were: manufacturers of textile mill products (SIC code 25), manufacturers of fabricated metals (SIC code 34), and manufacturers of machinery except electrical (Table III). Manufacturers of furniture and fixtures created 2,355 jobs in the state.

Almost 98 percent of these jobs were created in centers with a population of less than 30,000. Manufacturers of textile mill products created another 1,771 jobs in the state. Every one of these jobs was created in centers with a population of less than 30,000. This implies that small centers were highly conducive to these industrial types. Manufacturers of fabricated metals and manufacturers of machinery except electrical added another 1,396 and 1,769 jobs, respectively. These industries also created most of their jobs in small non-metropolitan areas.

Industries which created very few jobs in Oklahoma from 1963 through 1971 should be mentioned. Industries that created one percent or less of those jobs created by new manufacturing plants were those manufacturing: ordnance and accessories (SIC code 19); printing and publishing (SIC code 27); leather and leather products (SIC code 31); and instruments and related products (SIC code 38). All these types of industry together only created 526 jobs or 1.8 percent of all jobs created by new plants. This reveals that Oklahoma did have a wide variation in types of industry which located new plants from 1963 through 1971 and that only certain types of these industries were of any great importance to the state in terms of providing employment opportunities.

<u>Jobs Created by Expansions by Industry Type</u>

Expansions of existing plants were centered mainly around two types of industries, existing plants manufacturing transportation equipment (SIC code 37) and those manufacturing ordnance and accessories (SIC code 19). Manufacturers of transportation equipment created 19.1

percent while manufacturers of ordnance and accessories created another 17.3 percent of those jobs created by expansions (Table IV). The adverse of this was found to have been true of manufacturers of ordnance and accessories for new plant locations. Less than one percent of those jobs created by these two types of industry were created in centers with over 100,000 population. Manufacturers of ordnance and accessories created 4,654 (91.1 percent) jobs in large centers while manufacturers of transportation equipment added another 3,903 (69.1 percent) jobs to large centers. This suggests that expansions of existing plants were most active in large centers where the manufacturing base was already established, whereas new plants created most of their jobs in centers with a population of less than 30,000.

Other types on industry were also relevant to Oklahoma in creating jobs by expansion from 1963 through 1971. Manufacturers of apparel and related products (SIC code 23), machinery except electrical (SIC code 35), and electrical machinery (SIC code 36) created 12.4, 14.1 and 11.4 percent, respectively of those jobs created by expansions (Table IV). Most jobs created by each of these three types of industry were again created in centers with over 100,000 population. Overall, those industries that were active in expansions were located in large metropolitan areas.

An important aspect of the way industry expanded centers on whether gains occurred mainly because of the creation of new plants, or due to growth of existing plants. It was found that throughout Oklahoma the creation of new plants provided 49.7 percent and plant expansions provided 50.3 percent of the total amount of manufacturing jobs created. This reveals that location of new plants and growth of existing plants

TABLE IV

NUMBER OF JOBS CREATED BY EXPANSIONS OF EXISTING PLANTS IN OKLAHOMA FROM 1963 THROUGH 1971 CLASSIFIED BY INDUSTRY TYPE AND COMMUNITY SIZE

SIC Code	Industry Group	0-2,499	2,500-4,999	5,000-9,999	10,000-14,999	15,000-29,999	30,000-99,999	100,000+	Total	Percent
19	Ordnance and Accessories	0	0	0	20	436	0	4,654	5,110	17.3
20	Food and Kindred Products	39	0	151	79	66	32	403	770	2.6
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	200	0	500	250	0	0	0	950	3.2
23	Apparel and Related Products	175	217	1,901	570	388	285	131	3,667	12.4
24	Lumber and Wood Products	100	143	91	100	0	0	50	484	1.6
25	Furniture and Fixtures	15	0	30	0	0	7	90	142	0.5
26	Paper and Allied Products	11	0	0	17	0	0	41	69	0.2
27	Printing, Publishing and Allied Products	0	2	0	0	0	0	87	89	0.3
28	Chemicals and Allied Products	2	0	22	0	6	0	308	338	1.2
29	Petroleum and Coal Products	18	30	25	0	248	0	70	391	1.3
30	Rubber and Plastic Products	0	2	73	45	160	0	424	704	2.4
31	Leather and Leather Products	0	0	145	0	0	0	5	150	0.5
32	Stone, Clay and Glass Products	36	26	12	75	13	0	144	306	1.1
33	Primary Metals	0	122	60	190	81	0	279	732	2.5
34	Fabricated Metals	62	26	160	60	41	50	1,526	1,925	6.5
35	Machinery Except Electrical	188	36	363	199	212	419	2,758	4,175	14.5
36	Electrical Machinery	286	35	80	50	457	177	2,291	3,376	11.4
37	Transportation Equipment	423	14	138	456	440	275	3,903	5,649	19.1
38	Instruments and Related Products	0	0	100	0	0	2	139	241	0.8
39	Miscellaneous Manufacturing	0	0	48	60	0	13	132	253	0.9
	Total	1,555	653	3,899	2,171	2,548	1,260	17,435	29,521	100.0
	Percent	5.3	2.2	13.2	7.4	8.6	4.3	59.0	100.0	

were of approximately equal importance to the state. However, there was a difference in the size of communities in which each was active. Most jobs created by new plants were in centers with a population of less than 30,000, whereas expansions created most of their jobs in metropolitan areas with a population of over 100,000.

Number of Jobs Created by Types of New Plants

The types of manufacturing industries which have been locating in various community sizes in Oklahoma are another important aspect of employment characteristics of new plants. Overall, each community size attracted a wide variety of industrial types. Some were more prominent among certain community sizes than others. There was also a considerable difference in the number of jobs created each year by new plants in each community size.

Community Size Interval 0-2,499. Communities with a population in the range of 0-2,499 were most attractive to industries manufacturing textile mill products (SIC code 22) and paper and allied products (SIC code 26). Each accounts for approximately 15.5 percent of those 4,512 jobs created in this community size group (Table V). Also, industries manufacturing transportation equipment (SIC 37) created 621 jobs or 13.8 percent of all new jobs created in this community size interval. Together, these manufacturing industries generated 44.7 percent of all jobs created by new plants in the 0-2,499 community size group.

According to data in Table V, there appears to be an indication of an upward trend in the number of jobs being created form 1963 through 1971 when analyzed in three-year increments. More and more jobs

TABLE V

NUMBER OF JOBS CREATED BY TYPES OF NEW MANUFACTURING PLANTS IN COMMUNITIES WITH A POPULATION IN THE RANGE 0-2,499 IN OKLAHOMA FROM 1963 THROUGH 1971

SIC Code	Industry Group	1963	1964	1965	1966	1967	1968	1969	1970	1971	Total	Percent
19	Ordnance and Accessories	0	0	0	0	0	0	0	0	0	0	0.0
20	Food and Kindred Products	4	0	0	0	0	9	22	0	14	49	1.1
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	0	0	0	16	225	0	450	0	0	691	15.3
23	Apparel and Related Products	250	0	0	0	0	0	0	0	0	250	5.5
24	Lumber and Wood Products	0	0	0	0	0	0	0	108	0	108	2.4
25	Furniture and Fixtures	0	0	0	90	0	0	35	35	350	510	11.3
26	Paper and Allied Products	0	213	0	0	38	0	0	450	5	706	15.6
27	Printing, Publishing and Allied Products	0	0	0	0	0	0	0	0	0	0	0.0
28	Chemicals and Allied Products	4	3	3	0	0	125	52	0	0	187	4.1
29	Petroleum and Coal Products	12	64	0	0	9	11	0	0	0	96	2.1
30	Rubber and Plastic Products	0	0	0	0	0	0	0	0	0	0	0.0
31	Leather and Leather Products	0	0	0	0	0	0	0	40	0	40	0.9
32	Stone, Clay and Glass Products	0	0	5	0	0	350	22	10	0	387	8.6
33	Primary Metals	4	0	0	35	300	0	0	0	0	339	7.5
34	Fabricated Metals	0	0	0	0	55	0	18	35	20	128	2.8
35	Machinery Except Electrical	6	5	0	0	28	0	0	28	8	75	1.7
36	Electrical Machinery	2	0	0	182	0	50	30	0	0	264	5.9
37	Transportation Equipment	0	0	0	0	0	195	256	105	65	621	13.8
38	Instruments and Related Products	0	0	0	0	0	0	0	0	0	0	0.0
39	Miscellaneous Manufacturing	0	6	0	0	0	20	25	10	0	61	1.4
	Total	282	291	8	323	655	760	910	821	462	4,512	100.0
	Percent	6.3	6.4	0.2	7.2	14.5	16.8	20.2	18.2	10.2	100.0	

were created each succeeding three-year period, indicating an increasing trend in the number of jobs being created by new plants for this community size group.

Community Size Interval 2,500-4,999. Data in Table VI suggests that manufacturers of apparel and related products were the most popular industry for communities with a population between 2,500-4,999. Manufacturers of apparel and related products generated 24.0 percent of the total number of new jobs created in this community size group. Two other industrial types created a considerable number of jobs, those manufacturing textile mill products (SIC code 22), and those manufacturing machinery except electrical (SIC code 35). Together they were responsible for 25.7 percent of the jobs created in the 2,500-4,999 group from 1963 through 1971.

Most jobs created by new plants in the 2,500-4,999 interval were created from 1968 through 1970. A total of 1,470 new jobs were created during this three-year period (Table VI). However, other years were not so successful. Only 12 jobs were created in 1964, while 1967 only added another 34. Most remaining years added an average of about 90 jobs each.

Community Size Interval 5,000-9,999. Manufacturers of apparel and related products (SIC code 23) and furniture and fixtures (SIC code 25) dominated the communities with a population in the interval 5,000-9,999 (Table VII). Almost 45 percent of those new jobs in this community size was created by these two types of manufacturing industries.

The years most conducive to new plant location were again in the latter part of the 1960's. In the five-year span of 1966-70, a total of 5,150 new jobs were created in the 5,000-9,999 community size group (Table VII).

TABLE VI

NUMBER OF JOBS CREATED BY TYPES OF NEW MANUFACTURING PLANTS IN COMMUNITIES WITH A POPULATION IN THE RANGE 2,500-4,999 IN OKLAHOMA FROM 1963 THROUGH 1971

SIC Code	Industry Group	1963	1964	1965	1966	1967	1968	1969	1970	1971	Total	Percent
19	Ordnance and Accessories	0	0	0	0	0	0	0	0	0	0	0.0
20	Food and Kindred Products	10	0	12	0	0	0	20	0	0	42	2.2
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	0	0	0	0	2	180	0	0	75	257	13.6
23	Apparel and Related Products	0	0	70	0	25	150	110	100	0	455	24.0
24	Lumber and Wood Products	0	0	15	8	0	0	120	0	0	143	7.6
25	Furniture and Fixtures	25	0	0	0	0	0	0	6	0	31	1.6
26	Paper and Allied Products	0	0	0	0	0	0	0	0	0	0	0.0
27	Printing, Publishing and Allied Products	0	0	0	0	0	0	0	0	0	0	0.0
28	Chemicals and Allied Products	17	4	8	0	0	0	0	75	5	109	5.8
29	Petroleum and Coal Products	0	0	0	0	0	0	10	0	0	10	0.5
30	Rubber and Plastic Products	0	0	0	0	0	50	15	0	0	65	3.4
31	Leather and Leather Products	0	0	0	0	0	0	0	0	0	0	0.0
32	Stone, Clay and Glass Products	20	3	0	0	7	6	5	29	25	95	5.0
33	Primary Metals	0	0	4	59	0	0	0	15	0	78	4.1
34	Fabricated Metals	0	0	0	0	0	52	40	30	0	122	6.4
35	Machinery Except Electrical	0	0	0	5	0	0	225	0	0	230	12.1
36	Electrical Machinery	8	5	0	14	0	4	0	0	0	31	1.6
37	Transportation Equipment	0	0	0	0	0	3	52	130	0	185	9.8
38	Instruments and Related Products	0	0	0	0	0	9	0	0	0	9	05.
39	Miscellaneous Manufacturing	0	0	0	0	0	22	12	0	0	34	1.8
	Total	80	12	109	86	34	476	609	385	105	1,896	100.0
	Percent	4.2	0.6	5.8	4.5	1.8	25.1	32.1	20.3	5.6	100.0	

TABLE VII

NUMBER OF JOBS CREATED BY TYPES OF NEW MANUFACTURING PLANTS IN COMMUNITIES WITH A POPULATION IN THE RANGE 5,000-9,999 IN OKLAHOMA FROM 1963 THROUGH 1971

SIC Code	Industry Group	1963	1964	1965	1966	1967	1968	1969	1970	1971	Total	Percent
19	Ordnance and Accessories	0	0	0	0	0	0	0	0	0	0	0.0
20	Food and Kindred Products	5	0	3	10	11	20	285	0	250	584	8.0
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	85	0	0	21	0	0	150	0	55	311	4.3
23	Apparel and Related Products	145	0	0	85	77	300	375	500	315	1,797	24.6
24	Lumber and Wood Products	0	0	0	0	0	15	0	470	0	485	6.6
25	Furniture and Fixtures	0	6	0	1,018	400	0	0	0	0	1,424	19.5
26	Paper and Allied Products	0	0	0	0	0	0	35	0	0	35	0.5
27	Printing, Publishing and Allied Products	0	0	0	0	0	0	0	0	0	0	0.0
28	Chemicals and Allied Products	3	4	60	0	68	4	44	0	3	186	2.5
29	Petroleum and Coal Products	0	0	100	20	0	8	0	0	0	128	1.8
30	Rubber and Plastic Products	10	0	0	0	0	0	0	0	0	10	0.1
31	Leather and Leather Products	0	0	0	0	0	0	0	0	0	0	0.0
32	Stone, Clay and Glass Products	0	1	0	0	11	110	100	7	0	229	3.1
33	Primary Metals	0	0	0	50	0	120	0	0	600	770	10.5
34	Fabricated Metals	0	0	30	30	0	0	0	0	5	65	0.9
35	Machinery Except Electrical	0	24	94	57	0	0	139	5	58	377	5.2
36	Electrical Machinery	0	0	0	0	0	0	0	86	100	186	2.5
37	Transportation Equipment	0	0	0	0	150	100	11	50	200	511	7.0
38	Instruments and Related Products	0	0	0	0	100	0	0	0	0	100	1.4
39	Miscellaneous Manufacturing	0	0	0	8	0	0	100	0	0	108	1.5
	Total	248	35	287	1,299	817	677	1,239	1,118	1,586	7,306	100.0
	Percent	3.4	0.5	3.9	17.8	11.2	9.3	16.9	15.3	21.7	100.0	

<u>Community Size Interval 10,000-14,999</u>. The interval consisting of communities with a population in the range of 10,000-14,999 had most of their new jobs created by manufacturers of transportation equipment (SIC code 37). Of the 2,109 jobs created in the 10,000-14,999 group, 36.9 percent were created by this industrial type (Table VIII). The industry creating the next greatest number of jobs for these size communities was manufacturers of textile mill products. A total of 20.4 percent of the jobs created by the location of new plants was created by this type of industry. Manufacturers of furniture and fixtures accounted for another 15.2 percent. It appears that communities with a population between 10,000-14,999 were conducive to only a few types of industries while most other types of manufacturing industries chose to locate in other size communities.

<u>Community Size Interval 15,000-29,000</u>. Manufacturers of rubber and plastic products were the most popular type of industry for communities with a population between 15,000-29,999 (Table IX). A total of 41.5 percent of all jobs created from 1963 through 1971 in the 15,000-29,999 group was created by this type of manufacturers. Three other types of industry were also important to this population interval. Manufacturers of apparel and related products, fabricated metals, and transportation equipment created 17.5, 12.4 and 11.5 percent, respectively, of those new jobs generated from 1963 through 1971. These three industry types together accounted for 41.4 percent of those new jobs in this population interval.

Communities with a population between 15,000-29,999 and 10,000-14,999 received the largest yearly percentage of their new jobs in 1969 and 1971. However, both 1969 and 1971 were fairly good years for

TABLE VIII

NUMBER OF JOBS CREATED BY TYPES OF NEW MANUFACTURING PLANTS IN COMMUNITIES WITH A POPULATION IN THE RANGE 10,000-14,999 IN OKLAHOMA FROM 1963 THROUGH 1971

SIC Code	Industry Group	1963	1964	1965	1966	1967	1968	1969	1970	1971	Total	Percent
19	Ordnance and Accessories	0	0	0	0	0	0	0	0	0	0	0.0
20	Food and Kindred Products	10	0	0	0	0	4	0	0	0	14	0.7
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	55	0	0	100	0	75	200	0	0	430	20.4
23	Apparel and Related Products	0	0	0	0	0	125	0	0	0	125	5.9
24	Lumber and Wood Products	0	0	0	0	0	0	0	0	0	0	0.0
25	Furniture and Fixtures	0	0	0	0	220	0	100	0	0	320	15.2
26	Paper and Allied Products	0	0	0	0	0	0	0	0	0	0	0.0
27	Printing, Publishing and Allied Products	0	0	0	0	0	0	0	0	0	0	0.0
28	Chemicals and Allied Products	0	5	5	10	0	0	5	0	0	25	1.2
29	Petroleum and Coal Products	0	0	0	0	0	0	0	0	0	0	0.0
30	Rubber and Plastic Products	0	0	0	4	0	0	0	0	0	4	0.2
31	Leather and Leather Products	0	3	0	0	0	0	0	0	0	3	0.2
32	Stone, Clay and Glass Products	7	0	0	0	0	0	0	0	0	7	0.3
33	Primary Metals	0	0	0	0	0	0	28	0	0	28	1.3
34	Fabricated Metals	0	0	13	0	8	40	30	0	55	146	6.9
35	Machinery Except Electrical	0	0	0	0	0	0	0	0	100	100	4.7
36	Electrical Machinery	0	0	0	0	0	12	0	0	0	12	0.6
37	Transportation Equipment	5	0	23	5	45	0	50	150	500	778	36.9
38	Instruments and Related Products	0	0	0	0	0	0	0	0	0	0	0.0
39	Miscellaneous Manufacturing	0	0	117	0	0	0	0	0	0	117	5.5
	Total	77	8	158	119	273	256	413	150	655	2,109	100.0
	Percent	3.7	0.4	7.5	5.6	12.9	12.1	19.6	7.1	31.1	100.0	

TABLE IX

NUMBER OF JOBS CREATED BY TYPES OF NEW MANUFACTURING PLANTS IN COMMUNITIES WITH A POPULATION IN THE RANGE 15,000-29,999 IN OKLAHOMA FROM 1963 THROUGH 1971

SIC Code	Industry Group	1963	1964	1965	1966	1967	1968	1969	1970	1971	Total	Percent
19	Ordnance and Accessories	0	0	0	0	0	0	0	0	0	0	0.0
20	Food and Kindred Products	26	0	0	0	0	0	0	0	0	26	0.7
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	0	0	0	0	0	75	0	0	7	82	2.4
23	Apparel and Related Products	8	0	0	300	300	0	0	0	0	608	17.5
24	Lumber and Wood Products	0	0	0	0	0	0	0	40	0	40	1.1
25	Furniture and Fixtures	0	0	0	0	0	0	0	0	0	0	0.0
26	Paper and Allied Products	0	0	7	0	0	0	0	0	0	7	0.2
27	Printing, Publishing and Allied Products	0	0	0	0	0	0	0	0	10	10	0.3
28	Chemicals and Allied Products	0	0	0	0	0	0	0	0	0	0	0.0
29	Petroleum and Coal Products	0	0	0	0	0	20	0	0	0	20	0.6
30	Rubber and Plastic Products	10	0	0	3	0	100	1,300	0	30	1,443	41.5
31	Leather and Leather Products	0	0	0	0	0	0	0	0	0	0	0.0
32	Stone, Clay and Glass Products	0	0	0	0	0	135	0	0	0	135	3.9
33	Primary Metals	0	0	0	0	0	0	0	0	0	0	0.0
34	Fabricated Metals	16	0	79	0	0	297	40	0	0	432	12.4
35	Machinery Except Electrical	0	0	85	53	0	0	0	0	0	138	4.0
36	Electrical Machinery	65	0	6	15	0	0	0	0	0	86	2.5
37	Transportation Equipment	0	24	14	18	10	175	150	10	0	401	11.5
38	Instruments and Related Products	0	0	18	25	0	0	0	0	0	43	1.2
39	Miscellaneous Manufacturing	0	7	0	0	0	0	0	0	0	7	0.2
	Total	125	31	209	414	310	802	1,490	50	47	3,478	100.0
	Percent	3.6	0.9	6.0	11.9	8.9	23.1	42.8	1.4	1.4	100.0	

communities with a population in either interval. Communities in these intervals were less conducive to industry location than other size communities in 1964. That year yielded fewer jobs for these two intervals than any other one year.

Community Size Interval 30,000-99,999. There were four industrial types that dominated the 30,000-99,999 population interval from 1963 through 1971 (Table X). These were manufacturers of apparel and related products; rubber and plastic products; machinery except electrical; and transportation equipment. Manufacturers of nonelectrical machinery were most prominent by creating 23.7 percent of all jobs created in this population interval. The other three, manufacturers of apparel, rubber, and transportation equipment created 17.2, 16.6 and 20.5 percent, respectively. Altogether, these industrial types generated 78.0 percent of those jobs created from 1963 through 1971 by new plants in the 30,000-99,999 population interval.

The years most conducive to the location of new plants in communities with a population in the range of 30,000-99,999 were those years between 1967 and 1970 (Table X). The four years combined accounted for 80.5 percent of all jobs created between 1963-71 in the 30,000-99,999 population interval.

Community Size Interval 100,000+. Metropolitan areas with a population of over 100,000 were conducive to almost every type of industry which located new plants from 1963 through 1971 (Table XI). The most important type of manufacturing industry was the industrial group which manufactured electrical machinery. A total of 2,654 jobs or 34.2 percent was created by this type of industry. Other types

TABLE X

NUMBER OF JOBS CREATED BY TYPES OF NEW MANUFACTURING PLANTS IN COMMUNITIES WITH A POPULATION IN THE RANGE 30,000-99,999 IN OKLAHOMA FROM 1963 THROUGH 1971

SIC Code	Industry Group	1963	1964	1965	1966	1967	1968	1969	1970	1971	Total	Percent
19	Ordnance and Accessories	0	0	0	6	0	0	0	0	0	6	0.3
20	Food and Kindred Products	0	152	0	0	0	12	0	0	25	189	9.0
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	0	0	0	0	0	0	0	0	0	0	0.0
23	Apparel and Related Products	0	0	0	12	350	0	0	0	0	362	17.2
24	Lumber and Wood Products	0	0	0	0	25	0	0	0	0	25	1.2
25	Furniture and Fixtures	0	0	5	0	0	0	0	0	0	5	0.2
26	Paper and Allied Products	0	0	0	0	0	0	0	0	0	0	0.0
27	Printing, Publishing and Allied Products	0	3	0	0	0	0	0	0	0	3	0.1
28	Chemicals and Allied Products	0	0	0	0	0	0	0	0	0	0	0.0
29	Petroleum and Coal Products	0	0	0	0	0	0	0	0	0	0	0.0
30	Rubber and Plastic Products	0	0	0	0	0	350	0	0	0	350	16.6
31	Leather and Leather Products	0	0	0	0	0	0	0	0	0	0	0.0
32	Stone, Clay and Glass Products	0	0	8	10	0	0	3	0	0	21	1.0
33	Primary Metals	0	0	0	125	0	0	0	0	0	125	5.9
34	Fabricated Metals	0	0	60	0	0	0	30	0	0	90	4.3
35	Machinery Except Electrical	0	0	0	0	0	0	0	500	0	500	23.7
36	Electrical Machinery	0	0	0	0	0	0	0	0	0	0	0.0
37	Transportation Equipment	0	0	0	0	0	35	370	0	26	431	20.5
38	Instruments and Related Products	0	0	0	0	0	0	0	0	0	0	0.0
39	Miscellaneous Manufacturing	0	0	0	0	0	0	0	0	0	0	0.0
	Total	0	155	73	153	375	397	403	500	51	2,107	100.0
	Percent	0.0	7.4	3.5	7.3	17.8	18.8	19.1	23.7	2.4	100.0	

TABLE XI

NUMBER OF JOBS CREATED BY TYPES OF NEW MANUFACTURING PLANTS IN COMMUNITIES WITH A POPULATION OVER 100,000 IN OKLAHOMA FROM 1963 THROUGH 1971

SIC Code	Industry Group	1963	1964	1965	1966	1967	1968	1969	1970	1971	Total	Percent
19	Ordnance and Accessories	0	0	0	0	0	0	0	0	0	0	0.0
20	Food and Kindred Products	47	0	50	0	0	0	0	155	43	295	3.8
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	0	0	0	0	0	0	0	0	0	0	0.0
23	Apparel and Related Products	45	0	0	0	0	18	0	0	1,010	1,073	13.8
24	Lumber and Wood Products	0	0	10	0	0	0	0	3	0	13	0.2
25	Furniture and Fixtures	14	14	0	4	0	0	12	0	0	45	0.6
26	Paper and Allied Products	0	0	12	0	11	50	0	0	0	73	0.9
27	Printing, Publishing and Allied Products	0	192	50	0	39	0	0	0	0	281	3.6
28	Chemicals and Allied Products	0	0	8	0	9	0	0	194	5	216	2.8
29	Petroleum and Coal Products	65	9	0	53	0	0	0	0	0	127	1.6
30	Rubber and Plastic Products	0	7	0	104	168	25	1,050	52	0	1,406	18.1
31	Leather and Leather Products	0	27	0	0	0	0	0	0	0	27	0.4
32	Stone, Clay and Glass Products	0	150	0	0	15	0	55	0	0	220	2.8
33	Primary Metals	7	51	0	35	150	0	0	0	0	243	3.1
34	Fabricated Metals	40	0	155	51	74	25	35	33	0	413	5.3
35	Machinery Except Electrical	4	7	16	0	205	50	40	20	7	349	4.5
36	Electrical Machinery	2,517	0	6	71	30	0	30	0	0	2,654	34.2
37	Transportation Equipment	0	0	0	142	0	70	15	25	0	252	3.2
38	Instruments and Related Products	0	0	0	2	2	0	0	0	0	4	0.1
39	Miscellaneous Manufacturing	70	3	0	0	0	0	0	0	0	73	1.0
	Total	2,809	460	307	463	703	238	1,237	482	1,060	7,764	100.0
	Percent	36.2	5.9	4.0	6.0	9.1	3.1	15.9	6.2	13.6	100.0	

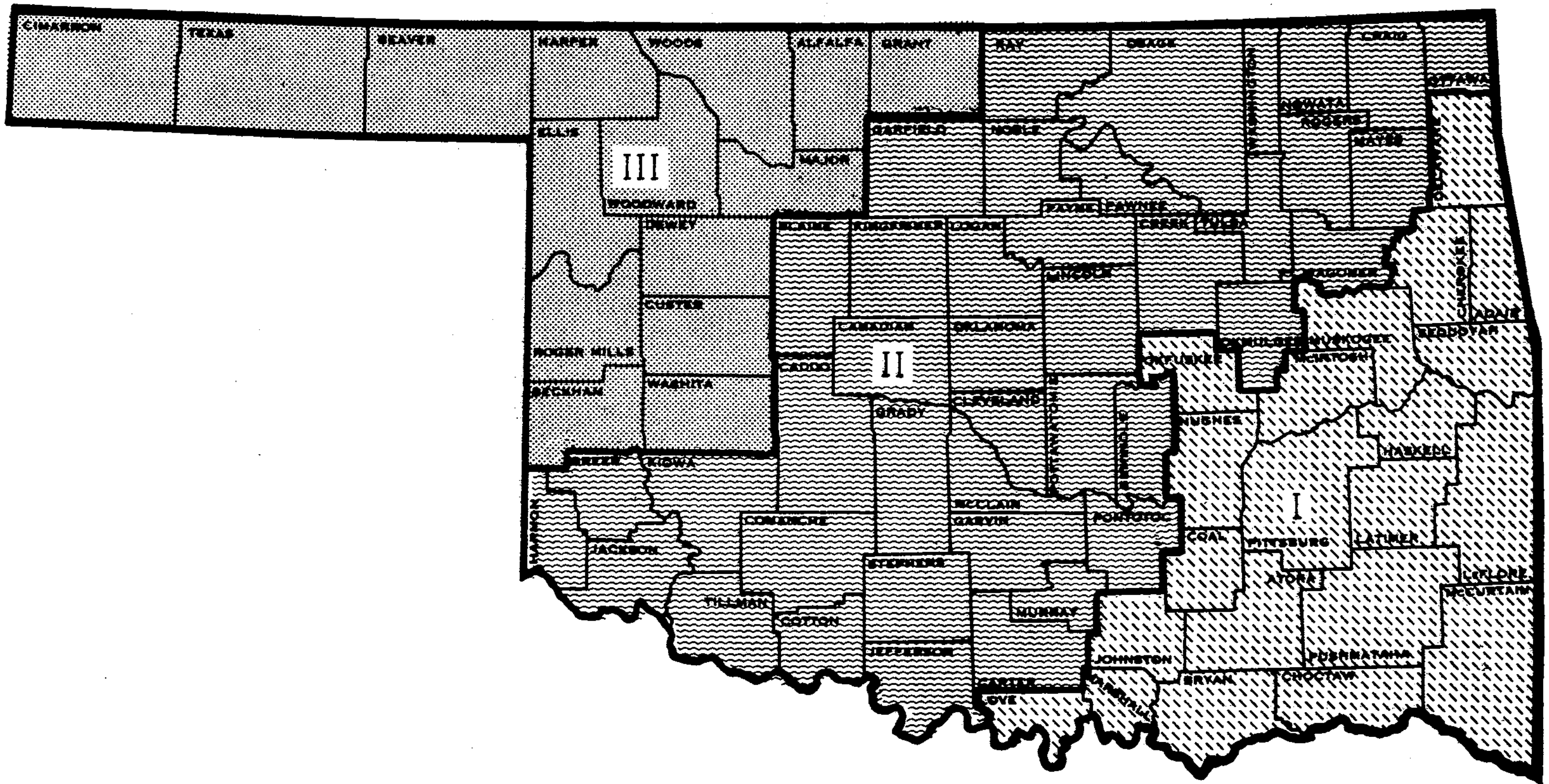
creating a substantial amount were manufacturers of lumber and wood products and manufacturers of rubber and plastic products.

The years from 1964 through 1971 were responsible for a substantial number of new jobs in community centers of over 100,000 population. The year 1963 promoted the most by creating 2,809 new jobs. Years 1969 and 1971 were also quite important with 1,237 and 1,060 new jobs, respectively.

Plant Location by Districts

Oklahoma was partitioned into three districts for comparison purposes. Boundaries for these districts were taken from a previous study by C. H. Little.[7] Because economic conditions within each district in this prior study are still very similar, the district delineation of that study was used in this analysis.[8] Three districts were formulated according to median family income by counties. This state breakdown should indicate if the geographic location of different size centers affects changes in their manufacturing employment. The three economic districts are outlined in Figure 1.

District I consists mainly of counties with median family income below $5,000. There are 21 counties in District I with the district having an average median family income in 1970 of $5,023. District I is characterized by economic activity related mainly to agriculture with farms usually small and very diversified. The largest metropolitan area in District I is Muskogee with a population of 37,331 in 1970. Usually, larger cities provide the momentum for economic growth and development and affect smaller communities within a wide radius around them. This being the case, the southeast corner of the state



Source: Charles H. Little, Economic Changes in Oklahoma. Stillwater, Oklahoma, Technical Bulletin, No. B-652, (January, 1967)

Figure 1. General Economic Districts in Oklahoma

may be disadvantaged since there are no large communities in the immediate area.

District II includes 41 counties and covers the entire center of the state on a northeast to southwest diagonal. This district is not as homogeneous as the other districts because of the wide range in community sizes. The average median family income for District II was $6,966 in 1970. The large number of trade centers of 5,000 of more population in this district is the major reason the district is considered as a unit. Most industrial activity in the state is located in District II, particularly around Oklahoma City and Tulsa. The presence of the large number of trade centers should provide the impetus for sufficient economic expansion.

Resulting from the sparse settlement pattern in District III there are no large metropolitan areas in the district. The average median family income for this district was $6,981 in 1970. District III is agriculturally oriented. Most farms and ranches located in this district are large and usually of little diversification. With all communities in District III having populations of less than 10,000, most chances for rapid growth and development are decelerated. These districts, as delineated, will provide some perspective on whether geographic location and urban orientation influence the development of different size communities.

New Plant Location in District I

The number of new jobs created from 1963 through 1971 amounted to 8,342 in District I (Table XII). This represented 14.2 percent of all jobs created in District I, 54.7 percent were created by new manufacturing plants (Table XII). The population interval in District I receiving more new jobs than any other was the interval 0-2,499. Over one-half of the jobs created in District I by new manufacturing plants were created in this community size group (Table XIII). This gives some indication of the importance of small centers to economic growth and development in this district.

TABLE XII

NUMBER OF JOBS CREATED BY NEW PLANTS AND EXPANSIONS IN DISTRICTS I, II, AND III IN OKLAHOMA FROM 1963 THROUGH 1971

	I	(Percent)	II	(Percent)	III	(Percent)
New Plants	4,567	(54.7)	21,521	(46.1)	3,084	(84.9)
Expansions	3,775	(45.3)	25,198	(53.9)	548	(15.1)
Total	8,342		46,719		3,632	

Other population intervals that were important to District I were intervals 2,500-4,999 and 5,000-9,999. These two intervals were responsible for 11.2 and 16.8 percent, respcetively, (Table XIII). When these two intervals are combined with the interval containing the small size communities, almost 80 percent of all jobs created by new plants in District I are accounted for. The other 20 percent of those jobs created by new plants were created in communities with a population between 10,000-99,999.

TABLE XIII

NUMBER OF JOBS CREATED BY TYPES OF NEW MANUFACTURING PLANTS IN DIFFERENT SIZE POPULATION INTERVALS WITHIN DISTRICT I OF OKLAHOMA FROM 1963 THROUGH 1971

SIC Code	Industry Group	0-2,499	2,500-4,999	5,000-9,999	10,000-14,999	15,000-29,999	30,000-99,999	100,000+[a]	Total	Percent
19	Ordnance and Accessories	0	0	0	0	0	0	0	0	0.0
20	Food and Kindred Products	17	20	250	0	0	175	0	462	10.1
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	450	0	0	0	0	0	0	450	9.8
23	Apparel and Related Products	250	100	300	125	0	0	0	775	17.0
24	Lumber and Wood Products	0	20	170	0	0	0	0	190	4.2
25	Furniture and Fixtures	250	25	18	10	0	5	0	308	6.7
26	Paper and Allied Products	488	0	0	0	0	0	0	488	10.7
27	Printing, Publishing and Allied Products	0	0	0	0	0	0	0	0	0.0
28	Chemicals and Allied Products	129	0	4	5	0	0	0	138	3.0
29	Petroleum and Coal Products	0	0	0	0	0	0	0	0	0.0
30	Rubber and Plastic Products	0	15	0	4	100	0	0	119	2.6
31	Leather and Leather Products	0	0	0	0	0	0	0	0	0.0
32	Stone, Clay and Glass Products	5	77	6	0	0	3	0	91	2.0
33	Primary Metals	300	0	0	0	0	125	0	425	9.3
34	Fabricated Metals	5	30	5	0	0	0	0	40	0.9
35	Machinery Except Electrical	5	225	7	100	0	0	0	337	7.4
36	Electrical Machinery	200	0	0	0	86	0	0	286	6.3
37	Transportation Equipment	235	0	8	73	18	0	0	334	7.3
38	Instruments and Related Products	0	0	0	0	0	0	0	0	0.0
39	Miscellaneous Manufacturing	7	0	0	117	0	0	0	124	2.7
	Total	2,341	512	768	434	204	308	0	4,567	100.0
	Percent	51.3	11.2	16.8	9.5	4.5	6.7	0.0	100.0	

[a]This population interval contains all zeros because no cities with over 100,000 population are located in District I.

Types of New Plants Locating in District I

There were many different types of manufacturing industies which chose to locate in District I from 1963 through 1971. Manufacturers of apparel and related products were the most active in creating jobs. This type of manufacturer created 17.0 percent of all jobs created in District I by new plants (Table XIII). Other types of manufacturing industries that created nine percent or more each were those industries manufacturing: food and kindred products, textile mill products, paper and allied products, and primary metals. Together, these industrial types created 40 percent of all jobs started by new plants. Most of these industries are labor intensive industries which indicate that this district of Oklahoma has a good supply of skilled and unskilled laborers.[9] Because manufacturers of paper and allied products use wood for their raw materials, they would be expected to locate in southeastern Oklahoma since most of that area is characterized by timber including many evergreens.

New Plant Location in District II

District II received more new jobs than any other district in Oklahoma from 1963 through 1971. A total of 46,719 new jobs were created in this district which represented almost 80 percent of the state total (Table XII). This is an indication of the influence of Oklahoma City and Tulsa. Roughly 54 percent of all jobs created in this district were created in Oklahoma City and Tulsa.

New plants were responsible for creating 46.1 percent of those jobs created in District II from 1963 through 1971 (Table XII). Oklahoma City and Tulsa accounted for 36.1 percent of all new jobs created by new manufacturing plants (Table XIV). Communities with a population between 15,000-29,999 were also conducive to new plant location in District II. These size communities accrued another 15.2 percent of the jobs created by new plants. A contrast between District I and District II can be seen. It was previously cited that 80 percent of all jobs created in District I by new plants were created in communities with a population of less than 10,000. In District II, almost 68 percent of those jobs created by new plants were created in communities with a population greater than 10,000. This is almost a complete reversal in the size of communities receiving most of the new plant location between District I and District II.

Types of New Plants Locating in District II

Most types of manufacturing industries located new plants in District II from 1963 through 1971. Among these types were four industries that were found to be attracted to District II more than other districts. These types of manufacturers included: apparel and related products, rubber and plastic products, electrical machinery, and transportation equipment. Manufacturers of rubber and plastic products were the most prevalent in District II creating 14.7 percent of all jobs created by new plants (Table XIV). The total amount of jobs created by these industrial types was 11,774, which represented 54.7 percent of all jobs created in District II by new plants.

New Plant Location in District III

District III is a very distinct district and much different than Districts I and II. No communities in this district exist with a

TABLE XIV

NUMBER OF JOBS CREATED BY TYPES OF NEW MANUFACTURING PLANTS IN DIFFERENT SIZE POPULATION INTERVALS WITHIN DISTRICT II OF OKLAHOMA FROM 1963 THROUGH 1971

SIC Code	Industry Group	0-2,499	2,500-4,999	5,000-9,999	10,000-14,999	15,000-29,999	30,000-99,999	100,000+	Total	Percent
19	Ordnance and Accessories	0	0	0	0	0	6	0	6	0.0
20	Food and Kindred Products	23	12	15	14	26	14	295	399	1.9
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	241	257	295	430	82	0	0	1,305	6.1
23	Apparel and Related Products	0	355	537	0	608	362	1,073	2,935	13.6
24	Lumber and Wood Products	8	123	315	0	40	25	13	524	2.4
25	Furniture and Fixtures	160	6	206	310	0	0	45	727	3.4
26	Paper and Allied Products	218	0	35	0	7	0	73	333	1.5
27	Printing, Publishing and Allied Products	0	0	0	0	10	3	281	294	1.4
28	Chemicals and Allied Products	58	109	167	20	0	0	216	570	2.7
29	Petroleum and Coal Products	76	10	128	0	20	0	127	361	1.7
30	Rubber and Plastic Products	0	50	10	0	1,343	350	1,406	3,159	14.7
31	Leather and Leather Products	0	0	0	3	0	0	27	30	0.1
32	Stone, Clay and Glass Products	382	18	213	7	135	18	220	993	4.6
33	Primary Metals	39	78	770	28	0	0	243	1,158	5.4
34	Fabricated Metals	123	92	60	146	432	90	413	1,356	6.3
35	Machinery Except Electrical	49	5	344	0	138	500	349	1,385	6.4
36	Electrical Machinery	52	15	186	12	0	0	2,654	2,919	13.6
37	Transportation Equipment	335	155	500	705	383	431	252	2,761	12.8
38	Instruments and Related Products	0	0	0	0	43	0	4	47	0.2
39	Miscellaneous Manufacturing	40	34	105	0	7	0	73	259	1.2
	Total	1,804	1,319	3,886	1,675	3,274	1,799	7,764	21,521	100.0
	Percent	8.4	6.1	18.0	7.8	15.2	8.4	36.1	100.0	

population of over 10,000 which is quite different than was found to be the case in District II. Also, District I had only a few centers with a population above 30,000 which delineates it from District III.

Industrial activity in District III created only 3,632 jobs from 1963 through 1971 (Table XII). This was only 6.2 percent of all jobs created in the state while roughly 30 percent of the land area was encompassed. This can be compared to the 79.6 percent of the state total number of jobs created in District II and 14.2 percent created in District I. Another contrasting characteristic of District III is the number of jobs created by new plants. In District III, 84.9 percent of all jobs were created by new plants. This is a much larger proportion than was created by new plants in District I and antonymous to the amount in District II. The majority of jobs created in District II was a result of expansions.

The amount of industrial activity generated by new plants in District III was concentrated mainly in the 5,000-9,999 population interval. A total of 86.0 percent of those jobs created by new plants was created in these size communities (Table XV). In District I, most of the industrial activity was in communities with a population of less than 10,000, but mainly concentrated in the 0-2,499 population interval. This is somewhat of a contrast with District III where only 11.9 percent of those jobs created by new plants in District III were created in communities with a population of less than 2,500 people.

Types of New Plants Locating in District III

The types of manufacturing industries that located new plants in District III were mainly of two types. Manufacturers of apparel and

TABLE XV

NUMBER OF JOBS CREATED BY TYPES OF NEW MANUFACTURING PLANTS IN DIFFERENT SIZE POPULATION INTERVALS WITHIN DISTRICT III OF OKLAHOMA FROM 1963 THROUGH 1971

SIC Code	Industry Group	0-2,499	2,500-4,999	5,000-9,999	10,000-14,999[a]	15,000-29,999[a]	30,000-99,999[a]	100,000+[a]	Total	Percent
19	Ordnance and Accessories	0	0	0	0	0	0	0	0	0.0
20	Food and Kindred Products	9	10	319	0	0	0	0	338	11.0
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0	0.0
22	Textile Mill Products	0	0	16	0	0	0	0	16	0.5
23	Apparel and Related Products	0	0	960	0	0	0	0	960	31.1
24	Lumber and Wood Products	100	0	0	0	0	0	0	100	3.2
25	Furniture and Fixtures	100	0	1,200	0	0	0	0	1,300	42.2
26	Paper and Allied Products	0	0	0	0	0	0	0	0	0.0
27	Printing, Publishing and Allied Products	0	0	0	0	0	0	0	0	0.0
28	Chemicals and Allied Products	0	0	15	0	0	0	0	15	0.5
29	Petroleum and Coal Products	20	0	0	0	0	0	0	20	0.7
30	Rubber and Plastic Products	0	0	0	0	0	0	0	0	0.0
31	Leather and Leather Products	40	0	0	0	0	0	0	40	1.3
32	Stone, Clay and Glass Products	0	0	10	0	0	0	0	10	0.3
33	Primary Metals	0	0	0	0	0	0	0	0	0.0
34	Fabricated Metals	0	0	0	0	0	0	0	0	0.0
35	Machinery Except Electrical	21	0	26	0	0	0	0	47	1.5
36	Electrical Machinery	12	16	0	0	0	0	0	28	0.9
37	Transportation Equipment	51	30	3	0	0	0	0	84	2.7
38	Instruments and Related Products	0	9	100	0	0	0	0	109	3.5
39	Miscellaneous Manufacturing	14	0	3	0	0	0	0	17	0.6
	Total	367	65	2,652	0	0	0	0	3,084	100.0
	Percent	11.9	2.1	86.0	0.0	0.0	0.0	0.0	100.0	

[a]These population intervals contain all zeros because no cities with a population over 10,000 are located in District III.

related products created 31.1 percent while manufacturers of furniture and fixtures created another 42.2 percent of the jobs created by new plants from 1963 through 1971 (Table XV). Together these industrial types accounted for almost 75 percent of the industrial activity generated by new plants in District III. Manufacturers of apparel and related products were also very active throughout Districts I and II, but those industries manufacturing furniture and fixtures were quite sparse.

The variety in types of manufacturers in District III is limited somewhat because of the predominance of agricultural activity. The northeast and north central areas of the district specialize more in wheat production, whereas cotton production is concentrated in the southern portion. With agriculture providing employment for most people in District III, little labor is available for manufacturing industries.

Capital-Labor Ratios

To analyze the relationship between labor and initial capital investment of those manufacturing plants which located in Oklahoma from 1963 through 1971, capital-labor ratios were developed. Capital-labor ratios indicate those amounts of initial capital investment per new job created. These ratios can be used to determine the capital intensiveness of each type of industry and each community size interval. The industry or population interval having large capital-labor ratios can be classified as capital intensive, whereas those industries or population intervals having small capital-labor ratios are labor intensive.

The average capital investment per new job created for all industries which located new manufacturing plants in Oklahoma from 1963 through 1971 was $18,561 (Table XVI).[10] This means that on the average, manufacturers who built new plants invested $18,561 for each job created. If one concludes that this is the average capital-labor ratio for the state, comparisons can be made between types of industries and also between population intervals with reference to their labor or capital intensiveness.

Manufacturers of paper and allied products had the largest capital-labor ratio at $136,073, indicating they were extremely capital intensive when compared to the average (Table XVI).[11] Next in order of magnitude were the industries engaged in the production of chemicals and allied products with a capital-labor ratio of $69,297. Other types of manufacturing industries that were capital intensive included those manufacturing rubber and plastic products and petroleum and coal products. Their capital-labor ratios were $41,542 and $41,456, respectively. Most types of manufacturers mentioned here were shown to be highly automated industries which required little labor for their operations.

Manufacturing industries which produce leather and leather products had the smallest capital-labor ratio at $1,457 (Table XVI). The low ratio is an indication of an industry that is labor intensive. Manufacturing industries producing apparel and related products were also labor intensive. The capital-labor ratio for this industrial group was $1,640. It seems realistic that these industrial types would be labor intensive since most of the assembly process for each product has to be done primarily by hand labor. Other industries that were also much more labor intenstive than the state average were those with SIC codes of 24, 25, 27, 34, 36, 37, and 39. These manufacturers had capital-labor ratios ranging from $2,747 to $6,978.

TABLE XVI

CAPITAL-LABOR RATIOS FOR TYPES OF NEW MANUFACTURING PLANTS
BY COMMUNITY SIZE IN OKLAHOMA FROM 1963 THROUGH
1971

SIC Code	Industry Group	0-2,499	2,500-4,999	5,000-9,999	10,000-14,999	15,000-29,999	30,000-99,999	100,000+	Average
19	Ordnance and Accessories	$ 0	$ 0	$ 0	$ 0	$ 0	$16,167	$ 0	$16,167
20	Food and Kindred Products	18,429	4,762	14,507	37,500	2,885	6,545	11,618	12,465
21	Tobacco Manufacturers	0	0	0	0	0	0	0	0
22	Textile Mill Products	17,004	16,593	7,401	8,721	13,333	0	0	12,989
23	Apparel and Related Products	1,400	3,000	2,590	200	859	1,202	967	1,640
24	Lumber and Wood Products	1,574	629	10,186	0	5,000	14,000	7,692	6,970
25	Furniture and Fixtures	3,406	1,000	2,921	7,269	0	23,000	6,611	3,720
26	Paper and Allied Products	147,991	0	2,286	0	2,857	0	14,391	136,073
27	Printing, Publishing and Allied Products	0	0	0	0	3,000	3,333	6,032	5,901
28	Chemicals and Allied Products	138,430	11,034	72,624	31,200	0	0	43,273	69,297
29	Petroleum and Coal Products	92,688	0	18,750	0	157,500	0	7,339	41,456
30	Rubber and Plastic Products	0	2,969	1,680	0	51,957	20,000	38,362	41,542
31	Leather and Leather Products	375	0	0	16,667	0	0	1,370	1,457
32	Stone, Clay and Glass Products	10,225	30,344	19,180	714	13,429	19,143	9,169	13,536
33	Primary Metals	59,248	8,999	30,195	35,714	0	10,800	6,342	30,381
34	Fabricated Metals	11,734	13,143	4,767	11,712	2,722	10,000	5,029	6,292
35	Machinery Except Electrical	7,209	15,424	6,727	50,000	5,470	50,000	4,974	23,032
36	Electrical Machinery	2,030	9,968	2,326	2,500	4,256	0	3,914	3,774
37	Transportation Equipment	3,892	3,343	2,252	13,423	2,671	5,946	4,917	6,978
38	Instruments and Related Products	0	1,111	25,000	0	5,833	0	10,000	20,426
39	Miscellaneous Manufacturing	2,705	2,045	3,148	855	4,286	0	5,288	2,747
	Average	$42,552	$9,754	$10,904	$12,230	$26,043	$19,109	$11,701	$18,561

Communities which had the largest capital-labor ratios were in the population interval 0-2,499. These size communities had a capital-labor ratio of $42,552 (Table XVI). This implies that most manufacturers which located in these small communities were extremely capital intensive indicating small labor requirements for their production process. This is what might be expected since these smaller communities do not have large supplies of labor. Communities with capital-labor ratios above the state average were those in population intervals 15,000-29,999 and 30,000-99,999. These two population intervals had capital-labor ratios of $26,043 and $19,109, respectively. Other size communities had ratios between $9,754 and $12,230 indicating they were more labor intensive than the state average.

FOOTNOTES

[1]Dikeman, Neil J., Jr., and Paula B. Mueller, Oklahoma Industrialization, Bureau of Business Research, College of Business Administration, University of Oklahoma, Norman, Oklahoma, January, 1964-1971.

[2]For a description of each SIC code, see Appendix B.

[3]Oklahoma Labor Market, Revised Labor Force Estimates, Oklahoma Employment Security Commission, Oklahoma State Employment Service, Research and Planning Division, Oklahoma City, Oklahoma, February, 1964 and 1972.

[4]Beale, Calvin L., Claude C. Haren, and Helen Johnson, "Rural America: New Force for Old Image," Farm Index, August, 1970, USDA.

[5]The communities are listed in their appropriate interval in Appendix A.

[6]See Appendix A.

[7]Charles H. Little, Economic Changes in Oklahoma, Stillwater, Oklahoma, Technical Bulletin No. B-652 (January, 1967).

[8]District IA delineated in footnote 1 is included in District III for this study.

[9]See Table XVII.

[10]This figure is in current dollars.

[11]The higher capital-labor ratios are due usually to only one or two highly capital intensive firms.

CHAPTER III

THE MODEL AND GENERAL LOCATION THEORY

Much effort has been put forth analyzing location theory. Studies using location theory and prediction models usually adopt a theory and a model which resulted from previous research. The purpose of this chapter is to provide the general location theory for this study and to present and explain the model.

The chapter is composed of three parts. The first part denotes in general terms the basic model used for eight of the 19 manufacturing industries and seven community intervals. The second part outlines the plant location theory used for aggregating various locational factors which determine specific plant locations and the justification for each factor's use. The final part of the chapter provides the criteria used in the selection of alternative regression equations.

The Model

Regression analysis is a statistical technique to estimate, from empirical data, a relationship between two of more variables. Multiple regression implies that more than two independent variables are involved. This technique has been employed by others to analyze the changes in the location of manufacturing industries, and to determine the importance of variables associated with these changes.[1] In these previous studies, multiple regression was used to explain location patterns that resulted from location decisions of individual owners and managers when these decisions were economically "rational" and were based upon past experience and knowledge of existing community characteristics.

Regression analysis was used in this study mainly because of its qualifications. With this type of anlaysis, it is possible to predict a "dependent variable" by using one or more "independent variables." Independent variables in this study included characteristics of communities where manufacturing industries located, dummy variables representing standard industrial classification codes, and dummy variables representing community size intervals. The dependent variable whose observed variations were explained was the change in manufacturing employment for the state from 1963 through 1971. It is assumed in this study that linear relationships are reasonable approximations of the form of true relationships.

The general form of the multiple regression equation is:

$$Y_i = \beta_o + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki} + u_i \qquad (3\text{-}1)$$

where

$i = 1, 2, \ldots, n$ observations,

Y_i = i^{th} observation on the dependent variable,

$\beta_o, \beta_1, \beta_2, \ldots, \beta_k$ = unknown parameters,

$X_{1i}, X_{2i}, \ldots, X_{ki}$ = i^{th} observation on the k independent variables, and

u_i = unknown error or disturbance terms.

The method of computation for these β coefficients is least squares, which minimizes the variance of all error terms; i.e., the method maximizes the portion of the total variance in the dependent variable that is explained by all independent variables. If least squares estimates are to be unbiased, there must be some assumptions made concerning the general model:[2]

1. The u_i (error terms) must be random variables and their expected value, or mean, of the distribution of the error terms is zero.
2. The u_i (error terms) have a constant variance σ^2 for all sets of values of the independent variables X and the u_i are not correlated with one another.
3. The numbers X_{1i}, X_{2i}, ..., X_{ki} are constant and not subject to random variation.
4. The number of parameters to be estimated (k) is less than the number of observations (n) and no exact linear relationships exist among any of the X variables.

The least squares procedure used to estimate these coefficients gives the estimated regression equation:

$$\hat{Y}_i = b_o + b_1X_{1i} + b_2X_{2i} + \ldots + b_kX_{ki} \qquad (3\text{-}2)$$

where

$\hat{Y}_i$ = the estimate of Y_i for the i^{th} observed values of the X's, and

b_o, b_1, ..., b_k are the estimates of β_o, β_1, ..., β_k.

Then, the observed value for the i^{th} Y is:

$$Y_i = b_o + b_1X_{1i} + b_2X_{2i} + \ldots + b_kX_{ki} + e_i \qquad (3\text{-}3)$$

where

$e_i = Y_i - \hat{Y}_i$ is the unexplained variation to be minimized by the equation.

There are 15 regression equations in total, one for each of the eight SIC codes and one for each of the seven community size intervals. The number of observations for each SIC code regression equation depends upon the number of plants that located in the state. For example, if 30 plants which produced transportation equipment located in the state, then there would be 30 observations for the regression equation representing SIC 37. Any SIC code having less than 17 observations was deleted from the regression analysis. An observation exists for a community size interval if one new plant located in a community with a population that conformed to that interval.

It is possible for multicollinearity to exist in the regression equations. Multicollinearity exists when two explanatory or independent variables are connected or related making is impossible to estimate the separate influences each has on the dependent variable.[3]

General Location Theory

Forces affecting the location of new plants is discussed in this section along with the location theory used for this study. Previous studies pertaining to location theory have been oriented toward an individual firm's point of view. It has been pointed out by Ben Zvi that location theory is only an extension of the theory of the firm, differing by the fact that location theory recognizes that there exists a set of factors, external to the firm which influence the firm's cost-profit structure.[4] In essence, the theory of the location of manufacturing deals with the question of: Where to produce?

A large volume of literature exists concerning the theory of plant location. Historically, the development of interest in the problem of the spatial aspects of economic activity is attributed to three German economists: Launhardt,[5] von Thuner,[6] and Weber.[7] Each of these economists was concerned with the grouping of factors into three major causes of plant location. Concentration was mainly in the areas of labor costs, factors affecting markets, and agglomerative factors such as adequate public facilities. This study deviates from the traditional form of location theory due to this study's objectives and sources of data.[8] The major concern of this study is to evaluate those factors which communities in Oklahoma exhibit for enticement of new industry.

In this study, location theory will be reflected in the characteristics of communities. Characteristics are classified into three groups which include (1) labor factors, (2) market factors, and (3) agglomeration factors. Agglomeration characteristics are those governing factors in location whenever market and labor differentials at alternative sites are relatively small. An example of an agglomerative factor could be percent urban population existing in the same county as that of the prospective plant site. This approach to location theory is closely related to that provided by the writings of Greenhut.[9] Also included in the study are dummy variables reflecting community size intervals and SIC codes.

To explain the change in employment by industry sector, there were 44 factors (including all community size intervals and SIC codes) selected as possibilities for influencing location decisions. Data were gathered and calculated from the information obtained from secondary sources.[10] Community size intervals are represented by dummy variable D_i, where $i = 1, 2, \ldots, 7$; labor factors are represented by X_i, where $i = 8, 9, 10$; market factors are represented by X_i, where $i = 11, 12, 13$, and D_i, where $i = 14, 15$; agglomeration factors are represented by X_i, where $i = 16, 17, \ldots, 24$, and D_i, where $i = 25$; Standard Industrial Classification codes are represented by D_i, where i = 26, 27, ..., 44. Specifically, these variables are:

Community Size Intervals:

D_1 = 0-2,499

D_2 = 2,500-4,999

D_3 = 5,000-9,999

D_4 = 10,000-14,999

D_5 = 15,000-29,999

D_6 = 30,000-99,999

D_7 = 100,000+

Labor Factors:

X_8 = persons available for work in county

X_9 = average weekly employment earnings for county

X_{10} = population 25-mile radius

Market Factors:

X_{11} = distance in miles to nearest interstate

X_{12} = distance in miles to Tulsa

X_{13} = distance in miles to Oklahoma City

D_{14} = all interstate miles to Tulsa

D_{15} = all interstate miles to Oklahoma City

Agglomeration Factors:

X_{16} = value of all farm products in county

X_{17} = value of all forestry products in county

X_{18} = value of all mineral products mined in county

X_{19} = percent urban population in county

X_{20} = percent minority population in county

X_{21} = population growth rate 1960-1970

X_{22} = population served by one physician

X_{23} = pupil-teacher ratio

X_{24} = average tax per $1,000 assessed value

X_{25} = inducement for new industry

Standard Industrial Classification Code:

D_{26} = SIC 20, Food and Kindred Products

D_{27} = SIC 22, Textile Mill Products

D_{28} = SIC 23, Apparel and Related Products

D_{29} = SIC 24, Lumber and Wood Products

D_{30} = SIC 25, Furniture and Fixtures

D_{31} = SIC 26, Paper and Allied Products

D_{32} = SIC 27, Printing, Publishing and Allied Products

D_{33} = SIC 28, Chemicals and Allied Products

D_{34} = SIC 29, Petroleum and Coal Products

D_{35} = SIC 30, Rubber and Plastic Products

D_{36} = SIC 31, Leather and Leather Products

D_{37} = SIC 32, Stone, Clay, and Glass Products

D_{38} = SIC 33, Primary Metals

D_{39} = SIC 34, Fabricated Metals

D_{40} = SIC 35, Machinery Except Electrical

D_{41} = SIC 36, Electrical Machinery

D_{42} = SIC 37, Transportation Equipment

D_{43} = SIC 38, Instruments and Related Products

D_{44} = SIC 39, Miscellaneous Manufacturing

These 44 variables were chosen to represent those characteristics of communities which received new plants between 1963 and 1971.

Variables D_1 through D_7 would have a value of one if a particular manufacturing industry created new employment in a city that conformed to the interval 2,500-4,999. Variables D_{26} through D_{44} will have a value of one if that industry created new employment in a community, otherwise the variable will have a zero value.

Selection Among Alternative Models

A multiple regression computer routine was used to estimate alternative regression equations for each of the eight SIC codes and seven city size intervals.[11] A procedure somewhat similar to the backward elimination procedure was used to select the "best" regression containing the most significant variables. The backward elimination procedure is described by Draper and Smith.[12] The first linear regression equation estimated for each city size interval and each SIC code includes all variables. The t-test and standard errors are computed for every variable treated as though it were the last variable to enter the regression equation. T-test values computed for each variable are compared with tabular values at a preselected significance level. Additional equations are derived by eliminating the less significant variables. This process is continued until most or all of the less significant independent variables have been eliminated. Sometimes the situation may occur where the elimination of a less significant variable may reduce the amount of variance explained by the regression so much that it is best to leave the variable in the equation.

The main contention for using the backward elimination procedure is to see all variables in the equation at once in order "not to miss anything."

In addition to the t-test for each independent variable, other statistical values for the equation can be analyzed. Such values as the square of the multiple correlation coefficient (R^2), the overall F-value, the significance level of the entire regression equation, the coefficient of variation and the standard error for each coefficient of X_i, are compared for alternative models. Also, the sign and magnitude of each coefficient are examined to check for violations in the hypothesized relationship between a particular real (X_i) or dummy variable (D_i) and the dependent variable (Y_i) being explained. A discussion concerning the computation and applications of these criteria is presented in Draper and Smith.[13]

The selection of a specific regression equation from all alternatives for each community size interval and each SIC code is based on those objectives of the empirical analysis. The first objective of this section on regression analysis is to determine those factors associated with plant location for each community size interval. The second objective of this section is to select regression equations that will predict future employment in specific manufacturing industries and also the change in future employment for various city sizes. To accomplish the first objective, the magnitude of each regression coefficient is scrutinized carefully to see if it is large relative to its standard error. To fulfill the second objective, the adequacy of the model and the precision and accuracy of all estimates are evaluated with criteria such as R^2, the overall F-test value, and the coefficient of variation. Only independent variables with coefficients significant at the 0.10 level of probability or less were included in each selected model unless a coefficient of a higher probability level contributed substantially to the R^2 and coefficient of variation.[14]

FOOTNOTES

[1] W. R. Thompson and J. M. Mattila, An Economic Model of Postwar State Industrial Development (Detroit, Wayne State University Press, 1959); Victor Fuchs, Changes in the Location of Manufacturing in the United States Since 1929 (New Haven, Yale University Press, 1962); and Robert G. Spiegelman, A Study of Industry Location Using Multiple Regression Techniques, Agricultural Economic Report No. 140, ERS, USDA, Washington, D. C., August, 1963.

[2] J. Johnston, Econometric Methods (New York, 1960), pp. 106-108.

[3] Ibid, pp. 201-207.

[4] Samuel Ben Zvi, Locational Determinants of Manufacturing; An Econometric Model for Oklahoma, Research and Planning Division, Oklahoma Industrial Development and Park Department, 1970.

[5] A. Launhardt, Mathematische Begrudung der Volkswirtschaftslehre (Leipsig, B. G. Teubner, 1885).

[6] J. H. von Thuner, Der Isolierte Staat in Bezichung auf Landwirtschaft und Nationalokonomie, 3rd edition (Berlin, Schumacherzarchlin, 1875).

[7] A. Weber, The Theory of Location of Industries (Chicago, The University of Chicago Press, 1929).

[8] Oklahoma Industrial Development and Park Department, Oklahoma Community Data; and U. S. Department of Commerce, Social and Economic Statistics Administration, Bureau of the Census, General Social and Economic Characteristics, Oklahoma, 1970 Census of Population, PC(1)-C38 Oklahoma, March, 1972.

[9] M. L. Greenhut, Plant Location in Theory and in Practice (Chapel Hill, The University of North Carolina Press, 1956).

[10] Oklahoma Community Data and Bureau of the Census.

[11] Anthony J. Barr and James Howard Goodnight, Statistical Analysis System (Raleigh, North Carolina, North Carolina State University, May, 1971).

[12] N. R. Draper and H. Smith, Applied Regression Analysis (New York, 1966), p. 167.

[13] Ibid, p. 115.

[14] A t-test for the null hypothesis H_o: $\beta_o = 0$ against the alternative H_1: $\beta_o \neq 0$ with the appropriate degrees of freedom is used to determine the significance level.

CHAPTER IV

EMPLOYMENT CHANGE FOR SELECTED SIC CODES AND COMMUNITY SIZE INTERVALS

In Chapter I, it was stated that local policy makers must understand how the market economy has been operating in the past in order for them to be prepared to compete with other communities in the enticement of new industry. A descriptive analysis was completed in Chapter II showing those types of plants which have been locating in various community sizes during the period 1963 through 1971. The intent of this chapter is to use the data in Chapter II along with these characteristics outlined in Chapter III and derive an empirical relationship between a performance variable and all independent or response variables.

Using the data presented in Chapter II, a linear multiple regression analysis will be utilized to explain the change in employment when a different community size interval or a different SIC code is considered. The models for different community size intervals and SIC code models are estimated with data from those communities having new employment during the period and secondary data pertaining to county characteristics.

Several models were estimated and evaluated for each dependent variable. All models are linear multiple regression models of the form specified in equation (3-2) in the preceding chapter. The independent real variables selected to compose the regression equations for each of the seven community size intervals and eight SIC codes are selected from those three classes denoted in Chapter III as labor, market, or agglomeration factors. Those independent dummy variables representing seven different community size intervals are included in the selection of variables for those regression equations explaining employment change by industry type. Dummy variables representing the 19 SIC codes are included as possible independent variables for those seven regression equations explaining employment change by community size.

Empirical Results

Community Size Interval Models

There are seven models, one for each community size interval, which includes all types of manufacturing industries in which there was some employment generated during the study period. Due to the presence of more small communities in Oklahoma than large communities, there were more observations available for these smaller size communities.

Model I: 0-2,499 Community Size Interval. The regression equation model selected to explain employment change for communities with a population less than 2,500 consists of 12 independent variables. The estimated regression equation is:[1]

$$\hat{Y} = \underset{(81.585)^{b}}{-154.698} + \underset{(.1169)^{b}}{.257X_{12}} - \underset{(.001)^{b}}{.002X_{16}} + \underset{(.0008)^{a}}{.003X_{17}} - \underset{(1.120)^{d}}{1.646X_{20}}$$

$$+ 5.013X_{23} + 1.112X_{24} + 125.201D_{27} + 191.262D_{28} + 88.831D_{30}$$
$$\quad (2.300)^b \quad (.799)^d \quad (45.758)^a \quad (64.459)^a \quad (30.779)^a$$

$$+ 84.651D_{31} + 35.753D_{37} + 107.144D_{38}$$
$$\quad (33.100)^a \quad (25.305)^d \quad (37.936)^a \qquad (4\text{-}1)$$

This model has an R^2 of 0.516 with an overall F-test value significant at the 0.0001 probability level. The coefficient of variation is 136.4.[2] It is desirable to have a small value for this coefficient.[3] There were 88 observations used in this regression equation leaving 75 degrees of freedom for the complete equation.[4] The R^2 value indicates that the real and dummy variables in the equation explain 51.6 percent of the variation in the change of employment for those communities represented in the sample for this community size interval.

The constant term in the equation which includes the coefficient for D_{26} is statistically significant at the 0.05 probability level. Coefficients for the independent variables which represent miles to Tulsa (X_{12}), value of all forestry products sold in county (X_{17}), percent minority population (X_{20}), pupil-teacher ratio (X_{23}), and average tax per \$1,000 assessed value (X_{24}) ranged in significance from the 0.02 level for X_{12} up to the 0.14 and 0.16 significant level for X_{20} and X_{24}, respectively. Those dummy variables which represent SIC 22, textile and mill products (D_{27}); SIC 23, apparel and other fabric products (D_{28}); SIC 25, furniture and fixtures (D_{30}); SIC 26, paper and allied products (D_{31}); and SIC 33, primary metal industries (D_{38}) have coefficients which are all significant at the 0.01 level except SIC 32, stone, clay, and glass products (D_{37}) whose coefficient is significant at the 0.15 level. An interpretation of the coefficient for D_{28} would be, if a manufacturer of apparel and related products is present in a community with a population between 0-2,499. Then, its coefficient would be added to the intercept term and the manufacturer's effect would be the summation of the intercept term and the coefficient of the dummy variable for the respective manufacturer.

It should be noted that two coefficients in this equation have negative effects on employment in communities with a population of 0-2,499. The coefficient for the independent variable (X_{16}) indicates that a one-unit increase in the value of all farm products in the county with all other variables held constant, will decrease the change in employment of communities represented in this sample by 0.002 units. If there is a one-percent increase in minority population (X_{20}) with all other variables fixed, then there will be a decrease in the change in employment for these cities by an amount of 1.646 units.

Dummy variables, which represent various SIC codes in this model, have coefficients which indicate large positive effects on employment change for the community size interval, 0-2,499. It is very important to recognize which industries were significant. It was shown in Chapter II which types of manufacturers created more jobs in communities with a population in this interval. Regression equation (4-1) indicates that manufacturing industries with an SIC code of 20, 22, 23, 25, 26, 32, or 33 representing manufacturers of food and kindred products;[5] textile and mill products; apparel and other fabric products; furniture and fixtures; paper and allied products; stone, clay and glass products; and primary metal industries are significant with those communities represented in this class interval.

It appears that many of the possible combinations of real and dummy variables that could have been included in this equation have been omitted. Many combinations of variables were included in different regression equations and from the large number of equations generated, the "best" equation was selected. There were some models generated that exhibited statistical characteristics, such as R^2 and overall F-values, that were similar. These regression equations were under close scrutiny and carefully selected according to the predetermined criteria, but it is possible that biases of the author swayed the decision of which regression equation was the best.

Model II: 2,500-4,999 Community Size Interval. The regression equation selected to explain employment change for all 53 observations in this community size interval contains five independent variables, two of which are real variables and three are dummy variables. The estimated function is:

$$\hat{Y} = \underset{(44.114)^{e}}{-44.484} + \underset{(.427)^{d}}{0.610X_9} + \underset{(.321)^{b}}{0.644X_{21}} + \underset{(28.688)^{a}}{153.508D_{27}} + \underset{(24.323)^{a}}{64.987D_{28}}$$

$$+ \underset{(32.982)^{d}}{53.263D_{40}} \qquad (4\text{-}2)$$

This model has an R^2 value of 0.463, and the F-test value with 47 degrees of freedom is significant at the 0.0001 probability level. The coefficient of variation for the equation is 122.38.

Signs for all real and dummy variables included in the selected equation conform to those relationships that should be expected between these variables and change in employment. Coefficients of two significant independent variables are average weekly employment earnings for the county (X_9), and the population growth rate between 1960 and 1970

(X_{21}). Neither of these two independent variables were significant in model (4-1) for communities in the 0-2,499 community size interval.

Only three manufacturing industries were found to be significant. These manufacturers include those engaged in the production of textile mill products (D_{27}), apparel and related products (D_{28}), and machinery except electrical (D_{40}). Based on the descriptive data from Chapter II, it was expected that these types of manufacturers would be significant in the regression equation explaining employment change for communities with a population between 2,500 and 4,999.

Model III: 5,000-9,999 Community Size Interval. The regression equation selected to explain employment change in this community size interval consists of five variables. The estimated function is:

$$\hat{Y} = \underset{(41.176)^{e}}{12.272} + \underset{(.281)^{c}}{0.485X_{12}} - \underset{(.677)^{c}}{1.244X_{21}} + \underset{(68.863)^{b}}{158.802D_{28}} + \underset{(73.171)^{a}}{211.352D_{30}} + \underset{(121.642)^{a}}{347.214D_{38}} \qquad (4\text{-}3)$$

This model has an R^2 value of 0.284, and the overall F-test value is significant at the 0.0008 probability level. The coefficient of variation for the selected model is 156.7. This regression equation was estimated using 70 communities in Oklahoma that had employment change during the study period.

The standard error of the estimate for the intercept is undesirable in this equation. However, alternative models generated for this community size interval did not display more favorable significant levels for the real and dummy variables.

Those real variables found to be important to communities represented in the 5,000 to 9,999 community size interval are miles to Tulsa (X_{12}), and population growth rate between 1960 and 1970 (X_{21}). The negative sign of the coefficient for the population growth rate variable is not what might be expected. The negative sign indicates that communities represented in this population interval which experienced a declining growth rate had an employment increase of 1.244 units for each one unit decrease in their population growth rate. The sign of the coefficient for miles to Tulsa conforms to the hypothesized relationship and implies that communities closer to Tulsa are in competition with Tulsa for the attraction of new jobs.

A different combination of manufacturers are significant in the explanation of change in employment in communities with 5,000 to 9,999 population, than were significant in models for smaller communities. Manufacturers significant in the regression equation are those producing apparel and related products (D_{28}), furniture and fixtures (D_{30}), and primary metals (D_{38}). Thus, these types of manufacturing industries are the most important industries to communities with a population between 5,000 and 9,999.

Dummy variables which represent the significant types of manufacturers have coefficients which are large when compared to other coefficients in the equation. The importance of these dummy variables in explaining employment change is signified by the magnitude of their coefficients. Signs of these coefficients are positive, indicating that the presence of these manufacturers will increase the number of jobs made available to communities in the 5,000 to 9,999 population interval.

Model IV: 10,000-14,999 Community Size Interval. The regression equation model selected for explaining employment change in communities with a population between 10,000 and 14,999 consists of only one real variable and two dummy variables. The estimated equation is:

$$\hat{Y} = \underset{(28.026)^{e}}{16.309} + \underset{(.002)^{d}}{0.003X_{18}} + \underset{(70.046)^{a}}{179.678D_{27}} + \underset{(47.578)^{b}}{101.927D_{42}} \qquad (4\text{-}4)$$

This model has an R^2 value of 0.341, and an overall F-test value of 4.1 which is significant at the 0.01 probability level. The coefficient of variation for the selected regression equation is 125.2. The R^2 value indicates that 34.1 percent of the variation in employment change among the communities represented in this population interval is explained by the estimated regression equation in (4-4).

The only real variable significant in the explanation of employment change in communities conforming to the 5,000 to 9,999 size interval, is the value of all mineral products mined in the county (X_{18}). The sign of the estimated coefficient is positive which indicates that the higher the value of the mineral products, the greater the change in employment will be. Since this is the only significant community characteristic, it infers that most of the employment change that occurred between 1963 and 1971 in communities with a population between 10,000 and 14,999 was implemented in communities that were located in counties with high amounts of accessible mineral deposits.

Dummy variables significant in the selected regression equation represent two industrial types. These two dummy variables are manufacturers of textile mill products (D_{27}) and manufacturers of transportation equipment (D_{42}). Consistent with those selected regression equations for all smaller community size intervals are the magnitude and signs of these coefficients for dummy variables in the model selected for this population interval.

Model V: 15,000-29,999 Community Size Interval. The selected regression model for explaining employment change among communities with a population between 15,000 and 29,999 is estimated from 33 different plants that located in this interval between 1963 and 1971. The estimated function is:

$$\hat{Y} = \underset{(115.912)^{e}}{128.545} - \underset{(2.433)^{c}}{4.234X_{11}} + \underset{(.642)^{b}}{1.257X_{12}} + \underset{(1.146)^{d}}{1.467X_{13}}$$

$$+ \underset{(113.359)^{a}}{278.292D_{35}} \qquad (4\text{-}5)$$

This model has an R^2 value of 0.290, and the F-test value with 28 degrees of freedom is significant at the 0.0411 probability level. The coefficient of variation for the selected model is 200.0.

Real variables significant in this equation are distance in miles to the nearest interstate (X_{11}), miles to Tulsa (X_{12}), and miles to Oklahoma City (X_{13}). These three independent variables are all classified as market variables and indicate that most industries causing employment change transport their finished products to regional or possible national demand points. The selected regression equation infers that transportation by way of interstate is very important to communities with a population between 15,000 and 29,999.

Notice that the estimated coefficient for variable X_{11} has a negative sign. This further emphasizes that communities conforming to this community size interval need to have an interstate highway nearby.

The further away a community of this size if from an interstate, the less will be the change in employment. Other independent variables indicate that the closer a community with a population between 15,000 and 29,999 is to Oklahoma City or Tulsa, the less chance it has for a positive change in employment.

The only dummy variable significant in the explanation of change in employment in communities conforming to this size population interval is the variable representing manufacturers of rubber and plastic products (D_{35}). This is the same type of manufacturer that was shown to be important to communities of this size in the descriptive analysis in Chapter II. This type of manufacturer created by far the most number of jobs in communities with a population between 15,000 and 29,999 during the period 1963 to 1971 than any other type of industry.

Model VI: 30,000-99,999 Community Size Interval. The regression equation model selected to estimate change for communities conforming to the 30,000 to 99,999 community size interval consists of all dummy variables. The estimated regression equation is:

$$\hat{Y} = \underset{(21.686)^{d}}{36.667} + \underset{(78.189)^{a}}{313.333D_{35}} + \underset{(78.189)^{a}}{463.333D_{40}} + \underset{(48.490)^{b}}{107.0D_{42}} \qquad (4\text{-}6)$$

This model has an R^2 value of 0.790, with an overall F-test value significant at the 0.0002 probability level. The coefficient of variation is 74.2. The regression equation selected for this community size interval is a better model, based on statistical characteristics, than any of the equations selected thus far to estimate employment change for a particular community size interval. The high R^2 value is one indication of the model's superiority and the coefficient of variation is also much smaller, which is a desirable characteristic for an estimated regression equation.

There are no real variables significant in the regression equation for this community size interval. This indicates that none of those community characteristics that were made available for choices were deemed as being relevant to manufacturing industries which located plants in these size communities between 1963 and 1971.

Dummy variables significant in the selected regression equation represent manufacturing industries. Industrial types being significant in the explanation of employment change in this community size interval include those industries manufacturing rubber and plastic products (D_{35}), machinery except electrical (D_{40}), and transportation equipment (D_{42}). Referring back to the R^2 value for this equation, these types of manufacturing industries explain 79.0 percent of the variation in employment change occurring among communities with a population between 30,000 and 99,999.

Signs of those coefficients for dummy variables conform to the hypothesized relationship. All signs are positive which indicate that the presence of these manufacturers enhance the chance for employment change among communities with a population conforming to the 30,000 to 99,999 population interval.

Manufacturers significant in the regression equation for the 30,000 to 99,999 community size interval are supported by the data presented in Chapter II. These three dummy variables (D_{35}, D_{40}, and D_{42}) each created a substantial proportion of the new jobs in the communities conforming to this population interval. Manufacturers of apparel and related products were shown to be important to the communities in this interval in the descriptive analysis, but were deleted from the regression equation because of lack of the desired significance level.

Model VII: 100,000+ Community Size Interval. The selected regression equation model to explain employment change in Oklahoma City and Tulsa is estimated from data for 31 different firms that located plants in these centers between 1963 and 1971. The selected model for this community size interval is similar to the preceding model since both models have no real variables and only three dummy variables which are significant. The estimated function is:

$$\hat{Y} = \underset{(45.142)^b}{103.040} + \underset{(165.861)^a}{433.460D_{28}} + \underset{(165.861)^a}{599.960D_{35}} + \underset{(165.861)^a}{1223.960D_{41}} \qquad (4\text{-}7)$$

This model has an R^2 value of 0.714, and the F-test is significant at the 0.0001 probability level. The coefficient of variation for the estimated regression equation is 90.8. The model selected for this community size interval is also one of the better models selected for all community size intervals since 71.4 percent of the variation in employment change among Oklahoma City and Tulsa is explained by the estimated regression equation.

There are no significan real variables associated with plant location in the 100,000+ population interval. This indicates that those plants which located in Oklahoma City and Tulsa between 1963 and 1971 were not particularly interested in any labor, market or agglomeration factors exhibited by these two metropolitan centers.

Manufacturers significant in explaining employment change among these two centers are manufacturing industries producing food and kindred products (D_{26});[6] apparel and related products (D_{28}); rubber and plastic products (D_{35}); and electrical machinery (D_{41}). These types of manufacturers were important in the descriptive analysis. Other types of manufacturing industries were not important in the descriptive analysis and the selected regression equation (4-7) supported this by deleting those dummy variables representing less important types of manufacturing industries from the equation.

Even though these dummy variables are all significant at the 0.01 significance level, the magnitude of variable D_{41} signifies that the presence of this type of manufacturer has much more of an impact on employment change than the other two dummy variables. It was found in the descriptive analysis that variable D_{41} created almost twice as many jobs as either of the other two significant variables. This information helps to indicate the validity of the selected regression equation for the 100,000+ city size interval.

SIC Code Models

Many of these 19 manufacturing industries analyzed in Chapter II did not lend themselves to regression analysis due to an insufficient number of observations. The final number of SIC codes which had a sufficient number of observations was eight. Each of these eight manufacturing industries were analyzed by determining those factors that are important to them when deciding on alternative location sites.

Model VII: SIC 20. The regression model selected to estimate employment change created by manufacturers of food and kindred products consists of three dummy variables and five real variables. The regression equation was estimated using data from 24 different communities that manufacturers of food and kindred products located a plant during

1963 to 1971. The estimated function is:

$$\hat{Y} = \underset{(163.341)^a}{-567.768} + \underset{(26.587)^a}{87.334D_3} + \underset{(48.546)^e}{56.757D_7} + \underset{(1.181)^a}{4.170X_9} - \underset{(32.210)^a}{109.727D_{15}}$$

$$+ \underset{(.0008)^b}{0.002X_{17}} - \underset{(.957)^a}{2.716X_{21}} - \underset{(7.006)^c}{12.061X_{23}} + \underset{(1.579)^a}{5.926X_{24}} \qquad (4\text{-}8)$$

This model has an R^2 value of 0.758, with an overall F-test value significant at the 0.002 probability level. The coefficient of variation for the estimated regression equation is 96.1.

There are two community sizes that are significant to manufacturers of food and kindred products. These two community sizes are represented as dummy variables and include communities with a population between 5,000 and 9,999 (D_3), and communities with a population over 100,000 (D_7). This indicates that industries with an SIC code of 20 located most of their plants in these two community sizes. Signs of the coefficients for these two variables are what might be expected, which indicates a positive effect on employment change among manufacturers of food and kindred products.

Real variables significant in the regression equation model are average weekly employment earnings for the county (X_9), value of all forestry products sold in the county (X_{17}), population growth rate between 1960 and 1970 (X_{21}), pupil-teacher ratio (X_{23}), and average tax per \$1,000 assessed value (X_{24}). Signs of the coefficients for variables X_{21} and X_{23} indicate that manufacturers of food and kindred products located most of their new plants in smaller community centers. Variable X_{17} denotes that many new plants producing food and kindred products located in counties with an abundant supply of forestry products. Variables X_9 and X_{24} indicate that more employment was provided by industries with an SIC code of 20 in counties with high weekly employment earnings and high taxes. These are characteristics which communities who want manufacturers of food and kindred products might evaluate to see their chances for acquiring such industries.

Model IX: SIC 23. The regression equation model for manufacturers of apparel and related products consists of one dummy variable and three real variables. The equation was estimated using data from 21 plants that created employment between 1963 and 1971. The estimated function is:

$$\hat{Y} = \underset{(110.063)^{c}}{-192.036} + \underset{(79.979)^{c}}{143.753D_3} - \underset{(.019)^{c}}{0.03X_8} + \underset{(.0005)^{a}}{0.002X_{10}} + \underset{(.519)^{a}}{1.655X_{12}} \qquad (4\text{-}9)$$

This model has an R^2 value of 0.637 and the F-test value is significant at the 0.002 probability level. The coefficient of variation is 79.96. This number indicates that there is less variation in the overall model than most of the other models that have been estimated for the regression analysis section of this study.

There is only one dummy variable that is significant in the regression equation model for manufacturers of apparel and related products. The dummy variable represents communities with a population between 5,000 and 9,999 (D_3). Data from the descriptive analysis substantiates this conclusion since more jobs were created in this community size by manufacturers of apparel and related products than any other one community size. The sign of the coefficient is compatible with the expected. The magnitude of the coefficient is quite large and gives some indication of the significance this community size is to manufacturers of apparel and related products.

Real variables significant in the regression equation for industries with an SIC code of 23 are persons available for work in the county (X_8), population in a 25-mile radius of the plant (X_{10}), and distance in miles to Tulsa (X_{12}). The coefficient of variable X_8 has a negative sign which is different from what theory might hypothesize. According to the selected regression model, the more persons available for work, the less will be the change in employment impelled by manufacturers of apparel. The coefficient for variable X_{10} indicates that the more people located in a 25-mile radius of the plant, the greater will be the change in employment. However, one should keep in mind that the significance of X_8 is at the 10 percent level whereas the significance of X_{10} is at the 1 percent level.

The coefficient for variable X_{12} indicates that manufacturers of apparel located their plants great distances from Tulsa. The sign and magnitude of the coefficient signifies that for each mile away from Tulsa a plant is located, the change in employment impelled by manufacturers of apparel and related products will increase by 1.655 units.

<u>Model X</u>: <u>SIC 25</u>. The regression equation model selected to explain employment change for manufacturers of furniture and fixtures consists of three variables. The model was estimated from data for 17 different plants manufacturing furniture. The estimated regression equation is:

$$\hat{Y} = \underset{(88.389)^c}{25.125} + \underset{(149.347)^c}{263.772D_3} + \underset{(142.899)^d}{214.996D_{15}} - \underset{(1.617)^c}{3.238X_{21}} \qquad (4\text{-}10)$$

This model has an R^2 of 0.357, with an overall F-test value significant at the 0.1133 probability level. The coefficient of variation for the model is 187.8.

The only community size significant to manufacturers of furniture and fixtures is the interval consisting of those communities with a population between 5,000 and 9,999 (D_3).

The independent variable significant to manufacturers of furniture and fixtures is population growth rate between 1960 and 1970 (X_{21}). The negative sign on this coefficient indicates that communities which had a high population growth rate during the study period were undesirable to manufacturers of furniture.

The other dummy variable in the regression equation model is all interstate miles to Oklahoma City (D_{15}). The magnitude of the coefficient denotes the influence this variable has on employment change for industries with an SIC code of 25. Variable D_3 implies that most of the new plants located by manufacturers of furniture were located in the 5,000 to 9,999 population interval.

<u>Model XI</u>: <u>SIC 28</u>. The selected regression equation model to explain employment change in industries manufacturing chemicals and allied products was estimated from data for 23 plants which located in Oklahoma between 1963 and 1971. The estimated function is:

$$\begin{aligned}\hat{Y} = \underset{(9.653)^{b}}{22.982} + \underset{(26.447)^{a}}{95.469D_7} - \underset{(26.419)^{a}}{78.585D_{14}} + \underset{(24.182)^{a}}{70.366D_{15}} \\ - \underset{(.0005)^{e}}{0.0005X_{17}} \qquad (4\text{-}11)\end{aligned}$$

This model has an R^2 value of 0.575 and the F-test value is significant at the 0.003 probability level. The coefficient of variation for the regression equation is 100.5.

This regression equation suggests that metropolitan centers with a population over 100,000 (D_7) are the only communities that are significant to manufacturers of chemicals and allied products. This is a change from preceding equations because no small community size intervals are significant to manufacturers of chemicals and their allied products.

Two other dummy variables are significant to manufacturers of chemicals. These variables include all interstate miles to Tulsa (D_{14}) and all interstate miles to Oklahoma City (D_{15}). Signs on these two coefficients are somewhat confusing. The negative sign of the coefficient for variable D_{14} indicates that if Tulsa is accessible by all interstate miles then there is an adverse effect on employment change among manufacturers of chemicals. However, if transportation to Oklahoma City is all interstate miles then there is a favorable impact on employment change in this type of manufacturer. It can be concluded that Oklahoma City has a desirable effect on manufacturers of chemicals while Tulsa imposes an adverse impact.

The real variable significant in the regression equation for manufacturers of chemicals and allied products is value of all forestry products sold in the county (X_{17}). The sign of the coefficient for this variable is negative which indicates that the presence of forestry products in the same county with chemical plants has an undesirable effect on employment change in these chemical plants.

Model XII: SIC 32. The regression equation model selected to estimate employment change in manufacturers of stone, clay, and glass products was estimated from data for 26 different manufacturing plants. The estimated regression equation is:

$$\hat{Y} = \underset{(33.203)^{a}}{87.942} - \underset{(.232)^{c}}{0.450X_{13}} + \underset{(45.899)^{b}}{102.684D_{14}} + \underset{(40.409)^{e}}{20.173D_{15}} - \underset{(.653)^{a}}{2.414X_{21}} \quad (4\text{-}12)$$

This model has an R^2 of 0.538 and the overall F-test value with 29 degrees of freedom is significant at the 0.0023 probability level. The coefficient of variation for the model (4-12) is 147.1.

One thing interesting about this equation is the lack of any significant community size variable. According to the regression equation model (4-12), there are no community size intervals that are of particular interest to manufacturers of stone, clay, and glass products. This is understandable since most plants producing these types of products are located wherever their raw product is readily accessible.

Dummy variables representing all interstate miles to Tulsa (D_{14}) and all interstate miles to Oklahoma City (D_{15}) are also significant in the regression equation for manufacturers of stone, clay and glass products. Employment in industries with an SIC code of 32 is enhanced greatly if their plants are located near interstate highways that lead to Oklahoma City and Tulsa. Both of these coefficients have positive signs whereas in the preceding model only variable D_{15} had a positive sign. This indicates that both metropolitan centers are important to producers of stone, clay, and glass products.

Real variables significant in the regression equation model (4-12) are miles to Oklahoma City (X_{13}) and population growth rate (X_{21}). Variable X_{21} suggests that plants producing stone, clay and glass products located most of their plants in slow growing communities between 1963 and 1971. The coefficient for variable X_{13} substantiates the conclusion arrived at by dummy variables D_{14} and D_{15}. Variable X_{13} indicates that the further from Oklahoma City a plant is located, the more it will adversely affect the change in employment among producers of stone, clay and glass products. To summarize the regression equation model (4-12), it could be said that manufacturers of stone, clay and glass products desire to be located near Oklahoma City in a slow growing center having all interstate miles to Oklahoma City and Tulsa.

Model XIII: SIC 34. The selected regression equation model for manufacturers of fabricated metals was estimated from data for 24 plants that located in Oklahoma between 1963 and 1971. The estimated regression equation is:

$$\hat{Y} = \underset{(33.910)^{e}}{-29.856} + \underset{(31.038)^{b}}{75.382D_5} + \underset{(50.065)^{a}}{129.609D_7} + \underset{(.00007)^{b}}{0.0002X_{10}}$$

$$+ \underset{(.223)^{d}}{0.331X_{13}} \qquad (4\text{-}13)$$

This model has an R^2 value of 0.581 and the F-test value is significant at the 0.002 probability level. The coefficient of variation for the regression equation model (4-13) is 99.3.

There are two community size dummy variables significant in regression equation (4-13). These two community sizes include communities in the 15,000 to 29,999 interval (D_5) and communities with a population over 100,000 (D_7). This indicates that producers of fabricated metals located most of their new plants in these two community size intervals between 1963 and 1971.

Real variables significant in the regression equation for manufacturers of fabricated metals are population in a 25-mile radius of the plant (X_{10}) and distance in miles to Oklahoma City (X_{13}). The coefficient for variable X_{10} suggests that more employment was generated by producers of fabricated metals when the area within a 25-mile radius of the plant was heavily populated. The sign of the coefficient for variable X_{13} does not completely agree with the sign of the coefficient for variable D_7. The coefficient for variable X_{13} suggests that it is desirable to manufacturers of fabricated metals to be located away from Oklahoma City, but one must keep in mind that the coefficient of X_{13} is significant at only the 20 percent level. A possible explanation for this inconsistency might encompass the proposition that most of the jobs created in the 100,000+ interval (D_7) were created in Tulsa, thus making it desirable for manufacturers of fabricated metals to locate near Tulsa and away from Oklahoma City.

Model XIV: SIC 35. The regression equation model selected to explain employment change among manufacturers of machinery except electrical exploited data from 28 firms that located new plants between 1963 and 1971. The estimated regression equation is:

$$\begin{aligned}\hat{Y} = \; & \underset{(48.687)}{105.575} + \underset{(57.865)^a}{427.888D_6} + \underset{(27.452)^a}{136.236D_7} + \underset{(.224)^e}{0.247X_{13}} \\ & - \underset{(.002)^a}{0.005X_{16}} - \underset{(1.751)^c}{3.19X_{20}} \end{aligned} \qquad (4\text{-}14)$$

This model has an R^2 value of 0.844 with an overall F-test value significant at the 0.0001 probability level. The coefficient of variation for the model (4-14) is 72.9. This regression equation has the highest R^2 value of any equation estimated for manufacturing industries.

There are two population intervals significant to manufacturers of machinery except electrical. These two intervals include communities with a population between 30,000 and 99,999 (D_6) and metropolitan centers with a population over 100,000 (D_7). Indication is given here that producers of machinery except electrical are attracted to only larger communities when locating new production facilities. The coefficient for the dummy variable D_6 is larger than the coefficient for the dummy variable D_7. This indicates that communities with a population between 30,000 and 99,999 are more attractive to manufacturers of machinery except electrical than larger centers. Those data presented in Chapter II substantiate this statement by showing that during 1963 to 1971 more jobs were created in communities with a population between 30,000 and 99,999 than larger metropolitan centers.

Real variables significant in the regression equation for industries with an SIC code of 35 are distance in miles to Oklahoma City (X_{13}), value of all farm products in the county (X_{16}), and percent minority population (X_{20}). The coefficient for variable X_{13} suggests that manufacturers of machinery except electrical prefer to be located in places other than Oklahoma City. For variable D_7 to agree with this statement, most jobs located in centers with a population over 100,000 must have been located in Tulsa instead of Oklahoma City during 1963 1971. Coefficients for variables X_{16} and X_{20} indicate that producers of nonelectrical machinery were attracted to communities with very few farm products in the surrounding area with the community having a low percentage of its population being in minority groups. In summary, it can be suggested that manufacturers of machinery except electrical were attracted to communities with a population between 30,000 and 99,999 and Tulsa with these centers having a small amount of farm products in the surrounding area and also having a small percent of minority population.

Model XV: SIC 37. The selected regression equation model for manufacturers of transportation equipment was estimated from data for 44 new plants which located in Oklahoma during 1963 to 1971. The estimated regression equation is:

$$\hat{Y} = \underset{(30.919)^b}{59.407} + \underset{(39.151)^d}{59.125D_4} - \underset{(33.384)^c}{59.020D_5} + \underset{(.003)^a}{0.009X_8}$$

$$- \underset{(.621)^e}{727X_{19}} + \underset{(33.724)^a}{83.326D_{25}} \qquad (4\text{-}15)$$

This model had an R^2 value of 0.425 and the F-test value is significant at the 0.0008 probability level. The coefficient of variation for this equation is 108.1.

There are two population intervals significant in the explanation of employment change among manufacturers of transportation equipment. Communities with a population between 10,000 and 14,999 (D_4) are attractive to these manufacturers while communities with a population between 15,000 and 29,999 (D_5) seem not to be attractive. Variable D_5 is the first community size variable that has displayed a negative sign on its coefficient.

Real variables significant in the regression equation for producers of transportation equipment are persons available for work in the county

(X_8) and percent urban population (X_{19}). The coefficient for variable X_8 suggests that industries with an SIC code of 37 are attracted to areas with an abundance of available workers. This is consistent with theory since most plants manufacturing transportation equipment are of such size that they require a very large work force. The coefficient for variable X_{19} indicates that most areas where transportation equipment plants are located have a low percentage of the county being urban.

The last dummy variable appearing in regression equation model (4-15) is inducement for new industry. The sign of the coefficient for this variable suggests that inducements are desirable to manufacturers of transportation equipment and also the magnitude of the coefficient indicates that inducements have a large effect on employment change among these types of manufacturers. This is the only type of industry analyzed to which inducements were significant in their location decisions.

FOOTNOTES

[1]The standard error for each coefficient is given in parenthesis and the significance level (α) of each coefficient is denoted by: a if $\alpha \leq 0.01$; b if $0.01 < \alpha \leq 0.05$; c if $0.05 < \alpha \leq 0.10$; d if $0.10 < \alpha \leq 0.20$; and e if $\alpha > 0.20$. This notation is used for all regression equations presented in this chapter.

[2]The coefficient of variation is the square root of the residual mean square divided by the overall mean $\bar{Y}$, for all Y values.

[3]Bernard Ostle, Statistics in Research, (Ames, Iowa: The Iowa State University Press, 1966), p. 64.

[4]The degrees of freedom indicate how many independent pieces of information involving the n independent numbers $Y_1, Y_2, \ldots, Y_n$ are needed to compile the sum of squares. For more discussion see N. R. Draper and H. Smith, Applied Regression Analysis (New York, 1966), p. 14.

[5]The variable representing manufacturers of food and kindred products is significant. The intercept term includes the effect of the food and kindred products industry as well as the effect of the overall mean.

[6]See footnote 5.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

The general objective of this study is to analyze the geographical pattern and economic implications of the number of jobs created by new plant locations and expansions in Oklahoma from 1963 through 1971. Secondary data are used to formulate tables which denote descriptive information about industrial activity in the state during the study period. To allow for an analysis of types of manufacturing industries in the state, all industries locating or expanding in Oklahoma during the period are grouped according to the Standard Industrial Classification (SIC) code. Consistent with the code, all manufacturing industries are broken down into 21 Major Groups by type of major activity in which engaged and assigned two digit numbers from 19 to 39. All communities in the state are then partitioned into seven community size intervals on the basis of their population in 1970. Those communities with small populations are assigned to intervals having less magnitude than larger metropolitan centers. As the population of these centers increases, the magnitude of the community size intervals which they conform to are also gradually increased.

For further analysis, the state is divided into three districts based on median family incomes by county in 1970. The division of the state into these districts described here provides a useful framework for analyzing prospects for economic growth in the state. Indication is given how, if any, the regional location of different size centers affects changes in their manufacturing employment.

Capital-labor ratios are also computed to identify those types of manufacturers along with those community size intervals that are capital-labor intensive. Capital-labor ratios indicate the amount of initial capital investment per new job created. The manufacturing industry or community size interval having large capital-labor ratios are classified as capital intensive, whereas those industries or intervals having small capital-labor ratios are labor intensive.

The final section of the study uses secondary data to arrive at the empirical relationship existing between employment change for seven community size intervals and for eight selected SIC codes and those characteristics considered important to a firm in its location decision. A linear multiple regression analysis is used to explain the change in employment when a different community size interval or a different SIC code is considered.

Conclusions

Results of Descriptive Analysis

The number of new jobs created by manufacturing industries establishing new plants or expanding existing operations in Oklahoma from 1963 through 1971 is 58,693. New manufacturing plants created 29,172 jobs (49.7 percent) and expansions created 29,521 jobs (50.3 percent).

The community size interval containing communities with a population of over 100,000 was more conducive to industrial activity than any other interval. This interval was responsible for 26.6 percent of those jobs created by new plants during the period and 59.1 percent of those jobs created by expansions of existing plants. The population interval receiving the least amount of jobs was the interval 2,500 to 4,999. This interval had 6.5 percent of those jobs created by new plants and only 2.2 percent of those jobs created by expansions of existing plants.

The type of new plants which created more jobs than any other (16 percent) was of apparel and related products. Existing plants manufacturing transportation equipment and those manufacturing ordnance and accessories were the most active in expanding their present operations. Manufacturers of transportation equipment created 19.1 percent while manufacturers of ordnance and accessories created another 17.3 percent of those jobs created by expansions. Most of the jobs created by these types of manufacturers were created in Oklahoma City and Tulsa.

Communities with a population in the range of 0-2,499 were attractive to industries manufacturing textile mill products and paper and allied products. Within the 2,500 to 4,999 interval, the manufacturers of apparel and related products were the most common type of industry. Manufacturers of apparel and related products along with manufacturers of furniture and fixtures were the most prevalent types of industries locating in communities with a population in the interval 5,000-9,999. The interval consisting of communities with a population in the range of 10,000 to 14,999 had most of their new jobs created by manufacturers of transportation equipment while manufacturers of rubber and plastic products were attracted to communities with a population between 15,000 and 29,999.

Manufacturing of apparel and related products, rubber and plastic products, machinery except electrical and transportation equipment dominated the 30,000-99,999 population interval. Metropolitan areas with a population of over 100,000 were conducive to almost every type of industry.

The division of the state into three districts provides the framework necessary to determine the geographical locations most conducive to plant location. The number of new jobs created from 1963 through 1971 amounted to 8,342 in District I which represented 14.2 percent of all jobs created throughout Oklahoma during the study period. The population interval in District I which more new jobs were created in than any other was the interval 0-2,499. Manufacturers of apparel and related products were the most active type of manufacturers in creating new jobs in District I.

District II, which contains Oklahoma City and Tulsa, received more jobs than either District I or District III. Roughly 54 percent of those jobs created in this district were created in Oklahoma City and Tulsa. Manufacturers of apparel and related products, rubber and plastic products, electrical machinery and transportation equipment were found to be more common than others.

District III had no communities with a population of over 10,000. Only 6.2 percent of those jobs created in the state were created in District III. Manufacturers of apparel and related products created 31.1 percent while manufacturers of furniture and fixtures created another 42.2 percent of those jobs created by new plants in District III.

The average capital investment per new job created for all industries which located in Oklahoma from 1963 through 1971 was $18,561.

Industries manufacturing paper and allied products had the largest capital-labor ratio at $136,073 whereas industries manufacturing leather and leather products had the smallest ratio at $1,457. Communities which had the largest capital-labor ratio were the ones in the population interval 0-2,499. These communities had a ratio of $45,552. Communities with the smallest ratio were those in the 10,000 to 14,999 population interval at $9,754.

Empirical Results

A computer multiple regression routine was used to estimate alternative regression equations for seven community size intervals and eight manufacturing industries. Predictions are made on the change in future employment in these eight manufacturing industries and community size intervals.

Characteristics important to manufacturing industry in the 0-2,499 community size interval include miles to Tulsa, value of all forestry products sold in the county, percent minority population, pupil-teacher ratio and average tax per $1,000 assessed value. Types of manufacturers that are significant in the regression equation for the 0-2,499 community size interval are those producing: food and kindred products; textile and mill products; apparel and other fabric products; furniture and fixtures; paper and allied products; and primary metal industries.

The equation selected for the 2,500-4,999 community size interval showed average weekly employment earnings for the county and the population growth rate between 1960 and 1970 to be the most important. Manufacturers found to be significant to this community size interval include those engaged in the production of textile mill products, apparel and related products and machinery except electrical.

Real variables found to be important to communities represented in the 5,000-9,999 community size interval are miles to Tulsa and population growth rate between 1960 and 1970. Manufacturers significant to communities in the sample used for estimating the regression equation for this interval are those producing apparel and related products, furniture and fixtures, and primary metals. The only real variable significant to communities conforming to the 5,000-9,999 community size interval is the value of all mineral products mined in the county. Manufacturers significant in the selected regression model are manufacturers of textile mill products and manufacturers of transportation equipment.

Real variables significant in the regression equation for the 15,000-29,999 community size interval are distance in miles to the nearest interstate, miles to Tulsa and miles to Oklahoma City. The only type of industry significant to communities in this size population interval is manufacturers of rubber and plastic products. There are no real variables significant in the equation for those communities represented in the sample for the 30,000-99,999 community size interval. Types of manufacturers being significant in the equation for communities in this community size interval include those industries manufacturing rubber and plastic products, machinery except electrical, and transportation equipment.

The final community size interval model representing metropolitan centers with a population over 100,000 has no significant real variables associated with plant location. Industries significant in explaining employment change among communities in this interval are those producing food and kindred products, apparel and related products, rubber and plastic products, and electrical machinery.

Community sizes significant to manufacturers of food and kindred products (SIC 20) include communities with a population between 5,000-9,999 and communities with a population over 100,000. Other variables appearing in the selected regression equation are: all interstate miles to Oklahoma City, average weekly employment earnings for the county, value of all forestry products sold in the county, population growth rate between 1960 and 1970, pupil-teacher ratio, and average tax per $1,000 assessed value.

The only community size interval significant in the regression equation for manufacturers of apparel and related products (SIC 23) represents communities with a population between 5,000 and 9,999. Real variables significant in the equation for industries with an SIC code of 23 are persons available for work in the county, population in a 25-mile radius of the plant, and distance in miles to Tulsa.

Only one community size is significant to manufacturers of furniture and fixtures (SIC 25). This interval consists of those communities with a population between 5,000 and 9,999. Other characteristics significant to manufactures of furniture and fixtures are population growth rate between 1960 and 1970 and a dummy variable representing all interstate miles to Oklahoma City.

The regression equation for SIC 28 suggests that metropolitan centers with a population over 100,000 are the communities significant in the equation for manufacturers of chemicals and allied products. Dummy variables significant in the regression equation for manufacturers of chemicals include all interstate miles to Tulsa and all interstate miles to Oklahoma City. The real variable important to manufacturers of chemicals and allied products is value of all forestry products sold in the county.

One important thing about the equation for manufacturers of stone, clay, and glass products (SIC 32) is the lack of any significant community size variables. Dummy variables representing all interstate miles to Tulsa and all interstate miles to Oklahoma City are found to be important to manufacturers of stone, clay, and glass products. Real variables significant in the selected regression model are miles to Oklahoma City and population growth rate.

There are two community size intervals significant in the selected regression equation for manufacturers of fabricated metals (SIC 34). Real variables important to these manufacturers are population in a 25-mile radius of the plant and distance in miles to Oklahoma City.

Population intervals significant in the equation for manufacturers of machinery except electrical (SIC 35) include communities with a population between 30,000 and 99,999 and metropolitan centers with a population over 100,000. Characteristics significant in the equation for industries with an SIC code of 35 are distance in miles to Oklahoma City, value of all farm products in the county and percent minority population.

According to the regression equation selected for manufacturers of transportation equipment (SIC 37), population intervals containing communities with a population between 10,000 and 14,999 and communities with a population between 15,000 and 29, 999 were found to be significant. Real variables significant to producers of transportation equipment are persons available for work in the county and percent urban population. The dummy variable appearing in the regression equation model is inducement for new industry.

Future Research

Much concern has arisen concerning the proper planning of rural communities throughout the United States. This study is specific to Oklahoma since it is based upon information pertaining to firms which chose this state as a location for their plants. Similar studies of other states or communities could be helpful in providing the needed information which would assist industrial developers in their efforts to determine which firms are most likely to settle in their communities.

Also, additional research effort for the state of Oklahoma would be helpful concerning those types of industries that were left out of the regression analysis section of this study. To determine those community characteristics and size communities that are important to each type of industry would add to the "fund" of knowledge deemed useful to development planners when competing for new industry. A knowledge of all types of manufacturing industries would enable community industrial developers to predict the adaptability of all firms to a community.

Discriminant analysis is another statistical technique that could be applied to data used in this study. The aim in this procedure is to determine whether one group of communities or industries is significantly different from another group or groups. And if this group is different, how are the differences manifested. By using this procedure, differences in communities could be analyzed and answers found to such questions as why is one rural community a viable growing center and another a moribund declining area.

Another technique that could be used to ascertain why some communities are growing and others are not is factor analysis. Factor analysis is a quantitative method which can determine relationships between a number of social and economic variables. The factors that emerge from the analysis will indicate the significant element of similarity and difference between communities receiving plants and those not receiving new plants.

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APPENDIX A

COMMUNITIES RECEIVING NEW EMPLOYMENT

Communities in Oklahoma which had new or expanded industry between 1963 and 1971 with a population between 0-2,499 in 1970.

Arnett	Forgan	Marietta	Seling
Billings	Fort Cobb	Marshall	Shattuck
Bokoshe	Gage	Maysville	Snyder
Burns Flat	Garber	Mooreland	Stigler
Carmen	Geary	Mountain Park	Stillwell
Carnegie	Gore	Mountain View	Talihina
Catoosa	Grandfield	Muldrow	Texhoma
Chelsea	Grove	Newkirk	Valliant
Cherokee	Hammon	Noble	Velma
Cheyenne	Hartshorne	Okeene	Wakita
Cresent	Healdton	Olustee	Watts
Custer City	Hennessey	Pawnee	Waurika
Cyril	Hominy	Perkins	Waukomis
Davis	Jones	Pocola	Weleetka
Duke	Konowa	Prague	Wetumka
Eakly	Luther	Quinlan	Wilburton
Erick	Mannford	Rush Springs	Wynnewood
Euraula	Mannsville	Ryan	Yale
Fairfax			

Communities in Oklahoma which had new or expanded industry between 1963 and 1971 with a population between 2,500-4,999 in 1970.

Antlers	Dewey	New Cordell	Skiatook
Bixby	Fairview	Nowata	Stroud
Bristow	Hobart	Pawhuska	Tishomingo
Broken Bow	Lindsay	Purcell	Tonkawa
Chandler	Madil	Sallisaw	Wagoner
Checotah	Mangum	Sayre	Watonga
Commerce	Marlow		

Communities in Oklahoma which had new or expanded industry between 1963 and 1971 with a population between 5,000-9,999 in 1970.

Alva	Frederick	Idabel	Tahlequah
Anadarko	Guthrie	Pauls Valley	Vinita
Blackwell	Guymon	Perry	Weatherford
Claremore	Henryetta	Poteau	Wewoka
Clinton	Holdenville	Pryor	Woodward
Cushing	Hugo	Seminole	Yukon
Elk City			

Communities in Oklahoma which had new or expanded industry between 1963 and 1971 with a population between 10,000-14,999 in 1970.

Ada
Broken Arrow
Chickasha
Durant
El Reno
Miami
Sand Springs

Communities in Oklahoma which had new or expanded industry between 1963 and 1971 with a population between 15,000-29,999, 1970.

Altus	Edmond
Ardmore	McAlester
Bartlesville	Okmulgee
Bethany	Ponca City
Del City	Sapulpa
Duncan	Shawnee

Communities in Oklahoma which had new or expanded industry between 1963 and 1971 with a population between 30,000-99,999 in 1970.

Enid
Lawton
Midwest City
Muskogee
Norman
Stillwater

Communities in Oklahoma which had new or expanded industry between 1963 and 1971 with a population over 100,000 in 1970.

Oklahoma City
Tulsa

APPENDIX B

ABSTRACT OF STANDARD INDUSTRIAL CLASSIFICATION SYSTEM

This is a listing of the 21 major groups of manufacturing industries along with a definition for each group. The listing was taken from the Oklahoma Directory of Manufacturers and Products for 1972.

Major Group 19. Ordnance and Accessories: This major group includes establishments engaged in manufacturing artillery, small arms, and related equipment; ammunition, tanks and specialized tank parts; sighting and fire control equipment; and miscellaneous ordnance and accessories, not elsewhere classified.

Major Group 20. Food and Kindred Products: This major group includes establishments manufacturing foods and beverages for human consumption, and certain related products, such as manufactured ice, chewing gum, vegetable and animal fats and oils, and prepared feeds for animals and fowls.

Major Group 21. Tobacco Manufacturers: This major group includes establishments engaged in manufacturing cigarettes, cigars, smoking and chewing tobacco, and snuff, and in stemming and redrying tobacco.

Major Group 22. Textile Mill Products: This major group includes establishments engaged in performing any of the following operations: (1) preparation of fiber and subsequent manufacturing of yarn, thread, braids, twine and cordage; (2) manufacturing broad woven fabric, narrow woven fabric, knit fabric, and carpets and rugs from yarns; (3) dyeing and finishing fiber, yarn, fabric, and knit apparel; (4) coating, waterproofing, or otherwise treating fabric; (5) the integrated manufacturing of knit apparel and other finished articles from yarn; and (6) the manufacture of felt goods, ace goods, bonded-fiber fabrics, and miscellaneous textiles.

Major Group 23. Apparel and Other Finished Products Made From Fabrics and Similar Materials: This major group, known as the cutting-up and needle trades, included establishments producing clothing and fabricated products by cutting and sewing purchased woven or knit textile fabrics and related materials such as leather, rubberized fabrics, plastics and furs.

Major Group 24. Lumber and Wood Products, Except Furniture: This major group included logging camps engaged in cutting timber and pulpwood; merchant sawmills, lath mills, shingle mills, cooperate stock mills, planing mills, and plywood mills and veneer mills engaged in producing lumber and wood basic materials; and establishments engaged in manufacturing some finished articles made entirely or mainly of wood or wood substitutes. Certain types of establishments producing wood products are classified elsewhere.

Major Group 25. Furniture and Fixtures: This major group includes establishments engaged in manufacturing household, office, public building, and restaurant furniture; and office and store fixtures.

Major Group 26. Paper and Allied Products: This major group includes manufacture of pulps from wood and other cellulose fibers, and rags; the manufacture of paper and paperboard; and the manufacture of paper and paperboard into converted products such as coated paper, paper bags, paper boxes, and envelopes. Certain types of converted paper products are classified elsewhere.

Major Group 27. Printing, Publishing and Allied Industries: This major group includes establishments engaged in printing by one or more of the common processes, such as letterpress, lithography, gravure, or screen; and those establishments which perform services for the printing trade, such as bookbinding, typesetting, engraving, photoengraving, and electrotyping. This major group also included establishments engaged in publishing newspapers, books and periodicals, regardless of whether or not they do their own printing.

Major Group 28. Chemicals and Allied Products: This major group included establishments producting basic chemicals and establishments manufacturing products by predominantly chemical processes. These establishments manufacture three general classes of products: (1) basic chemicals such as acids, alkalies, salts, and organic chemicals; (2) chemical products to be used in further manufacture such as synthetic fibers, plastics materials, dry colors, and pigments; (3) finished chemical products to be used for ultimate consumption such as drugs, cosmetics, and soaps; or to be used as materials or supplies in other industries such as paints, fertilizers, and explosives.

Major Group 29. Petroleum Refining and Related Industries: This major group includes establishments primarily engaged in petroleum refining, manufacturing paving and roofing materials, and compounding lubricating oils and greases from purchased materials.

Major Group 30. Rubber and Miscellaneous Plastics Products: This major group includes establishments manufacturing from natural, synthetic, or reclaimed rubber, gutta percha, balata, or gatta siak, rubber products such as tires, rubber footwear, mechanical rubber goods, heels and soles, flooring and rubber sundries. This group also includes establishments manufacturing or rebuilding retread tires, but automobile tire repair shops engaged in recapping and retreading automobile tires are classified in Services. This group also includes establishments engaged in molding primary plastics for the trade and manufacturing miscellaneous finished plastics products.

Major Group 31. Leather and Leather Products: This major group includes establishments engaged in tanning, currying, and finishing hides and skins, and establishments manufacturing leather and artificial leather products and some similar products made of other materials. Leather converters are also included.

Major Group 32. Stone, Clay, Glass and Concrete Products: This major group includes establishments engaged in manufacturing flat glass and other glass products, cement structural clay products, pottery, concrete and gypsum products, cut stone products, abrasive and asbestos products, etc., from materials taken principally from the earth in the form of stone, clay and sand.

Major Group 33. Primary Metals Industries: This major group includes establishments engaged in the smelting and refining of ferrous and nonferrous metals from ore, pig, or scrap; in the rolling, drawing, and alloying of ferrous and nonferrous metals; in the manufacture of castings, forging, and other basic products of ferrous and nonferrous metals; and in the manufacture of nails, spikes and insulated wire and cable. This major group also includes the production of coke.

Major Group 34. Fabricated Metal Products, Except Ordnance, Machinery and Transportation Equipment: This major group includes establishments engaged in fabricating ferrous and nonferrous metal products such as metal cans, tinware, hand tools, cutlery, general hardware, nonelectric heating apparatus, fabricated structural metal products, metal stampings, and a variety of metal and wire products not elsewhere classified. Certain important segments of the metal fabricating industries are classified in other major groups.

Major Group 35. Machinery, Except Electrical: This major group includes establishments engaged in manufacturing machinery and equipment, other than electrical equipment and transportation equipment. Machines powered by built-in or detachable motors ordinarily are included in this major group, with the exception of electrical household appliances. Portable tools, except hand tools, both electric and pneumatic powered, are included in this major group.

Major Group 36. Electrical Machinery, Equipment, and Supplies: This major group included establishments engaged in manufacturing machinery, apparatus, and supplies for generation, storage, transmission, transformation, and utilization of electrical energy. The manufacture of household appliances is included in this group.

Major Group 37. Transportation Equipment: This major group includes establishments engaged in manufacturing equipment for transportation of passengers and cargo by land, air, and water. Important products produced by establishments classified in this major group include motor vehicles, aircraft, ships, boats, railroad equipment, and miscellaneous transportation equipment such as trailers, motorcycles, bicycles, and horse-drawn vehicles.

Major Group 38. Professional, Scientific, and Controlling Instruments; Photographic and Optical Goods; Watches and Clocks: This major group includes establishments engaged in manufacturing mechanical measuring, engineering, laboratory, and scientific research instruments; optical instruments and lenses; surgical, medical and dental instruments, equipment, and supplies; ophthalmic goods; photographic equipment and supplies; and watches and clocks.

Major Group 39. Miscellaneous Manufacturing Industries: This major group includes establishments primarily engaged in manufacturing products not classified in any other manufacturing major group. Industries in this group fall into the following categories: jewelry, silverware, and plated ware, musical instruments; toys, sporting and atheletic goods; pens, pencils, and other office and artists' materials; bottons, costume novelties, miscellaneous notions; brooms and brushes; morticians' goods; and other miscellaneous manufacturing industries.

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