IMPACT OF DECLINING FARM INCOME AND RAPID PETROLEUM DEVELOPMENT UPON PUBLIC SERVICE EXPENDITURES IN RURAL COMMUNITIES OF WESTERN OKLAHOMA FROM 1975 TO 1984

By

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Bachelor of Arts

Phillips University

Enid, Oklahoma

1984

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
December, 1987

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ACKNOWLEDGEMENTS

There are several people whose assistance and support was instrumental in conducting this study and to whom I am grateful: my adviser, Dr. Gerald A. Doeksen, for his guidance, Dr. Dean F. Schreiner, Dr. Michael Woods, and Dr. James R. Nelson, for their advice and comments, Dr. Daryll E. Ray, for his advice on certain econometric problems, and Larry Watkins, for helping me get through my computer work during a time when the data center was in a state of transition. I am grateful to Dr. James E. Osborn and the Department of Agricultural Economics at Oklahoma State University for the financial support necessary for me to pursue this degree. I would also like to thank Dr. David Henneberry, Dr. Francis M. Epplin, and Dr. Daniel Tilley for their interest and encouragement in areas besides my research.

Throughout my education, my parents have provided moral and financial support which has been invaluable. I thank them for their unfailing love and understanding.

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CHAPTER I

INTRODUCTION

Statement of the Problem

The provision of public services in rural communities consists of more than providing an adequate level of service at a minimal cost. Because many policies affecting a community's population and income fall under the control of federal and state governments, the tools left to a community with which to influence its own development are limited. Communities are left a great deal of control in the provision of public services, hence community service programs are important instrument used by local decision makers to manage community development (5). Community service expenditures have a direct impact upon the quality of life in rural communities and help determine the attractiveness of a community to potential inmigrants, businesses, and investors. To plan the investment in and operation of community services, local decision makers need quality information about existing and projected levels of population and income.

The local economies of many communities in rural Oklahoma are based on the industries of petroleum extraction and agriculture. Farm income is subject to great year-to-year fluctuations. Traditionally, per capita farming income has been lower than the per capita income of urban Americans. Until recently farmers had been making steady progress towards reaching an equal economic footing with their urban counterparts. Agriculture is currently in a crisis which has the potential to reshape rural America. Activity in the "oil-patch" has experienced several boom-and-bust cycles. These cycles are a recurring phenomena in the Oklahoma petroleum industry. The effect of this phenomena may not be fully appreciated by decision makers at all levels of policy making in Oklahoma.

Rapid resource development can challenge the planning efforts of rural community leaders. Rapid resource development in rural areas can often be characterized as an energy impact cycle (16). An energy impact cycle is made up of three distinct periods: 1) pre-impact, 2) impact, and 3) post-impact. The pre-impact is associated with stable activity in the energy sector. During impact, activity in the energy sector accelerates rapidly. Post-impact experiences a slowdown in the energy sector. This can vary in intensity from a gradual abatement in activity to a sudden shutdown.

In a period of rapid resource development, local decision makers must have quality data and the analytical tools necessary to utilize these data effectively in decision making. The potential costs of mistakes made in planning investments in community service facilities are great. During an energy impact, such as an oil boom, a great deal of uncertainty exists concerning population and income levels from one year to the next. Will the next year bring yet more growth or will things "go bust"? Small communities in rural areas are often ill equipped to cope with the large influx of migration usually associated with the impact period. If a community's service capabilities are too small, serious problems can result. For example, during the oil boom in Texas' Permian Basin in the 1950s, the sewerage system of Odessa was so overwhelmed by the burgeoning population that raw sewerage flowed in the streets, resulting in associated health problems (14). On the other hand, communities which rely too heavily upon projections made by extrapolating current trends during a period of unusually high growth may overinvest in community service facilities and be plagued by a large debt which cannot be serviced when the expected growth does not materialize. One southwestern Oklahoma town is today faced with just such a problem due to its funding of what proved to be an unneeded water project. Another town in this same area paid for the construction of a hospital which was full during the impact period but now operates at only 40% capacity.

The American petroleum industry is today in the post-impact period of an energy impact cycle which was precipitated by the Iranian Revolution of 1979. Given the volatility of the Middle East, America's ever-growing dependence on imported oil, and the evaporation of federal funds for research of alternative energy sources, another energy impact cycle may appear. If this occurs decision makers in rural communities will be faced with problems similar to those which arose during the most recent energy impact. By studying community service expenditures during the recent energy impact cycle future decision makers will be better prepared to handle the difficulties which arise from rapid resource development.

Study Area

The study area was limited to the western portion of Oklahoma to insure that the sample communities would have similar economic structures. Goodwin (8) found significant differences in the community service cost functions between the eastern and the western half of the state. All counties west of I-35, excluding those which are part of a Standard Metropolitan Statistical Area (SMSA), were considered. If the proportion of total county employment in 1980 made up by employment in agriculture was less than that for the state as a whole, the county was discarded. The same process was repeated for employment in the mining sector. The result was a contiguous area of eleven counties. These counties are Beckham, Blaine, Custer, Dewey, Ellis, Harper, Kingfisher, Major, Roger Mills, Washita, and Woodward.

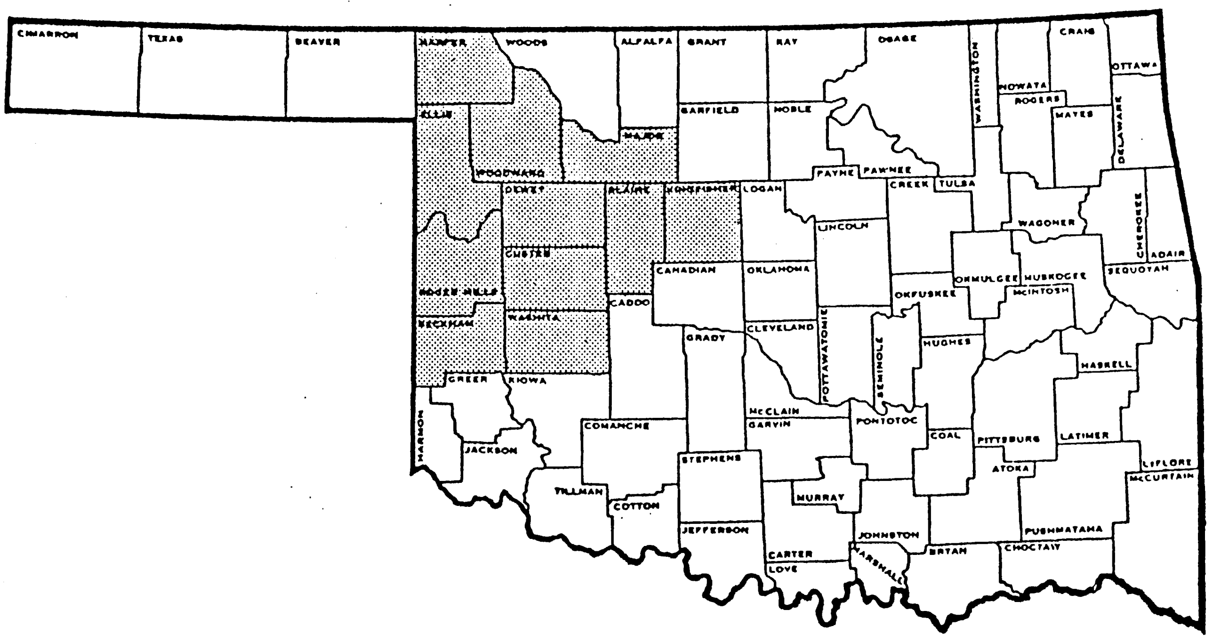

Figure 1. Study Area

From these counties a sample of twenty communities was chosen. This sample accounts for about one-third of the communities in the area. These communities were judged to be the major communities of their respective counties based on size or if the community was the county seat. Those communities with a unique economic structure, such as Weatherford, home of Southwestern Oklahoma State University, and those with incomplete data on community service expenditures, such as Clinton, were excluded. The communities included in the sample are Elk City, Erick, Sayre (Beckham county), Okeene, Watonga (Blaine county), Arapaho, Thomas (Custer county), Seiling, Taloga (Dewey county), Arnett, Shattuck (Ellis county), Laverne (Harper), Hennessey, Kingfisher (Kingfisher county), Fairview (Major county), Cheyenne (Roger Mills county), Burns Flat, Cordell (Washita), Mooreland, and Woodward (Woodward county). These communities were examined over a ten year period (1975-1984) which includes each of the three stages of the energy impact cycle and the recent agricultural crisis.

Objectives and Procedures

The general objective of the study is to examine community service expenditures in rural communities of Western Oklahoma during the recent energy impact cycle and agricultural crisis. The specific objectives are:

1) determine when each of the stages of the energy impact cycle occurred, when the agricultural crisis began to affect farm income, and how the sample communities were affected,
2) identify those factors which influenced community service expenditures in the study area,
3) quantify the impact of falling farm income and the energy impact cycle upon community service expenditures in the study area,

These objectives were met by three procedures. The study will:

1) examine historical data on personal income, community population, community revenues, and community expenditures of the sample communities over the study period,
2) use regression analysis to estimate a model of community service expenditures for rural communities of Western Oklahoma, and
3) conduct a simulation analysis using the coefficients estimated by the regression model to evaluate separately the impact of the drop in farm income and the energy impact cycle upon community service expenditures.

CHAPTER II

THEORETICAL CONSIDERATIONS AND RELATED RESEARCH

Introduction

Analyzing community service expenditures requires an understanding of the economic and demographic characteristics of a community as well as the implications of the public goods nature of community services for economic analysis of community service expenditures. This chapter reviews theory and research on community economics, community demographics, and community services separately and then looks at research which unifies these three topics and models community service expenditures.

Community Economics

Economic Impact of Rapid Resource Development

Rapid development of a rural area's natural resources, such as is characteristic of an oil boom, affects all aspects of an area's economy. Researchers have documented large increases in employment, income, local business activity, property values, and prices associated with the construction and operation of large-scale energy facilities and coal mining in the mountain states and the northern great plains. Much of this research has been reviewed by Leistritz, Murdock, and Leholm (12). Besides employing local labor, large energy projects draw substantial numbers of migrants into the impact area. Employers in other sectors of the impact area's economy have to increase wages as labor becomes scarce. Secondary employment is encouraged by purchases of supplies, materials, and services needed for construction and operation of the energy facility. This cycle of spending and respending is known as the multiplier effect. This scenario is similar to that which occurs in petroleum producing regions of the southern plains.

On the other hand, the crisis in agriculture is a long-term problem. Agricultural input and output markets are well developed in farming areas and are not subject to the extreme short run changes observed in the energy sector and industries supplying the energy sector during an energy impact cycle.

Export Base Theory

Export base theory is an effective tool for explaining and projecting changes in employment and income which result from a change in the activity of a basic sector, such as mining or agriculture (41). A basic industry or sector is one whose level of activity is, to a large extent, independent of the general level of economic activity within a region or community. Only those sectors which export a large amount of their output to other areas appear to be basic over the long-run (36). A secondary or nonbasic industry is one whose output is used in the area where it is produced. Basic income is that which is earned by companies exporting their goods and services to other areas while nonbasic income flows from an area's basic industries to an area's nonbasic industries. This interaction between basic and nonbasic industries is the foundation of the economic life of a region or community (30).

The role of basic sectors in an area's economy can be described in as simple a manner as the ratio of employment or income in nonbasic sectors to that in basic sectors. This is known as a derivative-basic ratio or a multiplier (30). The employment multiplier can be interpreted as the number of jobs that can be expected to be added to an area's nonbasic sectors given an increase in basic sector employment by one job. Likewise, the income multiplier is the amount of additional nonbasic income expected from a one dollar increase in basic income. For example, if the total employment of a community is 1500 jobs and 500 of those jobs are in basic sectors, then the employment multiplier of that community is 2. An assumption of much work done in export base theory is that the theory is most appropriate for smaller regions which are open to trade and do not have diverse economies (41).

The method used to separate basic and nonbasic activity, referred to as bifurcation, can have an effect upon the results of an export base study. The most accurate method is to directly survey each firm in the study area to see where production goes (30). This is very costly and time consuming. Bifurcation can be done less expensively, and less accurately, by indirect methods of estimating basic activity. The location quotient and minimum requirements techniques recognize that an individual sector may produce goods both for export and local use and thus be neither completely basic nor completely nonbasic. These methods estimate what proportions of each sector can be considered basic. A less accurate approach is the assignment or assumption method. This method simply assumes a sector to be entirely basic or entirely nonbasic based upon an a priori judgment. Although the assumption method is often used in research, the potential errors can be enormous (36).

Several regression studies utilizing time-series data have found a strong statistical association between basic and nonbasic sectors suggesting a causal link from basic to nonbasic activity. Yet the time lag between a change in basic activity and the corresponding change in nonbasic activity is not well understood (7). Leistritz, Murdock, and Leholm (12) report that low employment multipliers are often associated with the first year or two of large-scale resource development. Apparently large amounts of supplies and materials are imported into the impact area until businesses develop the capability to produce these locally. In a review of export base studies, Williamson (41) found a lag of zero to six months usually gave the best correlation between basic and nonbasic economic activity.

Community Demographics

Migration Theory

The neoclassical model of migration views wage differentials between regions as the major stimulus to migration (31). This is somewhat restrictive. Other factors such as climate, public services, psychic distance, amenities, availability and quality of information, social benefits, and the like enter into the decision to migrate. A more complete theory of migration might state that migrants have heterogeneous preferences and react to differences in expected utility. Applying this ideal theory of migration is easier said than done. Due to the ready availability of economic data, most migration research underestimates the importance of non-economic variables affecting migration (31).

Migration Research

Mead (15) estimated a simultaneous equations model of migration and employment growth for a sample of nonmetropolitan regions in the United States. Migrants were assumed to consider the migration decision as an investment decision. His results show migration to both affect and be affected by income and employment growth. High income areas exhibiting high rates of employment and income growth showed the highest inmigration rates.

Demographic Impact of Rapid Resource Development

Murdock, Leistritz, and Schriner (17) reviewed research concerning demographic changes associated with rapid growth in rural areas of the West. In general, migrants moving into the impact areas were young adults with few dependents. Those who had families often came to the impact area alone. Besides differences related to age, resource-related inmigrants were not found to be that much different from local residents or migrants in general. The authors analyzed population changes over a ten-year period in communities located in counties which were sites of large resource development projects. Communities with initial populations of less than 1000 showed an average population gain of 282 persons during this period. Those with an initial population between 1000 and 2500 gained an average of 1290 persons while those with populations greater than 2500 gained an average of 3535 persons. Although other factors affecting migration were not held constant, the data suggest that larger towns within impact areas exert more draw with respect to inmigration than smaller towns. This could be due to a more highly developed service structure which renders larger towns more attractive living places to potential inmigrants.

Community Services

Public Goods

Research into the provision of public services is complicated by the public goods aspects of public services. Day (4) defines a public good as one which meets one of three conditions: a) consumption by one does not inhibit consumption by another, b) external effects can accrue to non-constituents (i.e., free-riders), and c) production of the good is carried out by a decreasing cost industry. Tiebout (35) opts for a simpler definition; "... a public good is one which should be produced, but for which there is no feasible method of charging the consumers." Samuelson (32) refers to public goods as "collective consumption goods." His definition of a public good coincides to the first of Day's three conditions.

Economic Analysis of Service Expenditures

Public services are usually neither pure public goods nor pure private goods. For example, police protection is more nearly a pure public good than water service. Water service is provided so that the more water a customer uses, the more that customer pays. The amount an individual pays for police protection is not affected by how often an individual requires police assistance. The most important aspect of public goods with respect to economic analysis is that resource allocation takes place in a non-market environment. Traditional concepts of supply and demand, price per unit, and the definition and actual measurement of per unit output are quite complex when dealing with public services. The problems associated with measuring the quantity and quality of output impede the application of traditional production economics to the analysis of public services. It is likely that local government officials simply try to match revenues with expenditures given the constraint of maintaining a satisfactory level of service with little regard for marginal costs (42).

Ohls and Wales (20) attempted to circumvent the problems of measuring output and price by making certain assumptions of how demographic variables affect state and local service expenditures. Prior to this study research on public service expenditures was unclear on whether demographic variables affect expenditures by influencing demand or supply. The authors felt that it is most likely that demographic variables influence the cost of providing the service while income represents a budget constraint and thus affects demand. Costs were assumed to be independent of the level of service provided. Total public service expenditures observed were assumed to represent an equilibrium between supply and demand. The demand for state and local services was assumed to be a linear function of income and the price of the service. Price was stated as a function of factor prices and the demographic variables assumed to affect the cost of the service. This allowed Ohls and Wales to estimate a function stating total service expenditures as the product of the price and demand functions built with the help of their simplifying assumptions and, using the parameters estimated by regression analysis, calculate income and price elasticities of demand for state and local services.

The data used were for local expenditures, highway expenditures, and education expenditures within the 48 contiguous states. Demand for both local services and education was found to be inelastic with respect to price while demand for highways was more responsive to price. Income elasticities ranged from 0.6 to 0.9 for all three categories. The low price elasticity of demand could be interpreted as supporting the hypothesis mentioned earlier that local officials equate revenue with expenditures subject to providing a satisfactory level of service.

Schmandt and Stephens (33) used a novel measure of public service output. They held that per capita municipal expenditures only indicate that one community is spending more or less than another and bears no necessary relationship to actual output. A detailed breakdown of municipal functions was used as a measure of the quality of output; the greater the number of functions performed by a community, the higher the level of service provided.

Expenditures made by Milwaukee county communities on police protection, fire protection, solid waste disposal, and general government were analyzed. The results indicate economies of large scale in these services, especially for general government. The major factor affecting local spending was found to be the resources available to a community to pay for public services. Expenditures were positively associated with population, service quality, density, the percent of land area developed, and the age of the community.

Hitzhusen (9) used the American Insurance Association schedule for grading municipal fire defense as a guide for defining the quality of fire protection provided in 70 Texas communities. He felt that relying solely upon per capita expenditures as a measurement of output could lead to questionable policy recommendations with respect to economies of scale. A general fire protection cost-output model was constructed relating fire protection expenditures to population, dwelling density, the proportion of the population made up by transients, Blacks, Germans, and Mexicans, the proportion of housing accounted for by multi-units and older buildings, the amount of commercial property, climatic conditions, and base salary differentials. The value of burnable property was found to be more closely associated with cost differentials between communities than population. Size economies were indicated up to a population of about 10,000.

Impact of Rapid Resource Development upon Community Services

Researchers have had difficulty documenting or quantitatively measuring service level changes which have occurred in energy impact areas of the West. The fiscal impacts of rapid resource development can be defined as the locally financed agency costs which would not have been expected without resource development less any increase in revenues that can be attributed to development. The largest fiscal impact is usually felt in the first two or three years of development before the taxable assessed value of local property rises enough to provide more funding (18).

Milburn, Walker, and Knudson (16) studied the effects of the recent oil-boom upon acute health care delivery systems of rural oil and gas producing communities in Texas. Surveys and interview questionnaires were used to gather information from health care employees, local officials, and residents concerning local health care capabilities and the quality of service during the pre-impact, impact, and post-impact stages of the oil-boom. Most changes occurred during impact. In this period the incidence of automobile accidents, physical abuse, drug and alcohol abuse, and work-related injuries were at their highest. Although improvement in health care equipment and facilities was made possible during impact by the greater financial capabilities associated with the higher incomes of the impact period, manpower was strained to meet the increased demand for acute health care. Due to this upgrading of physical facilities, acute health care systems were judged better in the post-impact stage than they had been prior to the oil-boom. The study however did not deal with the financing of the construction of these facilities. Although some communities do have better facilities than during the pre-impact period, they may be having difficulty servicing their debt during post-impact.

Modeling Community Service Expenditures

Williford (42) used income and population predictions from a simulation model of the Oklahoma and Texas panhandles developed by Eckholm (5) and a public service expenditure model estimated using regression analysis to project future public service expenditures for communities in the region. His objective was to evaluate the impact of the reduced availability of groundwater for irrigation use upon the provision of public services in rural communities. His hypothesis, that the reduction in agricultural income and associated outmigration would lead to a reduction in community expenditures, was supported by the model.

Williford tried to use time-series data for some communities, but found large year-to-year fluctuations in expenditures which could not be explained by the model. A linear and a power model were estimated for water and sewer, street maintenance, police protection, and fire protection. Both models used community population and county per capita income as independent variables. In addition, the linear model included a variable for the percent change in community population from 1960 to 1970 while the power model used the ratio of the community's 1970 population to that of 1960. Only the population variable was significant in all ten of the estimated expenditure functions. All three of the variables were significant in only the linear function for total expenditures. Expenditures were positively related to population and per capita income (where it was significant) and negatively related to the change in population variable.

Projections were made for service expenditure levels for communities of various initial populations ranging from 2500 to 20,000. Results were estimated from 1978 to 2010. The projections of the two models differed. The linear model projections decreased less directly with respect to a reduction in population and in some instances did not respond to a decline in population at all. Williford judged the linear model to be the most reliable. The projections revealed that per capita expenditures will increase over time while total expenditures decline. The model projected that smaller communities would be less capable of reducing expenditures in response to declining population. Williford attributed this to the fact that capital intensive services make up a greater proportion of the total expenditures of small communities.

Goodwin (8) analyzed expenditures in 80 Oklahoma communities with populations of 10,000 or less. General econometric models relating operation and maintenance costs to local economic and demographic characteristics and particular types of industrial development were estimated. Separate equations were estimated for expenditures on water and sewer, sanitation, street maintenance, police protection, fire protection, parks and recreation, general administration, and total expenditures. The independent variables included population, per capita income, manufacturing employment, and a dummy variable indicating whether the community was in western or eastern Oklahoma. The model for total expenditures also included a variable indicating if water or sewer services were operated by the municipality.

Population was the only variable which was significant in all of the models. Per capita income was significant in the water and sewer, street maintenance, parks and recreation, and general administration models. Manufacturing employment was found to have a significant influence only on expenditures for street maintenance. The location variable indicated that fire protection and street maintenance are less expensive in western Oklahoma. Goodwin also tested if different industry types were associated with different costs of providing community services. The results were inconclusive except with respect to food products manufacturing which appeared to increase community service costs by more than $500 for every new employee.

Shapiro, Morgan, and Jones (34) developed a simple three-equation model to test the hypothesis that industrial expansion substantially raises community service costs. Using cross-sectional data from 25 Texas panhandle counties, a simple economic base model for the county level was estimated. Total employment was stated as a linear function of basic employment, total county population was stated as a linear function of total employment in the county, and total county, municipal, and educational expenditures for the county were stated as a cubic function of total county population. Basic employment was identified by the assignment method to be employment in agriculture, mining, and manufacturing. Several of the counties studied had no employment listed for mining and manufacturing due to disclosure restrictions. Because employment reported for these two sectors was highly correlated, they were handled together as a single sector. An earlier study had shown "little difference in service quality, cost and consumer satisfaction among counties with varying populations and population densities" in the Texas panhandle. Consequently, it was decided that expenditure levels provided an accurate indication of the actual output of services without any adjustment for quality.

Average and marginal community service expenditure curves were derived from the parameters estimated by the model. Employment expansion in the mining/manufacturing sector was found to have a greater impact upon average community service expenditures than an equal expansion of agricultural employment. The model predicts greater declines in per capita expenditures for industrial expansion compared to agricultural expansion up to a county population of 57,000. The authors conclude that, contrary to their initial hypothesis, industrialization and the resulting increase in population lead to "rather sharp declines in average and marginal expenditures" for the Texas Panhandle.

Summary

This chapter has reviewed theory and research of economics, demographics, and public services at the community level. Some general conclusions can be gleaned from the review which have implications for modeling community service expenditures. Export base theory was examined as a tool for modeling a community's economy. Basic income levels were judged to serve as reliable predictors of total income in the short-run, especially for small areas with simple economies open to a great deal of interregional trade. This is characteristic of the communities in the sample. The section on demographics focused on migration. Migration can be treated as an investment decision by the potential migrant. Areas experiencing high income levels and rapid income growth can expect high levels of inmigration. Several regression studies of public service expenditures were reviewed. Population was consistently the most important determinant of public service expenditures followed by per capita income. These conclusions will provide the theoretical basis for the construction of the model in Chapter IV.

CHAPTER III

INSPECTION OF HISTORICAL DATA

Introduction

To formulate the model, data on personal income, population, general fund revenue, and public service expenditures for the sample communities have been collected. In this chapter, this data will be examined to identify any trends during the study period. This will be helpful in determining the magnitude and duration of the energy impact cycle and the agricultural crisis.

Income

Personal income levels for each of the counties in which the sample communities are located are presented in Table I. County personal income is reported annually by the Bureau of Economic Analysis (39) (40). The income figures, like all dollar amounts used in this study, are given in 1980 dollars. Per capita income and income from transfer payments are reported by place of residence while income from agriculture, mining, and manufacturing is reported by location of industry.

Per capita income varied in a uniform manner across counties during the study period. Most of the counties

TABLE I

PER CAPITA INCOME, MINING INCOME, FARM INCOME, MANUFACTURING INCOME, AND INCOME FROM TRANSFER PAYMENTS FOR SELECTED COUNTIES FROM 1975 TO 1984 IN 1980 DOLLARS

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	ave.
Per Capita Income											
Beckham	5891	6783	7367	7376	8074	7844	8851	8718	7094	6610	7461
Blaine	6811	6655	7102	7183	7867	7855	7800	8207	8031	8196	7571
Custer	7207	7264	7332	7703	8131	8358	8796	9377	8377	8018	8057
Dewey	7750	7817	8224	7565	8385	8644	9630	9771	8827	9304	8587
Ellis	7177	8331	8025	7574	8053	9200	9782	9925	10300	10264	8865
Harper	8352	9918	7839	11300	12995	11755	10732	11728	10104	10924	10572
Kingfisher	8010	7620	7353	7982	9270	9933	10296	10289	9182	9173	8914
Major	6948	6730	7579	7624	8573	8634	10293	9708	8761	8998	8382
Roger Mills	7199	7352	8248	7334	8134	7034	7741	7156	7211	6899	7352
Washita	5746	6060	6151	6658	7823	6946	6682	6695	6238	6186	6495
Woodward	7508	7848	8372	7591	8154	8670	9649	9600	8325	8249	8370
Average	7145	7489	7599	7808	8562	8625	9114	9198	8405	8442	8239
% change		4.81	1.47	2.75	9.66	0.74	5.67	9.22	-8.62	0.44	
Mining Income (thousands of dollars)											
Beckham	4121	d	9315	11311	d	d	d	58153	23687	17984	20762
Blaine	2040	3545	4826	5374	5966	7815	8481	10130	6102	4621	5890
Custer	2806	3710	4371	5968	d	12283	24127	42264	18581	16444	14506
Dewey	2807	3632	3646	2616	4587	6189	11213	11112	5831	3974	5561
Ellis	5099	6389	8239	8736	10147	d	d	d	d	18011	9437
Harper	1750	1945	1961	1760	2952	2769	2300	3006	1592	1538	2157
Kingfisher	11997	14115	18063	16690	24305	35605	54694	46579	26733	23089	27187
Major	4062	5671	8209	7462	11952	11949	14611	14575	8094	7559	9414
Roger Mills	d	2637	4854	4722	d	d	d	10377	4105	3259	4992
Washita	1021	968	2832	4947	8019	14017	21341	21430	8432	5695	8870
Woodward	16884	23468	31729	30012	40076	52796	79059	84626	42964	6975	40859
Average	5259	6608	8913	9054	13501	17928	26978	30225	14612	9923	13826
% change		25.65	34.88	1.58	44.15	32.79	50.48	12.04	-51.66	-32.09	
Farm Income (thousands of dollars)											
Beckham	3603	7758	4443	9481	15086	6096	1666	3960	1691	1192	5498
Blaine	12230	5590	4194	8164	13947	7661	4202	9060	5012	5819	7588
Custer	20757	15508	3895	16448	23797	13494	6266	12675	6662	7553	12706
Dewey	8077	5807	3897	4693	7977	3570	2956	3587	1476	2188	4423
Ellis	3509	8215	1078	2758	5514	1892	1853	2031	2081	3661	3259
Harper	9109	14499	1511	18821	22447	18980	14314	16784	7465	10912	13484
Kingfisher	22790	13015	378	13366	17801	12688	4632	13367	4920	5537	10849
Major	11715	5200	5736	9611	15526	10443	7019	10654	5585	6742	8823
Roger Mills	7979	6012	4290	2619	5843	1915	1868	1988	1363	1312	3519
Washita	14089	12450	8481	15557	27694	8844	1161	8125	3361	2461	10222
Woodward	12787	6610	5120	4316	7578	4179	1341	3089	2142	1581	4864
Average	11513	9151	3911	9621	14837	8160	4298	7756	3787	4451	7749
% change		-20.52	-57.26	146.00	54.21	-45.00	-47.33	80.46	-51.17	17.53	

TABLE I (Continued)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	ave.
Manufacturing Income (thousands of dollars)											
Beckham	2200	2195	3539	3745	4063	2914	3411	4499	3297	3719	3363
Blaine	7679	8754	9046	9849	10404	9784	9361	9264	9151	9613	9291
Custer	11628	16937	18158	19343	22102	20031	26142	25158	24228	32387	21611
Dewey	184	195	203	241	221	172	190	229	224	249	211
Ellis	1068	972	1080	1082	1270	1705	1971	2179	3076	1850	1624
Harper	118	97	92	103	116	84	288	231	117	114	136
Kingfisher	1828	1916	2310	2519	2923	3194	3507	3311	3061	2908	2748
Major	3428	4091	4393	5016	5664	4884	7105	5584	4880	5468	5051
Roger Mills	95	113	127	160	336	147	57	59	65	117	128
Washita	1834	2005	2069	2411	3286	3761	2902	2749	2542	2560	2612
Woodward	5616	6784	6374	6429	6293	5987	5362	4460	4124	5014	5644
Average	3243	4005	4313	4627	5152	4788	5481	5248	4978	5818	4765
% change		23.50	7.69	7.28	11.35	-7.07	14.47	-4.25	-5.14	16.87	
Transfer Payments (thousands of dollars)											
Beckham	22494	23143	23418	22962	23693	24616	25426	27518	30680	30223	25417
Blaine	14213	14634	15199	15537	15738	16374	16996	17814	19143	19360	16501
Custer	24599	25982	27426	27611	28309	29701	29635	31340	34012	33974	29259
Dewey	6600	6954	7356	7456	7717	8148	8696	9164	9697	9792	8158
Ellis	5913	6156	6335	6372	6645	7054	7657	8272	8787	8661	7185
Harper	5078	5258	5416	5348	5443	5807	6041	6401	6687	6982	5846
Kingfisher	12410	12973	13279	13699	14353	15631	15602	16659	17193	17773	14957
Major	7104	7676	8030	8058	8276	8608	8940	9552	10044	10454	8674
Roger Mills	4584	4788	5170	5085	5348	5456	5815	6184	6665	6696	5519
Washita	13847	14436	14655	14513	15006	15887	16043	17557	19092	18691	15973
Woodward	14574	15420	16355	16127	17231	17940	19044	21313	23385	22776	18417
Average	11947	12493	12967	12979	13433	14111	14481	15616	16853	16853	14173
% change		4.57	3.79	0.09	3.50	5.05	2.62	7.84	7.92	0.00	

d - data not available due to disclosure restrictions.

Source: U. S. Department of Commerce. Local Area Personal Income 1974-1979. Southwest Region. Washington: Bureau of Economic Analysis, U. S. Government Printing Office, 1981. Local Area Personal Income 1979-1984. Southwest Region. Washington: Bureau of Economic Analysis, U. S. Government Printing Office, 1986.

achieved their highest per capita income levels in 1981 or 1982. Two reached their highest levels in 1979, one did so in 1977, and another did in 1983. Although none of the counties reached their highest per capita income levels in 1984, seven of the eleven counties' 1984 per capita income was higher than their respective average per capita income levels for the entire study period. Average per capita income for all counties grew at a steady pace during the late 1970s, increased rapidly between 1978 and 1979 and again from 1980 to 1982. County per capita income fell after peaking in 1982. The per capita income data indicate a pre-impact period from 1975 to 1978, an impact period from 1979 to 1982, and a post-impact period beginning in 1983.

Mining income is assumed primarily to be income earned by petroleum extraction although income from other extractive industries in the area, such as gypsum extraction, is included in mining income. The pattern observed is similar to that seen in per capita income. The only county which did not show its highest level of mining income in 1981 or 1982 showed no mining income at all during these years due to disclosure laws. This county was one of the two counties whose 1984 mining income was higher than its average mining income over the ten years of the study period. Undoubtedly, this county's average was biased downwards due to the missing observations. Average county mining income grew rapidly until 1982 and then declined rapidly. The only difference between the pattern seen in per capita income and in mining income was that the changes in mining income were much more pronounced and somewhat more uniform across counties.

County farm income was generally higher from 1975 to 1979 than it was from 1980 to 1984. Average annual county farm income was $9,807,000 from 1975 to 1979. This fell to $5,690,000 from 1980 to 1984, a drop of almost 42%. All of the counties had their highest or second highest levels of farm income for the study period in 1979. The same was true for nine of the counties in the years of 1975 and 1976. Six counties reached their lowest farm income in 1976 or 1977, while the other five did so in the 1980s. Average county farm income varied greatly from one year to the next. The only discernible pattern was that all the average farm income levels of the 1970s, except for 1977, were higher than those of the 1980s.

Manufacturing income was lower than the other three basic sectors. Average manufacturing income was higher than average farm income and average mining income in only two counties. The manufacturing income levels of Custer county were unusually high for this area. The percent change in average county manufacturing income levels indicates less variation across time in the county manufacturing income levels than in those of farming or mining.

Income from transfer payments showed much less variation than the other three basic sectors. Transfer payments consist of income from payments to individuals by the Federal and state governments other than payments to farmers which are included in farm income. Transfer payment income grew steadily throughout the study period. 1981 through 1983 saw somewhat higher growth while no change occurred between 1983 and 1984. What was interesting about income from transfer payments is not so much its pattern of change as its share of total county income relative to the other basic sectors. All but two of the counties had a higher average level of transfer payments over the study period than farm income. Average annual income for all counties from transfer payments over this period was $14,173,000 while farm income was only $7,749,000. Average annual mining income was $13,826,000. While this was slightly less than that of transfer payments, there are several missing observations for mining income. It is safe to say that transfer payments account for a much greater share (nearly twice as much) of total county income than farming and at least as great a share as mining. While it remains to be seen if transfer payments play as great a role as agriculture and petroleum in driving the local economies of western Oklahoma, transfer payments certainly make up a significant proportion of total income for this area.

Population

Community population estimates made by the Oklahoma Employment Security Commission (21) are presented in Table II. Estimates are for July 1 of each year except 1980. The 1980 estimates are for April 1. Data in the table show that

TABLE II

POPULATION FOR SELECTED COMMUNITIES
FROM 1975 TO 1984

Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Arapaho	600	650	700	750	850	851	1000	1150	1200	1250
Arnett	750	750	750	750	750	714	800	850	900	850
Burns Flat	1400	1650	1850	2050	2200	2431	3000	3700	3600	3400
Cheyenne	800	800	750	750	900	1207	1500	1800	1800	1700
Cordell	3100	3100	3000	3000	3100	3301	3800	4200	4200	3900
Elk City	7800	7900	8200	8600	9100	9579	11400	13200	13900	13800
Erick	1150	1150	1150	1250	1300	1375	1550	1750	1850	1800
Fairview	3100	3000	3000	3200	3400	3370	3600	3700	3700	3500
Hennessey	2200	2200	2250	2250	2250	2287	2400	2600	2600	2600
Kingfisher	4100	4200	4300	4300	4200	4245	4600	5000	5100	5000
Laverne	1300	1350	1400	1450	1500	1563	1600	1650	1650	1550
Mooreland	1200	1250	1250	1250	1300	1383	1500	1550	1550	1400
Okeene	1350	1350	1350	1350	1500	1601	1650	1700	1700	1650
Sayre	2600	2600	2700	2700	3000	3177	3500	3900	4100	4100
Seiling	1050	1100	1100	1100	1100	1103	1150	1250	1250	1200
Shattuck	1450	1500	1500	1600	1700	1759	1900	2050	2050	1950
Taloga	300	300	350	400	450	446	500	550	550	550
Thomas	1450	1450	1450	1450	1500	1515	1700	1900	2000	2100
Watonga	3800	4000	4200	4200	4200	4139	4300	4600	4600	4300
Woodward	10900	11700	12400	13000	13300	13610	15200	16300	16300	15100
Total	50400	52000	53650	55400	57600	59656	66650	73400	74600	71700
% change		3.17	3.17	3.26	3.97	3.57	11.72	10.13	1.63	-3.89

Source: Oklahoma Employment and Security Commission. Unpublished Population Estimates. Oklahoma City: State of Oklahoma, 1985.

community population grew steadily until 1982. All twenty communities grew in population from 1981 to 1982. After 1982 it is hard to generalize across communities. Some continued to grow on into 1984, while others reached their highest population for the study period in 1982 or 1983. The greatest increase in total population occurred between 1980 and 1981 while the only decrease occurred between 1983 and 1984. This suggests that the impact of the oil boom upon population occurred during fiscal years 1981, 1982, and 1983. This impact was one to one-and-a-half years behind the impact period suggested by the income data.

Volume of Sales

Community sales volume (Table III) is computed by dividing the community's sales tax receipts by the corresponding sales tax rate. Both the tax rate and tax receipts are reported by the Oklahoma Tax Commission (23). Community sales volume is an indicator of the general level of economic activity within a community. Sales volume for almost all of the communities increased until reaching a peak in fiscal year 1982 and declined thereafter. In only one community, Cheyenne, was 1983 sales volume greater than 1982. Only Taloga experienced a decline in sales volume from 1981 to 1982. All twenty communities had greater sales volume in 1982 than in 1984. The change in community sales volume follows more nearly the pattern seen in per capita income than that observed for population.

TABLE III

VOLUME OF SALES FOR SELECTED COMMUNITIES FROM FISCAL 1975 TO 1984 IN THOUSANDS OF 1980 DOLLARS

	FY75	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83	FY84
Arapaho	357	436	590	634	629	677	945	1277	1006	953
Arnett	2158	2218	2144	2072	2375	2244	2418	2940	2889	2311
Burns Flat	855	1505	1635	1032	2830	3172	4378	6234	5591	3143
Cheyenne	n.a.	n.a.	3622	4248	4691	4380	5062	6381	6688	4130
Cordell	14602	15658	16060	16865	17093	16967	18325	21662	21127	17351
Elk City	42989	43247	49597	59326	65788	72124	89983	148500	130811	85858
Erick	4739	4318	4528	4557	4749	4323	4508	5222	5156	4359
Fairview	14205	15553	16562	16986	17626	20574	23292	27952	23217	20713
Hennessey	10714	11148	12068	17174	19645	19312	26001	33407	21518	16801
Kingfisher	19812	23336	25132	27506	27495	29410	32604	39685	35369	34450
Laverne	5778	5585	5419	5496	5158	5821	6198	6405	5628	5938
Mooreland	3614	3620	3853	3782	4176	3959	3603	4090	4082	3268
Okeene	5294	5411	5447	5327	5579	5821	6061	6028	5194	5217
Sayre	12460	12341	13452	14531	15654	16546	17030	21498	20291	15775
Seiling	5188	5201	5092	5273	5218	5465	5772	6773	6748	5974
Shattuck	7294	7342	7146	7016	6877	7284	7651	8350	7333	6672
Taloga	634	806	872	898	977	1401	1159	1555	1464	1312
Thomas	4766	4769	4832	4895	4649	4284	4593	5790	5178	4466
Watonga	18700	20035	19775	20341	21804	22394	23649	26143	24762	21733
Woodward	72887	79857	89210	97768	103815	113660	133780	168300	129672	109063

n.a.- data not available

Source: Oklahoma Tax Commission. City Sales Tax Payments Ended June 30, 19 . Oklahoma City: State of Oklahoma, 1975-1984.

Community Revenues and Expenditures

General fund revenues and community expenditures are taken from reports filed by the communities with the State Board of Equalization (23). While the data in Table IV reports general revenue in 1980 dollars, these figures have not been adjusted to reflect differences in tax rates between communities or across time. General fund revenues followed the same general pattern found in per capita income and community sales volume. Revenue increased slowly up to fiscal year 1980 and then rose sharply between 1980 and 1982. All but one of the study communities took in greater revenue in 1982 than in 1980. Some communities nearly doubled their revenue from 1980 to 1982. Most of the communities had lower revenue in 1983 than the year before, although five communities actually had higher revenues in 1983. Seven communities had higher revenue in 1984 than 1983 or 1982, but, in general, 1982 was the peak revenue year for most of the communities.

Community service expenditures are reported in three categories. These are personal services, operation and maintenance, and capital outlay. Personal services and operation and maintenance expenditures were summed and are presented in Table V as current community service expenditures. These grew steadily in the late 1970s and increased rapidly in the early 1980s. However, there is no obvious peak year. Of the 14 communities with observations

TABLE IV

GENERAL FUND REVENUES FOR SELECTED COMMUNITIES FROM FISCAL 1975 TO 1984 IN 1980 DOLLARS

	FY75	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83	FY84
Arapaho	n.a.	9975	13535	23442	n.a.	23629	n.a.	42054	41822	50284
Arnett	n.a.	115333	n.a.	120457	n.a.	126369	n.a.	156647	138468	121257
Burns Flat	n.a.	34237	38126	86994	n.a.	141064	n.a.	297510	275186	207849
Cheyenne	n.a.	86726	119151	138733	n.a.	160162	n.a.	225594	222781	202414
Cordell	n.a.	347660	320445	358379	n.a.	376831	n.a.	603180	571571	550278
Elk City	1619527	1587933	1353596	1506417	n.a.	1828353	n.a.	3479087	2289095	1601313
Erick	194535	215976	230641	251127	n.a.	342452	n.a.	293104	239945	176565
Fairview	n.a.	429201	434652	n.a.	429993	504415	n.a.	539556	473072	n.a.
Hennessey	393961	395202	411907	430063	n.a.	650648	n.a.	1113673	n.a.	n.a.
Kingfisher	527603	610005	622167	766026	n.a.	868171	n.a.	1030777	1176231	1235390
Laverne	n.a.	157277	162468	163748	n.a.	164242	n.a.	179044	162016	168902
Mooreland	n.a.	90742	95042	92362	n.a.	97765	n.a.	108244	121651	126677
Okeene	n.a.	88575	87440	100347	n.a.	90748	n.a.	152153	138935	138572
Sayre	240679	246270	335254	397503	n.a.	410600	n.a.	532006	533943	404734
Seiling	n.a.	132999	n.a.	165013	n.a.	n.a.	n.a.	207638	220686	223744
Shattuck	n.a.	297919	n.a.	239538	n.a.	302591	n.a.	391482	338372	337381
Taloga	n.a.	52102	n.a.	71151	n.a.	84712	n.a.	114457	114353	97188
Thomas	n.a.	80684	78085	87082	n.a.	111115	n.a.	156522	136386	165949
Watonga	n.a.	640279	503014	737377	n.a.	806203	n.a.	1007669	1111078	1045841
Woodward	n.a.	2604757	2835490	3364310	n.a.	3431740	n.a.	6831098	5498353	4004388

n.a.- data not available.

Source: Oklahoma State Board of Equalization. Estimate of Needs and Financial Statement for Fiscal Year. Oklahoma City: State of Oklahoma, 1985.

TABLE V

TOTAL AND PER CAPITA COMMUNITY SERVICE EXPENDITURES
FOR SELECTED COMMUNITIES FROM FISCAL 1975
TO 1984 IN 1980 DOLLARS

	FY75	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83	FY84
Arapaho	n.a.	1757	1606	3395	n.a.	12110	n.a.	19784	22270	21055
per capita		2.93	2.47	4.85		14.25		19.78	18.56	17.55
Arnett	n.a.	61062	n.a.	66498	n.a.	56592	n.a.	55640	77850	51597
per capita		54.75		88.66		75.46		69.55	86.50	57.33
Burns Flat	n.a.	24528	27562	48554	n.a.	73574	n.a.	162170	188177	n.a.
per capita		17.52	16.70	26.25		33.44		54.06	52.27	
Cheyenne	n.a.	38471	n.a.	124587	n.a.	115223	n.a.	n.a.	n.a.	n.a.
per capita		48.09		166.12		128.03				
Cordell	n.a.	221594	173466	188487	n.a.	199036	n.a.	210460	431185	353986
per capita		71.48	55.96	62.83		64.21		55.38	102.66	84.28
Elk City	964969	789674	936275	728834	n.a.	1203778	n.a.	1384872	1945539	1176100
per capita	125.32	101.24	118.62	88.88		132.28		121.48	139.97	84.61
Erick	129432	147304	110954	148905	n.a.	152625	n.a.	169881	135743	119199
per capita	107.86	128.09	96.48	129.48		117.40		109.60	73.38	64.43
Fairview	n.a.	n.a.	315208	n.a.	330573	315618	n.a.	402632	367523	n.a.
per capita			105.07		103.30	92.83		111.84	99.33	
Hennessey	249106	245101	246847	258222	n.a.	331777	n.a.	645429	n.a.	n.a.
per capita	115.86	111.41	112.20	114.77		147.46		268.93		
Kingfisher	383167	393554	430183	481826	n.a.	669172	n.a.	656308	690965	742958
per capita	95.79	95.99	102.43	112.05		159.33		142.68	135.48	145.68
Laverne	n.a.	95707	104481	113195	n.a.	102082	n.a.	n.a.	98774	98829
per capita		73.62	77.39	80.85		68.05			59.86	59.90
Mooreland	n.a.	85543	69707	96004	n.a.	85089	n.a.	88207	88018	100942
per capita		71.29	55.77	76.80		65.45		58.80	56.79	65.12
Okeene	n.a.	70240	42580	59379	n.a.	73057	n.a.	80854	79540	119406
per capita		52.03	31.54	43.98		48.70		49.00	46.79	70.24
Sayre	112924	129574	153613	209792	n.a.	335621	n.a.	239876	405064	253605
per capita	43.43	49.84	59.08	77.70		111.87		68.54	98.80	61.86
Seiling	n.a.	58243	n.a.	50679	n.a.	43448	n.a.	54387	57345	98699
per capita		55.47		46.07		39.50		47.29	45.88	78.96

TABLE V (Continued)

	FY75	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83	FY84
Shattuck	n.a.	180986	n.a.	161255	n.a.	142863	n.a.	n.a.	224464	208214
per capita		124.82		107.50		84.04			109.50	101.57
Taloga	n.a.	22471	n.a.	26242	n.a.	31688	n.a.	39757	58368	63102
per capita		74.90		74.98		70.42		79.51	106.12	114.73
Thomas	n.a.	34491	32401	29774	n.a.	43415	n.a.	99375	93823	106679
per capita		23.79	22.35	20.63		28.94		58.46	46.91	53.34
Watonga	n.a.	n.a.	360238	363184	n.a.	514492	n.a.	483402	567027	556169
per capita			90.06	86.47		122.50		112.42	123.27	120.91
Woodward	n.a.	1222271	n.a.	n.a.	n.a.	1895318	n.a.	2357809	2741235	2914808
per capita		112.14				142.51		115.12	168.17	178.82

n.a.- data not available.

Source: Oklahoma State Board of Equalization. Estimate of Needs and Financial Statement for Fiscal Year. Oklahoma City: State of Oklahoma, 1985.

for each year from 1982 to 1984, one reached its highest expenditure level in 1982, six did so in 1983, and seven did so in 1984. This more closely resembles the pattern found in population than in income, sales volume, or revenue. It is more difficult to find a pattern in per capita expenditures. They varied greatly both across communities and across time for particular communities. Per capita expenditures were higher in the 1980s than in the 1970s.

Total and per capita expenditures for administration, fire protection, police protection, solid waste disposal, street maintenance, and parks are reported in Table VI. Expenditures on management, town clerk, treasurer, attorney, and municipal court were grouped together as administrative expenditures. Total administrative expenditures were higher in the last three years of the study period. Per capita administrative expenditures show no systematic pattern. Both total and per capita expenditures on fire protection increased over time. The same was true of police expenditures, solid waste disposal expenditures, and, to a lesser degree, expenditures on street maintenance. The highest average per capita expenditure on street maintenance occurred in 1980 rather than later in the study period as was the case with the other services. Park expenditures were the most difficult to reach general conclusions about. Only half of the ten communities reporting park expenditures reached their highest spending levels in one of the last three years of the study period.

TABLE VI

TOTAL AND PER CAPITA EXPENDITURES OF SELECTED COMMUNITIES FOR ADMINISTRATION, FIRE PROTECTION, POLICE, SOLID WASTE DISPOSAL, STREETS, AND PARKS FROM FISCAL 1975 TO 1984 IN 1980 DOLLARS

	FY75	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83	FY84
Administration										
Cordell	n.a.	17282	16873	17086	n.a.	17044	n.a.	17808	20843	19748
p. cap.		5.57	5.44	5.70		5.50		4.69	4.96	4.70
Elk City	94408	93573	96895	116937	n.a.	132836	n.a.	284577	156355	153490
p. cap.	12.26	12.00	12.27	14.26		14.60		24.96	11.25	11.04
Erick	14113	16491	16406	21836	n.a.	21114	n.a.	14408	16841	21329
p. cap.	11.76	14.34	14.27	18.99		16.24		9.30	9.10	11.53
Fairview	n.a.	18871	19364	n.a.	19827	22109	n.a.	25080	24798	n.a.
p. cap.		6.09	6.45		6.20	6.50		6.97	6.70	
Hennessey	28319	27784	28811	31573	n.a.	45910	n.a.	55626	n.a.	n.a.
p. cap.	13.17	12.63	13.10	14.03		20.40		23.18		
Kingfisher	27248	26268	27804	22739	n.a.	21234	n.a.	22726	13899	14785
p. cap.	6.81	6.41	6.62	5.29		5.06		4.94	2.73	2.90
Mooreland	n.a.	8603	7834	7947	n.a.	7569	n.a.	8071	8001	8404
p. cap.		7.17	6.27	6.36		5.82		5.38	5.16	5.42
Sayre	13843	13559	14013	20637	n.a.	34162	n.a.	61691	78107	68211
p. cap.	5.32	5.22	5.39	7.64		11.39		17.63	19.05	16.64
Watonga	n.a.	n.a.	31643	32684	n.a.	38721	n.a.	n.a.	46827	53765
p. cap.			7.91	7.78		9.22			10.18	11.69
Woodward	n.a.	116173	120898	n.a.	n.a.	134135	n.a.	136466	162836	180584
p. cap.		10.71	10.33			10.09		8.98	9.99	11.08
Fire Protection										
Cordell	n.a.	28330	28593	28091	n.a.	28711	n.a.	28739	35563	44848
p. cap.		9.14	9.22	9.36		9.26		7.56	8.47	10.68
Elk City	88110	99069	107191	110885	n.a.	125345	n.a.	154415	278151	223249
p. cap.	11.44	12.70	13.57	13.52		13.77		13.55	20.01	16.06
Erick	4188	2729	1918	2621	n.a.	2464	n.a.	2099	3237	2556
p. cap.	3.49	2.37	1.67	2.28		1.90		1.35	1.75	1.38
Fairview	n.a.	6994	14683	n.a.	9887	10930	n.a.	6229	4431	n.a.
p. cap.		2.26	4.89		3.09	3.21		1.73	1.20	
Hennessey	1686	2795	4105	1961	n.a.	5496	n.a.	12091	n.a.	n.a.
p. cap.	0.78	1.27	1.87	0.87		2.44		5.04		
Kingfisher	77274	84119	81395	94472	n.a.	147607	n.a.	138880	160313	188907
p. cap.	19.32	20.52	19.38	21.97		35.14		30.19	31.40	37.04
Mooreland	n.a.	692	655	983	n.a.	1566	n.a.	2128	2025	1953
p. cap.		0.58	0.52	0.79		1.20		1.42	1.31	1.26
Sayre	9850	12383	9954	11572	n.a.	15503	n.a.	21366	13620	14282
p. cap.	3.79	4.76	3.83	4.29		5.17		6.10	3.32	3.48
Watonga	n.a.	n.a.	43799	42787	n.a.	45020	n.a.	72287	53483	59474
p. cap.			10.95	10.19		10.72		16.81	11.63	12.93

TABLE VI (Continued)

	FY75	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83	FY84
Fire Protection (Cont'd)										
Woodward	n.a.	139511	n.a.	n.a.	n.a.	232131	n.a.	298216	347680	374354
p. cap.		12.80				17.45		19.62	21.33	22.97
Police										
Cordell	n.a.	41496	41614	43771	n.a.	47789	n.a.	60750	69420	81420
p. cap.		13.39	13.42	14.59		15.42		15.99	16.53	19.34
Elk City	139048	151768	165484	163596	n.a.	241859	n.a.	322391	588776	416839
p. cap.	18.06	19.46	20.95	19.95		26.58		28.28	42.36	29.99
Erick	25667	24446	20407	20501	n.a.	24604	n.a.	34793	39671	33193
p. cap.	21.39	21.26	17.75	17.83		18.93		22.45	21.44	17.94
Fairview	n.a.	62744	71333	n.a.	n.a.	116871	n.a.	137319	141746	n.a.
p. cap.		20.24	23.78			34.37		38.14	38.31	
Hennessey	44331	49709	51119	53868	n.a.	76639	n.a.	129324	n.a.	n.a.
p. cap.	20.62	22.60	23.24	23.94		34.06		53.89		
Kingfisher	88403	85612	100165	103993	n.a.	127791	n.a.	145780	153196	150670
p. cap.	22.10	20.88	23.85	24.18		30.43		31.69	30.04	29.54
Mooreland	n.a.	38676	39670	39203	n.a.	49397	n.a.	52342	51914	59228
p. cap.		32.23	31.74	31.36		38.00		34.89	33.49	38.21
Sayre	53925	58462	70633	61752	n.a.	76020	n.a.	105625	120165	107120
p. cap.	20.74	22.49	27.17	22.87		25.34		30.18	29.31	26.13
Watonga	n.a.	n.a.	89599	93908	n.a.	118241	n.a.	125073	142755	150547
p. cap.			22.40	22.36		28.75		29.09	31.03	32.73
Woodward	n.a.	184164	n.a.	n.a.	n.a.	379382	n.a.	489166	569186	581401
p. cap.		16.90				28.53		32.18	34.92	35.67
Solid Waste Disposal										
Cordell	n.a.	40542	41599	45286	n.a.	55490	n.a.	80592	207476	107899
p. cap.		13.08	13.42	15.10		17.90		21.21	49.40	25.69
Elk City	96903	102471	86200	60781	n.a.	55216	n.a.	n.a.	n.a.	n.a.
p. cap.	12.58	13.14	10.91	7.41		6.07				
Erick	16290	28806	26287	22083	n.a.	27444	n.a.	42329	34558	19054
p. cap.	13.58	25.05	22.86	19.20		21.11		27.31	18.68	10.30
Fairview	n.a.	116433	112738	n.a.	125375	77457	n.a.	107745	108223	n.a.
p. cap.		37.56	37.58		39.18	22.78		29.93	29.25	
Hennessey	65469	43757	45910	46607	n.a.	58529	n.a.	105627	n.a.	n.a.
p. cap.	30.45	19.89	20.87	20.71		26.01		44.01		
Kingfisher	51448	50323	53377	60967	n.a.	78956	n.a.	115286	122282	97740
p. cap.	12.86	12.27	12.71	14.18		18.80		25.06	23.98	19.16
Watonga	n.a.	n.a.	30456	32213	n.a.	32568	n.a.	36915	39583	40862
p. cap.			7.61	7.67		7.75		8.58	8.61	8.88
Woodward	n.a.	87150	n.a.	n.a.	n.a.	127030	n.a.	144767	155422	160669
p. cap.		8.00				9.55		9.52	9.54	9.86
Streets										
Cordell	n.a.	51424	12690	11881	n.a.	8971	n.a.	9805	31877	12431
p. cap.		16.59	4.09	3.96		2.89		2.58	7.59	2.96
Elk City	166896	123649	149692	94123	n.a.	275400	n.a.	196641	415762	169395
p. cap.	21.67	15.85	18.95	11.48		30.26		17.25	29.91	12.19

TABLE VI (Continued)

	FY75	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83	FY84
Streets (Continued)										
Erick	16290	28806	26287	22083	n.a.	27444	n.a.	42329	34558	19054
p. cap.	13.58	25.05	22.86	19.20		21.11		27.31	18.68	10.30
Fairview	n.a.	58182	61881	n.a.	53773	65508	n.a.	97567	88220	n.a.
p. cap.		18.77	20.63		16.80	19.27		27.10	23.84	
Hennessey	45283	54605	43132	50843	n.a.	34341	n.a.	109866	n.a.	n.a.
p. cap.	21.06	24.82	19.61	22.60		15.26		45.78		
Kingfisher	45219	53019	67002	77083	n.a.	122201	n.a.	98129	121611	120727
p. cap.	11.30	12.93	15.95	17.93		29.10		21.33	23.85	23.67
Mooreland	n.a.	12586	13313	13940	n.a.	14656	n.a.	15021	15687	17639
p. cap.		10.49	10.65	11.15		11.27		10.01	10.12	11.38
Sayre	19035	25593	42369	39895	n.a.	103326	n.a.	21319	63576	49370
p. cap.	7.32	9.84	16.30	14.78		34.44		6.09	15.51	12.04
Watonga	n.a.	n.a.	93252	80742	n.a.	111227	n.a.	86931	149736	128387
p. cap.			23.31	19.22		26.48		20.22	32.55	27.91
Woodward	n.a.	n.a.	n.a.	n.a.	n.a.	154038	n.a.	194944	224552	230671
p. cap.						11.58		12.83	13.78	14.15
Parks										
Cordell	n.a.	5061	4634	4071	n.a.	3338	n.a.	4856	9511	7853
p. cap.		1.63	1.49	1.36		1.08		1.28	2.26	1.87
Elk City	32579	13585	32416	20796	n.a.	86161	n.a.	58091	144048	57143
p. cap.	4.23	1.74	4.10	2.54		9.47		5.10	10.36	4.11
Erick	8280	7526	4864	29649	n.a.	8609	n.a.	11879	12754	14331
p. cap.	6.90	6.54	4.23	25.78		6.62		7.66	6.89	7.75
Fairview	n.a.	n.a.	16576	n.a.	39806	28074	n.a.	22416	28526	n.a.
p. cap.			5.53		12.44	8.26		6.23	7.71	
Hennessey	5549	6680	9929	7626	n.a.	3053	n.a.	28213	n.a.	n.a.
p. cap.	2.58	3.04	4.51	3.39		1.36		11.76		
Kingfisher	48295	47947	48424	72761	n.a.	80584	n.a.	62036	63379	71306
p. cap.	12.07	11.69	11.53	16.92		19.19		13.49	13.98	12.43
Mooreland	n.a.	1660	1573	1474	n.a.	1044	n.a.	887	844	814
p. cap.		1.33	1.26	1.18		0.80		0.59	0.54	0.53
Sayre	2246	6082	3779	10249	n.a.	20477	n.a.	18005	21415	4741
p. cap.	0.86	2.34	1.45	3.80		6.83		5.14	5.22	1.16
Watonga	n.a.	n.a.	17863	21547	n.a.	49389	n.a.	27964	27888	34677
p. cap.			4.47	5.13		11.76		6.50	6.06	7.54
Woodward	n.a.	73997	158188	134231	n.a.	123293	n.a.	200482	188631	160669
p. cap.		6.79	13.52	10.83		9.27		13.19	11.57	9.86

n.a.- data not available.

Source: Oklahoma State Board of Equalization. Estimate of Needs and Financial Statement for Fiscal Year. Oklahoma City: State of Oklahoma, 1985.

Table VII lists the average population and average per capita expenditures for the sample communities over the study period. These figures should give some indication of the long-run relationship between expenditures and population for the sample communities. Per capita total expenditures show a positive relationship with population. Seven of the ten larger communities spent an average of at least $100 per capita while only two of the ten smaller communities did so. If the twenty communities were providing the same quantity and quality of service, a negative relationship between population and per capita expenditures would be expected due to economies of scale. The fact that per capita expenditures actually rise with population indicates that public service output is greater in the larger communities of the sample. This could be attributed to larger communities providing a larger variety of services, producing a greater output of particular services, or a combination of both. Of the services examined, per capita expenditures on administration, police expenditures, and street maintenance appear to bear no relationship to population. Park expenditures show a slight tendency to be higher in larger communities. Only fire protection expenditures clearly rise with population. This could be due to a greater amount of volunteer fire protection in smaller communities. Solid waste disposal expenditures actually decline as community size increases. A reasonable conclusion is that each of the communities provide a comparable level of service and the declining per capita

TABLE VII

AVERAGE POPULATION AND AVERAGE PER CAPITA EXPENDITURES IN 1980 DOLLARS FOR SELECTED COMMUNITIES FROM FISCAL 1975 TO 1984

community	pop.	total	admin.	fire	park	police	s.w.d.	street
Taloga	429	86.78	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Arnett	800	72.04	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Arapaho	886	11.48	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Seiling	1143	52.19	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Cheyenne	1193	114.08	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Mooreland	1371	64.29	5.94	1.01	0.90	34.28	n.a.	10.73
Erick	1400	103.34	13.19	2.02	9.05	19.87	19.76	12.93
Laverne	1493	69.95	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Okeene	1514	48.90	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Thomas	1650	36.33	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Shattuck	1736	105.48	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Hennessey	2331	145.10	16.09	2.05	4.44	29.72	26.91	24.85
Burns Flat	2471	33.37	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sayre	3150	71.39	11.03	4.34	3.35	25.53	n.a.	14.54
Fairview	3338	102.47	6.48	2.73	8.03	30.97	32.71	21.07
Cordell	3500	70.97	5.22	9.10	1.57	15.52	22.26	5.81
Watonga	4243	109.27	9.36	12.20	6.91	27.63	8.19	24.95
Kingfisher	4450	123.68	5.09	26.87	13.91	26.59	17.38	19.51
Elk City	9988	114.08	14.08	14.33	5.21	25.70	10.02	19.70
Woodward	13729	151.35	10.20	18.83	10.72	29.64	9.29	13.84

n.a.- data not available.
s.w.d.- solid waste disposal.

Source: Oklahoma State Board of Equalization. Estimate of Needs and Financial Statement for Fiscal Year. Oklahoma City: State of Oklahoma, 1985. and Oklahoma Employment and Security Commission. Unpublished Population Estimates. Oklahoma City: State of Oklahoma, 1985.

solid waste disposal expenditures associated with increasing population are a result of economies of scale.

CHAPTER IV

THE MODEL

Introduction

The influence of changes in basic income upon community service expenditures during the energy impact cycle and agricultural crisis will be examined more closely by a model composed of separate equations for income, population, community revenues, and community expenditures. These equations will be estimated using regression analysis on data pooled across the sample communities and throughout the ten years of the study period. Much of the data were reported in chapter III. Before proceeding with the equations, the standard regression model will be briefly reviewed.

Methods

Regression analysis is a statistical technique whereby changes in one variable are explained by changes in other variables (19). Regression analysis estimates a statistical relation between a dependent variable and an independent variable or set of independent variables. A multiple regression model could be stated as follows:

$$Y = a + b_1X_1 + b_2X_2 + \ldots + b_nX_n + e$$

In the above equation, Y is the dependent variable, the X_i ($i = 1,2, \ldots ,n$) are the independent variables, the b_i are the coefficients, a is the intercept, and e is the error or disturbance term. The estimating procedure of least squares chooses the intercept and the coefficients such that the sum of the squared residuals is minimized. Each coefficient is equal to the covariance between its dependent variable and the independent variable divided by the variance of the dependent variable. A coefficient measures the rate of change in the expected value of the dependent variable with respect to one independent variable when all other independent variables are held constant. The classical linear regression model has five assumptions:

1) the dependent variable can be calculated as a linear function of a specific set of independent variables, plus a disturbance term,

2) the expected value of the disturbance term is zero,

3) the disturbance terms have constant variance and are not correlated with one another,

4) the observations on the independent variables can be considered fixed in repeated samples,

5) the number of observations are greater than the number of independent variables and no linear relationship exists among the independent variables (10).

The capability of a model to account for the variation in the dependent variable can be measured by the coefficient of multiple determination, R^2. This is the ratio of variation explained by the independent variables to the total variation. Since the procedure of least squares minimizes the sum of squared residuals (the unexplained variation) it automatically maximizes R^2.

Once the equations comprising the model have been estimated according to the relationships hypothesized, they will be reformulated without those variables whose coefficients were either not statistically significant or not of the hypothesized sign. Expenditure equations without the lagged capital expenditures variable will be estimated to take advantage of the greater number of observations this allows to be included in the analysis. The study by Shapiro, Morgan, and Jones (34) found an equation using a cubed population term to be the best predictor of county service expenditures. Consequently, equations employing a cubed population term as well as those other variables found to be significant will be estimated for all expenditure categories.

Those equations judged to be the most statistically sound will be evaluated using a Chow test to see if the relationship between the dependent variable and the independent variables remains stable over time. A simple discussion of the Chow test appears in Kennedy (10) while a more rigorous definition can be found in an article by

Chow (1). A Chow test involves computing a F-statistic to test whether a linear relationship remains stable from one period to another. One must estimate three equations, one for the first time period, one for the second, and one over both time periods. The error sums of square (SSE) of the two unconstrained regressions are summed and then subtracted from the SSE of the constrained regression (i.e., the regression run over both time periods). This figure is divided by the number of parameters used in the regression (P). The result is divided by the sum of the SSEs of the two unconstrained regressions divided by the total number of observations in both periods (N) less twice the number of parameters in the equation. This gives one an F-statistic with which to test whether the sets of coefficients of the two unconstrained equations are significantly different. The F-statistic can be stated as:

$$\frac{[SSE(constrained) - SSE(unconstrained)]/P}{SSE(unconstrained)/(N - 2P)}$$

If the results of the Chow test indicate a significant difference between the model's coefficients from one time period to another, indicator variables will be used to arrive at a form of the model which can be applied to the entire study period. These final equations will be used to examine what impact different levels of basic income would have had upon expenditures for communities of various sizes over the study period.

Income

County per capita income is an important independent variable in the population, revenue, and expenditure models. Finding a reliable relationship between county per capita income and income in basic sectors is the first step in modeling the impact of changes in basic sectors such as agriculture and petroleum upon community service expenditures. Although community specific income data would be ideal, data limitations force the assumption that county per capita income is equal to community per capita income for all communities within that county. The model for county per capita income is constructed as an export base model. Basic income for communities in this area is assumed to be that from agriculture, mining, manufacturing, and transfer payments. The equation is hypothesized to take the following form:

$$PCY = a + bFY + cMY + dTP + eMFY \quad (1)$$

where

PCY - county per capita income,

FY - county per capita farm income,

MY - county per capita mining income,

TP - county per capita income from transfer payments,

MFY - county per capita manufacturing income.

$H0: b,c,d,e > 1.$

There are two reasons why a per capita income model is preferred to a model estimating total income. First, it provides a direct estimate of per capita income without having to construct a separate model for county population. The other reason is that total county income is highly correlated with county population which in turn is highly correlated with transfer payments. This association between population and transfer payments is likely to result in an unduly large coefficient for transfer payments in a total income model.

Population

The population of a community in any one year will depend upon the community's population in the previous year, fertility and mortality rates, and migration. A simple population model could be stated as:

$$P = a + bLP + cLPSQ + dPCY + ePN + fCTY \qquad (2)$$

where

P - community population,

LP - community population in the previous year,

LPSQ - community population in the previous year squared,

PCY - county per capita income,

PN - population of the nearest larger community divided by the distance between the two communities,

CTY - change in total community income.

H0: b,c,d,f > 0; e < 0.

The coefficient for lagged community population (LP) could be interpreted as one plus the difference between the birth rate and the death rate. This equals the rate of natural population change. The other variables are hypothesized to affect population by their influence upon migration. While variables such as per capita income may influence fertility and death rates, it is assumed that these effects are negligible.

Per capita income serves as an indicator of how much a migrant could expect to earn if he could find a job in the community. The change in total income (CTY) is an indication of the likelihood that a prospective inmigrant could in fact find a job in the community. In computing CTY, total community income is calculated by multiplying county per capita income by community population. These estimates of total community income are then used to compute CTY. A high rate of growth in income should reflect a growing local economy and therefore increasing local employment opportunities. The higher the rate of income growth, the less risky inmigration is, thus increasing a prospective migrants expected utility of moving into the community. The longer a community has been experiencing sustained growth the lower the risk associated with inmigration. Also, by then potential inmigrants will more likely have heard of job opportunities in the community. Conversely, migrants will probably not move away immediately at the outset of an economic downturn, but will be increasingly liable to move away the longer an economic downturn is sustained. This indicates that the change in total income for the previous two or three years may be more appropriate than simply using the amount of income change from the most recent year.

Previous research suggests that larger communities have more draw with respect to migration than smaller communities in the same area (17). The previous year's population may affect current population not only via the rate of natural population change, but also by influencing migration. If communities with larger populations are more attractive to migrants than smaller communities, then a squared term of the previous year's population (LPSQ) should be positively related to current population. If a community is close to a larger community, this larger community may attract migrants which would normally have settled in the smaller community. If however the nearest larger community is very far away, a small, isolated community would experience more inmigration than if it were located close to a larger, more developed community. Therefore a variable accounting for the size of the nearest larger community adjusted by the distance between it and the community in question may help explain migration. The variable included in the model (PN) is hypothesized to have a negative affect upon migration into a community.

During an economic downturn, recent inmigrants should be more likely to leave than longtime residents.

Communities which attracted large amounts of migrants during an impact period should experience a correspondingly large amount of outmigration if the local economy begins to decline. The implication is that LPSQ and PN may have coefficients with the opposite sign as hypothesized during the post impact period.

General Fund Revenues

Over the long-run, community revenues and community expenditures must be equal, but in the short-run substantial differences may occur. Community general fund revenues come from several sources. For most communities in the sample, the source of greatest importance is sales tax receipts. The next three most important sources are usually the alcohol and beverage tax, franchise taxes, and,for communities which operate their own utilities, municipal utility receipts. Other sources of revenue may include occupation taxes, dog taxes, the sale and/or rental of municipal property, licenses and permits, fines, transfers from public works authorities, oil and gas royalties, and revenue exogenous to the community such as gifts, donations, and revenue sharing.

The revenue provided by some of these sources, such as the alcohol and beverage tax, could be stated as a simple function of community population. Such is the case of municipally operated utilities, depending on the similarity of rate structures from one community to the next and whether the community does in fact operate its own utilities. Some revenue sources depend upon the total economic activity of the community and the willingness of the community to pay for services (i.e., tax themselves). Sales tax receipts and franchise tax revenues belong to this category. The revenue equation is stated as:

$$REV = a + bTYTR + cPCPCY + dW + eS + fSW \tag{3}$$

where

REV - total community general fund revenues,

TYTR - total community income multiplied by the sales tax rate,

PCPCY- percent change in per capita income from the previous calendar year to the current calendar year,

W - an indicator variable for the presence of a municipal water utility,

S - an indicator variable for the presence of a municipal sewerage utility,

SW - an indicator variable for the presence of a municipal solid waste disposal utility.

$H0: b,c,d,e,f > 0$.

Total income is an indicator of the economic resources available to the community. The sales tax rate guages a community's willingness to pay for services and directly affects sales tax revenue. Total income multiplied by the tax rate (TYTR) measures both the community's ability and willingness to pay for community services. The rate of change in per capita income (PCPCY) is a reflection of local economic activity which could affect several revenue sources, most notably sales tax receipts.

The indicator variables (W) (S) (G) account for the presence of municipal utilities. Municipally operated utilities may be a source of substantial revenue. These variables will be tested in two forms. In one case they will be "zero" if no such utility is operated by the municipality or "one" if it is. In the other case the community's population will be used rather than "one" if a community operates a utility. This is because utility revenue is a function of population.

Community Service Expenditures

The model for expenditures will estimate current expenditures for several different types of services as well as total service expenditures. Data from all twenty of the sample communities are used to estimate the equation for total expenditures while only half of the sample communities reported data for specific services. These services are administration, fire protection, police protection, parks, and street maintenance. The general form of the function for all services is:

$$CX = a + bP + cPSQ + dPCP + ePCY + fPCPCY + gPN + hTR + iLK \qquad (4)$$

where

CX - current community service expenditures,

P - community population on the first day of the fiscal year,

PSQ - community population squared,

PCP - percent change in community population, PCY - per capita income,

PCPCY- percent change in per capita income,

PN - population of the nearest larger community divided by the distance between the two communities,

TR - community sales tax rate,

LK - capital expenditures in the previous fiscal year.

H0: $b,d,e,f,h > 0$; $c,g,i < 0$.

Observed levels of community service expenditures are assumed to represent an equilibrium between supply and demand. The equation uses variables assumed to affect both supply and demand and attempts to estimate an equilibrium level of current expenditures without explicitly deriving separate supply and demand functions. Nevertheless, some of the independent variables are assumed to affect the cost of providing services and thus influence supply while other variables influence a community's ability and willingness to pay for services and thus influence demand.

The most obvious variable affecting cost is community population (P). The more people a community has, the more that community will have to spend to provide a given per capita level of service. The rate of population change (PCP) should also increase costs. High rates of inmigration may be accompanied by higher crime rates and other phenomena associated with higher per capita service needs. Another variable affecting cost is the proximity of a large neighboring community (PN). Small communities may rely upon a large neighbor to provide some services. For example, residents of a small community may commute to a larger one in order to enjoy better recreational facilities. Such a community would be able to spend less on parks than a similar community in a more isolated setting. PN should be negatively related to expenditures.

It is likely that all of the study communities are in the declining cost portion of the long-run average cost curve. Evidence presented in Chapter III indicated scale economies in solid waste disposal. If these communities do have the potential of decreasing costs with an increase in size then, in the long-run, total expenditures should increase at a decreasing rate as population increases. A variable of population squared (PSQ) should bear a negative relation to expenditures. However, an increase in population from one year to the next may not necessarily lead to the immediate attainment of long-run economies of scale. Indeed, short-run diseconomies may be experienced as the community moves past the least cost point of its short-run average cost curve. For example, per capita police expenditures would fall if population increased and total police expenditures remained constant. Therefore a drop in per capita expenditures could be attributed to economies of scale when in fact it is due to a drop in per capita output of the service. Conversely, the achievement of economies of scale could be misinterpreted as a drop in output. Unfortunately, the data at hand do not allow a distinction between these two possible causes of changes in per capita expenditures.

Capital expenditures are assumed to enhance the quality of community service facilities and thus lower operating expenditures. It is hoped that capital expenditures from the previous year (LK) will help explain some scale economies. Although capital expenditures may influence current expenditures for several years to come, the effects of capital expenditures can only be examined upon current expenditures for the following year due to gaps in the data. These gaps also significantly decrease the number of observations available for regression. Lagged capital expenditures should lower current expenditures by moving the community further down its long-run cost curve. The coefficient of LK should therefore be negative.

Per capita income (PCY) is expected to be positively related to expenditures. Its influence, however, is not felt by determining costs but by affecting demand. The more affluent a community the more money it can spend on community services. Per capita income is an indication of the budget constraint faced by the community. The local sales tax rate (TR) is a reflection of preference. The higher the tax rate the more willing a community may be to spend money on community services.

Another variable which may affect demand is the rate of change of per capita income (PCPCY). Residents may be more willing to spend money for local services during a period of increasing affluence due to the greater confidence in the community's future. Such feelings would be reinforced if the community is experiencing long-term income growth. PCPCY will be tested not only for the year at hand but for a moving average of both the previous two years and the previous three years.

CHAPTER V

EMPIRICAL RESULTS

In Chapter IV, the theoretical considerations of Chapter II and the data discussed in Chapter III were combined to construct models to estimate county per capita income, community population, community general fund revenue, and current community service expenditures. Several hypotheses were discussed regarding the determinants of these dependent variables. The Statistical Analysis System (SAS) was used to estimate the model and test the hypotheses developed in the previous chapter. Following the discussion of these results is an example of an application of the model.

Estimation of the Model

The figures given in parentheses below the coefficients estimated by the regression models are the significance levels of the coefficients. They give the probability of finding a t-statistic for the variable with a greater absolute value. Thus the lower the figure the greater the significance of the variable.

Per Capita Income

Four regression equations for per capita income are listed in Table VIII. Use of the Chow test suggested separate

TABLE VIII

ESTIMATED EQUATIONS FOR PER CAPITA INCOME

Y	INT	FY	TP	MY	MFY	DV	N	R^2
PCY	2626	1.16	1.04	3.11	1.21		54	.73
79-84	(.0160)	(.0001)	(.0002)	(.0001)	(.0059)			
PCY	4317	1.13	1.02	1.20	0.82		41	.64
75-78	(.0003)	(.0001)	(.1750)	(.0001)	(.1150)			
PCY	2381	1.21	2.81	1.26	1.34		96	.70
75-84	(.0020)	(.0001)	(.0001)	(.0001)	(.0001)			
PCY	3076	1.17	2.15	1.03	1.04	698	96	.75
75-84	(.0001)	(.0001)	(.0001)	(.0001)	(.0017)	(.0001)		

Explanation of symbols:

Y - dependent variable,
INT- intercept,
FY - county per capita farm income,
TP - county per capita transfer payments,
MY - county per capita mining income,
MFY- county per capita manufacturing income,
DV - dummy variable indicating impact and post impact periods,
N - number of observations,
R^2 - R-square,
PCY- Per capita income.
Figures in parentheses are the significance levels of the coefficient listed above.

equations for 1975 through 1978 and for 1979 through 1984. The first time period corresponds to the pre-impact period identified in Chapter III while the second period corresponds to the impact and post-impact phases of the energy impact cycle. The equation for pre-impact (75-78) has a high intercept (4317) and low coefficients. In fact the coefficient for manufacturing income is less than one, nonsensically indicating that an additional dollar of per capita income in this sector adds less than a dollar to county per capita income. Three of the variables' coefficients reach their lowest levels in the pre-impact model, while the coefficient for mining income reaches its next-to-lowest value. The low coefficients combined with the high intercept and low R^2 suggest that the variables do a poor job of explaining changes in per capita income in the pre-impact period. The equation for the later time period (79-84) has a much lower intercept (2626) and a very high coefficient for per capita mining income.

Two equations span the entire study period. One simply uses the same variables as the first two equations. This however does not satisfy the requirements of the Chow test. The other rectifies this by using an indicator variable which adds 698 to the intercept during the impact and post-impact periods. The coefficient for mining income is quite low in this equation, suggesting that the indicator variable serves as a proxy for the effects of higher mining income from 1979 to 1984. Although this is a poor substitute for a coefficient which accurately models the effects of mining income, the indicator variable is necessary to reach a form of the equation which is valid for the entire study period.

The coefficient for farm income is fairly consistent across the four equations. The coefficient for transfer payments is low in the two equations modeling separate time periods and high in the two equations modeling the entire study period. Based on these conflicting results, the role of transfer payments in the local economies of this area is difficult to determine. Given the lack of variation observed in transfer payments, it could be that this variable serves primarily the role of part of the intercept. If so, the validity of the coefficient for transfer payments is doubtful for even small changes.

Population

Community Population (P) was found to depend on population in the previous year (LP), the change in total community income over the previous two years (CTY), and an indicator variable which added .10014 to the growth rate for the year of 1981 (D81).

$$P = \underset{(.9260)}{-1.52} + \underset{(.0001)}{1.0188(LP)} + \underset{(.0001)}{.0000248(CTY)} + \underset{(.0001)}{.10014(D81)}.$$

No other variables, including the intercept, were found significant. The inclusion of the indicator variable was necessary because of a non-random distribution of the residuals. This was identified by a visual inspection of the residuals plotted against time. Even with the indicator variable, the Chow test indicated great year-to-year instability in the model. No solution could be found to this problem. Despite the high R^2 (.997), obviously some important determinant of population change was not identified.

General Fund Revenues

The function estimated for general fund revenues is:

$$\underset{(.8456)}{\text{Revenue} = -7070} + \underset{(.0001)}{0.60(\text{TYTR})} + \underset{(.0001)}{61.58(\text{W})} + \underset{(.0001)}{77.87(\text{SW})}.$$

Total community income multiplied by the local sales tax rate (TYTR) and the presence of a municipally operated water (W) and/or solid waste (SW) utility were found to significantly influence general fund revenues. The percent change in per capita income (PCPCY), the presence of a municipally operated sewerage facility (S), and the intercept were not significant. The high R^2 (.970) indicates a good fit.

Community Service Expenditures

The functions estimated for community service expenditures are reported in Table IX. Three equations are presented for total current expenditures. The R^2 values ranged from .93 to .96. In the first equation a squared population (PSQ) term was used. The positive sign of PSQ's coefficient indicates that total current expenditures rise with population at an increasing rate. This does not lend support to the notion mentioned earlier that communities of this size are in a decreasing portion of their long-run

TABLE IX

ESTIMATED EQUATIONS FOR COMMUNITY SERVICE EXPENDITURES

Y	INT	P	PSQ	PCB	PCY	LK	TR	N	R^2
TC	-362733	170.59	.0077		33.03	-3.03		63	.93
	(.0708)	(.0001)	(.0005)		(.1322)	(.0001)			
TC	-511975	285.67	-.017	.0000011	36.26	-2.51		63	.93
	(.0264)	(.0029)	(.3548)	(.1813)	(.0988)	(.0001)			
TC	-305222	162.37	-.0109	.0000007	24.64			127	.96
	(.0001)	(.0001)	(.0033)	(.0001)	(.0005)				
AD	-11678	13.77						66	.82
	(.0067)	(.0001)							
FR	-81166	24.03			6.11	-.99		39	.90
	(.0044)	(.0001)			(.0949)	(.0605)			
FR	-84277	21.74			6.85			69	.88
	(.0002)	(.0001)			(.0150)				
FR	-90460	36.18	-.0026	.0000001	5.56	-.67		39	.91
	(.0121)	(.0121)	(.2528)	(.2091)	(.1292)	(.2363)			
FR	-98467	40.64	-.0037	.0000002	5.71			69	.90
	(.0002)	(.0001)	(.0062)	(.0024)	(.0299)				
PK	-36028		.00098		6.52	-1.11		40	.82
	(.1796)		(.0001)		(.0699)	(.0004)			
PK	-75307	31.17	-.0045	.0000002	5.96	-.58		40	.86
	(.0162)	(.0087)	(.0146)	(.0028)	(.0666)	(.0666)			
PK	-81776	30.88	-.0047	.0000003	6.72			70	.84
	(.0011)	(.0004)	(.0002)	(.0001)	(.0097)				
PL	-44308	15.12	.0013		9.29	-.24		39	.98
	(.0655)	(.0009)	(.0001)		(.0018)	(.1597)			
PL	-64362	12.33	.0014		12.80			68	.96
	(.0048)	(.0014)	(.0001)		(.0001)				
PL	-90054	51.41	-.005	.0000003	8.59	.099		39	.99
	(.0002)	(.0001)	(.0012)	(.0001)	(.0004)	(.5179)			

TABLE IX (Continued)

Y	INT	P	PSQ	PCB	PCY	LK	TR	N	R^2
PL	-111251	49.56	-.0048	.0000003	11.76			68	.97
	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)				
SW	-65849	11.58			12.80			51	.75
	(.0143)	(.0001)			(.0004)				
SW	-78071	33.95	-.0039	.0000002	10.30			51	.79
	(.0088)	(.0017)	(.0129)	(.0082)	(.0029)				
ST	-168886	46.03	-.00167		9.89	-.34	26457	39	.86
	(.0002)	(.0001)	(.0002)		(.0369)	(.0662)	(.0321)		
ST	-130251	34.65	-.00099		10.42		16604	69	.81
	(.0003)	(.0001)	(.0038)		(.0067)		(.1137)		
ST	-185440	58.41	-0036	.0000001	9.92	-.26	27566	39	.86
	(.0007)	(.0036)	(.2720)	(.5504)	(.0384)	(.2747)	(.0293)		
ST	-168245	62.08	-.0055	-.0000002	9.41		19417	69	.83
	(.0001)	(.0001)	(.0030)	(.0125)	(.0109)		(.0563)		

Explanation of symbols:

Y - dependent variable,
INT- intercept,
P - community population,
PSQ- community population squared,
PCB- community population cubed,
PCY- county per capita income,
LK - lagged capital expenditures,
TR - sales tax rate,
N - number of observations,
R^2 - R-square,
TC - total current community service expenditures,
AD - current administrative expenditures,
FR - current fire protection expenditures,
PK - current park expenditures,
PL - current police expenditures,
SW - current solid waste disposal expenditures,
ST - current street expenditures.

average cost curve. The relationship of this variable (PSQ) to economies of scale is not clear because of the problems in comparing per unit service output between communities. The significance level of the per capita income variable (.1322) was marginal. Capital expenditures of $100 were estimated to decrease current expenditures in the following year by $303.

The second equation used a cubic form of population. The significance level of per capita income (.0988) was somewhat better than in the first equation, while the significance levels of the squared population term (.3548) and the cubed population term (.1813) were poor. The third equation used the same variables as the second except for the lagged capital expenditures variable. Consequently, the number of observations used to estimate this equation (127) was much greater than that used to estimate the first two equations (63). The significance levels of all the variables were better than the previous equations and the R^2 (.96) was the highest of the three.

Only one equation for administrative expenditures is presented. In no cases were the sales tax rate, lagged capital expenditures, per capita income, or any of the polynomial forms of the population variable significant. The equation indicates that annual administrative expenditures increase by $13.77 for each additional resident in a community. The R^2 of .82 was somewhat low but acceptable.

Four equations are given for fire protection expenditures. The variable for lagged capital expenditures was significant when used with a linear form of the population variable. The second equation resembled the first equation for fire expenditures in the values of the coefficients. The most notable difference was the change in the significance level of the per capita income variable from .0949 to .0150 when the lagged capital expenditure variable was dropped. In the third and fourth fire protection expenditure equations a cubic form of the population variable was used. In the third equation the significance levels of population squared, population cubed, per capita income, and lagged capital expenditures were all unsatisfactory. When the lagged capital expenditures variable was dropped the values of the coefficients changed very little, yet the significance levels improved dramatically. The R^2 values for the fire protection equations ranged from .88 to .91.

A linear form of population was not found significant in explaining annual park expenditures. The first equation listed for park expenditures had three significant variables: population squared, per capita income, and lagged capital expenditures. The second equation used a cubic form of population. The absolute value of the lagged capital expenditures variable was about half of that in the first park expenditure equation. The last equation was similar to the second except for the absence of lagged capital expenditures, the greater number of observations, and the improved significance levels of the remaining variables. The R^2 values for the three equations were .82, .86, and .84.

The four equations presented for police expenditures had the highest R^2 values for any of the service categories. These ranged from .96 to .99. Unlike most of the other equations, lagged capital expenditures did not assert itself in any of the police expenditure equations. In the first police equation the value of the lagged capital expenditures variable's coefficient was small and its significance level was poor. In the third equation, lagged capital expenditures was clearly not significant. The second equation reported for police expenditures implied that police expenditures increase with population at an increasing rate. Perhaps larger communities in the sample provided a greater quantity or better quality of police protection. The analysis at the end of Chapter III however provided no support for a positive long-run relationship between community size and police protection output. An alternative explanation for the positive coefficient of population squared is that the energy impact was associated with both rising population and rising crime rates. The coefficient may, therefore, reflect a short-run affect of the energy impact. This was supported by the generally higher per capita police expenditures reported for the impact and post-impact periods. These were given in Table VI of Chapter III.

The lagged capital expenditures variable was not significant in any form of the solid waste disposal expenditures function. The R^2 values for the solid waste disposal equations (.75 and .79) were the lowest for any of the service categories studied. The first equation had a linear form of the population variable. Solid waste disposal expenditures were estimated to increase by $11.58 for each new resident and by $12.80 for each one dollar increase in per capita income. The value of the per capita income variable fell to 10.30 in the equation using a cubic population term. The significance levels of all the variables in both of the solid waste disposal expenditure functions were satisfactory.

The four equations for street expenditures had the distinction of being the only functions in which the sales tax rate was significant. The significance level of the sales tax rate was worse and the value of its coefficient was less when the lagged capital expenditure variable was not present. The first two equations used a quadratic form of population. The coefficient of the population squared variable was negative. This is consistent with the last portion of Chapter III which presented support of long-run economies of size in solid waste disposal. The last two equations used a cubic form of population. Population squared and population cubed were significant only when the lagged capital expenditures variable was not used.

Simulation Results

To estimate the influence of both the oil boom and declining farm income upon community revenues and expenditures, a simulation analysis was performed using these equations. Simulation analysis is a numerical technique for conducting experiments which involves certain types of mathematical and logical models that describe the behavior of an economic system over time. In this case the models used are those estimated by the regression analysis, the economic unit is a community, the time period is the last half of the study period, and the experiment consists of determining what affect different levels of farm and mining income would have had upon community revenues and expenditures. To demonstrate the use of the model upon communities of varying sizes, three of the sample communities, Fairview, Kingfisher, and Mooreland, were chosen to be used in the simulation. Estimates were made for three different situations: 1) a baseline assuming no change in basic income levels, 2) a scenario assuming no energy impact, and 3) a scenario assuming no drop in farm income during the 1980s. By comparing scenarios 2 and 3 to the baseline, an estimate is obtained of the impact of the area's two major economic events of the past decade, the energy impact and the farm crisis, upon community revenues and expenditures.

To compute per capita income assuming no energy impact, the peak observed in mining income during the early 1980s was leveled off. The difference between county mining income for 1984 and for 1978 was divided by the number of years between the observations (6) and the result was added to the 1978 figure successively to reach adjusted levels of mining income for each year from 1979 to 1984. Because the dummy variable was judged to serve as a proxy for higher mining income in the 1980s, its coefficient was dropped from the equation for the no-energy-impact scenario. Consequently, the intercept used to estimate per capita income assuming no-energy-impact was less by 698 than that used to estimate the baseline and the no-decline-in-farm-income scenario.

To estimate per capita income assuming no-decline-in-farm-income during the 1980s, average farm income from 1980 to 1984 was set at the same level as 1975 to 1979. Rather than using the same figure for each year during the 1980s, the observed farm income levels from 1975 to 1979 were substituted for the 1980 to 1984 figures. This was done to retain the great year-to-year variability characteristic of farm income. To model conditions during the 1980s somewhat more closely, the pre-1980 farm income figures were placed in years during the 1980s to insure that the level of farm income from one year to the next would follow the same pattern observed during the 1980s. The highest level of farm income from 1975 to 1979 replaced the highest level of farm income during the 1980s, the second highest level of farm income from 1975 to 1979 replaced the second highest level during the 1980s, and so on.

The simulation results are reported in Table X. For each of the three communities, there are five rows of figures. The first row (a) gives the baseline estimates, the second row (b) gives the estimates assuming no energy impact cycle, and the third row (c) gives the percent difference between the baseline and the no-energy-impact-cycle estimates. The figures in the third row indicate the magnitude of the affect of the energy impact cycle upon the sample community. The fourth row (d) lists the estimates assuming no decline in farming income and the last row (e) gives the percent difference between the fourth row estimates and the baseline. This gives an indication of the impact of the agricultural crisis upon the sample community. The first six columns report results for the last six years of the study period. This period coincides with the drop in farm income and the impact and post-impact periods of the energy impact cycle. The final column reports the annual average of the estimates over these six years.

<u>Per Capita Income</u>

The results of the simulation for per capita income show a large drop in income assuming no oil boom and a moderate rise assuming no decline in farm income. The largest difference between the baseline and the no-oil-boom scenario occurred in 1981 and 1982. The estimates of the average annual impact of the oil boom upon per capita

TABLE X

SIMULATION ESTIMATES FOR SAMPLE COMMUNITIES
FROM 1979 TO 1984

Year	1979	1980	1981	1982	1983	1984	Average
Per Capita Income							
Fairview							
a)	9859	9241	9195	9323	8057	8437	9019
b)	8640	8014	7691	7862	7283	7718	7868
c)	-14.11	-15.31	-19.55	-18.57	-10.62	-9.32	-14.58
d)	9859	9893	9610	9688	8107	8407	9261
e)	0.00	6.59	4.32	3.78	0.62	-0.37	2.49
Kingfisher							
a)	9391	10008	10460	10164	8225	8160	9401
b)	8218	8092	7339	7827	7233	7462	7695
c)	-14.27	-23.68	-42.51	-29.86	-13.72	-9.35	-22.23
d)	9391	10841	10123	10486	8799	8722	9727
e)	0.00	7.68	-3.32	3.07	6.52	6.44	3.40
Mooreland							
a)	8656	8689	9455	9424	7944	6535	8450
b)	7212	6509	6021	5843	5883	5837	6217
c)	-20.02	-33.49	-57.04	-61.29	-35.03	-11.96	-36.47
d)	8656	9165	9607	9634	8159	6715	8656
e)	0.00	5.19	1.59	2.18	2.64	2.69	2.38
Population							
Fairview							
a)	3337	3449	4005	4186	4104	4107	3865
b)	3342	3404	3386	3435	3464	3515	3424
c)	0.16	-1.35	-18.29	-21.85	-18.49	-16.86	-12.78
d)	3439	3662	4074	4128	4050	3996	3892
e)	2.97	5.81	1.68	-1.40	-1.32	-2.78	0.83
Kingfisher							
a)	4656	4999	5719	5875	5822	5769	5473
b)	4544	4671	4655	4711	4785	4830	4699
c)	-2.47	-7.02	-22.85	-24.73	-21.66	-19.43	-16.36
d)	4669	5076	5770	5878	5794	5648	5473
e)	0.28	1.52	0.89	0.05	-0.48	-2.14	0.02
Mooreland							
a)	1289	1353	1562	1626	1602	1577	1501
b)	1260	1255	1240	1241	1258	1280	1256
c)	-2.32	-7.83	-26.04	-31.05	-27.29	-23.15	-19.61
d)	1305	1385	1581	1628	1598	1511	1501
e)	1.19	2.34	1.18	0.09	-0.22	-4.35	0.04

TABLE X (Continued)

Year	FY80	FY81	FY82	FY83	FY84	FY85	Average
General Fund Revenues							
Fairview							
a)	1057296	1021798	1163573	1361317	1384799	1443811	1238766
b)	958472	915180	937085	1068627	1150737	1230235	1043389
c)	-10.31	-11.65	-24.17	-27.39	-20.34	-17.36	-18.54
d)	1071273	1104670	1212973	1390869	1379621	1426500	1264318
e)	1.30	7.50	4.07	2.12	-.038	-1.21	2.24
Kingfisher							
a)	1275366	1598855	1958530	1971660	1814732	1798074	1736203
b)	1144556	1308539	1307702	1394636	1433924	1477298	1344443
c)	-11.43	-22.19	-49.77	-41.37	-26.56	-21.71	-28.84
d)	1277332	1672037	1921083	2020559	1903617	1856554	1775197
e)	0.15	4.38	-1.95	2.42	4.67	3.15	2.14
Mooreland							
a)	659857	669073	752393	757141	665533	580858	680809
b)	546090	491780	453296	439756	461866	486857	479941
c)	-20.83	-36.05	-65.98	-72.17	-44.10	-19.31	-43.07
d)	661519	709633	766793	774402	683266	589074	697448
e)	0.25	5.72	1.88	2.23	2.60	1.39	2.34
Total Current Expenditures							
Fairview							
a)	384166	381548	441767	464526	424468	431939	421402
b)	354695	346260	336275	345998	334984	351408	344937
c)	-8.31	-10.19	-31.37	-34.26	-26.71	-22.92	-22.29
d)	395653	421345	459484	467253	419847	421371	430826
e)	2.90	9.45	3.86	0.58	-1.10	-2.51	2.20
Kingfisher							
a)	516527	568119	655536	664868	611436	607063	603925
b)	475693	486115	465859	483839	477062	487479	479341
c)	-8.58	-16.87	-40.72	-37.42	-28.17	-24.53	-26.05
d)	517910	587924	652661	673122	622594	605164	609896
e)	0.27	3.37	-0.44	1.23	1.79	-.031	0.98
Mooreland							
a)	100745	110342	157445	165190	125539	87496	124459
b)	61163	43150	29049	24802	28140	30045	36058
c)	-64.72	-155.72	-442.00	-566.04	-346.12	-191.22	-294.30
d)	102947	126437	163722	170629	130305	83106	129525
e)	2.14	12.73	3.83	3.19	3.66	-5.28	3.38
Administration							
Fairview							
a)	34272	35815	43471	45963	44834	44875	41538
b)	34341	35195	34947	35622	36021	36724	35475
c)	0.20	-1.76	-24.39	-29.03	-24.47	-22.20	-16.94
d)	35677	38748	44421	45165	44091	43347	41908
e)	3.94	7.57	2.14	-1.77	-1.69	-3.53	1.11

TABLE X (Continued)

Year	FY80	FY81	FY82	FY83	FY84	FY85	Average
Administration (cont'd.)							
Kingfisher							
a)	52435	57158	67073	69221	68491	68133	63752
b)	50893	52642	52421	53192	54211	54831	53032
c)	-3.03	-8.58	-27.95	-30.13	-26.34	-24.26	-20.05
d)	52614	58219	67775	69262	68105	66095	63678
e)	0.34	1.82	1.04	0.06	-0.57	-3.08	-0.07
Mooreland							
a)	6072	6953	9831	10712	10382	10037	8998
b)	5672	5603	5397	5411	5645	5948	5613
c)	-7.04	-24.08	-82.16	-97.98	-83.92	-68.76	-60.66
d)	6292	7393	10092	10740	10326	9128	8995
e)	3.50	5.96	2.59	0.26	-0.53	-9.96	0.30
Fire Protection							
Fairview							
a)	55804	54005	65777	70589	60134	62186	61416
b)	47562	44622	42018	44255	40919	45007	44064
c)	-17.33	-21.03	-56.55	-59.51	-46.96	-38.17	-39.92
d)	58021	63102	70120	71829	59303	60184	63760
e)	3.82	14.42	6.19	1.73	-1.40	-3.33	3.57
Kingfisher							
a)	81273	92956	111705	113069	98635	97624	99210
b)	70803	72701	67195	71755	69295	71842	70598
c)	-14.79	-27.86	-66.24	-57.58	-42.34	-35.89	-40.78
d)	81555	97870	110505	115340	101958	98256	100914
e)	0.35	5.02	-1.09	1.97	3.26	0.64	1.69
Mooreland							
a)	3039	4657	14448	15627	4967	-5228	6252
b)	-7482	-12407	-16076	-17273	-16630	-16466	-14389
c)	-140.62	-137.54	-189.87	-190.47	-129.87	-68.25	-142.77
d)	3387	8613	15902	17109	6353	-5430	7656
e)	10.27	45.93	9.15	8.66	21.81	-3.72	16.59
Parks							
Fairview							
a)	46334	43228	47573	49787	40674	42645	45040
b)	38190	34567	32228	33832	30207	33591	33769
c)	-21.33	-25.06	-47.61	-47.16	-34.65	-26.95	-33.79
d)	47289	49492	50886	51813	40604	42208	47049
e)	2.02	12.66	6.51	3.91	-0.17	-1.04	3.98
Kingfisher							
a)	53501	59871	67511	66556	53172	52562	58862
b)	44870	44871	39705	43354	39846	41677	42387
c)	-19.24	-33.43	-70.03	-53.52	-33.44	-26.12	-39.30
d)	53587	63540	65582	68740	56843	55368	60610
e)	0.16	5.77	-2.94	3.18	6.46	5.07	2.95

TABLE X (Continued)

Year	FY80	FY81	FY82	FY83	FY84	FY85	Average
Parks (cont'd.)							
Mooreland							
a)	9030	10534	19672	20628	10249	325	11740
b)	-1264	-6091	-9678	-10854	-10236	-10096	-8037
c)	-814.30	-272.95	-303.26	-290.05	-200.12	-103.22	-330.65
d)	9353	14363	21042	22075	11621	313	13128
e)	3.46	26.66	6.51	6.56	11.81	-3.90	8.51
Police Protection							
Fairview							
a)	127770	123565	137650	143742	126785	130271	131630
b)	113572	107910	103619	106968	100946	107440	106742
c)	-12.50	-14.51	-32.84	-34.38	-25.60	-21.25	-23.51
d)	130561	136943	144288	146573	126002	128153	135420
e)	2.14	9.77	4.60	1.93	-0.62	-1.65	2.69
Kingfisher							
a)	156163	171719	194314	194601	170516	169124	176073
b)	139630	141252	132007	139109	133919	137702	137270
c)	-11.84	-21.57	-47.20	-39.89	-27.33	-22.82	-28.44
d)	156480	179133	191581	198461	176590	172166	179068
e)	0.20	4.14	-1.43	1.94	3.44	1.77	1.68
Mooreland							
a)	47094	49942	66785	68759	50480	32996	52676
b)	28987	20526	14202	12148	13281	13594	17123
c)	-62.46	-143.32	-370.25	-466.03	-280.11	-142.73	-244.15
d)	47712	56760	69269	71301	52863	32679	55097
e)	1.30	12.01	3.59	3.57	4.51	-0.97	4.00
Solid Waste Disposal							
Fairview							
a)	98989	92375	98225	101959	84805	88552	94151
b)	83443	76149	71806	74562	67487	73645	74515
c)	-18.63	-21.31	-36.79	-36.74	-25.66	-20.24	-26.56
d)	100170	103187	104336	105960	84820	88034	97751
e)	1.18	10.48	5.86	3.78	0.02	-0.59	3.45
Kingfisher							
a)	108272	120142	134265	132283	106850	105717	117921
b)	91961	91819	81995	88890	82144	85596	87067
c)	-17.74	-30.85	-63.75	-48.82	-30.08	-23.51	-35.79
d)	108423	127088	130542	136439	113873	111196	121260
e)	0.14	5.47	-2.85	3.05	6.17	4.93	2.82
Mooreland							
a)	59874	61038	73263	73607	54385	36061	59705
b)	41055	31999	25579	23312	24021	23687	28276
c)	-45.84	-90.75	-186.42	-215.75	-126.41	-52.24	-119.57
d)	60060	67501	75429	76318	57091	37600	62333
e)	0.31	9.58	2.87	3.55	4.74	4.09	4.19

TABLE X (Continued)

Year	FY80	FY81	FY82	FY83	FY84	FY85	Average
Streets							
Fairview							
a)	93687	95755	121663	142810	129044	132146	119184
b)	81125	81716	89072	107231	103598	109546	95381
c)	-15.48	-17.18	-36.59	-33.18	-24.56	-20.63	-24.60
d)	96537	108430	127826	145081	128130	129815	122636
e)	2.95	11.69	4.82	1.57	-0.71	-1.80	3.09
Kingfisher							
a)	140680	163038	186019	194868	173441	172162	171701
b)	125597	134848	127558	142383	138062	141579	135004
c)	-12.01	-20.90	-45.83	-36.86	-25.63	-21.60	-27.14
d)	141011	169867	183695	198292	178774	174567	174367
e)	0.23	4.02	-1.27	1.73	2.98	1.38	1.51
Mooreland							
a)	36171	38566	53186	61553	55306	39837	47437
b)	20193	12707	7140	11992	22885	23113	16338
c)	-79.13	-203.49	-644.94	-413.29	-141.67	-72.36	-259.15
d)	36685	44548	55369	63804	57420	39627	49576
e)	1.40	13.43	3.94	3.53	3.68	-0.53	4.24

Explanation of symbols:

a)- baseline,

b)- estimates assuming no energy impact,

c)- percent difference between baseline and estimates assuming no energy impact,

d)- estimates assuming no drop in farm income,

c)- percent difference between baseline and estimates assuming no drop in farm income.

income ranged from 14.58% for Fairview to 36.47% for Mooreland. The average annual drop in per capita income due to the decline in farm income ranged from 2.38% for Mooreland to 3.40% for Kingfisher.

Population

Population was estimated using the results of the simulation for per capita income. The dummy variable which raises the growth rate by .10014 in 1981 was judged to be primarily a result of the oil boom. While it was used to estimate the baseline and the no-decline-in-farm-income scenario, it was dropped from the equation when estimating population under the assumption of no oil boom. The results indicate that the oil boom had a very large affect upon population. The average difference between the baseline estimates and the no-oil-boom scenario ranged from 12.78% to 19.61%. The largest differences occurred after 1980. The drop in farm income was estimated to have had a very slight impact upon community population. The average decline was less than 1% for all three communities. This is probably because the farming sector relies on the labor of longtime residents and proprietors who are less likely to leave a community than the highly mobile labor force of the petroleum industry. As the crisis in agriculture persists it will be interesting to observe the long-term affect upon population in this area.

Revenues and Expenditures

These estimates for per capita income and population were used to estimate levels of general fund revenues and service expenditures for these three communities. The results are similar to those for per capita income and population; large increases in revenue and expenditures due to the oil boom and small to moderate declines due to the drop in farm income. In both the per capita income and population simulations, Fairview showed the least change due to the oil boom while Mooreland showed the most. This persists in the revenue and expenditure results. The changes estimated for Mooreland are, however, so large as to warrant further inspection. In the case of fire protection and park expenditures, the estimates for Mooreland assuming no oil boom are negative. The increases in Mooreland's expenditures attributed to the oil boom range from 60.66% in the case of administrative expenditures to 330.65% for park expenditures. Mooreland also shows surprisingly large changes relative to those estimated for the other two communities due to the change in farm income. This is probably a result of the very large negative intercepts found in the expenditure equations and Mooreland's small population. The conclusion is that the model, while its coefficients were estimated using data which included observations from very small communities, is unreliable when used to estimate expenditures for very small communities. The following discussion of the estimates of revenues and expenditures will be limited to Kingfisher and Fairview.

Like the estimates of per capita income and population, the changes in revenue and expenditures attributed to the oil boom are greater for Kingfisher than Fairview. General fund revenue estimates for the energy impact were over 18% higher than those for the baseline in the case of Fairview and over 28% higher in the case of Kingfisher. The increase in total expenditures for both communities was estimated to be about 25%. Of the six expenditure categories, only administrative expenditures were estimated to have increased at a rate less than that of expenditures as a whole. The increases in police protection and street maintenance were only slightly greater than those of total expenditures while those for fire protection, parks, and solid waste disposal show greater increases than those for total expenditures. Regarding the change in farm income, the average drop in revenue and expenditures is in every case greater for Fairview than for Kingfisher. Once again, the rate of change in administrative expenditures is less than the rate of change for total expenditures while the rate of change for the other five expenditure categories is greater.

It is not clear whether these differences in the rates of change in the funding of different services are a reflection of the characteristics of the services involved, of community preferences to shift larger shares of increasing (decreasing) revenues to (away from) certain services during a period of growth (decline), or of some anomaly in the model itself. It could be theorized that the demand for fire protection and solid waste disposal rise at a greater rate than that for other services during an energy impact and that communities experiencing an unexpected rise in revenue may be more liable to allocate this windfall to "luxury" services such as parks. Yet the fact that these three services fall at as fast a rate due to the drop in farm income as they rise due to the energy impact indicates these differences in rates of change in the funding of particular services cannot be attributed to a community's proclivity to favor certain services during a period of increasing revenue. Such an interpretation would lead to the inconsistent conclusion that communities slight these same services during a period of decreasing revenue.

Summary

Equations for county per capita income, community population, general fund revenues, and community service expenditures were estimated by regression analysis. A Chow test was used to test for year-to-year changes in regime in each of the models. In those cases where regime changes were indicated, it was hoped that respecification of the model or the inclusion of time-related indicator variables would remedy the problem. Only with the per capita income model was remedial action found to be of value. In the case of the other equations it can only be pointed out which ones are and are not valid for the entire study period and kept in mind when interpreting the results. The models for street, police, fire, and administrative expenditures showed no regime changes over the study period. All of the other models showed some change of regime. Most were stable during the seventies (pre-impact) and unstable during the eighties (impact and post-impact). The population model was unstable throughout the entire study period.

Table IX lists those equations found to best explain community service expenditures. All but one of the equations had very high negative intercepts. This has been the case in previous studies where regression analysis was used to estimate community service expenditure functions (8). The variables for the percent change in per capita income (PCPCY), the percent change in population (PCP), and the proximity of a neighboring community with a larger population (PN) were not significant in any of the equations. Population (P) was significant in all of the equations and per capita income (PCY) was significant in all but one. The variable for capital expenditures in the previous year (LK) was significant in at least one of the equations for all but two of the service categories. It is interesting to note that where LK was significant in an equation with a cubic population term, the value and significance levels of the other variables increased in almost every case when LK was removed from the equation.

The sales tax rate (TR) was only significant in the case of street expenditures. The R^2s of the equations are all satisfactory. They range from .75 to .98.

Using the coefficients estimated by the model, a simulation analysis was performed on three of the sample communities. The results indicated that the energy impact had a large influence upon per capita income, community population, general fund revenues, and community service expenditures. It was estimated that the decline in farm income experienced in the early 1980s had a small to moderate impact upon community revenues and expenditures. The major determinant of community revenues and expenditures was population. As discussed earlier, the short-run impact of the agricultural crisis upon population has been small, therefore the estimated impact of the agricultural crisis upon community revenues and expenditures was also small. This may not remain to be the case as the crisis in agriculture persists and long-time residents come under more pressure to seek employment outside of agriculture.

CHAPTER VI

SUMMARY AND CONCLUSIONS

This study examined public service expenditures in rural communities of Western Oklahoma during a period of rapid resource development and declining farm income. The primary objective of the study was to evaluate the impact of the energy impact cycle and the farm crisis upon rural community service expenditures of a sample of twenty Western Oklahoma communities. This was accomplished in three ways: 1) demographic, economic, and community finance data from the sample communities for 1975 to 1984 were examined, 2) a regression model explaining income, population, revenue, and expenditure levels was developed, and 3) an application of this model was used to quantify the respective impacts of the energy impact cycle and the farm crisis upon community service expenditures. The results of the study should help the planning efforts of community decision makers by providing estimates of how changes in the two major basic industries of the area, petroleum extraction and agriculture, affect the determinants of community service expenditure levels.

Summary of the Model Results

Separate models were estimated for county per capita income, community population, general fund revenues, and current community service expenditures. Expenditure functions were estimated for total current community service expenditures and current expenditures in six service categories. These were administration, fire protection, parks, police, solid waste disposal, and streets. These models were estimated by regression analysis using data from twenty sample communities over a period of ten years. Community service expenditure levels were obtained by forms filed annually by the community with the State Board of Equalization. Because of accounting practices, the models for the six expenditure categories were able to utilize data from at most ten of the sample communities.

County per capita income was hypothesized to depend upon per capita levels of basic income. Basic income was assumed to be that from farming, mining, manufacturing, and transfer payments. Within the study area, income from mining comes primarily from petroleum extraction. Use of a Chow test indicated a change in the form of the per capita income function from the pre-impact period (1975-1978) to the impact and post-impact periods (1979-1984). This was accounted for by the use of a time-related dummy variable.

Population in the previous year, the change in total community income over the previous two years, and a dummy variable for the sudden rise in population between 1980 and 1981 were found to significantly affect community population. The variable for population in the previous year was assumed to account for the natural population change while the change in total community income was related to migration. General fund revenues were explained by total community income multiplied by the sales tax rate, the presence of a municipally-operated water utility, and the presence of a municipally-operated solid waste disposal utility.

Population turned out to be the most important determinant of community service expenditures. In some cases, a squared or cubed form of the population variable best explained community service expenditure levels. Per capita income was also significant for most expenditure categories. Capital expenditures in the previous year lowered operating costs for some services. The local sales tax rate significantly affected only street expenditures.

Summary of Simulation Results

The coefficients resulting from the regression analysis were used for a simulation analysis using data from three of the sample communities. Results were estimated for three different situations: 1) a baseline, 2) no energy impact, and 3) no farm crisis. By comparing the estimates of the two latter scenarios to those of the baseline, the influence of the energy impact and the drop in farm income upon community revenue and expenditures was measured.

The magnitude of the increases due to the energy impact were estimated to be much greater than the size of the decreases due to the farm crisis. The average annual increases in community revenue and expenditures due to the energy impact estimated for Fairview and Kingfisher ranged from 16.94% to 40.78%. In the case of the decline in farm income, the estimated average annual decreases in revenue and expenditures for these two communities ranged from -0.07% to 3.98%. The impact of the crisis in agriculture may grow if low farm income persists over the next several years.

Policy Implications

During impact the rise in income precedes the rise in population, while during post-impact the drop in income precedes the drop in population. During the post-impact period, the major determinant of general fund revenue drops while the major determinant of community service expenditures, population, remains high. This points out that the early post-impact period, before outmigration begins as a reaction to the drop in income, is a time with great potential to cause problems for rural communities' ability to provide services. Most of the sample communities reacted successfully to this by raising their sales tax rates during this period. Another strategy for dealing with the declining population and dwindling tax revenues of a post-impact period may be for communities to provide services jointly. If the agricultural crisis continues, such a strategy may become yet more attractive to communities.

Local decision makers need to recognize energy impact cycles as natural, recurring phenomena. Oil-booms do not last forever. It is important that communities not overinvest in public service facilities during the early portion of an impact period. The beginning of the impact period, when the rise in income precedes the initiation of rapid inmigration, is a time during which communities could take advantage of a short-term surplus in revenue generating capacity. There is the potential to develop a policy to save the excess revenue of the impact period for use during post-impact, thus avoiding the necessity of raising local tax rates while local incomes are falling. Such a policy should be in place prior to the beginning of the next energy impact cycle to be successful.

Limitations of the Study and Research Implications

The results of the study are obviously limited by the size of the sample. Only communities of a similar population range and with an economy similar to that found in Western Oklahoma could be expected to display similar results. The poor quality of the data used is also a consideration. The population estimates are "very unpublished" and the community finance data are subject to differences in accounting techniques and definitions from one community to another and even from year to year in the same community.

In the early stages of this study, an attempt was made to model per capita community service expenditure levels. This attempt proved to be unsuccessful. A more detailed understanding of the effect of community characteristics such as population and income upon per capita levels of community service expenditures would help account for changes in the per capita output of a service. The inability to compare service quality from one community to another when relying solely upon expenditures as a measure of service output limits the usefulness of modeling even per capita levels of community service expenditures. Such a dilemma could be approached by using survey data on service facilities and consumer satisfaction, but it is not clear whether it would be worth the expense of doing so.

The fact that three of the four independent variables used in the county per capita income model measure income by place of industry while the dependent variable is reported by place of residence introduces some inaccuracy into the model. Future attempts to model county per capita income using Bureau of Economic Analysis (BEA) data should use a per capita income variable calculated with the "personal income by place of residence" figure reported by BEA less the appropriate resident adjustment figure. The result would be a per capita income variable consistent with the basic income levels used as independent variables.

To assist year-to-year planning, more time-series studies are needed. The results of those cross-sectional studies which are available are of questionable value in making short-term projections. Future studies which pool cross-sectional and time-series data should address the statistical problems which arise from the simultaneous presence of heteroskedasticity and autocorrelation. A stronger emphasis on the statistical methods used in estimating community service expenditure functions could help untangle short-run and long-run effects and result in models more useful in both short-range and long-range planning.

Progress in statistical techniques will not however be of much value without better data. Of particular value in distinguishing between short- and long-run changes would be community specific data on existing service facilities and annual capital expenditures. More reliable annual population estimates would also be useful. The collection of primary data, including interviews with current and past community leaders, would strengthen our understanding of what strategies communities use to deal with a variety of challenges including energy impact cycles. This could also enable researchers to identify which strategies were or were not successful. A study to determine if it would be justifiable to invest the time and expense of building and maintaining a statewide database of community level statistics is needed.

This study is limited to current expenditures, ignoring the difficulties of planning capital expenditures and investments in public facilities. It is probably in this area that the challenges of managing local resources during an energy impact are greatest. Improper administration of the current expenditures of a community may only last a matter of months while investments based on faulty expectations may leave a community strapped with an impossible debt load.

One assumption used to construct the model was that reported levels of current community service expenditures represent an equilibrium between supply and demand. This should not be misconstrued as implying that local decision makers apply the concepts of supply and demand explicitly in determining expenditure levels. It is hoped that the use of expenditure functions by this study rather than supply and demand functions will not discourage the consideration of demand and marginal costs by local decision makers.

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Candidate for Degree of

Master of Science

Thesis: IMPACT OF DECLINING FARM INCOME AND RAPID PETROLEUM DEVELOPMENT UPON PUBLIC SERVICE EXPENDITURES IN RURAL COMMUNITIES OF WESTERN OKLAHOMA FROM 1975 TO 1984

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Enid, Oklahoma, February, 24, 1961, the son of John A. and Ramona Loewen.

Education: Graduated from Pioneer High School, Waukomis, Oklahoma, in May, 1979; received Bachelor of Arts Degree in Political Science and German from Phillips University in May, 1984; completed requirements for the Master of Science degree at Oklahoma State University in December, 1987.

Professional Experience: Teaching Assistant, Foreign Language Department, Phillips University, August 1983, to December, 1983; Teaching Assistant, Department of Agricultural Economics, Oklahoma State University, August, 1984, to December, 1984; Research Assistant, Department of Agricultural Economics, Oklahoma State University, January, 1985, to August, 1986.