ESTIMATION OF THE MUNICIPAL GOVERNMENT COSTS OF COMMUNITY SERVICES FOR RURAL OKLAHOMA COMMUNITIES

By

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INTRODUCTION

Statement of the Problem

Historically, the economy of Oklahoma has been based on agriculture and mining (petroleum). The success or failure of these two basic industries, ones which have spurred the development of many "spin-off" or multiplier jobs, have determined the success or failure of many Oklahoma communities and their surrounding areas. As a result, Oklahoma has been rurally oriented in both population and employment. In 1950, 49 percent of all Oklahoma residents were classified as rural, with agriculture and mining employing 147,000 and 40,189 persons, respectively (3). Since 1960, however, improvements in technology have increased agricultural output per unit of labor input, thus decreasing employment in agriculture. Simultaneously, petroleum reserves in Oklahoma have been gradually depleted, causing declining employment in mining. By 1970, agricultural and mining employment had declined to 90,000 and 32,568, respectively, and only 32 percent of Oklahoma's residents were classified as rural (3). Agricultural employment continued to decline through December, 1975, while mining employment had increased to 38,300 by December, 1975, due largely to increased coal mining and petroleum drilling activity spurred by the concern for more available energy (30).

Other demographic features such as population trends, net migration and median age reflect changes in the economic structure of Oklahoma.

For example, Oklahoma's rural population decreased by an average of 1.4 percent annually over the period 1950-1970, while the statewide population increased .7 percent annually and the national population increased 1.5 percent annually. Absolute state population increased from 2,233,000 in 1950 to 2,559,000 in 1970, with rural population decreasing from 1,126,099 to 819,902 over the same period. By July 1, 1976, Oklahoma's population had reached 2,766,000, an average increase of 1.2 percent per year since 1970. The rapid growth in population from 1,657,349 in 1910 to 2,396,040 in 1930 for the state and from 1,338,180 to 1,574,349 for rural Oklahoma was offset by the large number of residents that left the state during the Dust Bowl and World War II years. Migration statistics indicate that, for Oklahoma, there was a net out-migration of 218,553 persons in the decade of the 1950's and a net in-migration of only 13,349 in the 1960's (21) (42) (43) (44) (45).

During the period 1950 to 1960, Oklahoma's total rural population was both decreasing and aging reaching a high median age in 1970 of 33.9 years, as compared to 23.3 years in 1910 and 27.5 years in 1950 (21) (41) (43). The national average median ages for 1960 and 1970 were 29.5 and 28.1 years, respectively.

As Oklahoma's rural population has declined, support for services provided to the remaining rural residents has diminished. Realizing that employment opportunities in the agricultural and mining sectors of the local economy have declined, that out-migration has, in many instances, reduced rural community populations and that few young people remain in their home towns to live and work, leaders in rural communities have found themselves facing serious problems of community economic survival.

Residents of rural communities are becoming aware of the problem of declining economic base also. Many have seen industrial development as a solution and are willing to encourage industrial location in their communities, but many others oppose manufacturing type employment coming to their town and bringing some of its associated "problems" (11) (48). Therefore, community attitudes on alternative avenues of development are of concern to rural leaders. Research has been conducted to measure the attitudes of rural citizens toward industrial development. In a survey of Chamber of Commerce and women's club members, university students and other residents in a West Texas community, Green and Bruce (11) found that most of those surveyed approved of industrialization as a means of developing a more stable economic base.

Smith and Tweeten (36) performed a study, the objective of which was to detect the feelings of rural Oklahomans concerning industrialization. Their results indicated that most rural Oklahoma residents believe new jobs would benefit their community, with 83 percent of those surveyed indicating that industrial development would be a desirable solution to their job scarcity dilemma. Nearly one-half said they would take an additional job if available to supplement their income, and commuting workers said they would drive up to 30 miles if jobs were available in that radius.

Many studies have been conducted to identify and explain what is actually happening in terms of industrial development and population shifts in the rural south and in rural Oklahoma in particular. Results of several of these studies have implications concerning the factors which should be included in evaluations or explanatory models concerning service costs.

In a study of the Tennessee Valley region during the year 1959-1968, Garrison (10) employed shift-share analysis and basic entropy[1] techniques to indicate increases in the relative strengths of rural and small town counties[2] when competing with urban centers for industrial location and development. Some highlights of the study were:

1. Small town and rural counties showed a substantial increase (up to 42.4 percent) in their share of total manufacturing employment.

2. Over 56 percent of these new jobs were in labor intensive industries.

3. Sixty-five percent of all labor intensive jobs from 1959-1968 located in small towns and rural counties.

4. More entropy exists within each county category (small town-rural and urban) than exists between the county categories.

5. Despite rapid growth in manufacturing based employment, population in small town and rural counties increased only slightly, or decreased in many cases, with out-migration reaching 60 percent in some counties. This movement of people from small towns and rural areas to larger communities is thought to be due, in large part, to the great variety of services available to citizens in larger communities.

A more general study by Till (38) examines population and industrial growth in 13 Southern states using three county classifications: SMSA, fringe SMSA (0-50 miles from SMSA), and distant rural counties (greater than 50 miles from SMSA). These groups were compared to identify and evaluate changes in manufacturing employment, total non-farm employment and population.

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[1]Entropy is defined as the amount of disorder within a system. In this instance, it would refer specifically to patterns or lack of patterns detected in industrialization, both in plant type and plant location.

[2]Small town counties are counties having communities greater than 5,000 but less than 10,000 population. Rural counties are defined as counties having no community in excess of 5,000 population.

Till's study indicated that large increases in manufacturing based employment and total non-farm employment occurred in rural counties during the 1960's (61.1 and 48.9 percent, respectively). Similar increases occurred in fringe counties (52.5 and 48.3 percent, respectively). SMSA growth rates were 43.7 percent for manufacturing employment and 49.7 percent for total non-farm employment. Till's findings agree with those of Garrison (9) that industry location by type is closely related to the rural-urban characteristics of specific areas. That is, labor intensive industries tend to locate in rural areas and capital intensive industries tend to locate in urban areas.

Till reported that the population growth rate for the non-metropolitan South from 1960 to 1969 was considerably less than for either the nation as a whole or the metropolitan South. The non-metro South had a population growth rate of 3.5 percent compared to 13.3 percent and 22.4 percent for the nation and metropolitan South, respectively. The sizeable increase in non-farm employment in the non-metro South (674,345) was outweighed by the drastic decline (2.3 million) in farm employment during the 1950's and 1960's (25). Major declines in the extractive industries also had negative impacts on the population of the rural South (25).

Childs and Doeksen (5) observed that industries providing new jobs to Oklahoma communities with populations less than 10,000 in the period 1963-1971 were largely producers of textiles and apparel, wood and wood products, transportation equipment and furniture and fixtures. Eighty percent of the state's 58,793 new jobs during that time period were located in the "turnpike belt". This section of Oklahoma lies roughly between lines connecting Miami to Waurika and Ponca City to Mangum, extending from northeast to southwest and covering about one-third of the state. This central section contains both Tulsa and Oklahoma City and most other population centers. Only one population center of 40,000 or greater (Muskogee) is located in the southeastern one-third of the state. And the northwest one-third of Oklahoma has no cities with populations greater than 10,000.

To counter the problem of economic decline of rural communities and loss of population to urban centers, major thrusts for rural-based industry began in Oklahoma in the early 1960's. Of the 468 new plants locating in Oklahoma in the period 1963-1971, 241 located in communities of less than 10,000 (5). Data show that 13,711 new jobs, 47 percent of the total employment created by the 468 plants, were created in communities of this size (5). Existing plant expansions in rural communities accounted for an additional 5,904 jobs, 20 percent of the state's total expansion created jobs, bringing the total for all new rural manufacturing jobs to 19,615 (5).

These rural jobs impacted on rural communities. Population in non-metropolitan (non-SMSA) Oklahoma increased by 6.6 percent over the five year period of July 1, 1970 to July 1, 1975, compared with a 4.1 percent growth in metropolitan Oklahoma over the same five years. Forty-five non-metropolitan Oklahoma counties experienced net in-migration (21).

New industry can benefit a community by causing new employment and higher incomes and by creating new and better business services. But the influx of population and industry may pose serious problems for the public sectors (municipal government) in growing communities. Rapid influxes of population and development can potentially strain the fiscal situations of small communities by causing increased demands on public services where there may be inadequate tax base to support them, particularly if tax concessions have been made to attract industry.

The burden of deciding whether to encourage continued development of manufacturing based employment falls directly upon the leaders of a community. More often than not, these citizens must make decisions based on, at best, rough estimates of the public and private impacts of new industry on their community. Leaders of many small communities have neither the information nor the expertise to ascertain the effects of industrial development on the cost structure of service provision in their towns. Extension and substate planning district personnel, both of which work closely with small town leaders, convey that what these decision makers really want to know is, "What will the prospective industry cost the municipal government in terms of direct, or primary, costs in dollars?" Community leaders relate that direct dollar costs of service provision are readily understood by everyone concerned and give city officials an idea of what they might be getting the community into as far as present and future maintenance and operation costs, and possibly expansion or construction of new facilities. A community public service cost-estimating model could be of considerable assistance to rural community leaders in making decisions concerning the attraction of manufacturing firms to their community.

Objectives of the Study

The primary objective of this study is to develop a means useful to rural development professionals[3] in working with leaders of small communities in Oklahoma, those under 10,000 population, for determining the

[3]Extension personnel, multi-county planning district staff and other public agency personnel concerned with economic development of rural Oklahoma communities.

effects on community expenditures of industrial development. This objective will be accomplished by the development and testing of econometric models using economic and demographic data for various non-SMSA communities with populations of 1,000 to 10,000 to explain public costs of community services. Specifically, the research will involve:

1. Development and testing of general econometric models relating total operation and maintenance costs of municipal governments to economic and demographic characteristics of small rural Oklahoma towns.

2. Development and testing of models for identifying operation and maintenance costs associated with specific types of community services based on local economic and demographic characteristics.

3. Development and testing of models relating total operation and maintenance costs of municipal governments to particular types of local industrial development.

Related Research

In the past thirty years considerable research has been conducted relating to the effects of rural industrialization on local economics. Most of these studies have examined impacts on the private sectors of communities due to the establishment of new industry (6) (10) (14) (24) (32) (33) (39). The use of case study and input-output analysis methodologies have dominated research associated with impacts of rural industrialization. Most input-output studies of non-metropolitan industrial development have been directed toward the generation of employment and income multipliers (8) (10) (14) (32) (33). Case studies have typically involved the comparison of one or a few communities receiving industry with communities not receiving industry (6) (32) (39) (48).

Even though most studies have not dealt in great depth with municipal government expenditures and their estimation, some research has been devoted to the estimation of the costs of provision of public services by municipalities. In some cases such studies have been broadly focused on the total community impacts of industrial development. In other cases community public sector impacts of industrial development have been examined individually and in-depth. Examples of both of these types of studies are discussed below.

Studies Focusing on the Total Community Economy

Hirsch (14) used regional input-output analysis to estimate direct, indirect and induced income, employment and output resulting from local industrial development of 16 St. Louis SMSA communities. The primary and secondary changes in the private sectors of the communities were then related to fiscal structures of the public sectors to identify industrial impacts. Income and employment estimates were applied to these sectors to develop implications relating to the determination of local taxation policies and the anticipated costs of service provision. Hirsch's study was based on the observed flow of funds into and out of respective accounts in relation to direct and indirect effects for each sector. He presents a theoretical development of detailed equations to explain changes in sectoral economies based on employment, income and population changes and the interrelationships of costs and receipts.

In 1975, Clayton and Whittington (6) developed what they referred to as an Economic Growth Impact Model (EGIM). Their research focused on the impacts of a Florida community and the surrounding county (populations of 70,000 and 125,000, respectively) due to location of a large electronics plant. The Florida EGIM relied heavily on per capita costs of services for selected cities and counties using 1973-74 state comptroller data.

Results for the private, municipal government and school district sectors showed large overall community net economic gains, but estimated gains in city revenues were virtually offset by the increased costs associated with additional community service provision. Municipal revenues were computed and changes in operating expenses and incremental capital outlays were estimated. Clayton and Whittington state that the greatest value of their model is its capacity for quick analysis of complex economic situations related to alternative development and community growth options.

A group of North Dakota researchers used a case study approach to estimate the overall impacts of a rural community resulting from the location in the area of a major power generating plant. Toman et al., (39) estimated changes in public sector costs and revenues by using a model based on a set of regional input-output coefficients and a related set of cost and revenue estimators. The input-output model was used to estimate the indirect and induced changes in business volume, employment and income in the community. These estimates were then used as the bases for computing public sector costs and tax payments. The research team examined sources of revenue for both state and local government and looked, in particular, at the changes in service provision costs to the municipality. State averages for per capita costs of services were used to estimate the expected increases in costs associated with a given increase in population. With the inclusion of capital costs for expansion and improvement of systems, the study results indicated that the municipal government sector would have negative annual net returns over most of the 30 year life of the project, despite expected increases in ad valorem tax collections. The study showed a positive net accumulation for the state of over \$323,000,000 during the life of the plant. Toman, et al., concluded that without exogenous assistance from state or federal governments, an increase in local taxes or a cutback in services, the municipality could not maintain a balanced budget.

A benefit-cost model was employed by Schaffer and Tweeten (34) to examine the economic effects of 12 plants on five Eastern Oklahoma communities. Private, municipal government and school district sectors of local economies were surveyed in order to estimate primary and secondary effects of new plant locations on communities. Schaffer tested his benefit-cost model under three hypothetical situations: Case I--short run, full employment economy with refilling of some of the previous jobs and no consideration of secondary economic effects; Case II--short run with partial loss of previous jobs refilled and secondary effects accounted for in the local area; and Case III--intermediate-long run with all previous jobs refilled and secondary effects present in the local area. Results of the estimation procedure with regard to the overall community showed annual private sector net gains per plant averaging \$93,764 for case I, \$153,908 for case II, and \$169,809 for case III. Annual municipal government average net impacts ranged from \$259 per plant in case I to \$630 per plant in case III. Looking in particular at case II, the municipal government net fiscal impacts ranged from a loss of \$2,521 to a gain of \$3,246 per community, averaging only \$525 per plant for the study period 1960-1969. Municipal government net fiscal impacts were negative for three plants and less than \$750 for five others. Only four of the plants involved provided net fiscal impacts of over \$500 to the municipal governments.

Schaffer found that the type of industry locating in a community has a large influence on the net impacts on the community. In general, a small number of in-commuters in the plant work force, high intensity of employment of locally available inputs and a substantial amount of capital outlay involved in plant establishment tended to increase the positive net impact on each segment of the local economy and on the community as a whole. This study also indicated that, for the situations considered, the private sector received the vast majority of net economic gains, the municipal governments and school districts obtaining only .33 of one percent and .25 of one percent of the net gains, respectively.

Reinschmiedt (32) examined the net community impacts resulting from industrialization in the panhandle regions of Texas and Oklahoma. Reinschmiedtclassified community costs into five types: 1) costs of utilities to plants and new residents, 2) costs of all municipal services, 3) costs of service consumed by in-commuters, 4) locational incentives or subsidies given to new or expanding plants, and 5) indirect and induced expenditures due to increased demands on public services.

This particular research effort took the form of a disaggregated benefit-cost model utilizing the input-output model developed by Schaffer (33). Costs included increased operating expenditures as well as capital outlays for additional facilities. Net gains to the municipal government sector averaged \$3,484, with a range of \$77 to \$13,325. In all but two of the nine communities analyzed, net municipal government gains were very small. Results indicated that plants with large capital investments provided the highest net benefits to municipal governments due to increases in ad valorem collections.

Studies Focusing on the Municipal Government Sector of the Economy

Weber and Savage (48) conducted research dealing with the application of four different approaches to estimation of municipal government expenditures in a small, rapidly growing community in eastern Oregon. In this study, the abilities of the different models developed by Schaffer, Pattie, Mace and Wicker, and Isard and Coughlin to estimate revenues and expenditures were compared. The Mace and Wicker (24) model accounted for only a part of the per capita costs of facility expansion. Isard and Coughlin (17) used national averages of service costs to separately estimate capital and operation and maintenance costs.

Weber and Savage found that major differences exist in all of the estimation procedures tested in the handling of the costs and revenues of capital intensive services, such as water and sewer utilities. They also observe that a major portion of expenditures for such capital intensive services are used for debt repayment. They stated that most estimation methods ignore the higher initial costs that residents of a community must bear in order to build overcapacity plants to provide for future needs. Separate estimation of costs for capital intensive and operating cost intensive services is seen as a possible aid in dealing with this problem.

Shapiro, Morgan and Jones (35) conducted a study, the objective of which was to develop a simplified model linking changes in community public service operating expenditures to economic growth. This was accomplished by identifying multipliers between total employment and basic employment in the manufacturing, mining and agricultural sectors.

These multipliers were then used to develop a model relating multipliers to population. Once the population equation had been specified, the researchers regressed total community service expenditures against population and found that a cubic equation gave the best fit. This model was then used to derive average and marginal costs with a given population change. Results of the Shapiro, Morgan and Jones study showed a decline in per capita service operating expenditures of from $563 for a population of 10,000 to $186 at a population level of 57,000.

Williford (49) used both cross-sectional and time-series data to evaluate the net impacts of a declining economic base on community service expenditures for towns in the High Plains area of Texas and Oklahoma. Most of the communities were of like economic circumstances, agriculturally based with some industrial development.

In his study, Williford sought to identify some specific relationships between declining groundwater and the fiscal situation of the High Plains communities. His work was based on the assumption that declining groundwater would cause a decline in agricultural output, thereby causing a decrease in population or population growth. This change would cause a change in the level and nature of service provision costs to municipalities.

Williford made estimates for total expenditures and individual service expenditures based on alternative population estimates from a study by Ekholm (9) of depleting groundwater and petroleum in the same study area. Williford estimated changes in community service costs by several methods, finding that linear models using cross-sectional data were the most econometrically sound.

Projected total costs for the 47 observed communities with populations of from 500 to 25,000 indicated that economies of size exist in service provision. Actual estimates showed costs increasing, prices held constant, from $140,321 in 1978 to $214,051 in 2010, with per capita costs increasing from $46.39 to $89.04 in the same two years. Results indicate that smaller communities, those under 5,000 population, would be more seriously effected than the larger ones, their costs escalating more rapidly with declining groundwater. Concerning individual services, Williford found that street service was the least vital service to the smaller communities in the future and that the larger communities would concentrate much of their spending on police, fire and streets. Water and sewer services were projected to make up a smaller percentage of total expenditures in larger communities and a larger percentage in small communities.

Summary

Few previous studies have specifically examined changes in costs to municipal government of public service provision associated with changes in economic or demographic conditions in an area. The Williford thesis addressed such a question but it was limited by many assumptions and data limitations which effected the precision of the results. Schaffer did a thorough job of estimating net impacts of five eastern Oklahoma communities, but his data lacked the broad range of observations needed to make the results widely applicable to communities with populations of less than 10,000. The Weber-Savage study tested four different methods of cost estimation, but used the results on only one community, that community being affected by one particularly large industry. There is a need for generalized information concerning the relationship between industrial development in rural communities and the public sector costs of community services provision.

Organization of the Paper

The following chapter will discuss theoretical considerations relevant to this study and formulation of the models which are tested herein. The third chapter will deal with description of the study area and data to be evaluated. Following this, there will be a chapter presenting the emperical results of the models tested. Chapter V will present implications of the work, along with a summary.

CHAPTER II

THEORETICAL CONSIDERATIONS

The Changing Role of Local Government

Over the past 50 years, the role of local government in the United States has changed dramatically. The crash of the New York Stock Exchange in 1929 and the decade of the 1930's caused major revisions in the way in which the federal government viewed its responsibilities. Programs resulting from the Great Depression, such as Social Security, Public Works Authority, and the Civilian Conservation Corps, began the trend in increasing dependency of local governments on the federal government.

As the depression ended and the prosperity of the post-World War II period began, citizens became more concerned with the ability of local governments to provide a level of services commensurate with their demands. Local officials responded by improving and extending community services. These generally raised the costs to local governments of maintenance and operation of such services. In the 1960's and 1970's, environmental protection became a major concern. For example, numerous laws were enacted and federal regulations established to control garbage and sewage disposal, thus putting additional fiscal burdens on municipalities. Small towns were particularly hard hit by these latter restrictions since most of them were already operating on a tight budget.

Due to the introduction of new federal programs, take-over of responsibility by the state of many previously local responsibilities and the increased pressure of providing more and better public services, the role of local government has gradually evolved from one of social program determination to one of social service provision.

> While local government has lost to state and federal agencies authority to initiate programs and to set organizational policies and standards, it has gained responsibility for executing expanded old and new programs. An analysis of Gross National Product (GNP) shows local government expenditures are increasing relative to federal expenditures. Since 1955 local government purchases as a percentage of GNP have doubled, while federal purchases as a percentage of GNP have declined (2, p. 2).

Public Services Defined

Economists typically classify goods in two categories, private goods and public, or social goods. Private goods are priced, or market goods. Public goods are those goods used by everyone, and not under the market pricing system. A more in-depth examination of the nature and characteristics of private and public goods at this time will facilitate a greater understanding of exactly what categories public services fall into as goods.

By definition, private goods are ones which are generally consumed and produced privately and are divisible in form. More specifically, private goods can be made in units small enough to be purchased by individuals out of their own incomes. Utility is obtained almost exclusively by the individual purchaser. Private goods fall under the exclusion principle, in that all people who are not willing and/or able to pay market prices are excluded from the benefits and enjoyment that could be received by consumption of these goods.

Public goods can be defined as ones which are publicly produced, jointly consumed and basically indivisible (13). Pure public goods come in such large units that they generally cannot be purchased by an individual or produced profitably by private industry. Due to their very nature, public goods yield widespread benefits and satisfactions to society. Unlike private goods, public goods are not subject to the exclusion principle and as a result cannot be provided on the basis of buyer initiative through the market system (23). Public goods, as a rule, are produced by agencies on the basis of joint decisions and are almost always financed by tax collections. They are therefore produced through governments (city, state, national) based on collective choice, whereas private goods are produced by private enterprise based upon individual choice.

Bearing in mind the nature of private and public goods, community services can be seen to have characteristics of both. While most community services are produced publicly, many can be produced privately. Consumption may be either by individuals or households or by society as a whole. Community services cannot be considered private since they are not usually priced in the market system. But many community services are not pure public goods, since some can be purchased by individuals.

Community services are inseparable from their delivery systems, whether capital or labor intensive in nature, and may be said to have the following characteristics, as identified by Jones and Gessaman (19):

1. Community services are necessary for the public good.
2. Community services are available to and utilized by the public.
3. They are provided through rigid institutional structures.
4. Fees for community services are not set in the market.
5. Fees for these services often do not cover all fixed costs and perhaps not all variable costs.
6. Unit charges are uniform regardless of the level of service use.

It was previously mentioned that community service goods are inseparable from their delivery systems. The delivery system must, then, be adequate in relation to service provision. A delivery system may be said to be adequate if it provides the services at a cost, time, place and form acceptable to the consumer. The adequacy of each system will vary according to preferences and desires in each community.

The Nature of Various Community Services

The services of most rural communities include water and sewer, sanitation, streets, police, fire protection, parks and recreation and general administration. There are substantial differences in the structure of these services. In the paragraphs which follow, the nature of each of these types of services is discussed as it relates to the concepts of private and public goods.

Water and Sewer Services

Water and sewer services are services which may be provided either by municipal governments or private authorities. They have many characteristics of private goods; however, they are often provided publicly. They are frequently operated by the public sector because they tend to be natural monopolies with large initial capital requirements and significant economies of size. The pricing structures of such services depend upon whether they are provided by municipal governments or by private authorities. In the first instance, pricing is usually administered so as to make up the difference between actual costs and the taxes received to support the service. Privately produced services must be priced to cover total costs including profits. The principle of exclusion can apply to these services in that they can be terminated if the consumer is unwilling or unable to pay. These services may be either jointly or privately consumed, depending on whether the use is for city needs or for individual needs.

Sanitation

Sanitation services are very similar in nature to water and sewer services. Such services are often provided publicly, but on a fee-for-service basis. Costs vary depending upon the disposal system used. Pricing of the service is determined largely by who operates the service, whether it be a municipal government or a private authority. The exclusion principle can apply to sanitation services as it does to water and sewer services in that any consumer unwilling or unable to pay for this service can lose it. Funding for sanitation services comes from both taxes and use fees.

Streets

Unlike the two services discussed above, streets are nearly a pure public good. Street maintenance and operation is financed by tax collections and decisions for street improvement are made by elected officials. As a general rule, most annual expenditures are made for operation and maintenance. Individuals cannot produce streets out of their own incomes and benefits of streets are received by all residents of a community. Streets are clearly indivisible goods, goods provided by the government for use by all citizens.

Police Protection

Police protection is very nearly a pure public good. Everyone benefits from police protection. These services are financed totally by tax revenue and all decisions on police are influenced by elected officials. It would be very difficult for a single individual to provide protection. No individual can be excluded from benefiting from this service. With exception of the police headquarters and patrol cars, virtually all expenditures are for labor services.

Fire Protection

Fire protection also falls under the classification of a nearly-perfect public good. Only a minimal amount of the revenue used to finance a fire department comes from fees, most of these being collected from fires outside the incorporated bounds of the city. Government grants, city tax revenues and donations finance this service, again one which is largely operation and maintenance cost oriented. All residents of the city benefit from this service, a service that individuals cannot easily provide for themselves.

Parks and Recreation

Parks and recreation represent one classic instance of public goods. Except in the rare case in which user fees are charged for recreational facilities, all people, even if they pay no taxes, can enjoy and benefit from them. This service is open to all and is not divisible in any fashion into units. Parks and recreation are tax supported, with most operating expenditures coming in the form of labor and maintenance to the facilities.

General Administration

General administration can be thought of as a public good. Administrative services are indivisible, benefits are widespread and decisions are generally made by an elected official responsible to the public for his actions. And of course administration is supported entirely by tax dollars.

Model Formulation

The following sections of this chapter will be devoted to discussion of the formulations of the general models utilized in this study. The statistical assumptions underlying these models are discussed. Then each of the variables included in the models and the theoretically expected relationships between the dependent and independent variables will be treated.

The Method

One theoretical approach typically used in economic analysis states that changes in any one variable can be either partially or totally explained by changes in various other variables. This type of relationship is described in simple terms as a multiple linear regression equation of the form,

$$Y_i = B_0 + B_1X_{i1} + B_2X_{i2} + \ldots + B_KX_{iK} + \varepsilon_i.$$

where Y denotes the dependent variable, the X's denote the explanatory variables, and ε is a stochastic disturbance (18). The subscript i refers to all i^{th} observations with the next subscript identifying the variable in question. The B coefficients are unknown parameters, the value of which can be estimated by least squares regression. This method minimizes the variance of the error terms, or, stated otherwise, maximizes the portion of variation explained by the independent variables. In order for these least squares estimates to be unbiased and have minimum variation, the following assumptions concerning the basic model must be made (20):

1. ε_i is normally distributed.
2. $E(\varepsilon_i) = 0$.
3. $E(\varepsilon_i^2) = \sigma^2$.
4. $E(\varepsilon_i \varepsilon_j) = 0 \ (i \neq j)$.
5. Each of the explanatory variables is nonstochastic with values fixed in repeated samples and such that, for any sample size, $\Sigma_1^N = 1 \ (X_{ij} - \overline{X}_k)^2/n$ is a finite number different from zero for every $k = 1, 2, \ldots, K$.
6. The number of observations exceeds the number of coefficients to be estimated.
7. No exact linear relationship exists between any of the explanatory variables.

With the above assumptions specifying the basic multiple regression model, the distribution of Y_i is normal, as follows:

$$E(Y_i) = B_0 = B_1 X_{i1} = B_2 X_{i2} + \ . \ . \ . + B_K X_{ik}.$$

In this framework, B's cannot be identified and therefore must also be estimated. The resultant equation,

$$E(Y_i) = b_0 = b_1 X_{i1} + b_2 X_{i2} + \ . \ . \ . + b_K X_{iK},$$

accurately describes the general multiple regression model in the anlaysis that follows.

The Model

For purposes of this study, community service costs are functionally specified as follows:

$$CS = f(P, Y, M, LD) \quad ,$$

where CS = Municipal government operation and maintenance cost of community service provision,

P = Population of the community,

Y = Per capita income in the community,

M = Total manufacturing based employment in the community, and

LD = Location dummy to identify whether the community is in eastern Oklahoma or western Oklahoma.

Additional models to describe effects of individual services and manufacturing types on costs of services can be formulated as follows:

$$CS_i = f(P, Y, M, LD) \quad ,$$

where CS_i = Municipal government operation and maintenance cost of provision of specific community services, 1975,

i = Community service type,

P = Population of the community, 1975,

Y = Average per capita income in the community, 1975,

M = Total manufacturing based employment in the community, 1975, and,

LD = Location dummy to identify whether the community is in eastern Oklahoma or western Oklahoma;

and:

$$CS = f(P, Y, M_i, LD) \quad ,$$

where CS = Municipal government operation and maintenance cost of community service provision,

P = Population of the community,

Y = Per capita income in the community,

M_i = Total employment of a specific type of industry,

i = Industry type, and

LD = Location dummy to identify whether the community is in eastern Oklahoma or western Oklahoma.

The Independent Variables

Each independent variable included in the above specified basic models is discussed in this section. Discussion centers around the expected influence of independent variables on the dependent variable, based on economic theory.

Population. Applying basic supply-demand theory, it can be seen that an increase in population would cause an increased demand for community services. The increased demand must be met by an increase in the total level of services supplied if citizens are to remain satisfied. As a community strives to meet these increased demands, total costs will increase.

So theoretically, one would expect the independent variable, population, to have a significant effect on the dependent variable, "cost of service". A positive coefficient is expected to appear for the population variable, as increases in population will cause increases in total costs of services.

Per Capita Income. The expected effects of community per capita income on costs of community services can also be explained by supply-demand theory. Increases in per capita income mean higher standards of living. Acquisition of appliances such as dishwashers and washing machines increase the strain on water and sewer systems. Wealthier citizens demand higher quality policy and fire protection. Better streets are demanded to improve the appearance and comfort of the city trafficways. Improved parks for recreation will be demanded. All these things cause changes in the costs of community service provision. Changes in community service costs are expected to be positively correlated with per capita income.

Manufacturing Employment. Effects on costs of services from manufacturing stem from three basic sources. The industry itself will demand services. New residents brought into the community by the industry will cause more services to be consumed. Additionally, commuting workers will affect service use.

As before, the supply-demand framework may be used to predict the algebraic sign of the coefficient of the manufacturing employment variable. Bearing in mind the relationships of new industry, new residents, and commuting workers, the coefficient should be positive, with increases in any of these three factors causing an increase in service demand, and therefore, an increase in total operation and maintenance costs of service provision.

<u>Location Dummy</u>. This variable is included due to the possible effects of community location in Oklahoma on costs of services. Substantial differences exist in the economic, demographic and physical characteristics of the eastern and western parts of Oklahoma.

Water and sewer services are expected to have lower operation and maintenance costs in water-rich eastern Oklahoma than in the more arid western region. Sanitation services costs are expected to be less in western Oklahoma due largely to topographical characteristics which make operation and maintenance of land fills less expensive in that part of the state. Street maintenance is also expected to be less costly in the west, due again to topography and also to the drier weather. Police protection costs are anticipated to be lower in the west because of socio-demographic and cultural differences between the two areas of the state. The eastern part has a higher incidence of poverty and minority groups as well as more densely populated land area, factors which tend to require more law enforcement personnel.

The author has no expectations concerning the relationships between costs for fire protection, parks and recreation and general administration, respectively, and community location. It is not clear how costs of these community services should relate to community location, if they relate at all.

CHAPTER III

STUDY AREA AND DATA

The purpose of this chapter is to familiarize the reader with the study area considered in this research and also to describe the nature and sources of the data utilized. Discussion of some general characteristics of Oklahoma, such as topography, climate, population, income and employment, are presented. This will be followed by detailed accounts of the nature and sources of data used in the emperical analysis of community service provision costs.

Study Area

The study area considered in this research consists of all of rural Oklahoma. U. S. Highway 81 cuts Oklahoma approximately in half from north to south (Figure 1). Certain characteristics of the state indicate that this highway is an important dividing line. Elevation in Oklahoma increases from the southeast to the northwest, rising 500 feet in the extreme southeastern corner of Oklahoma to 5,000 feet in the Panhandle. Average rainfall amounts vary by more than 40 inches. The Ouachita Mountain Region (southeast) receives nearly 60 inches per year while certain areas of the Panhandle receive only 15 inches annually. In general, it can be said that the portion of Oklahoma west of Highway 81 averages 20 inches of rain or less per year and the portion east of it averages from 30-50 inches per year. The topography of the two regions

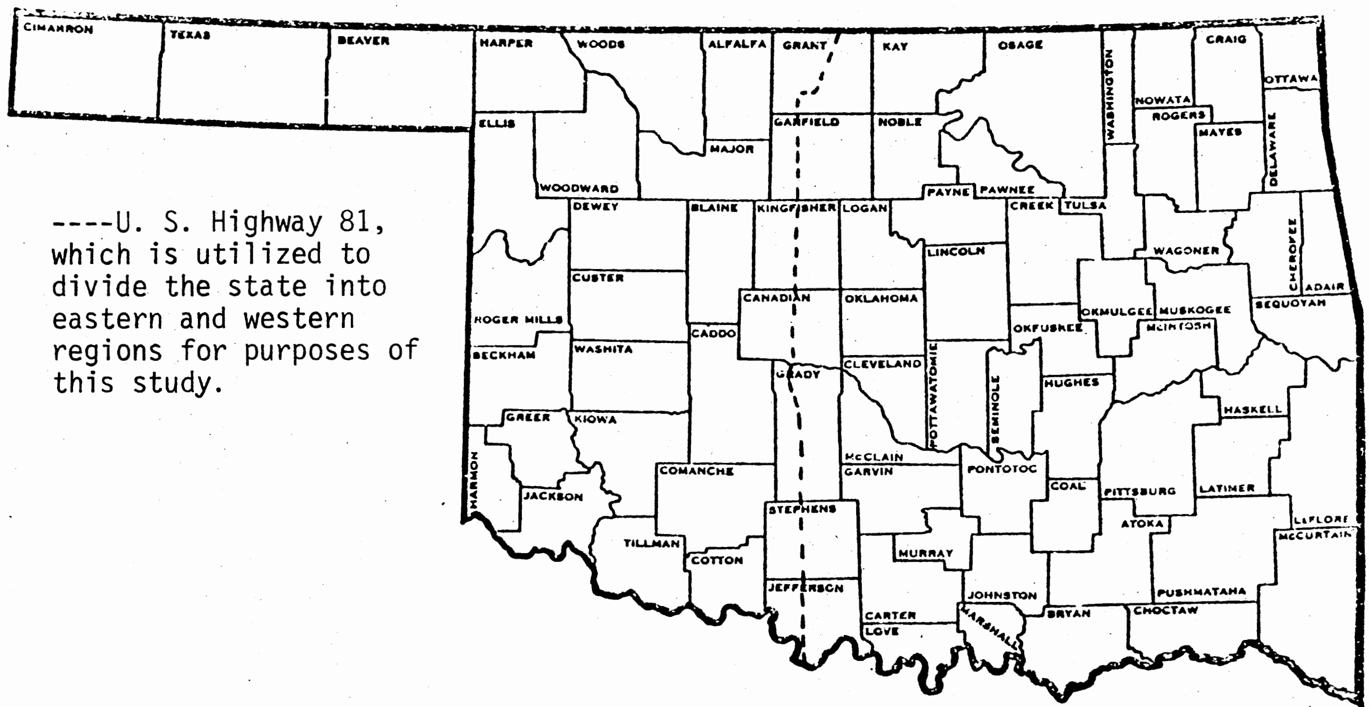

Figure 1. State of Oklahoma as Geographically Divided for Research Purposes

is also varied. With only a few exceptions, western Oklahoma is characterized by low rolling hills to flat, upland prairies. In the eastern part of the state, however, the face of the land varies from the flood plains of numerous creeks and rivers to prairie to hilly, wooded, near mountainous regions of the Ozark, Ouachita and Arbuckle areas.

Agriculturally, the eastern and western sections of Oklahoma differ as well. Western Oklahoma is characterized by large farms and ranches, the farms generally being devoted to wheat or grain sorghums with some areas also producing cotton and alfalfa. Ranches in this region are mainly native pasture types, rainfall prohibiting, in large part, the establishment of tame pastures. In contrast, eastern Oklahoma farms and ranches are generally smaller, the land having been held in families for years or being in such small parcels so as to make acquisitions of large adjoining tracts near impossible for the most part. The most common crops in this part of the state are alfalfa, corn, soybeans, grain sorghum and peanuts, except that substantial wheat production exists in the northern and western portions of eastern Oklahoma. Horticultural crops also are of economic significance, particularly in the far eastern part and in and near some of the river bottom lands. Ranch pastures are both native and tame, but tame pastures are becoming more common in many areas due to their greater productivity.

Eighty Oklahoma communities were selected for analysis in this research. None of the communities were in Standard Metropolitan Statistical Areas (SMSA's). SMSA communities were excluded from consideration for a number of reasons. Substantial structural differences exist between the economies of SMSA and non-SMSA communities. Many municipalities which are located in metropolitan areas are "bedroom communities" for commuters working elsewhere in the SMSA. Many supportive industries, industries which produce materials for other nearby manufacturing firms, locate in SMSA communities. Relatively small towns located within SMSA's may offer small supportive industries advantages of relatively inexpensive land, taxes and labor with close proximity to markets (larger SMSA manufacturers). Another factor justifying the exclusion of SMSA communities from this study is their dependency, in many instances, on the larger cities for community services. Water, sewer and sanitation are often services which are provided, for a fee, to smaller communities by large ones.

As of July 1, 1975, there were 176 communities in Oklahoma with populations of 1,000-10,000. Fifty-eight of these communities were within the boundaries of one of the four Oklahoma SMSA's and were therefore eliminated from inclusion in the sample. An additional 16 communities had incomplete expenditure data (costs of services) so they were also excluded. Twenty-two other communities reported no manufacturing employment. These 22 communities were omitted from the sample because the primary objective of this study is to determine the effects of rural industrialization on costs of community service provision.

The distribution, by size, of study area communities with 1975 populations between 1,000 and 9,999 is as follows:

1,000-1,499	16 communities
1,500-1,999	12 communities
2,000-2,499	13 communities
2,500-3,499	14 communities
3,500-4,999	7 communities
5,000-7,499	11 communities
7,500-9,999	7 communities

Average 1975 per capita income for the 80 communities was $3,576. A total of 18,379 persons were employed in manufacturing jobs in the sample communities in 1975.

Data

An effort was made to estimate the general models specified in the previous chapter, and also selected sub-models based on these general models, from 1975 data. Under ideal circumstances, data used for estimation of these models would be as follows for each of the eighty communities considered:

1975 population,

1975 average community per capita income,

1975 total manufacturing employment,

1975 manufacturing employment by industry type,

1975 total operation and maintenance cost of community service provision, and

1975 total operation and maintenance cost of community service provision by type of service.

As is often the case in socio-economic research, reality does not conform to these ideal circumstances. Some of the data needs specified above could not be perfectly satisfied, so it was necessary to seek next best alternatives.

Population

All population data were obtained from U. S. Bureau of Census sources. Population figures for 1975 were taken from a supplemental census publication, Current Population Reports, Population Estimates and Projections (46). These figures were estimates based on net migration, tax returns, school enrollment and licensing of automobiles. Further details on the exact methodology used to derive the population estimates employed for analysis may be obtained by referring to the aforementioned publication.

Per Capita Income

Per capita incomes for the 80 sample communities were available from U. S. Bureau of Census publications (46) (47). The same data source used for population, Current Population Reports, Population Estimates and Projections (46), provided the necessary per capita income figures for the analysis of the models using 1975 data for other independent variables. Per capita income information for all 80 sample communities found in the latter publication was based on Internal Revenue Service tax return forms of 1973 and 1974. This allowed all observations to be included in the emperical analysis of the general models specified in Chapter II.

Manufacturing Employment

Data on manufacturing employment were available, as needed, for 1975. Such data were obtained from the Oklahoma Industrial Development Commission's Directory of Manufacturers and Products (31). The directory divides industries into 19 broad categories based on two-digit SIC codes, with very specific four-digit codes dividing manufacturers by product produced. For each industry in each community in Oklahoma which has any manufacturing-based employment, a complete listing including names of company, manager, number of employees, both temporary and permanent, and product produced can be found. Information on manufacturing employment in the state area communities was aggregated into seven categories as follows:

M1 = Petroleum - SIC 13 and 29

M2 = Foods - SIC 20

M3 = Textiles - SIC 22 and 23

M4 = Wood and Wood Products - SIC 24, 25 and 26

M5 = Miscellaneous Light Industry - SIC 27, 31, 38 and 39

M6 = Metals and Metal Works - SIC 33, 34, 35, 36, and 37

M7 = Chemicals, Glass and Cement - SIC 28 and 32

Location

Locations of study area communities are quantified based on whether they lie east or west of U. S. Highway 81 (Figure 1). Communities located on or east of Highway 81 were assigned a location dummy variable (LD) value of zero. Communities west of Highway 81 were assigned a location dummy variable value of one.

Costs of Services

Oklahoma state law requires each municipality with total expenditures in excess of $12,000 to file an approved audit with the State Board of Equalization. This information facilitated the collection of 1975 costs of services data for each of the communities studied. Community expenditures on services were categories as follows:

CS1. Water and Sewer

CS2. Sanitation

CS3. Streets

CS4. Police Protection

CS5. Fire Protection

CS6. Parks and Recreation

CS7. General Administration

The cost data include payments for personnel and maintenance and operation for each of the public services provided and for the general administrative costs of local government. The various service categories differ due to community size, accounting procedures, or the existence of a municipal authority which administers a part of the services provided. In the latter instance, no expenditures were recorded. Sinking funds or specially created funds also do not appear in the expenditure figures. Water and sewer system cost observations were the most inconsistent, with this service being provided by an authority of some nature in 40 of the 80 communities. This problem was handled by a dummy variable which was assigned a value of one for municipalities providing water and sewer services and a value of zero for communities having private water and sewer authorities.

The accounting systems of municipalities are typically less than desirable for purposes of determining costs of community services. Most cities and towns use the fund system of accounting, often showing expenditures for individual services from two or more funds. Capital outlay is shown simply in a lump-sum form, with capital expenditures appearing only in one year. No attempt is made to amortize or depreciate capital assets acquired by municipalities since these things are generally done for tax purposes, something community leaders are not concerned with. For these reasons, service costs considered in this study include only those costs incurred in the operation and maintenance of the municipality.

Revenue sharing funds are included in the costs of services for each community which actually received such funds and used them for non-capital expenditures. Records of expenditures from revenue sharing were handled in several fashions. In some cases, a breakdown of these expenditures by use (labor, operation and maintenance, capital outlay) for each service was reported. In such cases, expenditures, excluding capital outlays were attributed to the respective service. In other cases, total revenue sharing expenditures were reported by use. Revenue sharing data for these communities were included in "total costs of services", again excluding capital outlays. In still other instances, only a lump sum figure was recorded for revenue sharing expenditures. For these observations, the entire amount was attributed to "costs of services". The small number of communities reporting in this fashion and the nature of expenditures of revenue sharing funds in other communities (largely spent on operation and maintenance) warranted handling the data in this manner.

CHAPTER IV

EMPERICAL RESULTS

Results of the econometric analyses of the various models specified in Chapter II are presented in this chapter. Three forms of the general model (hereafter referred to as "aggregate models") thought to be most statistically sound as measured by R^2's, t-tests of variables and overall F tests of models are discussed at length, as are individual service and industrial models.

In searching for the specific models which serve best as estimators, it was necessary to create and test 190 different model formulations. An explanatory listing of each variable is shown in Appendix A. Statistical summaries of 76 of the models tested are presented in Appendix B. Models in Appendix B are grouped by type and form (Aggregate, Service and Industry; Linear and Logarithmic).

The estimation procedure selected for analysis of each model was the Statistical Analysis System (SAS) computer routine developed by Barr and Goodnight (1). SAS provides a great deal of flexibility in data organization and an easy use of option commands (ANOVA, correlation coefficients, residual plots and predicted values). Additionally, SAS lends itself particularly well to the testing of multiple regression models.

Aggregate Models

On the basis of theoretical considerations and results of emperical testing, the following three basic models of community service costs were selected for discussion:

I. CS75 = f(P75, Y75, M75, LD)

II. CS75 = f(P75, Y75, M75)

III. CS75 = f(P75)

where CS75 = Operation and maintenance oost of community service provision, fiscal year ending June 30, 1976,

P75 = Population of the community, 1975,

Y75 = Per capita income in the community, 1975,

M75 = Total manufacturing based employment in the community, 1975, and,

LD = Locational dummy. LD = 1 if the community lies west of U. S. Highway 81; LD = 0 if the community lies east of U. S. Highway 81.

Complementary to these basic models are other models with somewhat different structures. Narratives relating to these model variations and their results will be contained within the sections corresponding to their related equations.

The application of basic model I (above) and of two variations of basic model I to data from the study yielded the results shown for equation (1a) in Table I. Equations (1b) in Table I is the logarithmic form of model I. Equation (1c) in Table I is a linear equation of model I with the addition of a dummy variable WDUM to account for the fact that water and sewer service in some communities is provided by authorities (WDUM = 0), while in other communities such service is provided by local government (WDUM = 1).

TABLE I

SUMMARY OF EQUATIONS FOR AGGREGATE MODELS OF COMMUNITY SERVICE COSTS FOR RURAL OKLAHOMA COMMUNITIES[a]

Equation	Intercept	P75[c]	Y75[d]	M75[e]	LD[f]	WDUM[g]	R^2
(1a)	-276354.41 (.0001)	113.4079 (.0001)	74.6568 (.0001)	65.0189 (.2485)	-39580.72 (.1296)		.89
(1b)[b]	-5.0191 (.0115)	1.2034 (.0001)	.9754 (.0002)	.0091 (.8171)	-.0853 (.4057)		.82
(1c)	-252223.07 (.0001)	112.0129 (.0001)	54.7619 (.0018)	68.1978 (.1769)	-26815.19 (.2583)	89878.82 (.0001)	.91
(2a)	-262192.24 (.0001)	112.4434 (.0001)	67.1076 (.0002)	78.2048 (.1657)			.89
(2b)[b]	-4.5736 (.0162)	1.1968 (.0001)	.9196 (.0003)	.0163 (.6686)			.82
(2c)	-241949.36 (.0001)	111.3219 (.0001)	49.0414 (.0033)	77.7188 (.1247)		92998.77 (.0001)	.91
(3a)	-40540.64 (.0682)	121.4019 (.0001)					.86
(3b)[b]	2.1802 (.0007)	1.2985 (.0001)					.78
(3c)	-85899.81 (.0001)	118.7725 (.0001)				108319.30 (.0001)	.90

TABLE I (Continued)

[a]Numbers appearing in parentheses represent the observed significance level of the variable as determined by the "student-t" values.

[b]Logarithmic form of equation.

[c]1975 Population.

[d]1975 Average per capita income.

[e]1975 Total manufacturing employment.

[f]Location dummy. "1" if community is west of U. S. Highway 81, "0" if community is on or east of U. S. Highway 81.

[g]Water dummy. "1" if municipally operated water and sewer service, "0" if privately operated.

Equations (1a), (1b), and (1c) all proved to have relatively good fits. The R^2 values of .89, .82 and .91, respectively, indicate that substantial portions of the variation about the mean are explained by the models as specified.

The "student-t" test is generally accepted as a test for the reliability of variables included in a predictive equation. The intercept term, as well as all explanatory variables, proved to be significant at the .25 level or better in two of the three models, the logarithmic form (1b) being the exception. Coefficients of the variables population, per capita income and manufacturing employment were consistent with theoretical expectations, all three having positive signs, which would indicate that increases in population, per capita income and manufacturing employment result in increases in total operation and maintenance costs of service provision. The location dummy had a negative sign in all three instances. This indicates that Oklahoma communities west of U. S. Highway 81 can be expected to have lower annual service provision costs than communities east of U. S. Highway 81.

Based on equation (1a), it would be expected that each additional person becoming a part of a community will increase annual total service costs by \$113.40. Each dollar increase in per capita income results in a \$74.66 increase in costs per year, while, each additional manufacturing job increases costs by \$65.02 per year. Location of the community in western Oklahoma decreases costs by \$39,480.72 per year.

The logarithmic model (1b) failed to improve on equation (1a). Significance levels of the manufacturing employment and location dummy variables were lowered to a level below acceptance. Much of this is probably due to the very nature of a logarithmic formulation in that it tends to lessen the effect of variation in larger observations and accentuate the variation in smaller observations (22). Since well over one-half of the observations in the sample set of communities fall in the "smaller" category (population less than 5,000 and low absolute numbers in manufacturing employment) it follows that a logarithmic equation would not be as well suited for predictive purposes as would a linear form.

It was hypothesized that a difference would exist in community service expenditures for communities in which the municipal government provided water and sewer services and those in which a private authority provided them. Model (1c), which includes the dummy variable WDUM, facilitates the testing of this hypothesis. This model improved upon the fit of the preceding models ($R^2 = .91$) while maintaining a significance level of better than .30 for all variables and the intercept term. It is important to note that the "water dummy" tested significant to the .0001 level. This, coupled with the improved R^2 value of equation (1c), lends support to the inclusion of the "water dummy" in the analysis. This equation yields similar annual effects on costs by each variable as does equation (1a). Based on equation (1c) it would be expected that a new community resident increases community service costs by $112.01, each one dollar increase in per capita income increases community service costs by $54.76, and each new manufacturing job increases community service costs by $68.20. A $26,815.19 reduction in costs results if the community is west of U. S. Highway 81. The expected effect on community service costs is an $89,878.83 increase if the municipal government provides water and sewer services.

The second basic model to be tested involved the use of only population, per capita income and manufacturing employment as independent variables in estimating total cost of service for the communities (basic model II). This model yielded equations (2a), (2b) and (2c) in Table I.

The R^2 for these equations are .89, .82 and .91, respectively. Once again a relatively high amount of the variation about the mean is explained by the selected independent variables. Virtually no difference in R^2 resulted from omitting location as a factor in the analysis.

The independent variables employed in equation (2a), (2b) and (2c) were significant at a level better than .20 for all variables except the manufacturing variable in the log-form equation. The intercept, population and per capita income terms were significant at the .003 level or better in all equations. Coefficients of the explanatory terms were consistent with theoretical expectations in that all terms are positively correlated with costs of services, increases in any of the terms resulting in an increase in the dependent variable.

In equation (2a), effects of population, per capita income and manufacturing employment can be seen to be similar to those in equation (1a). Based on equation (2a), for each additional person in a community, operation and maintenance costs for community services increase by \$112.44. An increase in per capita income of one dollar raises community service costs by \$67.11, while each manufacturing job added will increase such costs by \$78.02.

Analysis of the data by use of a logarithmic form of basic model II (equation 2b) does not yield results as reliable as the linear forms tested. The coefficient of the manufacturing variable is not significant. Coefficients for the intercept, population and per capita income terms are significant but the R^2 is relatively low.

Equation (2c), including the water dummy, shows population to cause an annual increase in costs of \$111.32 per person. Per capita income, on a per dollar basis, raises costs by \$49.04 per year. Addition of each manufacturing job adds \$77.72 to total annual expenditures by the municipal government for service provision. The presence of a municipally operated water and sewer system increases costs by \$92,998.75 annually, an amount differing by about \$3,000 from that indicated in equation (1c).

The third of the basic models uses population as the primary explanatory variable (Table I). The linear (3a) and logarithmic (3b) forms of this model yielded R^2's of .86 and .78, respectively. Equation (3c), including both population and the water dummy as independent variables, yielded an R^2 of .90. Positive correlation again existed between the independent and dependent variables. It would appear, then, that population is a major determinant in predicting the costs of community service expenditures to municipal governments, an implication that is logical in view of the population oriented nature of community services themselves.

Service Models

One of the major fiscal concerns of leaders of rural municipalities is that of the total operation and maintenance costs incurred in the provision of public services to the residents of the community, and rightly so. Provision of services accounts for the majority of a municipal government's annual expenditures. While total costs of service provision draw the most attention from rural leaders, information about expected changes in individual service costs as other factors in the community change would be useful to them. Due to the diverse nature of individual community services (sanitation is necessarily very different in nature than fire protection) it was hypothesized that there might be discernable differences in the ways that costs of the seven different types of community services considered are affected by community characteristics. To test this hypothesis, several models were developed to explain the costs of providing these specific services.

Two basic model formulations were selected for emperical analysis of industrial service costs. They were of the forms:

IV. $CS_i75 = f(P75, Y75, M75, LD)$

V. $CS_i75 = f(P75)$

where CS_i75 = Municipal government operation and maintenance cost of provision of specific community services, fiscal year ending June 30, 1976,

i = Community service type,

P75 = Population of the community, 1975,

Y75 = Average per capita income in the community, 1975,

M75 = Total manufacturing based on employment in the community, 1975, and

LD = Location dummy. LD = 1 if the community lies west of U. S Highway 81; LD = 0 if the community lies east of U. S. Highway 81.

Results of applying these two models to data gathered on costs of specific services for study area communities are shown in Table II. All communities surveyed did not report costs for each of the services considered. The number of observations available for analysis of each service type are designated in the table. Specific service models based on model (IV) are labeled as models (4a), (4b), (4c), (4d), (4e), (4f) and (4g). Specific service models based on basic model (V) are labeled as models (5a), (5b), (5c), (5d), (5e), (5f) and (5g). For each of the types of community service considered, the model including population

TABLE II

SUMMARY OF EQUATIONS FOR SERVICES MODELS OF COMMUNITY SERVICE COSTS FOR RURAL OKLAHOMA COMMUNITIES[a]

Model	Dependent Variable	Number of Observations	Intercept	P75[b]	Y75[c]	M75[d]	LD[e]	R^2
(4a)	Water and Sewer Costs	40	-92171.88 (.1584)	29.1869 (.0002)	23.7618 (.2044)	19.228 (.7640)	1314.82 (.6177)	.58
(5a)	Water and Sewer Costs	40	-10438.50 (.6008)	32.0628 (.0001)				.55
(4b)	Sanitation Costs	48	10532.94 (.5216)	13.3958 (.0001)	-3.9224 (.5529)	-4.6404 (.8108)	5103.11 (.5766)	.61
(5b)	Sanitation Costs	48	903.74 (.8903)	12.8151 (.0001)				.60
(4c)	Street Costs	62	-34783.00 (.1081)	12.0962 (.0001)	12.6207 (.0493)	28.0497 (.1816)	-14436.87 (.1042)	.61
(5c)	Street Costs	62	3879.00 (.5873)	14.5417 (.0001)				.56
(4d)	Police Protection Costs	62	-7645.75 (.6063)	18.4524 (.0001)	.8325 (.8475)	3.4769 (.8037)	-1745.42 (.7698)	.84
(5d)	Police Protection Costs	62	-5154.22 (.2628)	18.6763 (.0001)				.84
(4e)	Fire Protection Costs	62	-29398.45 (.0218)	15.8089 (.0001)	2.6332 (.4732)	-.4109 (.9722)	-6697.16 (.1870)	.84

TABLE II (Continued)

Model	Dependent Variable	Number of Observations	Intercept	P75[b]	Y75[c]	M75[d]	LD[e]	R^2
(5e)	Fire Protection Costs	62	-21456.32 (.0001)	15.6504 (.0001)				.83
(4f)	Parks and Recreation Costs	49	-28087.95 (.0277)	6.5932 (.0001)	5.5523 (.1108)	-4.2829 (.7024)	-164.21 (.9702)	.59
(5f)	Parks and Recreation Costs	49	-8414.14 (.0277)	6.3821 (.0001)				.56
(4g)	General Administration Costs	62	-40375.05 (.2981)	18.726 (.0001)	16.930 (.1406)	6.7172 (.8551)	1972.26 (.8999)	.49
(5g)	General Administration Costs	62	14806.41 (.2360)	20.440 (.0001)				.46

[a]Numbers appearing in parentheses represent the observed significance level of the variable as determined by the "student-t" values.

[b]1975 Population.

[c]1975 Average per capita income.

[d]1975 Total manufacturing employment.

[e]Location dummy. "1" if community is west of U. S. Highway 81, "0" if community is on or east of U. S. Highway 81.

as the only variable explains almost as much variation in service costs as the model with more independent variables. And, in most cases, independent variables other than population are not significant. There are some notable exceptions to this, however.

Per capita income is a relatively significant variable for explaining water and sewer costs, street costs, parks and recreation costs and general administration costs (Table II). Regression coefficients are positive in each of these cases. This implies that residents of wealthier communities are more desirous of quality water and sewer services, better streets, more and better parks and recreational facilities and more and better governmental administrative talent.

Manufacturing employment has a positive and significant relationship to costs of street maintenance (Table II). This is probably due to the fact that manufacturing industries often locate in industrial parks or other designated areas of communities with special access roads which can serve industry. For a rural community, the maintenance of roadways in such an industrial area can make up a substantial portion of the community's budgeted expenditures for streets.

The location dummy variable exhibited negative and fairly significant coefficients in the equations relating to street costs and fire protection costs. These coefficients indicate that such costs tend to be lower in western Oklahoma communities than in comparably sized eastern Oklahoma communities. An obvious explanation for lower street maintenance in the western part of the state is the drier weather common to that region. Extended periods of wet winter weather, characteristic of eastern Oklahoma can leave streets in conditions of substantial despair. The explanations for the lower fire protection costs indicated in western Oklahoma are that the area has a much higher proportion of cultivated land and much lower population density. Cultivated land does not burn easily. And people cause fires.

Industry Models

Many diverse types of manufacturing plants exist within the sample communities identified in this study. These manufacturing plants, different as they are, demand different types and levels of community services. For example, a food processing plant has a different demand for community services than does a shirt factory or a pipe casting plant. In order to test the hypothesis that individual industry types actually cause total service expenditures to react differently, a basic model was specified, as follows:

VI. $CS75 = f(P75, Y75, M_i75, LD)$

where CS75 = Municipal government operation and maintenance cost of community service provision, fiscal year ending June 30, 1976,

P75 = Population of the community, 1975,

Y75 = Average per capita income in the community, 1975,

M_i75 = Total manufacturing employment in the community by industry type, 1975,

i = Industry type, and,

LD = Location dummy. LD = 1 if community lies west of U. S. Highway 81; LD = 0 if community lies east of U. S. Highway 81.

Each of the seven industrial groupings specified in Chapter III was analyzed under the framework of the above model. Simple least squares regression again served as the method of econometric analysis. Summaries of the analyses are shown in Table III.

TABLE III

SUMMARY OF EQUATIONS FOR INDUSTRY TYPE MODELS OF COMMUNITY SERVICE COSTS FOR RURAL OKLAHOMA COMMUNITIES[a]

Model	Number of Observations	Intercept	P75[b]	Y75[c]	M75[d]	LD[e]	R^2
(6a)	20	-397433.83	137.0414	85.6932	422.8267	12343.21	.92
		(.0407)	(.0001)	(.1045)	(.3516)	(.8427)	
(6b)	42	-375105.42	115.7715	109.677	526.1823	90942.14	.88
		(.0043)	(.0001)	(.0026)	(.2876)	(.0266)	
(6c)	31	-368912.49	115.4386	105.1311	90.2143	-65523.88	.89
		(.0067)	(.0001)	(.0113)	(.4769)	(.1841)	
(6d)	20	-161817.58	105.8147	51.4107	-54.979	26667.31	.95
		(.1390)	(.0001)	(.1190)	(.4860)	(.6199)	
(6e)	73	-257481.74	121.1246	69.6369	-481.684	40941.49	.89
		(.0003)	(.0001)	(.0007)	(.2314)	(.1483)	
(6f)	50	-312031.03	116.9854	85.4862	73.4144	-47961.65	.86
		(.0071)	(.0001)	(.0104)	(.6675)	(.2773)	
(6g)	48	-323022.22	118.4469	85.181	351.3605	-55481.25	.88
		(.0032)	(.0001)	(.0032)	(.4229)	(.1336)	

[a]Numbers appearing in parentheses represent the observed significance levels of the variables as determined by the "student-t" values.

[b]1975 Population.

TABLE III (Continued)

[c]1975 Average per capita income.

[d]Manufacturing employment by industry type as follows:

Model 6a. M75 = Manufacturing employment, petroleum.
Model 6b. M75 = Manufacturing employment, food products.
Model 6c. M75 = Manufacturing employment, textiles.
Model 6d. M75 = Manufacturing employment, wood and wood products.
Model 6e. M75 = Manufacturing employment, miscellaneous light industry.
Model 6f. M75 = Manufacturing employment, metals and metal works.
Model 6g. M75 = Manufacturing employment, chemicals, glass, and cement.

[e]Location dummy. "1" is community is west of U. S. Highway 81, "0" if community is east of U. S. Highway 81.

Regression results indicate that for only two of the seven types of manufacturing considered are the coefficients of change in community service costs even marginally significant. The coefficient for the food products manufacturing employment variable in equation (6b) is significant at better than the .30 level (Table III). This coefficient indicates that total annual municipal costs of community services can be expected to increase by $526.18 for every new employee in the food products manufacturing sector. This estimated change in total annual service costs per new food products employee is substantially greater than the $70 change estimated for manufacturing employees in general (Table I). The large difference in estimated costs is likely to be due to the fact that food products manufacturers tend to be very high users of water and sewer services.

The coefficient for miscellaneous light industry manufacturing employment in model (6e) also tests to be fairly significant. However, the coefficient is negative. As estimated, this coefficient implies that total community service costs decline as the number of employees working in miscellaneous light industries increases. Such an occurrence is not consistent with the theory of costs of community services presented in Chapter II. This author feels that in this case, rejection of the null hypothesis would constitute a type I error.

Economies of Size

An effort was made to detect the existence of economies or diseconomies of size in community service provision. Logarithmic models (Tables I, II, and III) and per capita cost models (Appendix B) were emperically tested in the aggregate and by service and industry type. Results of these analyses were inconclusive. Regression coefficients were not significant and the R^2's of the equations were very low.

CHAPTER V

SUMMARY AND IMPLICATIONS

Research efforts employed in this study have focused upon evaluating the effects of a common rural development technique--rural industrialization--on the cost structure of community service provision. The primary objective of this study was to develop a means useful to rural development professionals and leaders of rural communities for determining the effects of industrialization on community expenditures. Specific objectives were to: 1) develop and test general econometric models relating total operation and maintenance costs of municipal government to specified independent socieconomic and demographic variables, 2) develop and test models for identifying operation and maintenance costs associated with specific service types, and 3) develop and test models relating total operation and maintenance costs of municipal governments for all services by specific industry types.

Eighty communities with populations of less than 10,000 were selected to make up the sample. Municipalities located within SMSA's were excluded from consideration in order that the sample communities would reflect a more nearly correct picture of their own economic structure. The sample communities were analyzed as to their service expenditures with relation to population, per capita income, manufacturing employment and location. All 80 communities had some manufacturing employment.

Summary of Aggregate Models Results

Numerous aggregate models were formulated in order to achieve the first of the three specific objectives. Nine of these models were discussed and summarized in Chapter IV. Of these nine, three are felt to serve best as predictive tools for use by various municipalities under 10,000 population in Oklahoma. Population, per capita income, manufacturing employment and location variables are included in these models along with a water system variable to account for the fact that local government provides water and sewer services in some communities while private authorities provide them in others.

The first of the three aggregate models, which involves the use of all the variables previously mentioned, tested quite well statistically, with an R^2 of .91 and significance levels equal to or better than .25 for all terms involved. Increases in operation and maintenance costs to municipalities for provision of services were shown to result from per unit increases in population, income and manufacturing employment. The location coefficient indicated that municipalities west of U. S. Highway 81 could expect costs to be less than those east of this line.

The second of the three aggregate models thought to be especially significant did not consider the community's location as a factor in cost determination. Despite the exclusion of the location dummy, the fit of the estimated regression line was not noticeably affected. (R^2 is .91 for both when rounded to two digits.) Significance levels for the intercept and independent variables remained at virtually the same levels (better than .20 for all terms), with the intercept, population and per capita income terms being significant to the .003 level or better.

Increases in costs of service provision were shown to result from per unit increases in population, average per capita income and manufacturing employment. These relationships are similar to those indicated by the first aggregate model tested.

The third basic model was constructed to test the capability of population to explain community service costs. This simple formulation resulted in a highly significant population coefficient and an equation whose R^2 value is .90. Because of these favorable results and the simplicity of the equation, the third aggregate form may be desirable for use by community leaders as they predict changes in municipal costs of services.

Summary of Service and Industry Models Results

Population is the only variable considered which was consistently significant in explaining costs of specific services. Per capita income is a relatively significant variable for explaining water and sewer costs, street costs, parks and recreation costs and general administration costs. Manufacturing employment is estimated to have a positive and somewhat significant relationship to costs of street maintenance. Coefficients of location indicate that street maintenance and fire protection costs tend to be lower in western Oklahoma than in eastern Oklahoma.

Regression results were inconclusive in suggesting different costs of community services associated with employment in different industry types. Only for food products manufacturing was a reasonable and somewhat significant coefficient of community service costs estimated. The relatively large value of this coefficient does suggest, however, that community service costs per employee are substantially greater for food products manufacturing than for manufacturing in general.

Implications

Models used to test certain hypotheses of rural industrialization's effect on the cost of community service provision incurred by municipal governments have been presented. These various formulations have been theoretically justified and emperically tested using the Statistical Analysis System. Results have been presented both in detailed form in Chapter IV and in a summarized form in this chapter. In this section the implications of this research for policy and for further research will be discussed.

Implications for Policy

There are several policy implications which can be drawn from the results of this research. As was previously stated, the prime objective of this study was to develop a means useful to rural development professionals and leaders of rural communities that would enable them to more accurately estimate the effects of rural industrialization on service provision costs. By use of the models presented herein this end can be accomplished. Application of these models to specific community situations could result in the formation of definite community policies on industrialization.

Great care should be exercised in deriving general policies for all rural communities based on this research. Each community is unique. The set of circumstances which will determine the impacts resulting from rural industrialization are different for each. By acting from a well informed position based on close scrutiny of the municipality's situation, citizens, as well as decision-makers, can influence the direction their community will take with regard to economic development. Trade-offs between effects of industrial development and quality of life can be considered. More directly related to this study, community leaders can weigh the alternatives of increased levels of services demanded against needed increases in fees or taxes to support these services. Guidelines may also be set concerning the amount of industry a particular community may wish to attract.

Certain of their decisions could affect the actual fiscal structure of a rural municipality. As a matter of course, budgets must be created at the beginning of each fiscal year. By use of aggregate model (1c), a community anticipating the location of a plant which would raise per capita income $10, employ 100 persons and attract an additional 200 persons as a result of families and other spin-off jobs, could expect expenditures for operation and maintenance of service provision to increase $40,970 per year, on the average. Using this as a starting point, leaders of a community can consider several alternatives: 1) Can the municipal government absorb an increase in budget of this nature by relying on increases in revenues or by budget realignment in other areas of government? 2) If it is apparent that they cannot, would it be better to raise taxes or cut back services: 3) If they decide to do neither, can bonds be floated to take care of increased yearly expenditures? 4) Are present service provision systems operating at full capacity? 5) If so, what will it cost in terms of capital outlay to improve systems in order to handle the increased demands placed upon them as a result of the industrial location?

Implications for Research

The development of a reliable and economically sound model for the estimation of overall effects to all sectors of a community resulting from rural industrialization would be of great value. One potential use of this study by other researchers would be to incorporate findings herein into broader analyses to estimate the total impacts of rural industrialization on communities. The depth with which this study handles costs could enhance the ability of other models to give an accurate and reliable account of overall community situations. The combination of private sector oriented input-output and multiplier type analyses with this regression-based analysis could yield results with widespread applicability to rural communities.

through

This study could serve as a basis for further research into fiscal structuring of rural municipalities. There is a possibility of improving both the accounting systems and the overall service efficiency of municipal governments by using the specific cost information offered herein to develop techniques municipal officials could apply to local situations. With more data (particularly on capital expenditures) and more observations (perhaps of the time-series nature) greater insight into identifying the actual cost functions of municipal governments could be gained from employing the same type of regression procedure used in this study.

Limitations of This Study

One major limitation of this study was lack of reliable capital cost information. In any complete evaluation of service costs, capital outlay information would necessarily be required in order to get an accurate picture of total costs. Attempts were made to obtain these cost figures by seraching municipal audits on file in the Oklahoma State Board of Equalization Office. However, only lump sum recordings of capital expenditures were available, and often the particular items for which these expenditures were made were not recorded. No amortization of costs or recording of yearly depreciation of capital assets was available. There was no way to detect the quality or expected life of the capital equipment purchased. It was thought that perhaps bonded indebtedness or ad valorem tax collections could serve as a proxy for capital outlay figures, but problems with completeness of data and with theoretical interpretation of resultant coefficients prohibited this course of action.

Another limitation was the necessity to use a cross-sectional rather than time-series data analysis approach. Due to lack of a series of yearly audits for each community and lack of complete population and income data for each year, there seemed to be no viable alternative to analysis of community service costs with cross-sectional data. Certainly availability of data for a greater number of years would improve upon the quality of predictive equations which resulted from analysis of the basic theoretical models presented in this study.

Overall lack of data for all communities for non-census years and for communities less than 2,500 population for some variables in census years posed another limitation. Originally it was intended that a comparison of costs in 1972 and 1975 be made for the respective communities, but the unavailability of per capita income data for 1972 for communities less than 25,000 prevented this. Incorporation of population density into the analysis as an effective variable was also prevented by data limitations.

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APPENDIX A

GLOSSARY OF VARIABLES

Dependent Variables

CS75	Total cost of maintenance and operation of municipal government for fiscal year ending June 30, 1976 (FY'76)
LCS75	Log of CS75
CSP75	Total operation and maintenance cost of municipal government, FY'76 divided by total community population, 1975
LCSP75	Log of CSP75
CS175	Total operation and maintenance cost of water and sewer services, FY'76
LCS175	Log of CS175
CS275	Total operation and maintenance cost of sanitation services, FY'76
LCS275	Log of CS275
CS375	Total operation and maintenance cost of streets, FY'76
LCS375	Log of CS375
CS475	Total operation and maintenance cost of police protection, FY'76
LCS475	Log of CS475
CS575	Total operation and maintenance cost of fire protection, FY'76
LCS575	Log of CS575
CS675	Total operation and maintenance cost of parks and recreation, FY'76
LCS675	Log of CS675
CS775	Total operation and maintenance cost of municipal government administration, FY'76
LCS775	Log of CS775

Independent Variables

P75	Population of community, December 31, 1975
LP75	Log of P75
Y75	Per capita income of community, December 31, 1974
LY75	Log of Y75
D	Density, measured in persons per square mile, of community, 1970
LDENS	Log of D
M75	Total manufacturing employment of community, December 31, 1975
LD	Location of dummy LD = 0 if community lies west of U. S. Highway 81. LD = 1 if community lies east of U. S. Highway 81.
WDUM	Water and sewer services dummy WDUM = 0 if private authority provides water and sewer services WDUM = 1 if community provides water and sewer services
M175	Total manufacturing employment in petroleum, December 31, 1975
LM175	Log of M175
M275	Total manufacturing employment in foods, December 31, 1975
LM275	Log of M275
M375	Total manufacturing employment in textiles and apparel, December 31, 1975
LM375	Log of M375
M475	Total manufacturing employment in wood and wood products, December 31, 1975
LM475	Log of M475
M575	Total manufacturing employment in miscellaneous light industries, December 31, 1975
LM575	Log of M575

M675	Total manufacturing employment in metals and metal works, December 31, 1975
LM675	Log of M675
M775	Total manufacturing employment in cement, glass, and chemicals, December 31, 1975
LM775	Log of M775

APPENDIX B

SUMMARY TABLE OF ECONOMETRIC ANALYSIS, COMMUNITY SERVICE MODELS, 1975

Model	No. Obs.	R^2	FValue	p>F	B_0	B_1	B_2	B_3	B_4	B_5
AGGREGATE:										
<u>LINEAR</u>:										
CS75=P75, Y75, D, M75	37	.836	40.8	.0001	.0408	.0001	.0111	.2812	.1786	
CS75=P75, Y75, M75, LD	80	.891	152.9	.0001	.0001	.0001	.0001	.2485	.1296	
CS75=P75, Y75, D75, M75, LD	37	.840	32.6	.0001	.0322	.0001	.0091	.3743	.2474	.3657
CS75=P75, M75, LD	80	.866	162.9	.0001	.104	.0001	.6976	.7161		
CS75=P75, Y75, M75	80	.887	199.5	.0001	.0001	.0001	.0002	.1657		
CS75=Y75, M75, LD	80	.418	18.2	.0001	.0189	.0002	.0001	.9067		
CS75=P75, LD	80	.865	247.1	.0001	.1097	.0001	.6463			
CS75=P75	80	.865	499.0	.0001	.0682	.0001				
CS75=P75, Y75, M75, WDUM	80	.910	190.5	.0001	.0001	.0001	.0033	.1232	.0001	
CS75=P75, Y75, M75, D, WDUM	37	.879	44.9	.0001	.0624	.0001	.1161	.1940	.2115	.0025
CS75=P75, Y75, M75, LD, WDUM	80	.912	153.2	.0001	.0001	.0001	.0018	.1769	.2583	.0001
CS75=P75, WDUM	80	.898	340.4	.0001	.0001	.0001	.0001			
<u>LOG</u>:										
LCS75=LP75, LY75, LDENS, LM75, LD	37	.864	39.4	.0001	.7869	.0001	.0039	.1360	.5875	.5277
LCS75=LP75, LY75, LM75, LD	80	.819	84.9	.0001	.0115	.0001	.0002	.8171	.4057	
LCS75=LP75, LM75, LD	80	.783	91.6	.0001	.0032	.0001	.6193	.8668		

MODEL	No. Obs.	R^2	Fvalue	p>F	B_0	B_1	B_2	B_3	B_4	B_5
LCS75=LP75, LY75, LM75	80	.817	113.4	.0001	.0162	.0001	.0003	.6686		
LCS75=LP75, LY75, LDENS, LM75	80	.862	50.1	.0001	.9223	.0001	.0042	.0001	.0941	.4686
LCS75=LP75, LD	80	.783	138.7	.0001	.0008	.0001	.7431			
LCS75=LP75	80	.782	280.4	.0001	.0007	.0001				
PER CAPITA:										
LINEAR:										
CSP75=P75, Y75, D, M75, LD	37	.343	3.2	.0182	.1651	.6644	.0012	.1383	.3134	.5157
CSP75=P75, Y75, D, M75	37	.334	4.0	.0095	.1297	.5128	.0012	.1008	.248	
CSP75=P75, Y75, M75, LD	80	.282	7.4	.0001	.9099	.2239	.0001	.8821	.2396	
CSP75=P75, Y75, LD	80	.282	9.9	.0001	.9326	.1060	.0001	.2225		
CSP75=P75, M75	80	.070	2.9	.0613	.0001	.0247	.5732			
CSP75=P75, Y75, D, MP75, LD	37	.337	3.2	.0203	.2275	.9195	.0012	.1114	.3845	.5529
CSP75=P75, Y75, MP75, LD	80	.283	7.4	.0001	.9939	.1079	.0001	.6701	.2097	
CSP75=P75, MP75	80	.088	3.7	.0293	.0001	.0272	.1685			
LOG:										
LCSP75=LP75, LY75, LDENS, LMP75, LD	37	.218	2.9	.0294	.7869	.7814	.0039	.1360	.5875	.5277
LCSP75=LP75, LY75, LDENS, LMP75	37	.309	3.6	.0160	.9223	.8819	.0042	.0941	.4686	
LCSP75=LP75, LY75, LMP75, LD	80	.302	8.1	.0001	.0115	.0077	.0002	.8171	.4057	

Model	No. Obs.	R^2	Fvalue	p>F	B_0	B_1	B_2	B_3	B4	B_5
LCSP75=LP75, LY75, LMP75	80	.245	10.6	.0001	.0162	.0074	.0003	.6686		
LCSP75=LY75, LMP75, LD	80	.232	7.6	.0002	.0151	.0001	.3652	.4108		
LCSP75=LY75, LMP75	80	.225	11.2	.0001	.0211	.0001	.2593			
LCSP75=LP75	80	.160	14.8	.0002	.0007	.0002				
SERVICES:										
LINEAR:										
CS175=P75, Y75, M75, LD	40	.581	12.1	.0001	.1584	.0002	.2044	.7640	.6177	
CS275=P75, Y75, M75, LD	48	.608	16.7	.0001	.5216	.0001	.5529	.8108	.5766	
CS375=P75, Y75, M75, LD	62	.609	22.2	.0001	.1081	.0001	.0493	.1816	.1042	
CS475, Y75, M75, LD	62	.839	74.2	.0001	.6063	.0001	.8475	.8037	.7698	
CS575=P75, Y75, M75, LD	62	.838	73.6	.0001	.0218	.0001	.4723	.9722	.1870	
CS675=P75, Y75, M75, LD	49	.592	16.0	.0001	.0307	.0001	.1108	.7024	.9702	
CS775=P75, Y75, M75, LD	62	.486	13.5	.0001	.2981	.0001	.1496	.8551	.8999	
LINEAR:										
CS175=P75	40	.552	46.8	.0001	.6008	.0001				
CS275=P75	48	.600	69.0	.0001	.8903	.0001				
CS375=P75	62	.557	75.5	.0001	.5873	.0001				
CS475=P75	62	.838	311.4	.0001	.2686	.0001				
CS575=P75	62	.832	296.9	.0001	.0001	.0001				

Model	No. Obs.	R^2	Fvalue	p>F	B_0	B_1	B_2	B_3	B_4	B_5
CS675=P75	49	.562	60.3	.0001	.0277	.0001				
CS775=P75	62	.464	51.9	.0001	.2360	.0001				
<u>LOG</u>:										
LCS175=LP75, LY75, LM75, LD	40	.624	14.5	.0001	.1158	.0001	.0714	.8571	.6473	
LCS275=LP75, LY75, LM75, LD	48	.522	11.7	.0001	.7225	.0001	.6581	.1964	.9934	
LCS375=LP75, LY75, LM75, LD	62	.601	31.4	.0001	.1431	.0001	.0339	.6244	.5339	
LCS475=LP75, LY75, LM75, LD	62	.787	52.7	.0001	.7618	.0001	.6315	.3482	.5489	
LCS575=LP75, LY75, LM75, LD	62	.674	29.4	.0001	.0116	.0001	.2108	.3038	.2489	
LCS675=LP75, LY75, LM75, LD	49	.484	10.3	.0001	.0070	.0002	.0355	.2979	.4497	
LCS775=LP75, LY75, LM75, LD	62	.516	15.2	.0001	.3415	.0001	.0464	.8014	.4750	
INDUSTRY:										
<u>LINEAR</u>:										
CS75=P75, Y75, M175, LD	20	.925	46.1	.0001	.0407	.0001	.1045	.3516	.8427	
CS75=P75, Y75, M275, LD	42	.881	68.8	.0001	.0043	.0001	.0026	.2876	.0266	
CS75=P75, Y75, M375, LD	31	.889	52.0	.0001	.0067	.0001	.0113	.4769	.1841	
CS75=P75, Y75, M475, LD	20	.954	77.7	.0001	.1390	.0001	.1190	.4860	.6199	
CS75=P75, Y75, M575, LD	73	.886	131.6	.0001	.0003	.0001	.0007	.2314	.1483	
CS75=P75, Y75, M675, LD	50	.857	67.6	.0001	.0071	.0001	.0104	.6675	.2773	
CS75=P75, Y75, M775, LD	48	.884	82.3	.0001	.0032	.0001	.0032	.4229	.1335	

Model	No. Obs.	R^2	Fvalue	p>F	B_0	B_1	B_2	B_3	B_4	B_5
<u>PER CAPITA</u>:										
CSP75=P75, Y75, M175, LD	20	.268	1.4	.2888	.6382	.1350	.2085	.8738	.7155	
CSP75=P75, Y75, M275, LD	42	.254	3.2	.0245	.8168	.6669	.0027	.8324	.0835	
CSP75=P75, Y75, M375, LD	31	.377	3.9	.0126	.9678	.4909	.0020	.9933	.0982	
CSP75=P75, Y75, M475, LD	20	.478	3.4	.0344	.3294	.5693	.0422	.1739	.7079	
CSP75=P75, Y75, M575, LD	73	.248	5.6	.0008	.6837	.1794	.0001	.5886	.3037	
CSP75=P75, Y75, M675, LD	50	.196	2.7	.0396	.7522	.5396	.0042	.9510	.4736	
CSP75=P75, Y75, M775, LD	48	.331	5.3	.0018	.9560	.1974	.0001	.3104	.1515	
<u>LOG</u>:										
LCS75=LP75, LY75, LM175, LD	20	.822	17.4	.0001	.8036	.0001	.4701	.9048	.6225	
LCS75=LP75, LY75, LM275, LD	42	.882	69.4	.0001	.1293	.0001	.0027	.8008	.0741	
LCS75=LP75, LY75, LM375, LD	31	.890	52.8	.0001	.0709	.0001	.0044	.3368	.0553	
LCS75=LP75, LY75, LM475, LD	19	.925	43.0	.0001	.9101	.0001	.5212	.1815	.8927	
LCS75=LP75, LY75, LM575, LD	73	.818	76.5	.0001	.0407	.0001	.0018	.2163	.4824	
LCS75=LP75, LY75, LM675, LD	50	.843	60.6	.0001	.1258	.0001	.0052	.8554	.6592	
LCS75=LP75, LY75, M7775, LD	50	.846	61.8	.0001	.1254	.0001	.0017	.0547	.1314	

VITA 2

Harold Lloyd Goodwin, Jr.

Candidate for the Degree of

Master of Science

Thesis: ESTIMATION OF THE MUNICIPAL GOVERNMENT COSTS OF COMMUNITY SERVICES FOR RURAL OKLAHOMA COMMUNITIES

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Sapulpa, Oklahoma, February 24, 1953, the son of Mr. and Mrs. Harold L. Goodwin.

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Professional Experience: Served as Research and Teaching Assistant at Oklahoma State University from August, 1976, to June, 1978; worked in Technical and Planning Pool, Eastern Oklahoma Development District, Muskogee, Oklahoma, May-August, 1975, and 1976.

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