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DETERMINANTS OF PUBLIC SERVICE EXPENDITURES IN FAST GROWING LOCAL GOVERNMENTS OF MICHIGAN

By

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ABSTRACT

DETERMINANTS OF PUBLIC SERVICE EXPENDITURES IN FAST GROWING LOCAL GOVERNMENTS OF MICHIGAN

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This study analyzes the factors that determine the variations in per capita public service expenditures of forty-six fast growing local governments in the State of Michigan. Fast growing local governments were defined as cities and townships that had 5,000 or more residents by 1990 and had grown by at least 1,000 persons between 1980 and 1990. All the seventeen cities and twenty-nine of the fifty-two townships that qualified as fast growing communities in the state were included in the study. Categories of public services considered in the study included general government, public safety, public works, public services, health and welfare, and recreation and culture.

The study was based on US Census population figures of 1980 and 1990 and the 1994 population projection of the Michigan Department of Management; public service expenditures from the Comprehensive Annual Financial Report (1981 to 1995) of the local governments; state equalized value of properties (1981 to 1995) of the all the communities; public safety data of 1990 and 1995 for all cities and townships in the study; and roads and streets expenditure for selected communities. An expenditure decision model of local governments was developed assuming that the general objective of local governments is to provide the best possible public services (maximizing service benefits)

with minimum expenditures. A rigorous method of data preparation for the purpose of such analysis was developed and a *Fixed Effects* econometric model was employed to analyze the huge panel data sets.

The empirical results showed that: in terms of 1995 constant dollars, per capita public service expenditures of fast growing communities in Michigan vary widely; cities and townships of different population sizes have different expenditure patterns (while cities with smaller population size spend more than cities with larger population size, townships with larger population size spend more than smaller townships); and communities located in Southeast Michigan spend more than those in the rest of the state. More importantly, while the explanatory power of all variables varied across community groups, the per capita state equalized value of total property was found to be a consistently significant variable in explaining the variations in expenditures of local governments. The more wealth, the more spending.

The general policy implication derived from the empirical findings was that more people could be added to the existing smaller communities to decrease per capita expenditures. If small communities were to grow to achieve economies of scale in utilizing the existing service infrastructures, they need not contribute to sprawl since sprawl refers to low density development, not growth in population. If re-directing population growth into smaller size communities is to be actualized, the savings that could be obtained from the joint impact of increased population and a dense new residential development could be substantial.

I dedicate this dissertation to my children Noah and Gabrielua through whom I remember my past and in whom I find meaning for my life in the future.

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CHAPTER ONE

AN INTRODUCTION TO PUBLIC SERVICE EXPENDITURES

1.1 Introduction

> *"Two factors of practical efficiency may be applied to the government of a city: What does it provide for the people, and what does it cost the people?"* (James Bryce, 1914)

As municipal corporations, authorized by their respective charters, local governments in Michigan provide basic public services like police protection, fire control, roads, water and sewer, parks and recreation, public improvements, planning and zoning, and general administrative services to the residents in their jurisdictions. These services have associated costs that are commonly referred to as public service expenditures. The services provided and expenditures incurred are, more or less, similar for most local governments in Michigan. They are paid for by the residents in form of taxes, charges, assessments, and state transfers. Yet, there are significant variations in the amount and range of the per capita public service expenditures across most communities in Michigan, ranging from $34 to $1,029 in constant 1995 dollars. From where do these variations or differences in expenditures come?

Although each local government in Michigan gets a sizable amount of dollars from the state revenue sharing, they finance most of the public services they provide through the revenues they generate locally. The public service revenue sources include taxes on properties, businesses, and income. These revenue sources largely depend on how communities use their lands. For instance, communities characterized by agricultural or residential properties will be quite different from communities characterized by industrial or commercial developments in their revenue generating ability.

All communities do not have equal number of residents (or population) and they do not necessarily grow at equal rate. Public services are neither exclusionary nor rival in their consumption. But, there are limits to how much services could be provided to a growing number of people without reducing the quality of life (or services) and incurring additional costs to the existing residents. On average, there is a threshold of population size to a given level of public service beyond which the marginal cost of providing the services could rise immensely.

There are several ways in which residents of adjoining communities could create costs to communities in which they do not live or pay for the costs they create. Roads, police and fire, public libraries and parks are few such services from which outsiders can not be excluded. Then, is it settlement congestion, as measured by location of communities, or population size, growth rate, and density that drive expenditures of communities? Or, it is the land use or development patterns of each local government that is the sources of variations in expenditures of communities in Michigan?

Inquiry into this topic is not new; it has been around since the early 1900. Several studies have been conducted; but, no consensus has evolved. The current study attempts to contribute its share in clarifying the factors that drive public service expenditures of local governments by: (1) developing a rigorous method of organizing and using relevant data sets, and (2) enriching the method of analysis by employing the *Fixed Effects Regression* analysis of the extensive time-series cross-section (panel) data of Michigan.

The chapters are organized as follows: problem statement and research objectives including this section of introduction are presented in Chapter One. Chapter Two contains the literature review in which several major works in the topic are reviewed and the lessons from the studies are highlighted. Chapter Three develops the conceptual framework of the research and explains the model, the variables, and the classes of analysis. Chapter Four discusses the analytical methods of the study and explains the methods of adjusting and organizing the data, the econometric model chosen, and the mathematical representation of the regression equation. Chapter Five presents the empirical results and discussion of the analysis and the reliability test of the model. Finally, Chapter Six summarizes the findings obtained from the study, policy implications for local governments, and future research needs.

1.2 Background

Michigan, with a population of 9.5 million and a job base of 4.9 million in 1995, has 83 counties and about 2,100 local governments. Nearly 50 percent of the population and employment are located in the Southeast Michigan region, which comprises only seven counties; Livingston, Macomb, Monroe, Oakland, St. Clair , Washtenaw, and Wayne. It is projected that the population of Michigan will grow by 1.1 million people and 670,000 new jobs between 1995 and 2020. According to this projection, 38 and 44 percents of the new population and jobs respectively will be in Southeast Michigan (MSPO: 1995; Burchell: 1997).

The Michigan Society of Planning Officials reported that if the current pattern of development continues, the state will incur significant costs for new infrastructure as well as the costs of urban decline. It further notes that this pattern of development is not inevitable and an informed public could achieve different future through coordinated and integrated land-use planning and have a dramatic effect on the public and private resources consumed for land development (MSPO: 1995). Thus, among many critical settlement issues that need further research and knowledge are where and how to settle the increased population to save on resources consumed and the associated public service expenditures (Burchell: 1997; Schmid: 1997).

Observing that many of the cities in the US have increased their public service expenditures by more than 40 percent between 1951 and 1954 alone, Harvey E. Brazer suggested that this rapid increase in expenditures by American cities emphasizes the importance of extending our knowledge into the study of the relationship between public service expenditures and the factors that influence such expenditures (Brazer: 1959).

Michigan provides an excellent environment to study the factors that influence increases and variations in public service expenditures, because it is one of the states that have the highest per capita public service expenditures in the nation. Citizens Research Council of Michigan (CRC) reported that in 1972/73 Michigan had a relatively higher per capita expenditures (combined per capita expenditures for state and local governments) in comparison with the national average and with those of the eight competitor states; Indiana, Ohio, Wisconsin, New York, Illinois, Pennsylvania, New Jersey, and Michigan. Michigan, with an average of $809.00 per capita public service expenditures, was the second highest after New York in 1972. That same year, its exceeded the national average per capita by $97.00 (CRC, 1975).

The general fund expenditures in Michigan increased by 66 percent (from $1.55 billion to $2.57 billion) between 1970 and 1974. The average annual increase was about 13.5 percent. Similarly, total expenditures from all operating funds increased by 58.2 percent (from $3.13 billion to $5.37 Billion) during the same period. These increases in expenditures had given rise to increases in the general tax levels, including 10 percent increase in the state and local personal income tax combined (CRC, 1975).

Similarly, the US Bureau of Census for fiscal 1987/88 reported that the state and local governments in Michigan had both relatively high revenues and expenditures compared with the national average and the average of the fifteen states with populations of over five million people. The fifteen most populous states are California, New York, Texas, Florida, Pennsylvania, Illinois, Ohio, Michigan, New Jersey, North Carolina, Virginia, Massachusetts, Indiana, and Missouri. During this fiscal year, state and local expenditures in Michigan were the fifth highest per capita and second highest per $1,000.00 personal income. The per capita expenditures were 7 percent higher than the average of the fifteen states and 9 percent higher than the national average (CRC, 1990).

In contrast to this steady increase in per capita public service expenditures in Michigan, the per capita personal income rose by only 11 percent in real terms from 1979 to 1988. During this period, the fifteen states had a remarkable average of 23 percent increase in personal income and the national average was 21 percent (CRC, 1990). But, Michigan ranked fifth among the fifteen states in collecting more revenue, especially revenue from property and personal income taxes. The average per capita revenue for Michigan, the fifteen states, and the US were $3,107, $3,005, and $2,958 respectively (US Bureau of the Census, Government Finances in 1987/1988).

1.3 Problem Statement

Recently, the Southeast Michigan Council of Governments (SEMCOG) had commissioned two studies relating to the costs of alternative settlement patterns in Michigan. The first was a study on Fiscal Impacts of Alternative Land Development Patterns in Michigan by Robert Burchell of Rutgers University. The other was a study on Impact of Population Growth and Distribution on Local Government Expenditures in Michigan by Allan Schmid of Michigan State University.

The Burchell study focused on the resource consumption and public service costs of two alternative patterns of settlement, namely current trend (i.e. sprawl) and contained developments (i.e. dense). The study was a micro density study that compared the costs of infrastructure, housing, land, and public services at each selected study community level under the two scenarios and informed which one of the two will save resources and costs. This study, while very useful for the purpose of micro-settlement management, did not explain what the underlying factors other than settlement density were responsible for the steady increase in and variations of public service expenditures across communities in Michigan.

The Schmid study was a macro-density approach focusing on the impact of population size and location of the community in relation to metropolitan area and investigated their impacts on public service expenditures. By employing a cross-sectional regression analysis for 1990 and 1995, it determined the most important explanatory variables that shaped the variations in public service expenditures.

Generally, population growth could be expected to increase the tax base and revenue sources of a community (Oakland & Testa: 1995). On the other hand, as population increase reaches a certain threshold, demands for more and improved public services increase. This increase in demand, in turn, will place more pressure on local government budget and public service expenditures. Most of the public services (public safety, water and sewer, and roads for example) are congestable goods with capacity constraints. Thse classes of goods may be having scale economies over a certain range of population and have a zero marginal cost as the number of users increases from zero to some given number. As congestion sets in, the addition of more users reduces the utility of services of all users and the marginal cost of additional users begins to rise sharply as an absolute capacity constraint is reached (Randall: 1987). It is a conventional wisdom that local governments need to invest more on public services in order to keep the quality and quantity of services from declining as a result population growth and congestion. However, many of the earlier studies have indicated that population growth and congestion are just few of the many other factors that explain the forces that drive public service expenditures of communities.

Most of these studies were based on the use of a single year cross-sectional data. A cross-section analysis may be important not only for understanding of the underlying factors of local government expenditures as they are, but also for what it may hint about the possible future changes. However, as will be explained more in the literature review section, these studies were not able to create consensus on which variables are the most significant factors in shaping public service expenditures. It is this lack of uniformity in the findings of the different studies that motivated the current study that employs different approach and methods of studying the topic. Accordingly, the two strategic research questions that guide this study were: (1) what are the determinants or the significant factors that explain the variations in public service expenditures across communities in Michigan?; and (2) what are the policy implications of the findings for future population settlement and growth strategies for local governments Michigan?

1.4 Research Objectives

This study attempts to identify the significant factors (determinants) that are behind the variations in per capita public service expenditures of fast growing communities (local governments) in the State of Michigan. The analysis seeks to underscore how the association between per capita expenditures of the selected study communities and the explanatory variables will be affected by population size groups, types of government (city or township), and location (Southeast Michigan or rest of state). More specifically, the study attempts:

(a) to establish a method of collecting, adjusting, and using local and state governments expenditures data to conduct a study of public service expenditures for different communities of Michigan;

(b) to establish a method of comparing public service expenditures of different communities in Michigan;

(c) to determine if there are significant differences in public service expenditures across communities in Michigan by population size, types of government, and geographic location;

(d) to determine the significance of selected variables in influencing the variations in public service expenditures across fast growing communities in Michigan; and

(e) to discuss the policy implications of the findings for future population settlement policies and growth strategies in Michigan.

CHAPTER TWO

LITERATURE REVIEW OF STUDIES ON PUBLIC SERVICE EXPENDITURES

2.1 Introduction

The first section of this chapter reviews some of the major public service expenditure studies conducted so far. It focuses on the economic variables considered frequently and itemizes the important findings of the studies. It also describes the types of data used and methods of analysis applied in detail. The objectives, variables, and research outcomes of the studies are also presented in a form of summary (Table 2.1). The second section presents a brief summary and critique of the studies and points out how the current study will be different from them in the methods and approaches it used. This form of presenting the review was selected with the aim of providing better opportunity to identify and incorporate the most important economic variables frequently used by prior researchers into the current empirical model and analysis.

2.2 Public Service Expenditures Studies

Although costs of governments had been interest of research for long time, the importance of more focused research on this vital area of concern, especially on the factors influencing public service expenditures, was spurred by the rapid increase in public service expenditures of state and local governments in the US after the World War II (Brazer, 1959; Schmandt and Stephens, 1963).

As the US was leaving the war period, the surpluses accumulated by state and local governments had to be used and some capital outlay and maintenance, deferred during the war, were resumed. Thus, interest in inquiring into the budgets and expenditures of state and local governments to determine if expenditures were extravagant or efficient, taxes were too high or low, and whether borrowing was for planned developments or for benefit of interest groups grew (Berolzheimer, 1947). As a result, mainly in 1950s and 1960s, several major studies and number of specialized articles on various aspects of local government finance appeared in professional literature. For example, Josef Berolzheimer wrote on "Influences Shaping Expenditure and Economic Structure in the United State" in 1952; Amos H. Hawley published an article on "Metropolitan Population and Municipal Government Expenditures in Central Cities" in 1952; Solomon Fabricant published his book titled *The Trend of Government Activity in the United State Since 1900* in 1952; Scott and Feder examined the relationship between municipal expenditures and some selected variables for 192 cities in California in 1957; Brazer presented his study on *City Expenditures in the United States* in 1959; Johannes Delphendahl of Michigan State University wrote his doctoral dissertation on *Expenditure Patterns and Services Rendered by Michigan Townships* in 1961; Schmandt and Stephens contributed the article on "Local Government Expenditure Patterns in the United States' in 1963; Woo Sik Kee wrote his doctoral dissertation on *Metropolitan Area Finance Studies* in 1964 and published an article on "Central City Expenditures" in 1965.

Public service expenditures are all public resources expended by state or local governments to produce certain public goods and services (such as police protection, fire control, public education, public health, roads, water and sewer systems. park and recreation, etc.) to improve the welfare and quality of life of the residents of that political jurisdiction. The focus of the researchers including those mentioned in the following table were the factors that derive or influence the public resources expended to provide these services. Different researchers had submitted different answers, and some others have supported each others findings.

Berolzheimer (1947) analyzed the expenditure of operation of states and local governments in the US using the data reported by the Bureau of Census for the fiscal year 1942. The cities were divided into ten population size groups and a correlation analysis was done on the assumption that the independent variables that affect state and local expenditures were population size and density, income payments, and the volume of government functions. On the expenditures side, it was only the expenditure for operations that was considered. The operation expenditure, according to the author, was one significant part of expenditures and was sufficient, by itself, to provide tentative explanation relating to the association between state and local expenditures and the independent variables. That was because operation expenditure comprised all public pay rolls, current materials, current maintenance, public assistance payments, and other operations, representing most of the annually recurring costs of government.

Table 2.1 Summary of Selected Studies on Public Service Expenditures

Study	Objectives	Variables	Findings
Berolzheimer(1947)	(1) To explore the factors shaping state and local operation expenditures, (2) to identify systematic ways of classifying and comparing public finances	*Dependent variable*: the cost [expenditures] of public operations *Independent variables*: total population, population density, income payments, volume of functions.	(1) City expenditures were correlated with population size, (2)excepting for counties with population less than 10,000, county expenditures did not vary markedly with population size
Hawley, 1951	Testing the interdependence of populations lying within and without the boundaries of local governments involving the use of the municipal government expenditures	*Dependent variable*: per capita all government expenditures, operating expenditures, and capital improvement expenditures. *Independent variables*: population size, density, and growth rate, number in labor force, number in white collar occupation, number of houses, houses per square mile, area in square miles, percent of population incorporated, and percent of total district population.	(1) The per capita government expenditures were more closely related to population residing outside the city than to population within the city, and (2) operating costs were more related to population residing outside the city than population within the city

Table 2.1 (Cont'd)

Study	Objectives	Variables	Findings
Brazer, 1959	(1) establishing patterns of differences in per capita expenditures of cities, (2) analyzing the association between city expenditures per capita and measurable economic variables	*Dependent variable*: total operation and functional category expenditures per capita. *Independent variables*: population size, population density, population growth rate, median family income, percentage of population employed, and intergovernmental revenue.	(1) population density and intergovernmental revenue per capita were the most significant variables in explaining all categories of expenditures. (2) population size and population growth rate were of least importance in shaping city expenditures, and (3) median family income was significant in explaining variations in functional categories only.
Schmandt and Stephens, 1963	(1) give an overview of local government expenditure patterns by geographic regions, and (2) indicate the factors that influence local spending levels	*Dependent variable*: mean per capita expenditures of total and functional categories *Independent variables*: total population, population density, territorial area, state aids, median family income	(1) state aids and median family income were the most important variables influencing per capita spending by county area aggregate, and (2) total population and density did not affect total per capita expenditures appreciably

Table 2.1 (Cont'd)

Study	Objectives	Variables	Findings
Woo Sik Kee, 1965	(1) Discuss critical differences of socio-economic and governmental characteristics between the city and areas outside the central city. (2) Show the relationships between the level of per capita city expenditures and selected explanatory variables	*Dependent variables*: (1) total general expenditures, (2) non-educational expenditures, and (3) non-aided expenditures *Independent variables*: (1) per capita income, (2) owner-occupied housing units as percent of total occupied units, (3) population density, (4) ratio of central city population to total SMSA population, (5) ratio of state and local functional responsibility, and (6) per capita state aid	Determinants of each of the dependent variables by ranking were: (1) for total general expenditures: state aid, ratio of central city population to its SMSA population, per capita income, ratio of state and local expenditure responsibility, and owner-occupied housing units as percent of total occupied units; (2) for per capita non-educational expenditure: state aid, owner-occupied housing units as percent of total occupied units, ratio of central city population to its SMSA population, and ratio of state and local expenditure responsibility; and non-aided expenditure.

Table 2.1 (Cont'd)

Study	Objectives	Variables	Findings
Masten and Quindry, 1970	Explain that the relative importance of the popular expenditure factors, other than population and intergovernmental transfers, can be most meaningfully assessed only for areas of relatively homogenous population sizes.	Dependent variable: total city per capita current general purpose expenditures Independent variables: population, population density, per capita adjusted gross income, per capita full value of assessed property, and land area.	(1) The coefficient of multiple determination (R^2) was low for cities ranging from 5,000 to 20,000 and high for cities with population of 20,000 to 100,000. (2) The contributions of the independent variables to the coefficient of multiple determination vary by city sizes.
Schmid, 1997	(1) Investigate if public service expenditures could be reduced by altering macro-patterns of future settlement (or development). (2) Determine if growth location and population size have effect on public service expenditures.	Dependent variable: total expenditures per capita. Independent variables: total population, population growth rate, location, total state equalized value of property, and percent of state equalized value of residential property	(1) expenditures and population size matters for townships; (2) location mattersfor cities; and (3) cities in southeast Michigan had higher total expenditures per capita than cities in the rest of the state while townships did not show such difference

The correlation analysis revealed that city expenditures were highly correlated with population size. Per capita city expenditures ranged from $72.69 (in cities with populations over one million) to $11.22 (in cities with populations less than 2,500). The direction of changes in population size and expenditures followed the same direction without any exception; i.e., expenditures increase when population sizes increase and expenditures decrease when population sizes decrease.

In contrast to the variation in city expenditures in relation to population, the per capita county expenditures did not vary significantly among population size groups excepting for the smallest group. While all of the four county population size groups (over 250,000; 50,000 - 250,000; 25,000 - 50,000; 10,000 - 25,000; and under 10,000) had per capita county expenditures within the range of $12.38 to $13.76, the smallest counties with populations less than 10,000 had per capita expenditure of $22.72 showing diseconomies of scale.

Amos H. Hawley's 1952 study was based on two major assumptions. (1) City services which were bought with municipal government expenditures were developed to meet the total need generated by activity carried on within the city. (2) Some of those activities, and hence some of the need for city services, arose from the population residing outside the city boundaries. According to Hawley, the outlying population uses the city streets and public buildings; it creates more police problems, thus affecting the expenditure of that service; it causes additional fire risks which must be factored in allocation of funds for fire protection; and its movement in and out of the city is a factor in the budget of the health department of the city. Then, the hypothesis arising from these assumptions was that the annual expenditures of city governments should vary with the sizes of populations occupying adjoining areas. A corollary hypothesis of these assumptions was that the larger the proportion of the total population living outside the city, the heavier should be the tax burden on the population living within the city.

Hawley used the 1940 Bureau of Census data for seventy six cities with population over 100,000 to perform correlation analysis. The correlation between all per capita expenditures of city government and city population was found to be was slightly curvilinear ($\gamma = 0.51$). However, he believed that the curvilinearity may be due to lack of control of related variables and assumed, but not tested, that multiple correlation analysis could correct the problem.

The zero-order correlation coefficient was computed for each of the three dependent variables (namely, all government expenditures, operating expenditures, and capital improvement expenditures) with the eight demographic variables of the city governments and the remainder of the districts (population size, population density, population growth rate, number in labor force, number in white collar occupation, number of houses, houses per square mile, area in square miles, percent of population incorporated, and percent of total district population). The per capita expenditures of the governments (computed on the population residing within the city) were more closely related to population living outside the city than to the population residing within the city. The per capita operating costs also revealed similar result. Based on this general observation, the major hypothesis that stated the annual expenditures of city governments should vary with the sizes of populations occupying adjoining areas appeared to hold. However, the study showed that the capital improvement expenditures were only slightly associated with the independent variables reflecting, according to the author, the inadequacy of a single year data for a study of capital improvement expenditures.

The operating expenditures were more sensitive to variations in population than were capital improvement expenditures. Likewise, government expenditures were more closely associated with density of population within the city (r = 0.53) than with the size of city population (r = 0.40)

The correlation between population growth rate and the dependent variables was found to be slight and inverse in Hawley's study. The cities and their surrounding districts also showed no appreciable differences in this respect. Similarly, the association between the labor force and government expenditures was insignificant for both the cities and the remainder of the districts. However, the result became highly correlated when it was for the number of people employed in white collar occupations and government expenditures. Housing density was also found to be more consistently related to government expenditures than the number of houses in the city or the total area of the city in square miles.

Taking note of the major finding of his study, Hawley focused more on the correlation of population and the dependent variables and asked to what extent the association between expenditures and population was influenced by variations in other independent variables. Then, multiple correlation (R) for government expenditures and population was computed by successively adding each of the other variables specified for the cities and the remainder of the districts. Of all the variables, the density of population within the cities was found to exert significant influence on the association of all expenditures and population size; the measure of the population and government expenditures changed from r = 0.40 to R = 0.55. The influence of the rest of the variables was found to be not significant.

The extent to which all the independent variables (8 for cities and 10 for the surrounding metropolitan districts) explain the variations in all city government expenditures was computed and R^2 of 0.57 was obtained . That is, the total effect of all the independent variables accounted for only 57 percent of the variation in all municipal expenditures in the cities. The R^2 for operating expenditures and capital improvement expenditures were found to be 0.59 and 0.54 respectively

Forty percent of the variation in city government expenditures remain unexplained. The existence of such large residue, according to Hawley, may have been due to inadequate definitions of jurisdictional areas (like metropolitan districts) employed by the Bureau of Census or missing important variables in the model. For instance, consideration of per capita income may be important in that it reflects the ability and willingness of the population to support the city governments expenditures. Similarly, the nature of the local economy could be important in that the economic characteristics of the surrounding cities have significant impact on the budget and expenditures of the city under consideration.

With the main objectives of establishing patterns of differences in per capita expenditures of cities and analyzing the association between city expenditures per capita and important economic variables, Harvey E. Brazer studied per capita expenditures of 462 US large cities in 1951 and per capita expenditures of the 40 largest of these cities in 1953. The expenditure categories included were total general operating and six functional categories (police, fire, highways, recreation, general control, and sanitation). Capital outlays, largely reflecting construction programs, were excluded from the study because the author considered this category of expenditure to vary from year to year. Yet, the capital expenditures of police, fire, and general control were not netted out because the Census Bureau data used for the study did not provide a breakdown between capital and current expenditures of these functional categories by individual cities.

Measures of variations of expenditures per capita, as computed from the data of Bureau of the Census, Compendium of City Government Finances (1950), for all the 462 cities indicated that the variation coefficient for total general operating was 54.3 and 22.8 for common functions[1]. These variations coefficients reflected the differences among cities in the distribution of functional responsibilities.

The mean, lowest, and highest total general operating expenditures for all the 462 cities were $47.57, $12.86, and $165.16 respectively; and $28.26, $11.31, and $80.66 for common functions. The data, when evaluated by geographic divisional means, showed that there was a variation in the per capita total general operating expenditure ranging from $28.28 for cities of the West North Central states to 89.19 for cities in the New England states. The highest per capita expenditures were found to be in the older cities of New England, Middle Atlantic, and South Atlantic states, where, the author believed, traditions of local autonomy in government were strongest and their cities had retained responsibilities for most of the optional functions of city governments. Most of these functions were administered by the state, school district, or county elsewhere in the nation. In contrast, the per capita total general operation expenditure was the lowest for newer cities of West North Central and West South Central states, where cities generally enjoy fewer measures of political and economic importance.

Taking California, Ohio, and Massachusetts as states for regional comparison, Brazer found that the variation coefficients of the total general operating expenditure for cities in these states were very different from that of the 462 cities considered together. They were 23.5 for 35 cities in California, 8.8 for 30 cities in Ohio, and 25.0 for 32 cities in Massachusetts compared to 54.3 for all the 462 cities across the nation. The between states and within states variance of the total general operating per capita expenditure category were 6,097.58 and 215.48 respectively with F value of 28.3, while those for the common functions category were 468.40 and 47.28 with 9.9 F value.

The correlation analysis of the association between expenditure categories revealed that only two sets of functional categories (police protection and fire control and police protection and general control) had a correlation coefficient greater than 0.5. If all functional categories were shaped or influenced by same explanatory variable(s), the author explained, high coefficient of correlation would have been obtained among all categories. Moreover, the budgetary patterns among cities were extremely diverse suggesting that no single factor accounted for the variation among cities in per capita expenditures. Therefore, there was no compelling evidence to expect cities within individual states to follow a consistent pattern than in the case of the 462 cities taken together.

The least-square multiple regression analysis was used to describe the average relationship between the per capita expenditure and the selected independent variables. The cities were divided into five sub-groups: the 462 cities with population greater than 25,000 in 1950 (because complete data for that year was available for places with

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[1] Common function category included were police, fire, highways, recreation, general control, and sanitation.

population of 25,000 or more sizes); 35 cities in California; 32 cities in Ohio; 30 in cities in Massachusetts (the three states were selected as three sub-groups for the purpose of holding the factors peculiar to individual states constant); and 40 cities, excluding Washington DC, with population greater than 250,000 in 1950 (because they form homogeneous group in terms of population and expenditure data for their overlying units of governments were available. These data were required to compute the ratio of the city's population to that of its metropolitan area).

The basic assumption of the analysis was that all of the relationships among the variables were linear and the sum of the squared deviations of the estimated values were reduced to their least possible magnitude. The regression results were presented in terms of estimated coefficients (β), elasticities, and multiple correlation coefficients. The estimated coefficients were the weight assigned to a particular independent variable. The elasticities were the measure of percent change in the dependent variable induced by 1 percent change in the specified independent variable. The multiple correlation coefficients measure the degree of association between the dependent and independent variables.

The coefficients of multiple correlation of the regression analysis range from 0.76 for total general operating to 0.24 for functional category of recreation. That means, the highest ability of the model to explain the factors behind expenditures was 58 percent at its best and 6 percent at its lowest. However, some instructive generalization had emerged from the exercise. With a due caution of census data error, the analysis had shown that the association between population size and almost all, but police, per capita expenditures was not statistically significant as measured by its β value and elasticity measure (.015).

In a sharp contrast to the role of population size in explaining expenditure variations for the 462 cities, population density had shown a remarkable association with all types of expenditures with the exception of recreation. Excepting for its minor association with total operation and fire protection expenditures, population growth did not appear to have role in shaping municipal expenditures. The median family income, excepting for total general operating expenditure, had statistically significant positive association with all expenditures of functional categories. Ratio of employment had a sort of mixed results. The association between employment in manufacturing, trade, and service sectors and per capita expenditures appeared to increase as population increased. But the regression coefficients relating this variable with most of the expenditures were not compelling. Of all the six independent variables in the regression model, it was only the intergovernmental revenue per capita that was significant in explaining all expenditure categories.

The research conducted by Schmandt and Stephens (1963) was national in scope, covering all the 3,096 counties in the nation. Using the 1957 Census of Government data, it employed county area aggregates (in which expenditures by all local governments and special and school districts were grouped together) as unit of analysis.

The 3,096 counties were sub-divided into the traditional nine regions classification of the Bureau of Census (New England, Middle Atlantic, East north Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific). Like in Hawley's (1952), zero order correlation analysis was used to determine the relationship of the mean per capita expenditures of county area aggregates and the independent variables. The independent variables were total population, population density, territorial area, state aids, and median family income. The total expenditures were composed of two expenditure categories: total current expenditures and capital expenditures. The functional categories included in the study were highways, public education, police, fire, parks and recreation, general control, sewerage and sanitation, and health and welfare.

The descriptive statistics of the data showed wide differences in the regional aggregate per capita total expenditures ranging from an average low of $80.56 (for the East South Central States of Alabama, Kentucky, Mississippi, and Tennessee) to average high of $221.06 (for the Pacific region including California, Oregon, and Washington). In general, the Southern states were at the low end of all the per capita expenditures and the western states were toping the list, followed by the Middle Atlantic States of New York, New Jersey, and Pennsylvania. The ranking by functional categories also followed the same pattern.

The computation of the expenditures data for counties in all regions, excepting the East South Central, indicated that those counties with population less than 5,000 had the highest operating expenditures of all population size categories. However, the authors cautioned that care must be taken in making a generalized assumption of systematic relationship between per capita expenditures and population size because of the existence of considerable variations within size groups as well as between them. In addition, the data used in this particular study suggested that both the very large and very small counties suffer from diseconomies of scale yielding the usual "U" shaped curve on the population-per capita expenditures space.

The population per capita expenditure scenario appeared to be a little different when the capital improvement expenditure was considered separately. Although the counties with population under 5,000 spent more than the subsequent four population size categories of higher order, the difference was very small. The steeper upswing started with the population size category of 50,000 - 100,000 and the per capita expenditures of capital improvements kept increasing with each subsequent class. The largest jump occurred in counties with population over one million. Although the mean per capita for capital improvement indebtedness followed the same pattern, the authors were a bit cautious that comparisons among jurisdictions on the basis of a single fiscal year may prove unreliable because capital expenditures of governmental units tend to move unevenly over time.

The percentage of budget allocated to schools and roads indicated a negative relationship to population size, but that expended on health and welfare, police, fire, sewerage and sanitation, and parks and recreation showed positive association. The authors argued that the explanation for this observation depended on the facts that local governments in rural counties may discharge their principal responsibilities when they provide for the education of the children and see that their residents have adequate network of passable roads. Urbanization, on the other hand, brings with it the need and demand for sewerage disposal, public health measures, recreational facilities, better police and fire protection, and similar type of services.

Schmandt and Stephens, found several important associations between per capita expenditures (total and functional categories) and the five independent variables. Amongst several conclusions that could be drawn from their analysis were:

(1) state aids, followed by median family income, emerged as the most important variable influencing per capita expenditures by county area aggregate. State aids and family income were measures of the availability of resources and reflect what communities can afford to expend on public services.

(2) while per capita expenditures tended to rise in all functional categories with increase in median family income police and fire, welfare, highways, and public education were more influenced by State aids.

(3) although they showed significant association with functional categories like protective services (police and fire), total population and density did not affect total per capita expenditures appreciably. The reason for this relationship was, according to the authors, that population and density were inversely related to expenditure for streets and highways because the per capita mileage to be maintained decreases as population and density rise. The protective services, on the other hand, were urban type functions and their magnitude increased as population and population density increased.

(4) while state aid showed little relation to population size, median family income was significantly associated with population size and population density. This was a reflection of the greater economic opportunities and wealth that exist in the large urban centers.

(5) total current expenditure per capita showed higher association with territorial size of the counties than with total population and population density.

Woo Sik Kee (1965) observed that most of the empirical studies regarding expenditure behavior of central cities had not been satisfactory because, (1) they were limited in scope (in terms of areas, class of governments, or functions they considered); (2) they did not recognize the fiscal interdependence between state and local governments on the one hand, and among the local governments on the other. Thus, in his attempt to augment the previous studies with a research that considered intergovernmental financial interdependence and one with broader scope he set two specific purposes for his study. They were: (1) discussing critical differences of socio-economic and governmental characteristics between the city and areas outside the central city[2], and (2) showing the relationships between the level of per capita city expenditures and selected explanatory variables by incorporating the effects of intergovernmental fiscal responsibilities into multiple regression analysis.

Thirty six Standard Metropolitan Statistical Areas (SMSAs) showing variations in geographic location, population size, patterns of state and local governmental system, were selected. Public services of these 36 SMSAs were provided by a total of 4,482 local units of governments. Using the 1957 Census Bureau data six explanatory variables (per capita income, owner-occupied housing units as percent of total occupied units, population density, ratio of central city population to total SMSA population, ratio of

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[2] The definition of "central city" established by the US Bureau of the Census, which Kee adopted, was a city or adjoining (twin) cities within 20 miles of each other that contain total of 50,000 or more inhabitants.

state and local functional responsibility, and per capita state aid) were regressed on three dependent variables (total general expenditures, non-educational expenditures, and non-aided expenditures).

The central cities and the rest of the metropolitan areas had substantial variations ($61.22 for Savannah, GA to $256 for Sacramento, CA and New York) with regard to per capita total expenditure and other major expenditure categories such as education, welfare, health, and highways. The variations were attributed to the differences in population characteristics, degree of urbanization, the level of income, and social and economic preferences in the study areas. Yet, the major hypothesis of the study was that the large part of the differences in per capita local expenditures within metropolitan areas was attributable to the differences in the distribution of governmental responsibilities between the state and its political subdivisions and the attendant share of state aid.

Although it was true that substantial variations existed between central cities and the rest of the metropolitan areas (sub-urban areas) in total per capita expenditure, it was not evident from the data that central cities spent more than the rest of the metropolitan all the time. For example, while the total expenditure of New York sub-urban areas was $259.38, it was only $256.22 for New York City. Likewise, cities of Albany, Bridgeport, Buffalo, Norwalk, Stamford, Syracuse and Utica spent less than their sub-urban areas. This observation was a serious challenge to the earlier findings of Hawley (1952) and Brazer (1959 and 1962) that state (1) the total per capita expenditure of the central cities was closely related to the ratio of the central cities to the total population of their metropolitan districts, and (2) higher total expenditures were consistently incurred in the central cities (Brazer, 1962). According to Kee's argument the mere fact that central cities, in many instances, spend relatively more than the sub-urban areas does not establish the evidence that the residents of the sub-urban areas impose a net expenditure burden on the central cities. In cases where the sub-urban communities spend more than the central cities, he argued that it was so because of the relatively greater state aid to the areas outside the city.

Woo Sik Kee cautioned that expenditure burdens of central cities and sub-urban areas are much more difficult to be explained by simple comparison of expenditures in that central cities, quite often, incur additional functions like urban renewals that could make the level of expenditure look higher at one point in time, where as some features of sub-urban areas (voluntary community services like fire fighting and privately operated sanitation) are ignored, there by making the level of expenditure look lower. Instead, he suggested that contrasting individual functions would be a more adequate method of comparison between the two places. Accordingly, he computed the coefficient of variation[3] for each function in the central cities and sub-urban areas to compare the relative dispersions of the various classes of expenditure. The computation revealed that, excepting for health and hospitals, the coefficients of variations for per capita total general expenditure, total education, highways, and public welfare were higher for the sub-urban areas than the cities. Kee claimed that these variations of per capita expenditures of each category indicate that there is a great difference in the allocation of functional responsibilities between state and local governments.

[3] The coefficient of variation (V) is a measure of variation used to compare inter-functional and inter-jurisdictional per capita expenditures. The formula used to calculate was $V = s/x^{\wedge}$, where s is the standard deviation and $x^{\wedge}$ is the arithmetic mean of the 36 selected central cities and areas outside the cities.

Masten and Quindry (1970), using the 1966 per capita expenditures gathered through the Wisconsin State Department of Revenue, studied city expenditure determinants of 567 cities and villages in the State of Wisconsin in 1970. The sub-groupings of these 567 cities and villages consisted of 477 cities and villages with total population of less than 5,000, 62 cities and villages with total population of 5,000 - 20,000, and 25 cities and villages with population of 20,000 - 100,000. The relative importance of expenditure determinants for cities and villages of different population sub-groupings were examined with the use of basic regression and correlation models.

When all cities and villages were analyzed together, the regression analysis revealed that the estimated βs of the five independent variables, namely, total population, population density, per capita adjusted gross income, per capita full value of assessed property, and land area were 0.179, 0.161, 0.138, 0.688, 0.485 respectively . This showed that the per capita full value of property has the highest explanatory power than all other variables. The ranking of the independent variables in accordance to their contribution of increasing the coefficient of multiple determination (R) was found to vary by city and population sizes. For places with population less than 5,000 the ranking by descending order was per capita full value of assessed property, per capita adjusted gross income, land area, population density, and total population. For places with population 5,000 - 20,000 it was per capita full value of assessed property, total population, population density, per capita adjusted gross income, and land area. For places with population 20,000 - 100,000 it was population density, per capita full value of assessed property, per capita adjusted gross income, land area, and total population.

This study highlighted that the ability to pay taxes (revenue for city services) was very important for the first and second sub-groupings, and second most important, following population density, for the third sub-grouping. In contrast, total population (excepting for its second place in the second sub-grouping) was the least important in influencing the coefficient of multiple determination.

Population density variable was the strongest expenditure determinant for 25 cities and villages in the 3rd sub-grouping. More importantly, as cities became more populated, the changing positions and importance of the determinants suggested unique growth process. For instance, for the first two sub-groupings with population less than 20,000 the ability to pay for city services, as measured by property value, was the most important variable. When rapid urbanization phase was reached and the city expanded beyond a certain population size, street improvement, improved sewerage facilities, modernized fire fighting equipment, and other departmental expansions necessitated more than proportional increase in per capita expenditures and this phenomenon was represented by the increasing importance of the density factor as an explanatory variable in cities of the next higher population sub-grouping (20,000- 100,000). Confirming some findings of some other earlier studies, in particular that of Schmandt and Stephens (1963), they suggested that the interrelationship between per capita value assessed property, population density, and total population on the one hand and per capita expenditures as city size changed on the other reflected economies or diseconomies of scale in the provision of city services.

The deviations and confusions between most of previous studies on factors influencing expenditures of local governments, according to Masten and Quindry, were attributed to the general lack of data of cities and villages and the varying circumstances under which the studies were conducted. For instance, they cited the rejection of city size by pervious studies while it was later found to be very important in determining the relative explanatory ability of other socioeconomic factors as an example. Finally, they underscored the fact that the expenditure impact of the five basic variables considered as significant in previous expenditures studies, varied with city sizes; and all but one, land area, were found to be significant explanatory factors for cities and villages in the State of Wisconsin.

The most recent study of the association between public service expenditures and selected explanatory variables was the one conducted by A. Allan Schmid (1997) for the State of Michigan. This study was original not only in its methodological approach but also in the type and quality of data it used. Seventeen cities and twenty-nine townships, representing different geographic locations and population size groups in Michigan, were purposefully selected out of the 71 communities in the State that have grown by a population of at least 1,000 between 1981 and 1990 and have a population of 5,000 or more.

Fifteen years total expenditures data (excluding enterprise funds) was used in this study. The data was collected directly from the annual reports of cities and townships included in the research. The data was superior in quality when compared with all other data used in prior studies because: (1) they were actual expenditures (as opposed to budgeted expenditures) audited by certified public accountants and filed with the Michigan Department of Treasury; (2) the total operation expenditure were adjusted for the general inflation and were in 1995 constant dollar; and (3) the total capital improvement expenditure was adjusted and amortized over a stand period (30 years) to avoid the erratic nature of capital investment expenditure.

Multiple regression of cross sectional data for 1990 and 1995 were performed to determine the association between the dependent variable (total expenditures per capita) and the selected explanatory variables (total population, population growth rate, location, total state equalized value of property, and percent of state equalized value of residential property).

The study had revealed several findings that were both in agreement and disagreement with previous studies. For instance, where most of previous studies indicate that there is strong association between population and expenditures in general, Schmid found that the relationship between city population and expenditures were negatively correlated and statistically not significant. His simple regression of population over expenditures per capita showed that only 12% of the variation in city expenditures was explained by population size. However, when similar analysis was done for townships separately from cities, total population and per capita expenditures showed statistically significant and positively correlated association. The simple regression of population over expenditures per capita also showed that 57%[4] of the variation in township expenditures

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[4] The table below was reproduced here just to show the impressive predication ability of the single variable regression model that explained only 57% of the variations in expenditures of townships. The per capita expenditure prediction was calculated by multiplying the total population of the given township by the β value (which is 0.003) of the model (p. 33).

Township	Predicted Per Capita Expenditure	Actual 1990 per capita Expenditure
Clinton	342	321
Waterford	282	313
W. Bloomfield	252	278

were explained by population size. According to the author, while the offsetting of some of the increasing cost tendencies in cities by some other decreasing costs over some size ranges may explain the observed relationship of population and expenditures, new service needs and associated jump in expenditures as townships grow indicate the positive association between population and expenditures. Moreover, unlike the townships, large and small cities provide similar services and there will not be dramatic jumps in expenditures as they grow in size. Therefore, it will not be inconsistent that population size and expenditures exhibit inverse relationship.

The multiple regression results of this study showed that all the selected explanatory variables jointly explained 75 and 60 percents of the variations in the 1990 expenditures of townships and cities respectively with similar results for 1995. For the townships, population size, state equalized property value, and proportion of residential properties were statistically significant. While population and property value were positively associated with expenditures, proportion of residential property was negatively correlated. The broad specification of location (as Southeast Michigan or not) and population growth rate, however, did not contribute to the explanations of per capita expenditures of townships significantly.

For the cities, the only statistically significant variable was location. Population was not significant and population growth rate (also not significant) was negatively correlated. The model revealed a slightly different results for 1995: population growth rate, location, and proportion of residential property were barely significant.

Meridian	192	255
Macomb	162	110
Fruitport	132	122

Similar analysis was performed using per household expenditures as the dependent variable with the same explanatory variables. For cities, using the 1990 data, none of the explanatory variables was significant. But, for townships, with a slightly decreased ability of the joint explanatory variables in explaining expenditures (69% vs. 75%), the same variables (population size, state equalized property value, and proportion of residential property value) remained significant.

The rate of expenditure analysis of the study revealed that: (1) increase in expenditures for fastest growing townships was no different than the average for all townships, (2) large townships had higher expenditures regardless of their rate of growth, (3) the rate of growth in expenditures and population followed the same direction for cities, and (4) regardless of their growth pattern, larger cities did not exhibit higher expenditures.

In order to give more insight into the relationship between expenditures and population size, the study presented some historical perspectives of the fifteen years total expenditures and individual expenditures of some functional categories (general government, public safety, roads and streets, and water and sewer) by dividing the sample communities into seven population size groups without distinction between the form of government (city or township) and location. The functional categories, according to the author, were public service types that mark certain expenditure threshold as population or density increase.

The analysis revealed some observations that explain the relationship between expenditures of functional categories and population size. For example, it showed that the expenditure for public safety in townships increases at a decreasing rate with rise in population; and while mid-sized cities have shown increase in roads and streets per capita expenditure over a range of period, large and small size group cities do not show any firm pattern in per capita spending.

Schmid started out the study with two major questions: (1) do population size and location of local governments have effect on public service expenditures? and (2) if they do, could public service expenditures be reduced by altering macro-patterns of future settlement (or development)? The answer to both questions was yes. Population size and location may affect cities and townships differently, but there is evidence from the study that the macro pattern of population location and the micro pattern of size and density of population are policy tools that can reduce the public service expenditures levels.

2.2 Lessons From the Studies

It can be summed from the foregoing review that population size and growth rate have been found to be the most important variables that explain variations in public service expenditures by Berlozheimer (1947) and Schmid (1997), as it only related to townships. On the other hand, for Hawley (1951), Brazer (1959), Schmandt and Stephens (1963), Kee (1965), and Masten and Quindry (1970) population size and growth rate were of the least importance. Instead, excepting for Masten and Quindry, population density and the ratio of the population of the community to that of its metropolitan district were very important.

In addition to the authors reviewed above, other distinguished early researchers had also attempted to show which of these variables influence public service expenditures most. For instance, Mabel L. Walker (1930), in her study of municipal expenditures, had found that per capita costs of government increase rapidly as the population increases. Supporting her conclusion, Donald H. Davenport (1947) studied 56 cities around New York and determined that there was positive correlation between per capita expenditures of cities and population size. Hansen and Perloff (1944) and Solomon Fabricant (1952) have also confirmed these findings.

Contrary to the conclusion of these researchers, Gerhard Colm *et al* (1936), affirmed that density of population is of utmost importance in the cost of public services to the taxpayer. Nevertheless, since the authors believed that industrialization and wealth influence density of population, they had enjoined that it is difficult to isolate the genuine influence of density on public costs and it could be further assumed that density can decrease per capita costs in certain area of functional categories. Five years later, Arnold

Brecht (1941) also published a research, which supports Colm *et al* by concluding that it is only density of population that is highly correlated with per capita expenditures of municipal services.

Scott and Feder (1957), on the other hand, published a totally different finding. They studied 192 California cities with 1950 population of 2,500 or more and examined the relationship between the municipal expenditures per capita (excluding public service enterprise expenditures and those financed through special assessments) and the explanatory variables they considered. The independent variables they used in the model were retail sales per capita, rate of growth of population, median number of persons per occupied dwelling unit, total population, population density, and adjusted property valuation per capita. They attributed expenditure differences in California cities to variations in tax paying ability of the population. The analysis showed that it was the adjusted property valuation per capita that had statistically significant regression coefficient. But four years later, Shapiro (1961) came with an other different conclusion ranking land area of a local government as the most important explanatory variable.

It can be said that little agreement existed amongst the researchers reviewed here as to which independent variables are most important in explaining local government expenditures. As a result, there is no single formula or rule that satisfactorily explains the casual relationships involved. Nevertheless, there are some variables that are more frequently offered as the leading factors. That includes, total population, population growth rate, population density, median household (family) income, land (territorial) area, inter-governmental revenues, and property value.

To their credit, most of the authors recognize that public service expenditures are determined not only by the economic elements which have been considered here, but also by many political, social, and personal factors (Walker, 1930; Colm et al, 1936; Brazer, 1959; Schmid, 1997). Although these social, political, and personal influences could have effect only within a framework set by the economic factors determining the requirements for and costs of public services and the resources available for financing them, the ambition of an able governor, mayor or legislator, for example, may have an important influence on the kind and size of public expenditures in a state or local government. Unfortunately, there is no definite and ready measure of such variables that could help the analysts to quantify its effect on the casual relationships between public service expenditures and the factors involved.

Notwithstanding Woo Sik Kee's criticism, most of the studies reviewed, excepting that of Schmid, are of national or regional scope. Studying public service expenditures at larger levels of system of government (state, regional, or federal) could have both advantages and disadvantages. On the advantage side, (1) it creates ease of comparing public service expenditures among states and regions for which data are readily available from the Census Bureau, and(2) it eliminates the influence of differences in the distribution of service responsibilities among the various types of local governments of city, township, or school district (Schmandt and Stephens, 1963).

On the disadvantage side, it hinders the ability of a researcher to compare expenditure patterns among and between the smallest units of governments and suppresses the role of each variable that has different explanatory ability for different size and types of local government. For instance, Masten and Quindry found that population density was the most important variable in explaining the expenditure behavior of all the 25 cities and villages with a population range of 20,000 - 99,999 in the State of Wisconsin in 1966. But, at the same time, they found that population density ranked fourth, out of five explanatory variables, in its ability to explain the expenditure behavior of all the 567 cities and villages in Wisconsin considered together. Hence, it will be difficult to accept results based on the findings of larger set of cities without qualification.

Similarly, the Michigan study by Schmid (1997) revealed that population size was the most important variable that explained the expenditure patterns of 29 Michigan townships, while it, at the same time, showed no significant association with the expenditures of the 17 cities considered in the study. Distribution of service responsibilities vary among cities and townships. Accordingly, their revenue collection ability and patterns of expenditures are different. Therefore, it will be inaccurate to put all local governments in one pot and analyze the casual relationships of the variables that are of interest without making any distinction to their form and structure.

Finally, the type of data used by most of the researchers are susceptible to inadequacy. First, the data were collected by the Bureau of Census and it is not clear as to how much these data are fitting the objectives of the researchers without any adjustment. Some of the researchers have noticed the discrepancy between the data they needed and what was available to them. This discrepancy had created definite constraints on their ability to carry out a reliable analysis. Secondly, most of the researchers relied on a single year cross-sectional data to perform the analysis. Some were aware of the drawbacks that the use of a single year data was imposing on their analysis. As a result, some of them were forced to abandon the consideration of capital improvement expenditures from their analysis all together. Others have some how went ahead with the one year data available to them and cautioned that the findings be seen only as an ad hoc. Even if the problem surrounding abandonment or use of capital improvement expenditure is to be tolerated, how much could the results of all other expenditures based on a single year data be reliable?

The main point of departure between the current study and the prior studies is around this question. The method of analysis applied and types of data used are very different. The current study used fifteen years time-series cross-section data on population, expenditures, and state equalized value of properties along with other supplementary data of individual service categories. It performed rigorous and extensive statistical and regression analysis of panel data for forty six fast growing local governments of different population size groups, geographic location, and types of government in the State of Michigan.

CHAPTER 3

CONCEPTUAL FRAMEWORK TO ESTIMATE DETERMINANTS OF PUBLIC SERVICE EXPENDITURES

3.1 Introduction

This chapter develops a conceptual framework that can be used to estimate the determinants of per capita public service expenditures (expenditures, here after) in the fast growing communities of Michigan. The model derived can also be viewed as a local government expenditure decision model. Expenditures patterns of communities are expected to vary by types of government (city or townships) and are further sub-classified by geographic location and population size groups. Furthermore, expenditures are assumed to be functions of total population size, population growth rate, population density, residential property as percent of total property, and value of properties.

3.2 The Expenditures Model

Following the general models developed by Masten and Quindry (1970) and Schmid (1997), the model of analysis of was specified as follows:

expend = f(poptotal, popgrwth, popdenst, rsdntprp, totalprp)

Where: poptotal = total population
popgrwth = population growth rate
popdenst = population density

rsdntprp = residential property
totalprp = total property

The general objective of local governments was assumed to be providing the best possible public services (maximizing service benefits) with minimum expenditures. However, efficiency of the governing bodies (or public service providers) on the one hand and quality and quantity of the public services provided on the other were variables that were very difficult to measure, at least for this study. Consequently, they were not included in the model specification.

3.3 The Dependent Variable

The dependent variable was the per capita total expenditures for public services. It was computed by dividing total expenditures by total population of each study community. The total expenditures were adjusted for inflation and were in 1995 constant dollars. The functional categories for which the total expenditures were computed included general government, public safety, public works, welfare and social services, culture and recreation, capital outlay, and debt service.

3.4 The Independent Variables

There were five independent variables considered in this study. They were total population, population growth rate, population density, residential property as percent of total property, and equalized value of total properties.

3.4.1 Total Population

Total population of communities was one of the variables that was often offered as the most important variable that affects expenditures in much of the literature (Donald H. Davenport, 1926; Brazer, 1959; Census Bureau, 1951; Schmid, 1997). It was, therefore, hypothesized that the higher the population size, the higher the expenditures will be. Furthermore, changes in per capita expenditures and total population were expected to move in the same direction.

The hypothesis relied on the assumption that demands for more and improved public services will increase as the population of a community grows. The increase of demand for public services, holding quality of public services constant, will place more pressure on local government budget and will increase public service expenditures.

Most of the public services (public safety, water and sewer, and roads for example) are congestable goods with capacity constraints. These classes of goods may be having scale economies over a certain range of population and may have a zero marginal cost as the number of users increases from zero to some given number (capacity threshold). But, as population keeps increasing, the addition of more users reduces the utility of services and quality of life of all users and the marginal cost of additional users begins to rise. As the absolute capacity constraint is reached, the marginal cost of additional user will increase sharply (Randall, 1987). Then, governments are expected to invest more on public services and their related infrastructures to at least keep the quality and per user quantity of services constant when faced with growing population.

Diseconomies of scale may also be a factor that raises the expenditures of communities that have passed a certain population threshold. As the total population of a community increases beyond a certain level, different types of services may become economically feasible or necessary. Some communities may grow to a population size that may require them to provide their own services (like police and/or fire protection, for instance) instead of contracting from other agencies or jurisdictions. Or new types of land development that may have been necessitated by population growth (more multi-family dwellings vs single family dwellings, or more commercial developments vs residential developments) may require better and more fire trucks, more and wider streets than the existing ones, etc.

Most of the infrastructures of public services are lumpy in nature. At times, improving infrastructures and services by increment may not be possible. It may become necessary to totally scrap the old infrastructures and build new ones. This will cause a large capital expenditure. Furthermore, the per capita expenditures on the construction, maintenance, and service of these new lumpy infrastructures could stay high because it may take a while for the optimal number of people making use of them to settle.

Population could also have indirect impacts on expenditures through other factors that have direct relationship with expenditures. For instance, income could be a function of population (Brazer, 1959). Mostly, economic opportunities are higher where population is the highest. As a result, income could be high where economic opportunities are high. Then, the high income population could be more willing to demand and able to pay for higher quality of public services.

3.4.2 Population Growth Rate

Although it was assumed that the needs and demand for public services increase as the population of communities grow, it was hypothesized that expenditures and the rate of population growth will not necessarily flow in the same direction. Even if population may be growing at a faster rate, new expenditures on infrastructures may not be necessary as existing facilities could be used more intensively because the existing service facilities may have excess capacities, or simply budgetary allocations commonly do not keep pace with the expansion of service requirements (Brazer, 1959; Schmid, 1997). Budget allocation is a function of several factors, including political choices and tax payers willingness to finance the service investment. That means, the service expenditures do not necessarily grow proportionately with the rate of increase of population. Some earlier studies have indicated that governmental infrastructures and institutions, once established for minimum purposes, grow with population but at a rate less than population. Therefore, inverse relationship between population growth rate and expenditures was expected.

3.4.3 Population Density

Population density, as a measure of the extent to which people live close to each other, was considered in this study because levels of expenditures of the major public services were reported to be functions of density in several earlier studies. In the case of highways and streets, for example, it had been reported that as the density of population increases road per capita expenditure will decline (Colm, *et al*, 1936). As density increases per capita mileage of roads to be maintained should fall and it is unlikely that greater traffic volume resulting from higher density will offset this benefit (Brazer, 1959). On the other hand, the need for police and fire protection, for example, may be increasing as population density rises. Therefore, it is hypothesized that population density and total per capita public service expenditures are highly associated; but the sign of the correlation depends on the budget share of each functional category. If, for instance, police and fire protections constitute major share of the total public service expenditures, it should be expected that the sign of estimated coefficient and correlation would be positive.

3.4.4 Property Value and Land Use Characteristics

Land use in the State of Michigan could be divided into four major groups; agricultural, commercial, industrial, and residential. Different types of land use will require different types of public services. If, for instance, a community is characterized as rural and agricultural, its road, fire and police protection, or water and sewer requirements will be different from those of commercial or industrial communities. Industrial communities may require more governmental services than agricultural communities. The demands for highways, sanitary services, communication, protection, etc. increase inevitably with industrialization and urbanization. Therefore, it was hypothesized that there is a systematic relationship between land use and public service expenditures. Residential property is expected to have inverse relationship with expenditures whereas industrial and commercial properties will be positively related to expenditures.

The state equalized value of all types of properties are used as proxies to measure the impacts of land use characteristics on expenditures. Property value captures both the wealth and tax paying ability of a community and many earlier studies have established that general government expenditures of a community are closely related to income and wealth in that jurisdiction (Schmid, 1997). Therefore, since public services are predominantly determined by the resources available for expenditures, it was hypothesized that the value of total property will determine the relationship between the effective demand for public services and services provided by local governments.

3.5 Attributes of Services and Model Specification

Most of the past studies of public service expenditures have recognized the possible relationship between efficiency of governments and quantity and quality of services on the one hand and per capita public service expenditures of local governments on the other. But, they did not attempt or, may be, they were unable to develop a method of analyzing the association between these attributes of local government and public services and the associated expenditures. For example, the same amount of dollar outlays to construct a water and sewer infrastructure in different geographic or topographic areas may not produce the same physical amount or unit of infrastructure at these different places. If it did, then, the infrastructures at these different places must be of different quality or are done with a varying degree of efficiency. But, how can we measure this type of association between these attributes and expenditures at national, regional, state, or local levels? Unfortunately, much remains to be explored in solving this problem. Still to date, there is no meaningful statistical or any other empirical method that could be used to measure the different elements of these attributes and their impacts on public service expenditures (Colm, et al., 1936 ; Brazer, 1959; Schmid, 1997).

Consequently, this study analyzed impacts of selected economic variables on expenditures of local governments rather than on costs of a given quality and per capita quantity of services provided by local governments. Also, little data on service levels (per capita quantity of services provided) are available. For example, we may know the exact number of police officers in a given community and that number (and the expenditure) may appear to be too high in comparison with other similar community of equal size. But it will not be known if that community has decided to have that many officers because crime is more common in that community or just because the community chose to have a higher level of services such as faster response time.

3.6 Omitted Variables

Two revenue variables that were used by many of the earlier researchers were not considered in this study for several reasons. These variables were inter-governmental revenue transfers and household (family) income.

3.6.1 Inter-governmental Revenue Transfers

Does the source of revenue affect the level of expenditures? Or conversely, would there be difference in expenditures whether the expenditures are paid for by revenues from intergovernmental transfers or taxes collected from the residents? Intergovernmental revenue transfer was not specified as an independent variable in this study. However, it has been offered by some of the earlier researchers as one of the leading factors influencing the level of expenditures. Indeed, it was one of the major contributors to revenues of most of fast growing local governments in Michigan (over 20% for many of the cities and townships). Nonetheless, this analyst did not find it to be compelling to consider this variable in the model because he argues that changes in expenditures of local governments would flow in the same direction with changes in intergovernmental revenue transfers. If the revenue transferred to a local government from the state is high, that local government is now getting more money to spend on new services or to improve on the quality and quantity of existing services. If the revenue transferred is less, that local government will have less to spend. Unless it is intended to investigate whether intergovernmental revenue transfer is associated with other economic variables (say, population size, density, or growth rate), which was not the objective of this study, there was no need to consider it in the model as an independent regression variable apart from the other public revenues. Furthermore, it had been indicated in some of the earlier studies that intergovernmental revenues and per capita expenditures are significantly and positively correlated (Schmandt and Stephens, 1963; Woo Sik Kee, 1965).

3.6.2 Household (Family) Income

Some of the earlier studies have used household (family) income in their studies of public service expenditures. Using this variable may have not caused any significant problem in their analysis because: (1) they did not include other economic variables that have strong correlation with it in their models; and (2) they were using a single year cross-sectional data. However, this variable was excluded from the model of the current study exactly for the two reasons it was used by earlier researchers. First, a correlation analysis performed with the 1992 median household income in the 46 fast growing communities in Michigan showed a very high correlation (0.88) with the equalized value of residential property. Such high correlation creates a multicollinearity problem in the regression analysis and will make the model weak in explaining factors that drive the variations in expenditures of the communities . Second, household income data is neither available on yearly basis nor could it be projected. The current study requires the exact income data for the fifteen years period covered. Therefore, household income was dropped from the model and, instead, the equalized values of properties were used as proxy of wealth and income of the study communities.

3.7 Unit of Observation and Categories of Analysis

The analysis in this study was conducted using a local governments as a unit of observation. All the data were for municipalities and townships. However, in order to make a meaningful comparison by creating homogeneity among the units of analysis, the local governments were categorized by type of government (city or township), two general geographic locations (Southeast Michigan or Rest of State), and two arbitrary population size groups (equal to or more than 50,000 and less than 50,000).

3.7.1 Types of Government

Different local governments have different responsibilities and taxing power in provisions of public services. The two types of governments in Michigan that were included in this study are cities and townships. These governments operate under different laws and they are different in their distribution of public service responsibilities. For example, cities have to provide their own road and street services, while the responsibility of constructing and maintaining roads and streets in townships is assigned to the County Road Commission since 1931 (Delphendahl, 1961).

In most of the cases, cities have more responsibilities in providing public services to their residents when compared to townships and, as a result, they have higher expenditures. On average, in 1995, for instance, the sampled fast growing cities in Michigan spent more per resident than the townships. Townships may use some of the services provided by adjoining cities or counties free or with minimal pay. Consequently, they could have less expenditures.

Furthermore, cities and townships differ in their taxing power. For example, a charter township can levy 5 to 10 mills with a vote of the people, while cities may levy up to 20 mills. These differences in service provision responsibilities and revenue collection authority have significant impacts on the patterns and extent of expenditures. The seventeen cities and twenty nine townships included in this study have significant difference in expenditures. Therefore, cities and townships can not be mixed and compared..

3.7.2 Geographic Location

Location of a local government was used as a sub-category of comparison. It was expressed as whether a place is in Southeast Michigan (SEM) or Rest of the State. Southeast Michigan is the most populous region of the state where more than 50% of the population is currently residing. Cities and townships in this region are more clustered than anywhere in the state. That is, local governments in Southeast Michigan are located close to each other and exhibit a degree of settlement congestion. Per capita public service expenditures of communities in a relatively congested area would be expected to be higher because a considerable portion of the expenditures would be caused by residents of the adjoining communities. The residents of the adjoining communities are attracted by activities and facilities in that particular community. The effective population of a local government, where high settlement density is observed, is considerably greater than what is contained within the incorporated boundaries of that political jurisdiction (Hawley, 1952; Schmid, 1997).

The impacts of the economic variables in explaining expenditures by location was investigated by separating the sample cities and townships into the two locations mentioned above. Location does not vary from period to period and remains to be a constant in the panel. Moreover, the econometric model chosen for the study, *Fixed Effects* regression, does not allow the use of individual level covariates in the model. Therefore, it was not considered as an independent regression variable in the model.

3.7.3 Population Size Groups

Population has a unique position in the public service expenditures of all local governments. Unlike geographic location, for instance, it can serve as a sub-category of comparison and, because it varies from year to year, can be used as an independent variable of regression in the model at the same time. Many of the earlier studies have presented different reports on the association between expenditures and different sizes of population. The impact and ranking of the explanatory power of other variables, for instance, were reported in some of the earlier studies to have been dependent on the sizes of population. Thus, in order to comprehend the significance of the variable in shaping expenditures of communities, it was decided to thoroughly analyze the relationship between population and expenditures in this study at two levels with a data set that considers the continuos changes in population.

CHAPTER FOUR

ANALYTICAL METHODS FOR ESTIMATING DETERMINANTS OF VARIATIONS IN PUBLIC SERVICE EXPENDITURES

4.1 Introduction

The main purpose of this chapter is to develop an empirical method of estimating the determinants of per capita public service expenditures in the fast growing local governments in the State of Michigan. Two major tasks are accomplished in the chapter. First, the data used in the empirical analysis are described in detail and all the procedures and processes involved in cleaning, adjusting, and organizing all the data are presented in several sub-sections. Finally, the econometric method employed for the analysis is discussed and the regression equation is developed.

4.2 The Data

The data used in this study include: US Census population figures of 1980 and 1990 for all the fast growing communities in Michigan and the 1994 population projection of the Michigan Department of Management; public service expenditures of all service categories (general government, public safety, public works, recreation and culture, capital outlay, debt service, etc) from the Comprehensive Annual Financial Report (1981 to 1995) of the forty-six communities; state equalized value of agricultural, commercial, industrial, personal, and total properties (1981 - 1995) of the all the forty-six communities; public safety data of 1990 and 1995 for all cities and townships in the study; and roads and streets expenditure for selected communities.

4.2.1 Population

The study covered the period between 1981 to 1995. Population data of the US Census Bureau were only available at ten years interval and the 1980 and 1990 population figures were used to determine the fast growing local governments that were included in the study. Communities with a population greater than 5,000 and had grown by 1,000 people between 1981 and 1990 were purposefully defined as fast growing local governments. However, townships of Alpine in Kent County and Muskegon and Fruitport in Muskegon County, which have grown by less than 1,000 residents, were included in the study for the purpose of having a reasonable geographic distribution and representation of the local governments in the study. That brought the total number of local governments in Michigan defined as fast growing communities to sixty-nine (17 cities and 52 townships). While all the seventeen cities (100%) were included in the study, a sample of twenty-nine townships out of total population of fifty-two (56%) were selected. These twenty-nine townships fairly represent different population sizes and geographic locations.

Table 4.1: All Fast Growing Cities in Michigan, 1980 - 1990

City	Pop 1980	Pop 1990	Pop Change 1980 - 1990
Sterling Hts	108,999	117,810	8,811
Portage	38,157	41,042	2,885
Wyoming	59,616	63,891	4,275
Troy	67,102	72,884	5,782
Farmington Hls	58,056	74,652	16,596
Rochester Hill	40,779	61,766	20,987
Kentwood	30,438	37,826	7,388
Novi	22,525	32,998	10,473
Holland	21,767	25,086	3,319
Grandville	12,412	15,624	3,212
Walker	15,088	17,279	2,191
Aubrn Hls	15,598	17,076	1,478
Wixom	6,705	8,550	1,845
Marysville	7,345	8,515	1,170
Lapeer	6,198	7,759	1,561
Brighton	4,268	5,686	1,418
Walled Lake	4,748	6,278	1,530

Table 4.2: All Fast Growing Townships in Michigan, 1980 - 1990

Township	*Pop 1980*	*Pop 1990*	*Pop Change 80 - 90*
Clinton	72,400	85,866	13,466
Shelby	38,939	48,655	9,716
Waterford	64,437	66,692	2,255
W. Bloomfield	41,962	54,516	12,554
Canton	48,616	57,040	8,424
Meridian	28,754	35,644	6,890
Georgetown	26,104	32,672	6,568
Delta	23,822	26,129	2,307
Plainfield	20,611	24,946	4,335
Chesterfield	18,276	25,905	7,629
Harrison	23,649	24,685	1,036
Macomb	14,230	22,714	8,484
Commerce	23,757	26,955	3,198
Independence	21,537	24,722	3,185
Orion	22,473	24,076	1,603
Van Buren	18,940	21,010	2,070
Delhi	17,144	19,190	2,046
Holland	13,739	17,523	3,784
Pittsfield	12,997	17,668	4,671
Northville	12,987	17,313	4,326
Garfield	8,747	10,500	1,753
Allendale	6,080	8,022	1,942
East Bay	6,212	8,307	2,095
Oshtemo	10,958	13,401	2,443
Alpine	8,934	9,863	929
Byron	10,104	13,235	3,131
Cascade	10,120	12,869	2,749
Gaines	10,364	14,533	4,169
Grand Rapid	9,294	10,760	1,466
Sparta	6,934	8,447	1,513
Hamburg	11,318	13,083	1,765
Washington	10,213	13,083	2,870
Brandon	9,526	12,051	2,525
Lyon	7,078	9,450	2,372
Milford	10,187	12,121	1,934

Table 4.2: (Cont'd)

Township	Pop 1980	Pop 1990	Pop Change 80 - 90
Oxford	10,569	11,933	1,364
Springfield	8,295	9,927	1,632
Grand Haven	7,238	9,710	2,472
Park	10,354	13,541	3,187
Antwerp	7,744	9,293	1,549
Scio	8,029	11,077	3,048
Fruitport	10,646	11,485	839
Muskegon	14,557	15,302	745
Kinross	1,891	6,566	4,675
Long Lake	3,823	5,977	2,154
Texas	5,643	7,711	2,068
Ada	6,472	7,578	1,106
Algoma	4,411	5,496	1,085
Caledonia	4,927	6,254	1,327
Cannon	4,983	7,928	2,945
Ira	4,316	5,587	1,271
Northfield	4,672	6,732	2,060

Table 4.3: Townships Selected for the Study.

Clinton	Delhi
Shelby	Holland
Waterford	Pittsfield
W. Bloomfield	Northville
Canton	Alpine
Meridian	Cascade
Georgetown	Grand Rapid
Delta	Sparta
Plainfield	Milford
Chesterfield	Fruitport
Harrison	Muskegon
Macomb	Long Lake
Commerce	Ira
Orion	Northfield
Garfield	

A simple arithmetic method was used to compute the annual total population of each community. The annual population growth rate between 1980 - 1990 was obtained by computing the percentage change between 1980 and 1990 and dividing that by 10: $[(pop_{90} - pop_{80})/pop_{80}]/10$. The annual total population between 1980 and 1990 were interpolated by multiplying the preceding year's population by one plus the annual growth rate. For instance, if the annual growth rate of a community was 2%, 1981 population of that community will be 1980 population plus the computed annual growth,

i.e., $pop_{(81)} = pop_{(80)} \times (1+0.02)$.

Similar calculation was used for the period between 1991 and 1994 on the basis of the 1994 population projection of the Michigan Department of Management and Budget. The population figures of all the communities for 1995 were extrapolated by using the same growth rate calculated for the period between 1991 and 1994.

4.2.2 Expenditures

Tables 4.4 through 4.8 display the expenditures data for fifteen years period (1981-1995) obtained from Comprehensive Annual Financial Report (CAFR) and annual audit of local governments[1]. CAFR are prepared by certified independent public accountants and are approved by Michigan Department of Treasury. A 1994 revenue-expenditure balance sheet of all Governmental Funds Types for Meridian Township was

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[1] There were few instances, like in the case of City of Walker, Kent County, where CAFR of some years were missing. Interpolation of estimated expenditures based on the averages of the preceding and succeeding years in conjunction with data from F-65 for the missing years had been applied to complete the data requirements.

presented in Table 4.4 as an example of a typical financial statement for a local government in Michigan.[2]

A closer look at the CAFR of all the local governments indicates that their revenue-expenditure accounts are organized on the basis of different types of funds and account groups. A fund is a separate accounting entity with a self-balancing set of accounts. Each of the account groups are considered a separate accounting entity and contain information related to assets, liabilities, fund equity, revenues, and expenditures. Public resources are allocated to an individual type of fund based upon the purpose for which they are to be used. They are grouped into seven fund types (General Funds, Special Funds, Debt Service Funds, Capital Project Funds, Enterprise Funds, Internal Service Funds, Trust Funds). These fund types are grouped within three broad categories; namely, Government Funds, Proprietary Funds, and Fiduciary Funds.

The Government Funds, the only funds category used in this study, is for those funds through which most typical governmental functions are financed. As shown in Table 4.4 above, four types of government funds are included in this category: General Fund; Special (Selected) Revenue Funds; Debt Service Funds; and Capital Projects Funds. Debt Service Funds are not used in the empirical analysis for reasons explained elsewhere in this chapter.

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[2] All the sample tables and figures on expenditures and state equalized values of properties presented in this chapter are those of Meridian Township. There is no particular reason why Meridian is chosen over the other local governments. The same tables and figures are done for all the 46 local governments included in this study. It is decided to stick to one local government for the purpose of showing the logic and sequence of cleaning, adjusting, and organizing the data. All data pertaining to the 1994 fiscal year are highlighted.

4.2.2.1 General Fund

This is the basic and primary operating fund for general government operations. It records financial resources used for day-to-day general government service activities, such as municipal administration, public safety, parks and recreation, environmental health, etc. This fund receives the majority of its financing from such sources as property taxation, state shared revenues, fees and charges for services, investment income, and an annual operating transfer from other departmental funds in accordance with provisions in the governmental charter.

Table 4.4: Combined Statement of Revenues and Expenditures, Meridian Township, 1994

Revenues	General Fund	Special Fund	Debt Service	Capital Project
Taxes	5,814,445		335,991	
License and permits	276,873			
Intergovernmental	2,626,085			
Charges for services	954,225			718,470
Interest	258,855	32,773	67,886	136,765
Special assessments		81,094	155,178	
other	389,060			
TOTAL REVENUES	**10,319,543**	**113,867**	**559,055**	**855,235**
EXPENDITURES				
Current:				
Legislative	130,740			
General government	2,614,675	2,285		
Public service				
Public safety	5,633,909			
Public works	414,553			
Health and welfare				
Recreation and Cultural	46,009			
Other	128,392			182,184
Capital Outlay	304,826	8,550		653,395
Debt Service				
Principal		5,000	1,229,545	
Interest and fees	4,416		429,955	
Total Expenditures	**9,700,084**	**15,835**	**1,659,500**	**835,579**
Other Financing Sources				
Operating transfers in		80,552	391,675	100,000
Operating transfers out	(88,552)			(1,984,675)
Bonds issue proceeds				1,575,000
Loan proceeds	113,210			
Total Other financing	24,658	80,552	391,675	(309,675)
Excess (Deficiency)	644,117	178,584	(708,770)	(290,019)
Fund Balance, beginning	756,888	442,396	1,105,019	3,362,864
Fund Balance, end	**1,401,005**	**620,980**	**396,249**	**3,072,845**

4.2.2.2 Special Revenue Funds

These are fund types used to account for the proceeds of specific revenue sources (other than special assessments, expendable trusts, and major capital projects) that are legally restricted to expenditures for specified purposes. They include funds like the Highway and Major Streets Fund, Highway and Local Streets Fund, both established by State of Michigan Public Act 51 of 1951, County Road Tax Fund established by the State of Michigan Public Act 283 of 1909, Public Library Fund, Police Criminal Justice Training Fund, etc.

4.2.2.3 Debt Service Funds

These are fund types used to account for the accumulation of resources for and the payment of principal, interest, and related costs of general long-term debt obligation and special assessment long-term debt. The general obligation debt service fund accounts for the servicing of current maturity requirements (that include principal, interest, and agent fees) on general obligation bonds like building authority bonds and other bonds issued by Authority of State of Michigan Act 40. The revenues to finance such debt service obligations are derived from property taxation, transfers from other funds, and investment income. Special assessment debt service funds account for the servicing of outstanding long-term debt in the form of special assessment bonds. Revenues to finance these debt service obligations arise from special assessments levied against benefiting property owners in approved special assessment districts for which the bonds were originally issued.

4.2.2.4 Capital Projects Funds

These are funds used to account for financial resources utilized for the acquisition or construction of major capital assets or infra-structures other than those projects financed by Proprietary Funds and Expendable Trust Funds. Financing for these kinds of projects include operating transfers from other funds, special assessments, private sector donations, and grant funding. Each of the projects in this group of funds are normally budgeted and accounted for as multi-fiscal year to encompass revenues and expenditures that span the entire open period of the specific project from inception to completion. However, project revenues and expenditures are also recognized by individual fiscal year for annual financial purposes.

4.2.3 Adjusting Expenditures

Although the data in the CAFR of the local governments are of high quality and reliable, they needed to be adjusted and rearranged in a way that they fit the objectives of the study. Consequently, some of the data specific to some service categories were excluded; some of the fund types and categories were netted out; all of the expenditures and equalized values of property data were adjusted for inflation; and the capital project expenditures were amortized.

4.2.4 Excluded Fund Types

Three types of funds were purposefully excluded from the study. They were Enterprise Funds, Internal Service Funds, and Fiduciary Funds. The first two types of funds are used to account for the local government's ongoing organizations and activities similar to those found in the private sector. They are accounted for on a cost of service or capital maintenance measurement focus. All assets and liabilities associated with their activity are included on their balance sheets, and operating statements present increases and decreases in net total assets.

Enterprise funds account for: (a) operations that are financed and operated in a manner similar to business entities, where the intent of the service provider is that the expenses, including depreciation, of providing goods and services to the general public on a continuing basis be financed primarily through user charge; or, (b) operations where the governing body has decided that periodic determination of revenues earned, expenses incurred, and/or net income is appropriate for capital maintenance or other purposes. Examples of such funds are water and sewer fund, power utility funds, parking lots fund, municipal airport fund, depot operations fund, and recycling pickup fund.

Internal Service Funds are used to account for the financing of goods and services provided by one department or activity of a city or township to other departments or activities of the government; and/or to other governmental units on a cost-reimbursement basis. These funds are established, managed, and operated as a proprietary type operation, providing financial accountability for (a) operating and non-operating revenues and expenses, (b) current assets, restricted assets, capital assets, liabilities, and fund equity.

Examples of these funds include information services fund, equipment revolving fund as mandated by State of Michigan Act 51 of 1951, postage services fund, telephone services fund, fire vehicle and equipment fund, vehicle and property insurance fund, health and dental insurance fund etc.

Fiduciary Funds, also referred to as Trust and Agency Funds, are used to account for assets held by the local government in a trustee capacity or as an agent for individuals, private organizations, other governments, and/or other funds. These include Expendable Trust, Non-expendable Trust, and Agency funds. The Expendable Trust Fund is accounted for in essentially the same manner as a Governmental Fund, which means both principal and earnings are spendable. The Pension Trust Fund is accounted for in the same manner as Proprietary funds (only earnings are spendable). The Agency Funds are custodial in nature and do not involve measurement of results of operations. Disbursements from these funds are made in accordance with trust agreements or applicable legislative enactment for each individual fund. Examples of these funds are: Expendable Trust Funds: utilities guaranteed fund, police community relations fund, and municipal airport donations fund; Non-expendable Trust Fund: cemetery perpetual care fund, library endowment fund; and Agency Fund: current tax collections fund, employee deferred compensation plan fund, and employee flexible spending fund.

Moreover, including Enterprise Funds such as water and sewer fund creates problem when comparing expenditures across communities. The service boundaries of such service categories may not necessarily coincide with the political boundaries of local governments (Schmid, 1997). Some local governments may not serve all the residents of their political boundary and others may extend the service to residents of other political jurisdictions. Pittsfield Township, for instance, has an area where its sewer service does not reach and those residents use their own septic systems. On the other hand, the water authority of the Detroit Metropolitan Water authority is serving many of the local governments in Southeast Michigan.

4.2.5 Netting Out Expenditures

A special care was taken to avoid double counting and over stating expenditures. The special revenue and debt service sections of the expenditures account present such a problem. Debt service appears as both functional category and fund types at the same time (see Table 4.4). It accounts for principal retirement and interest and fees paid out of both the special revenue and debt service funds.

It was assumed here that debt services are mostly related to capital project outlays. Careful examination of the CAFR of each local government in the study did not indicate otherwise. Moreover, capital project outlays are significant in the calculation of expenditures of all local governments. For example, the beginning and ending fund balances of the 1994 financial statement of Meridian Township indicate that the capital project fund accounts for more than 50% of the total Ending Fund Balance. Similarly, the financial statements of the 46 local governments for the fifteen years show that capital projects outlay is an essential part of local governments expenditures. Unlike most of prior studies that have ignored it, it is deemed necessary to consider the capital project expenditures along with the total operating expenditures of all local governments in the study.

However, including both the capital project outlays and debt service expenditures in the calculation of the total capital project expenditures poses the problem of overstating the total expenditures of the local governments. The debt service expenditures could include: (1) the capital outlays incurred prior to the study period; and (2) part of payment on capital project expenditures already entered under its own fund type, depending on when such expenditure was incurred in the fiscal year. Hence, it was necessary to: (1) exclude the debt service fund all together; (2) net out the capital outlay expenses in the special revenue account; and (3) amortize all entries under the capital project funds to account for only the study period expenditures and avoid over/under stating yearly expenditures. Table 4.6 was presented below to show the necessary first step in adjusting public service expenditure accounts, especially columns e and f.

5.2.6 Inflation Adjustment

The operating and capital project expenditures of all the study communities were adjusted by a national index of deflators shown in Table 4.5. This was done for the purpose of accounting for inflation and generating comparable expenditure figures in terms of constant dollars. The operating and capital project expenditures have different deflators and were computed accordingly. For example, in 1994 Meridian Township had a total operating expenditures of $9,710,919 (Table 4.6). When adjusted for inflation, the expenditure was equal to $10,011,257 in 1995 dollars. Adjusted and amortized total expenditures of Meridian Township are displayed in Table 4.7 as a sample. It must be noted, however, that the adjustment of capital project expenditures was different from that of operating expenditures. It involved two steps of operations. First, the yearly total capital project expenditures were amortized. Then, the amortized yearly expenditures were adjusted by the corresponding deflators. This will be discussed in the next section.

Table 4.5: Deflators of Operating and Capital Project Expenditures

Year.	Operation Exp. Deflator (%)	Capital Project Exp. Deflator (%)
1981	59.5	73.1
1982	63.1	73.4
1983	65.5	74.0
1984	68.7	76.4
1985	71.6	80.6
1986	73.9	82.2
1987	76.6	83.0
1988	79.9	86.8
1989	83.2	89.5
1990	86.7	91.0
1991	89.7	91.6
1992	92.2	91.5
1993	94.6	93.6
1994	97.0	96.7
1995	100.0	100.0

Source: Survey of Current Businesses

Table 4.6 Unadjusted Public Service Expenditures of Meridian Township , 1981 - 1995

	Gen Fund a	Sp. Fund Tot b	Prin Ret c	Int. Chg d	Net Sp. Fund (b-c-d) e	Tot Oper. Exp. (a+e) f	Cap. Proj. g
1981	3,668,436	26,578	16,096	10,482	-	3,668,436	99,472
1982	4,292,643	55,781	16,515	10,250	29,016	4,321,659	236,613
1983	3,780,334	669,673	23,812	4,237	641,624	4,421,958	97,717
1984	4,196,108	651,369	23,769	61	627,539	4,823,647	1,873,457
1985	4,960,567	474,636	19,702	80	454,854	5,415,421	316,631
1986	5,678,377	53,806	19,703	75	34,028	5,712,405	377,991
1987	5,810,477	61,885	17,228	-	44,657	5,855,134	43,447
1988	6,112,932	42,615	10,222	-	32,393	6,145,325	35,976
1989	6,855,610	25,124	15,217	9,907	-	6,855,610	30,536
1990	7,604,565	57,753	5,000	52,753	-	7,604,565	1,242,594
1991	8,779,804	62,242	5,000	-	57,242	8,837,046	1,477,270
1992	9,056,282	742,602	5,000	-	737,602	9,793,884	440,707
1993	9,627,854	430,094	5,000	-	425,094	10,052,948	83,216
1994	9,700,084	15,835	5,000	-	10,835	9,710,919	835,579
1995	9,052,483	858,182	57,911	24,786	775,485	9,827,968	605,378

Source: Charter Township of Meridian, Comprehensive Annual Financial Report, (1981 - 1995)

4.2.7 Amortization

As noted above, the capital project expenditures of all the study communities were standardized by amortizing the actual capital spending that had occurred during the study period. The amortization was for 30 years period at a fixed 5% interest rate. This approach was selected for several reasons. First, it showed the underlying production cost of services without confusing them with how local governments might have decided to finance them (Schmid, 1997). Second, each year's capital project spending is distributed into the future, mostly 30 years, through bond issuance and similar means. Although actual cash disbursement in full amount of the project cost might have taken place during one fiscal period of a local government, assigning the total amount of that disbursement to that particular year's expenditure will be overstatement. Analogously, it will be under statement of the expenditures of the subsequent years. Third, the total expenditures of the study period will not be affected by expenditures prior to 1981 because debt service expenses were netted out.

The amortization process is depicted in Tables 4.8 and 4.9 below. For example, if the 1981 Meridian Township capital project expenditure of $99,472 is amortized for 30 years at 5% interest rate, there will be equal annual payments of $6,471 each year for 30 years before inflation adjustment. The capital project expenditures entered for each of the fifteen years were the horizontal sums of the amortized and adjusted capital project expenditure in Table 4.7. For example, the 1994 capital project expenditure of Meridian Township is $483,762. This is the sum of all the annual capital project payments from 1981 to 1994. But, in 1994 Meridian Township had incurred an actual spending of

Table 4.7: Adjusted and Amortized Total Expenditures of Meridian Township

Year	Op Exp.	CP Exp.	Adjusted Op Exp.	Adjusted Amortized CP Exp.
1981	3,668,436	99,472	6,165,439	8,852
1982	4,321,659	236,613	6,848,905	29,786
1983	4,421,958	97,717	6,751,081	38,134
1984	4,823,647	1,873,457	7,021,320	196,454
1985	5,415,421	316,631	7,563,437	211,771
1986	5,712,405	377,991	7,729,912	237,563
1987	5,855,134	43,447	7,643,778	238,678
1988	6,145,325	35,976	7,691,270	230,925
1989	6,855,610	30,536	8,239,916	226,178
1990	7,604,565	1,242,594	8,771,125	311,277
1991	8,837,046	1,477,270	9,851,779	414,149
1992	9,793,884	440,707	10,622,434	445,934
1993	0,052,948	83,216	10,626,795	441,712
1994	**9,710,919**	**835,579**	**10,011,257**	**483,762**
1995	9,827,968	605,378	9,827,968	507,179

$835,579 (see Tables 4.4, 4.5, 4.7, and 4.8). Out of this $835,579, it is only the amortized and adjusted value of $56,211 that entered as part of the 1994 capital project expenditures (see Table 4.9). The amortized balance of this $835,579 actual spending (excepting the payment of $54,356 in 1995) will be carried into future periods that are outside the time range of this study. The grand total expenditures of all the study communities was computed by summing the total operating and capital project expenditures reported in Table 4.7 after completing all the netting out of the total operating expenditures, amortizing the capital project expenditures, and adjusting both expenditures for inflation. Each year's grand total expenditures were divided by the corresponding total population to obtain the total per capita public services expenditures (see Table 4.10)

Table 4.8 Amortized and Nominal Capital Project Expenditures of Meridian Township, 1981 - 1995

Yr.	CP Exp.	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1981	99,472	6,471														
1982	236,613	6,471	15,392													
1983	97,717	6,471	15,392	6,357												
1984	1,873,457	6,471	15,392	6,357	121,871											
1985	316,631	6,471	15,392	6,357	121,871	20,597										
1986	377,991	6,471	15,392	6,357	121,871	20,597	24,589									
1987	43,447	6,471	15,392	6,357	121,871	20,597	24,589	2,826								
1988	35,976	6,471	15,392	6,357	121,871	20,597	24,589	2,826	2,340							
1989	30,536	6,471	15,392	6,357	121,871	20,597	24,589	2,826	2,340	1,986						
1990	1,242,594	6,471	15,392	6,357	121,871	20,597	24,589	2,826	2,340	1,986	80,833					
1991	1,477,270	6,471	15,392	6,357	121,871	20,597	24,589	2,826	2,340	1,986	80,833	96,099				
1992	440,707	6,471	15,392	6,357	121,871	20,597	24,589	2,826	2,340	1,986	80,833	96,099	28,669			
1993	83,216	6,471	15,392	6,357	121,871	20,597	24,589	2,826	2,340	1,986	80,833	96,099	28,669	5,413		
1994	**835,579**	**6,471**	**15,392**	**6,357**	**121,871**	**20,597**	**24,589**	**2,826**	**2,340**	**1,986**	**80,833**	**96,099**	**28,669**	**5,413**	**54,356**	
1995	605,378	6,471	15,392	6,357	121,871	20,597	24,589	2,826	2,340	1,986	80,833	96,099	28,669	5,413	54,356	39,381

Table 4.9 Amortized and Adjusted Capital Project Expenditures of Meridian Township, 1981 - 1995

Yr.	CP Exp.	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1981	8,852	8,852														
1982	29,786	8,816	20,970													
1983	38,134	8,744	20,800	8,590												
1984	196,454	8,470	20,147	8,320	159,517											
1985	211,771	8,028	19,097	7,887	151,205	25,555										
1986	237,563	7,872	18,725	7,733	148,262	25,058	29,913									
1987	238,678	7,796	18,545	7,659	146,833	24,816	29,625	3,405								
1988	230,925	7,455	17,733	7,323	140,404	23,730	28,328	3,256	2,696							
1989	226,178	7,230	17,198	7,102	136,169	23,014	27,474	3,158	2,615	2,219						
1990	311,277	7,111	16,914	6,985	133,924	22,634	27,021	3,106	2,572	2,183	88,827					
1991	414,149	7,064	16,804	6,940	133,047	22,486	26,844	3,085	2,555	2,169	88,245	104,911				
1992	445,934	7,072	16,822	6,947	133,192	22,511	26,873	3,089	2,558	2,171	88,342	105,026	31,332			
1993	441,712	6,913	16,444	6,791	130,204	22,006	26,270	3,020	2,500	2,122	86,360	102,669	30,629	5,783		
1994	**483,762**	**6,692**	**15,917**	**6,574**	**126,030**	**21,300**	**25,428**	**2,923**	**2,420**	**2,054**	**83,591**	**99,378**	**29,647**	**5,598**	**56,211**	
1995	507,179	6,471	15,392	6,357	121,871	20,597	24,589	2,826	2,340	1,986	80,833	96,099	28,669	5,413	54,356	39,381

Table 4.10 Per Capita Public Service Expenditures of Meridian Township

Year (a)	Grand Total Exp. (b)	Population (c)	Total Exp. Per Capita (b/c)
1981	6,174,291	29,443	210
1982	6,878,691	30,132	228
1983	6,789,215	30,821	220
1984	7,217,774	31,510	229
1985	7,775,209	32,199	241
1986	7,967,475	32,888	242
1987	7,882,456	33,577	235
1988	7,922,196	34,266	231
1989	8,466,094	34,955	242
1990	9,082,402	35,644	255
1991	10,265,929	35,770	287
1992	11,068,368	35,896	308
1993	11,068,507	36,022	307
1994	**10,495,019**	**36,148**	**290**
1995	10,335,147	36,274	285

4.2.8 State Equalized Value of Properties

The fifteen years state equalized value of properties in the forty-six local governments were collected directly from the report of State Tax Commission, Department of Treasury. Following the same procedure of inflation adjustment, all of the equalized values were adjusted by the capital expenditure deflators. The section labeled "other" includes properties listed under Timber-Cut-over Real Property, Developmental Real Property, and Personal Property. The first two real properties are seldom available in all the communities and were very insignificant. They were added with Personal Property and labeled "Other" just to account for 100% equalized property value in a community.

Table 4.11: State Equalized Value of Properties, Meridian Township, 1981 - 1995

Yr.	Agricultural	Commercial	Industrial	Residential	Other (Personal)	Total
1981	1,613,680	94,734,747	1,659,781	293,176,197	20,123,803	411,308,208
1982	1,537,330	110,551,499	1,777,520	336,425,674	21,872,480	472,164,503
1983	1,615,676	118,987,432	2,089,459	336,264,189	25,292,973	484,249,730
1984	1,301,963	117,537,696	1,729,319	340,026,309	26,001,832	486,597,120
1985	1,240,695	121,415,261	1,709,677	336,287,345	26,698,635	487,351,613
1986	1,141,363	120,506,691	1,763,260	344,689,294	28,172,749	496,273,358
1987	1,116,386	126,547,229	1,728,313	377,020,602	31,988,434	538,400,964
1988	1,126,037	147,769,700	1,855,530	428,123,502	38,203,341	617,078,111
1989	1,071,844	155,746,145	1,844,581	486,192,961	41,163,911	686,019,441
1990	683,407	169,502,637	2,195,495	536,495,604	45,009,670	753,886,813
1991	712,882	196,199,891	2,673,035	582,643,231	48,819,323	831,048,362
1992	676,612	199,558,142	2,686,448	602,218,256	49,346,120	854,485,578
1993	1,323,932	208,894,444	2,501,282	636,589,530	48,635,363	897,944,551
1994	1,004,550	201,243,226	3,539,917	638,557,446	49,305,895	893,651,034
1995	1,231,100	213,711,600	3,377,400	655,350,400	50,729,800	924,400,300

Source: State Tax Commission, 1981 - 1995

4.2.9 Population Density

Population density was one of the significant variables in the empirical analysis of this study. The yearly population densities were calculated by dividing the total population by the land area of the communities. Table 4.12 shows the changes in annual population density of Meridian Township as an example while Table 4.13 displays the total land area of each local government in the study,. Similar population density tables were prepared for all the study communities.

Table 4.12: Total Land Area and Population Density of Meridian Township

Year	Land Area (sq. mile)	Density (persons/Sq. Mile)
1981	33	892
1982	33	913
1983	33	934
1984	33	955
1985	33	976
1986	33	997
1987	33	1,017
1988	33	1,038
1989	33	1,059
1990	33	1,080
1991	33	1,084
1992	33	1,088
1993	33	1,092
1994	33	1,095
1995	33	1,099

Table 4.13: Land Area of the Fast Growing Local Governments in the State of Michigan

City/Township	Land Area	City/Township	Land Area	City/Township	Land Area
Sterling Hts (C)	36	Delta (T)	35	Fruitport (T)	30
Troy (C)	36	Delhi (T)	28	Cascade M (T)	35
Farmington Hills (C)	33	Commerce (T)	30	Alpine (T)	36
Clinton (T)	28	Chesterfield (T)	28	Marysville (C)	6
Wyoming (C)	26	Macomb (T)	36	Lapeer (C)	6
Waterford (T)	36	Holland (T)	30	Grand Rapid (T)	16
Shelby (T)	35	Holland (C)	14	Garfield (T)	28
Rochester Hills (C)	36	Pittsfield (T)	33	Wixom (C)	10
Canton (T)	36	Plainfield (T)	36	Sparta (T)	36
W. Bloomfield (T)	30	Orion (T)	57	Milford (T)	36
Portage (C)	38	Walker (C)	27	East Bay (T)	39
Novi (C)	31	Northville (T)	18	Walled Lake (C)	3
Meridian (T)	33	Muskegon (T)	23	Long Lake (T)	36
Kentwood (C)	23	Grandville (C)	17	Ira (T)	19
Georgetown (T)	41	Auburn Hills (C)	18	Brighton (C)	4

Source: (1) Department of State Police, Fire Marshal Division, 1996,
(2) Michigan Fire Service Directory, 1995-96, Lansing, Michigan;
(3) Telephone survey by the author (December, 1996)

4.3 The Empirical Method of Analysis

The data set used in this study is interchangeably called panel, longitudinal, or cross-section time-series data. Fifteen years of observations on cross-section of forty-six local governments, a total of 690 observations, were made available. There were sixty-nine local governments that qualify as fast growing communities according to the definition adopted for this particular study. Forty-six local governments representing different population sizes, geographic location, and government types were selected as samples.

Two major inferences were drawn from earlier studies that relate to this research. The first one was that variations in public service expenditures across communities can not be fully explained by an analysis of a historical data for a single variable of observation (a local government in this case) over a certain period of time only. This suggested that a time-series analysis that uses a set of observation drawn from one observational variable at a number of points in time should not be used alone. Secondly, an observation of a single year data of many observational variables did not help to produce consensus on factors explaining the variations in public service expenditures. Consequently, cross-section analysis that uses a sample of a number of observational variables all drawn at the same point in time should not be used alone. Therefore, panel data, that comprises both cross-sectional and time-series data, was collected and organized and a corresponding panel data analysis technique that combines the above two methods of analysis in a single econometric equation was employed.

4.3.1 The *Fixed Effects* Econometric Model

The econometric model used to analyze this data set is called the *Fixed Effects* model. Indeed, there is one other model, the Random Effects model, that could have been considered as an alternative to the use of *Fixed Effects* model. But, because (a) the random effects model presupposes the existence of an overall intercept for all units of observation (local governments), and (b) it assumes that the random error associated with each cross-section unit is uncorrelated with other or missing regressors, it is not applicable for this particular study. For instance, if public service expenditures per capita is regressed on total number of population, and that demography (which is actually a missing variable in this particular study) can affect the intercept, then, running the regression with random effect model will create correlation between the error term and population, because population and demography are likely to be correlated. The fixed effect model, however, avoids these sorts of problems and produces results conditional on the units in the data set only (Greene, 1997).

Moreover, while Random Effects model is suitable for a small sample data drawn from a larger population at random, *Fixed Effects* is usually used for a data set that exhausts the population (Kennedy, 1992). In the case of this study, the sample data set used exhausts the population in that it consists of all the cities (100%) and twenty-nine of the fifty-two townships (56%). Therefore, the choice and use of the *Fixed Effects* model was justified.

4.3.2 Assumptions of the *Fixed Effects* Regression

The use and application of the *Fixed Effects* regression technique in this study are based on the three basic assumptions of the model: heterogeneity, stochastic relationship, and residuals.

4.3.2.1 Heterogeneity of Units of Observations.

Heterogeneity across the observation units in the context of this study was considered to be essential. It was based on the assumption that the constant term, α_i, of the regression equation (model) vary across the local governments and the time periods and the differences across units can be captured in differences in the term.

4.3.2.2 Stochastic Relationship

Preliminary observation of the expenditure data set showed that the relationship between the public service expenditures and the explanatory/independent variables were not fixed, exact, or deterministic. Since the study was conducted under a non-experimental and uncontrolled environment, it was necessary to assume that the relationship between the explanatory variables and the dependent variable (the per capita public service expenditures) are stochastic in nature.

4.3.2.3 The Residuals

This is a critical assumption in that it is based on the assertion that the relationship between the dependent and the independent variables of the model is significantly influenced by the disturbance or error terms (commonly called residuals). In other words, the estimation of the unknown α and β parameters of the independent variables largely depends on the nature of the error terms.

Error terms could arise in this study from one or combinations of the following factors. First, several variables (like demography and politics, for instance) that may have systematic and/or irregular influences on public service expenditures were not included in the model. This omission could constitute specification error that leads to inaccurate estimation of the economic relationship between public service expenditures and the independent variables.

Second, because of data collection difficulties and the inherent measurement problems in some of the variables, measurement errors could be committed. For example, the figures used for density were more or less approximation. That is, besides dividing the total population by the total land area of the local governments, the exact measure of density for the communities was not available.

Third, people decided public service expenditures. Usually, people randomly make different decisions under identical circumstances that can not be explained or measured with identifiable variable. The *Fixed Effects* regression technique, by taking all these assumptions into consideration, performs a complex statistical analysis that controls these and similar error terms and yield more reliable empirical results.

4.3.3 Mathematical Representation of the Fixed Effects Model

The basic framework of the *Fixed Effects* model utilized here to describe the average relationships between the dependent and the independent variables was as developed by William Gould (1997) and Greene (1997):

$$y_{it} = \alpha + \beta x_{it} + v_i + \varepsilon_{it} \qquad (1)$$

where:

y_{it} = dependent variable (per capita public service expenditures of unit *i* at time *t*)
x_{it} = vector of all independent (explanatory) variables (of unit *i* at time *t*)
α = constant (intercept)
β = estimated coefficients of the independent variable
v = unit-specific residual (differs between *i* units but constant for any particular unit)
ε = "usual" residual (with mean 0, uncorrelated with itself, uncorrelated with *v*, and homoscedastic)

From equation (1) it follows that

$$\bar{y}_i = \alpha + \bar{x}_i\beta + v_i + \varepsilon_i$$

where:

$\bar{y}_i$, $\bar{x}_i$, and ε_i are averages of y_{it}, x_{it}, and ε_{it}. In other words, they are within-group means.

Subtracting equation (2) from (1), we obtain

$$y_{it} - \bar{y}_i = (x_{it} - \bar{x}_i)\beta + (\varepsilon_{it} - \bar{\varepsilon})_i \qquad (3)$$

Equation (3) is the most common form of the *Fixed Effects* estimator. But, in this formula, α remains unestimated. Therefore, with further mathematical manipulation, it follows from equation (1) that

$$\hat{y} = \hat{x}\beta + \bar{v} + \hat{\varepsilon} \tag{4}$$

where

$\hat{y}$, $\hat{x}$, $\bar{v}$, and $\hat{\varepsilon}$ are the grand averages of y_{it}, x_{it}, v_i, and ε_{it}.
The computation of the grand averages follows the formula,

$$\hat{y} = \{(\sum_{i=1}^{n}\sum_{t=1}^{Ti} y_{it}) / N\}$$

where N = number of observations

Summing equations (3) and (4), we obtain

$$y_{it} - \bar{y}_i + \hat{y} = \alpha + (x_{it} - \bar{x} + \hat{x})\beta + (\varepsilon_{it} - \bar{\varepsilon}_i + \bar{v}) + \hat{\varepsilon} \tag{5}$$

Then, the *Fixed Effects* regression estimates the above equation under the constraint v = 0. That means, it estimates

$$y_{it} - \bar{y}_i + \hat{y} = \alpha + (x_{it} - \bar{x} + \hat{x})\beta + noise$$ [3];

[3] It should be noted that adding in grand means to the left and right hand sides of the equation has no effect on the estimated β.

CHAPTER FIVE

DETERMINANTS OF PER CAPITA PUBLIC SERVICE EXPENDITURES IN FAST GROWING COMMUNITIES OF MICHIGAN

5.1 Introduction

This chapter presents results of the statistical analysis of the variables described in previous chapters and the empirical output of the *Fixed Effects* regression model developed in Chapter Four. Descriptive statistics of the selected variables are discussed in detail. Methods used for data classifications are presented and the diagnostic regression performed to check for existence of any statistical problem in the model is explained. The final regression results of the model are displayed in their respective categories and, finally, the result of the reliability test of the model is shown.

5.2 The Variables

Although all of the forty six local governments selected for this study are generally classified as fast growing communities, they are very diverse in their population size, population growth rate, population density, land use characteristics, and level of total expenditures per resident. They range from Sparta Township in Kent County, which spent only $34 per person (in 1981) to City of Auburn Hills, Oakland County that spends $1,029 (in 1995). A general summary of the selected explanatory variables of the communities is presented in Table 5.1.

Table 5.1: Minimum, Maximum, and Mean Values of Selected Variables, 1981 - 1995.

Variable	*Mean*	*Minimum*	*Maximum*
Expenditure Per Capita	287	34	1,029
Total Population	28,745	4,038	119,929
Population Growth Rate	0.018	-0.01	0.06
Population Density	1,086	112	3383
Agricultural Property	281	0	2,259
Commercial Property	3,542	392	12,177
Industrial Property	1,602	0	12,335
Personal Property	2,254	351	10,731
Residential Property	11,879	5,107	34,706
Business Property	7,399	789	25,945
Total Property	19,558	8,558	58,331
Total Land Area	28	3	57

5.2.1 Population

The annual population growth rate from 1981 - 1995 for most of the communities is about 2% on average. However, there are a few cases where population increases and decreases have deviated from the general pattern of steady growth. For example, the 1994 projected population data for Cascade Township, Kent County, indicated a decline of population to 12,352 in 1994 from 12,896 in 1990. This has resulted in a projected 1% decline in annual population growth rate of the township between 1991 and 1995. On the other hand, there are some places that have shown sharp increase much above the average for all communities between 1981 and 1990. Macomb Township, for example, had a growth rate of 4 to 6 percent each year during the period.

Table 5.2: Average Total Population of the Seventeen Fast Growing Cities in Michigan, 1981 - 1995.

City	Average Population	Counties
Sterling Hts	115,590	Oakland
Troy	72,686	Oakland
Farmington Hills	71,133	Oakland
Wyoming	63,157	Kent
Rochester Hills	57,569	Oakland
Portage	49,303	Kalamazoo
Kentwood	36,127	Kent
Novi	31,277	Oakland
Holland	24,336	Ottawa
Auburn Hills	17,085	Oakland
Walker	17,011	Kent
Grandville	14,992	Ottawa
Wixom	8,311	Oakland
Marysville	8,259	St. Clair
Lapeer	7,534	Lapeer
Walled Lake	5,942	Oakland
Brighton	5,452	Livingston

The population distribution in the study communities ranged from 4,038 in Long Lake Township in 1981 to 119,929 in the City of Sterling Heights in 1995 with a grand mean of 28,745 (Long Lake Township had a population of 5,977 in 1990 to be included in the study). Most of the communities with the largest population are cities and townships in Southeast Michigan. Four of the first five cities in Table 5.2 (Sterling Heights, Troy, Farmington Hills, and Rochester Hills) with the highest average population for the study period are cities in Southeast Michigan. Likewise, there is no fast growing township outside of Southeast Michigan that has a population of 50,000 or more or is in the group of the first five townships with the highest average population during the study period. In general, fast growing big cities and townships in Michigan are concentrated around the City of Detroit, in Southeast Michigan.

Table 5.3: Average Total Population of the Sampled Fast Growing Townships in Michigan, 1981 - 1995.

Township	*Average Population*	*Counties*
Clinton	83,597	Oakland
Waterford	67,262	Oakland
Canton	55,762	Wayne
W. Bloomfield	51,711	Oakland
Shelby	46,535	Macomb
Meridian	33,703	Ingham
Georgetown	30,660	Ottawa
Commerce	26,726	Oakland
Delta	25,882	Clinton
Harrison	24,741	Macomb
Plainfield	24,358	Kent
Chesterfield	24,164	Macomb
Orion	24,143	Oakland
Macomb	20,733	Macomb
Delhi	19,032	Ingham
Holland	17,047	Ottawa
Pittsfield	16,717	Washtenaw
Northville	16,466	Wayne
Muskegon	15,096	Muskegon
Cascade	11,941	Kent
Milford	11,879	Oakland
Fruitport	11,382	Muskegon
Grand Rapid	10,313	Kent
Garfield	10,178	Grand Traverse
Alpine	9,686	Kent
Sparta	8,047	Kent
East Bay	7,835	Grand Traverse
Long Lake	5,560	Grand Traverse
Ira	5,369	St. Clair

5.2.2 Equalized Value of Properties[1]

The distribution of per capita state equalized values of properties ("properties" henceforth) in these communities has some identifiable patterns. All cities and townships combined, the residential properties range from $5,107 to $34,706 and business properties[2] range from $789 to $25,945. Overall, the mean value of residential property in the entire study communities is more than that of business property by nearly $4,500.

Many of the seventeen cities, with the exception of the cities of Portage, Novi, Holland, and Lapeer, do not have agricultural land at all. Even in these four cities, the per capita value of agricultural properties is insignificant when compared to those of other types of properties. In the case of townships, however, all the twenty-four townships in the study have some agricultural properties. Those townships that do not have agricultural properties are Clinton, Harrison, and West Bloomfield townships in Southeast Michigan and Cascade and Grand Rapids in Kent County (outside of Southeast Michigan). In sum, agricultural property is the type of property with the lowest mean, minimum, and maximum per capita value in all the study communities. Its contribution to the per capita value of total properties is insignificant; it is just a little more than 1 percent of the total properties.

All cities and townships, excepting Long Lake Township in Grand Traverse County, have both commercial and industrial properties. Long Lake Township did not have industrial properties from 1981 - 1991. The value of its commercial properties for the

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[1] Unless stated otherwise, all references to different types of properties must be understood in terms of per capita state equalized values (PCSEV).

[2] It should be noted that business properties are expressed in terms of per capita value and not a per business value.

period between 1981 - 1995 was also not significant; it ranged between \$392 - \$574 in comparison to the \$3,542 mean for all places.

Four of the five communities (Table 5.4) with the highest average value of business properties (Wixom, Troy, Auburn Hls, and Novi) are cities located in Southeast Michigan. But, five of the communities with the highest average value of residential properties consist of three townships (W. Bloomfield, Cascade, and Northville) and two cities (Farmington Hls and Troy). However, still four of the five communities, with the exception of Cascade Township again, are located in Southeast Michigan[3]. It is worth noting that (1) Cascade Township, with a combined business and residential per capita value of \$41,006, tops all communities included in the study, and (2) most of the communities that have the highest average value of residential properties are townships.

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[3] Average values of business properties are the sum of average PCSEV of industrial, commercial, and personal properties.

Table 5.4 (a): Average PCSEV of Business Properties, Cities, 1981 - 1995

City	*Business Properties*
Wixom	22,161
Troy	18,966
Auburn Hills	13,793
Novi	13,572
Marysville	13,289
Brighton	11,515
Walker	11,390
Kentwood	11,350
Farmington Hills	10,012
Wyoming	8,653
Portage	7,969
Lapeer	7,700
Sterling Hts	7,178
Grandville	6,773
Walled Lake	6,058
Rochester Hills	5,767
Holland	5,345

Table 5.4 (b): Average PCSEV of Residential Properties, Cities, 1981 - 1995

City	*Residential Properties*
Farmington Hills	17,366
Troy	17,166
Rochester Hills	16,557
Novi	14,460
Sterling Hts	12,069
Marysville	11,240
Brighton	10,731
Grandville	10,304
Walled Lake	9,550
Holland	9,144
Kentwood	9,058
Walker	8,874
Portage	8,770
Wyoming	8,061
Wixom	7,835
Auburn Hills	5,907
Lapeer	5,605

Table 5.4 (c): Average PCSEV of Business Properties, Townships, 1981 - 1995

Township	*Business Properties*
Cascade	15,719
Garfield	12,296
Pittsfield	12,071
Delta	10,597
Holland	8,858
Milford	7,596
Chesterfield	6,093
Meridian	5,639
Grand Rapid	5,553
Commerce	5,504
Orion	5,365
Waterford	4,941
Shelby	4,896
Alpine	4,755
Ira	4,532
Plainfield	4,331
Canton	4,173
East Bay	4,099
Northville	3,956
Muskegon	3,741
Sparta	3,732
Harrison	3,608
Clinton	3,573
W. Bloomfield	3,314
Delhi	2,772
Georgetown	2,509
Macomb	2,260
Fruitport	1,446
Long Lake	925

Table 5.4 (d): Average PCSEV of Residential Properties, Townships, 1981 - 1995

Township	*Residential Properties*
W. Bloomfield	26,440
Cascade	25,287
Northville	17,827
Grand Rapid	16,191
Long Lake	16,094
Commerce	15,496
Milford	14,379
Shelby	13,789
East Bay	13,685
Meridian	13,527
Orion	13,327
Macomb	13,027
Harrison	12,736
Delta	11,822
Georgetown	11,613
Waterford	11,539
Canton	11,356
Clinton	10,973
Plainfield	10,581
Chesterfield	10,535
Garfield	9,357
Fruitport	9,051
Delhi	8,785
Holland	8,684
Pittsfield	8,284
Alpine	8,152
Ira	7,612
Sparta	7,359
Muskegon	6,236

5.2.3 Total Land Area and Population Density

The average land area for all the communities in the study is 28 square miles. It varies from the smallest area of 3 square miles, Walled Lake City, to 57 square miles, Orion Township, both in Southeast Michigan. The average density over the 15 years period is 1,086 persons per square mile and ranges from 112 persons per mile in Long Lake Township in 1981 to 3,383 persons per square mile in Clinton Township in 1995. Generally, most of the communities with the highest population density are cities. While thirteen of the seventeen cities in the study have a population density of 1,000 or more only seven of the twenty nine townships have a population density that is comparable to the cities. Furthermore, excepting for the cities of Wyoming, Holland, Kentwood, and Portage, nine of the thirteen cities are located in Southeast Michigan(see Table 5.5b). Similarly, with the exception of Meridian Township (Ingham County) all of the six townships in this category are also in Southeast Michigan (see Table 5.5a). Generally, most of the populated communities are currently located in Southeast Michigan.

Table 5.5(a): Townships with Average Population Density (persons per sq. mile) of 1,000 or More, 1981 - 1995

Township	*Density*	*Location*
Clinton	2,986	SEM
Waterford	2,156	SEM
Harrison	2,019	SEM
W. Bloomfield	1,981	SEM
Canton	1,549	SEM
Shelby	1,330	SEM
Meridian	1,021	ROS

Note: In Tables 5.5a and 5.5b SEM stands for Southeast Michigan and ROS for Rest of the State.

Table 5.5(b): Cities with Average Population Density of 1,000 or More, 1981 - 1995

City	*Density*	*Location*
Sterling Hts	3,211	SEM
Wyoming	2,429	ROS
Farmington Hills	2,156	SEM
Troy	2,019	SEM
Walled Lake	1,981	SEM
Holland	1,868	ROS
Rochester Hills	1,599	SEM
Kentwood	1,571	ROS
Marysville	1,376	SEM
Brighton	1,363	SEM
Portage	1,297	ROS
Lapeer	1,256	SEM
Novi	1,009	SEM

5.2.4 Per Capita Public Service Expenditures

The mean per capita public service expenditures for all communities combined over the fifteen year period is $287 and individual community mean expenditure range from $34 to $1,029 in constant 1995 dollars. There is a clear pattern of expenditures in relation to type of government and geographic location of communities. Over all, cities spend more per person than townships, and communities located in Southeast Michigan (cities or townships) spend more than those in the rest of the state. However, as an exception to this observation, out of the twenty-nine townships of the study communities, three townships in Southeast Michigan (Shelby, Clinton, and Waterford) have spent a little more than three cities (Rochester Hills, Kentwood, and Grandville).

Inter city comparison reveals that cities in Southeast Michigan spend more than cities in the rest of the state. It is only the City of Holland in Kent County, outside of Southeast Michigan, that is among the top ten cities with the highest per capita expenditures. For townships, they are only Delta, Meridian, and Muskegon townships, outside of Southeast Michigan, that are among the top ten with the highest expenditures.

The association between total population size and expenditures is not conclusive when all communities are combined. This is because there is no clear pattern of association between population and expenditures for cities. Nonetheless, it is observed that smaller population size cities spend more than larger population size cities on the average. For example, seven of the ten cities with the highest expenditures are from the smaller population size group (see Table 5.6). In the case of townships, however, there is a general trend of positive association between per capita public service expenditures and total population size. The larger the population size, the higher the expenditures (see Table 5.7).

Table 5.6: Average Expenditures and Population, Cities, 1981 - 1995

Cities	*Expenditure*	*Population*
Lapeer	791	7,534
Marysville	636	8,259
Auburn Hills	618	17,085
Holland	604	24,336
Brighton	569	5,452
Wixom	514	8,311
Walled Lake	514	5,942
Troy	503	72,686
Sterling Hts	457	115,590
Farmington Hills	450	71,133
Novi	449	31,277
Walker	440	17,011
Wyoming	376	63,157
Portage	335	49,303
Grandville	317	14,992
Rochester Hills	292	57,569
Kentwood	285	36,127

Table 5.7: Average Expenditures and Population, Townships, 1981 - 1995

Township	*Expenditure*	*Population*
Shelby	325	46,535
Clinton	307	83,597
Waterford	296	67,262
Canton	275	55,762
Delta	262	25,882
W. Bloomfield	257	51,711
Meridian	254	33,703
Pittsfield	233	16,717
Harrison	225	24,741
Muskegon	206	15,096
Northville	198	16,466
Cascade	192	11,941
Holland	183	17,047
Commerce	176	26,726
Delhi	164	19,032
Chesterfield	141	24,164
Garfield	139	10,178
Orion	137	24,143
Grand Rapid	128	10,313
Milford	119	11,879
Plainfield	111	24,358
Macomb	102	20,733
Georgetwon	102	30,660
Fruitport	101	11,382
East Bay	100	7,835
Ira	92	5,369
Alpine	91	9,686
Long Lake	68	5,560
Sparta	52	8,047

5.3 Data Classification

Preliminary review of the study data indicates that the local governments in the study sample are very different in many respects. For instance, cities and townships have substantial differences in services they provide and expenditures they incur; local governments in Southeast Michigan have expenditures that are significantly higher than those of municipalities and townships in the rest of the state; and townships with a larger total population size have higher per capita expenditures than townships with a smaller population size. These differences in patterns and levels of expenditures call for classification of the study communities into some homogeneous or uniform sub-groups of communities in order to carry out a meaningful empirical investigation. This analyst contends that ignoring these observable differences and performing a general empirical analysis by putting all the study communities in one group may make the results flawed and less important for future use.

5.3.1 Classification by Type of Government

As noted earlier, cities and townships are very different in their service responsibilities and financing authority. For example, cities have to provide for the construction and maintenance of roads and streets in their jurisdictions. Townships, to the contrary, are not required to provide road services; they are served by county road commissions. Consequently, road and street expenditure, which is very significant in terms of annual financial outlay of a community, creates significant difference between a city and township budgets. Because townships do not have this huge expenditure, their budget appears to be significantly lower than those of city budgets.

Furthermore, cities in the study provide their own police and fire protection, whereas townships could contract such services from a neighboring jurisdiction, county, or the state. While all the cities have their own police and fire departments, by 1995 there were only ten of the twenty-nine townships (Canton, W. Bloomfield, Shelby, Waterford, Pittsfield, Clinton, Meridian, Chesterfield, Grand Rapids, and Ira) that had their own public safety departments. The remaining nineteen townships were contracting the services from the adjoining city or county departments. This also contributes to the disparity between city and township budgets and expenditures. Therefore, it is necessary to separate the communities by their respective type of governments (city or township) first and foremost.

It is possible to investigate the impact of type of government on expenditures of communities by specifying it as one of the independent variables in the regression analysis using other econometric techniques like the Ordinary Least Square (OLS). But, since this study is using a *Fixed Effects* regression model of panel data type of government can not be used as an explanatory variable because it remains as a constant within the panel throughout the fifteen years period of the study. Because it does not change year by year (a community is a city or a township throughout the period) it can only be represented by dummy variables 0 or 1 in the model. Since individual level covariates are not compatible with the *Fixed Effects* regression model, the variable will automatically be dropped from the regression analysis if included[4]. Therefore, the opportunity of regressing expenditures (dependent variable) on type of government (independent variable) without using other regression model is not available in this study.

A single factor analysis of variance (ANOVA) is performed to test the appropriateness of separating the study communities by types of government. The result obtained (see Table 5.8) shows the existence of significant difference between cities and townships and the classification is justified. The associated two-sample t-test, which indicates the source of the differences also gave a t-statistics[5] of 26.7 at 0.05 confidence level with a P-value of 0.

Table 5.8: Single Factor ANOVA, by Type of Government

Type of Gov't	*Count*	*Average Expenditure*	*Variance*	*F value*	*P-value*
Cities	255	475	28594		
Townships	435	174	7351		
Between Groups				964	0

[4] A *Fixed Effects* regression was performed with location as an independent variable to illustrate how such variables that remain constant in the panel will be treated by the model. While its inclusion does not affect the regression result, the variable will just be dropped (see Appendix F). Same result would have been obtained if similar regression was performed with type of government variable.

[5] All t-statistics in this study are at 0.05 confidence level and critical value of 1.96

5.3.2 Sub-Classification by Population Size and Geographic Location

The study communities are further sub-classified by population size and geographic locations. Cities and townships are respectively sub-grouped into two population sizes (large and small) and two general geographic locations (Southeast Michigan and Rest of the State). These sub-classifications are necessitated because the preliminary review of the data indicated that population size and geographic location are significant in shaping the level and patterns of expenditures of the communities. The determination of the two population size groups (more than 50,000 and less than 50,000) is arbitrary. The broad locational sub-categorization is confirmed by the test and result of a Single Factor ANOVA and a two-sample t-test assuming unequal variances yielding a t-statistics of 10 and 0 P-value.

Table 5.9: Single Factor ANOVA, by Geographic Location

Location	*Count*	*Average Expenditure*[6]	*Variance*	*F value*	*P-value*
Southeast Michigan	360	351	42826		
Rest of State	330	214	19802		
Between Groups				101	0

[6] The average expenditure indicated here is computed before disaggregating the communities into their respective types of government.

5.4 Characteristics of the Study Communities by Sub-Classification

This sub-section will present the descriptive statistics of all the study communities arranged by the major classification of type of government and the sub-classifications of population size and geographic location. To further highlight the differences between the communities of different sub-class, two summary tables, one for cities and one for townships, will be presented.

5.4.1 Cities

The seventeen fast growing cities of Michigan included in this study are characterized by average expenditures of $479, total population of 35,633, population growth rate of 2%, population density of 1,547 per square mile and total property value of $21,478. While only six of the seventeen cities have larger population size (more than 50,000) in 1990, four of them are located in Southeast Michigan. Moreover, eleven of all the fast growing cities (65%) are again in Southeast Michigan.

5.4.1.1 Cities of Larger Population Size

The six cities in this population size group are Sterling Heights, Troy, Farmington Hills, Wyoming, Rochester Hills, and Portage. On the average, this group spends about $402, which is $77 less than all cities combined. Consistent with the average population growth rate for all fast growing cities, this group has average population of 71,573 with nearly 2% annual growth rate. The average per capita value of its total properties is

$23,084 and it is slightly over the average for all cities by $1,607. Its population density is much higher (by 573 persons per square mile) than the average for all cities.

5.4.1.2 Cities of Smaller Population Size

Cities of Kentwood, Holland, Novi, Auburn Hills, Walker, Grandville, Wixom, Marysville, Lapeer, Walled Lake, and Brighton make this group. The group spends $522 per person on the average (that is $120 more than cities with larger population size) and $43 more than the average of all cities combined. The average population is 16,030 and the growth rate is more or less consistent with all cities combined. The value of its average total properties is less than that of larger cities by nearly $2,500. Its population density is significantly less than that of the larger cities by 884 persons per square mile.

5.4.1.3 Cities in Southeast Michigan

The fast growing cities in Southeast Michigan are Sterling Heights, Troy, Farmington Hills, Rochester Hills, Novi, Auburn Hills, Wixom, Marysville, Lapeer, Walled Lake, and Brighton. The average expenditure of this group $527, which is $48 more than that of all cities combined. Its average total population size is a little more than the average of all cities combined (by 807), while its average annual population growth rate (2.2%) is significantly higher than all other categories. It has the highest average per capita value of total properties and slightly higher population density than the average for all cities.

5.4.1.4 Cities in the Rest of the State.

The fast growing cities outside of southeast Michigan are Wyoming, Portage, Kentwood, Holland, Walker, and Grandville. This group spends $134 less per person than cities in Southeast Michigan. Its average total population is less than the average for all cities combined by 1,478 and for larger cities by 2,285. Its annual population growth rate (1.5%) is the slowest when compared to all sub-classes of communities. It also has the lowest average value of properties ($3,853 less than that of all cities combined) and population density only higher than the communities with smaller population.

Table 5.10: Summary of Basic Characteristics of Fast Growing Cities in Michigan 1981 - 1995

Variables	*Large*	*Small*	*SE Michigan*	*Rest of State*	*All*
Expenditure	402	522	527	393	479
Total Population	71,573	16,030	36,440	34,155	35,633
Pop Growth . Rate	1.9	2.0	2.2	1.5	2.0
Pop Density	2,119	1,235	1,613	1,425	1,547
Property Value	23,084	20,602	23,580	17,625	21,478

5.4.2 Townships

Out of the total fifty-two fast growing townships in Michigan twenty-nine (56%) are included in this study. While fourteen of these townships are in Southeast Michigan the other fifteen are in the rest of the state. On the average, this sample group is characterized by per capita expenditure of $174 (which is $305 per person less than that for the cities), population of 24,707, population growth rate of 1.8%, population density of 816 persons per square mile (almost half of the cities) and per capita property value of $18,432 (nearly $3,000 less than the average of the cities). There are only three townships in the entire group of the fast growing townships in Michigan that have a population size greater than 50,000 by 1990 and all three of them are located in Southeast Michigan..

5.4.2.1 Townships of Larger Population Size

The three townships in Southeast Michigan that make the large population size group are Waterford, Clinton, and W. Bloomfield. This group has an average expenditure of $287, which is more than the average for all townships combined by $104. Its average population size is 67,523 and its annual growth rate of 1.6% is close to the average of all the townships combined. The population density in this group is very high, 2,193 persons per square mile and is almost three times that of all the townships. Its average per capita value of properties exceeds that of all townships combined by $1,800.

5.4.2.2 Townships of Smaller Population Size

Twenty-six of the twenty-nine sample townships are in this group. These townships spend $161 per person, significantly less (by $126) than the townships with larger population size. The average population size is 19,768 and the annual population growth rate is equal to that of the average for all townships (1.8%). It has a low population density of 658 persons per square mile. This is less than a third of that of the larger population size townships. The average per capita value of its properties is also less than that of larger townships by $2,057.

5.4.2.3 Townships in Southeast Michigan

The fourteen sample townships in southeast Michigan are Clinton, Waterford, W. Bloomfield, Commerce, Orion, and Milford in Oakland County; Shelby, Harrison, Chesterfield, and Macomb in Macomb County; Canton and Northville in Wayne County; Pittsfield in Washtenaw County; and Ira in St. Claire County. Their average per capita expenditure ($206) is more than the average for all townships by $32. The group average population is about 34,000 with an average annual growth rate of nearly 2%, higher than the population growth rate for all townships combined. The average per capita property value and population density are also greater than those for all townships combined.

5.4.2.4 Townships in the Rest of the State

Townships in the rest of the state are Plainfield, Cascade, and Grand Rapids in Kent County; Meridian and Delhi in Ingham County; Holland and Georgetown in Ottawa County; Delta in Clinton county; Muskegon and Fruitport in Muskegon County; and Garfield, East Bay, and Long Lake in Grand Traverse County. These townships spend $62 less per person than townships in Southeast Michigan. Their average population (16,048), annual growth rate (1.6%), per capita total property value ($17,966), and population density (511 persons per square mile) are also considerably less than those of Southeast Michigan.

Table 5.11: Summary of Basic Characteristics of Fast Growing Townships in Michigan, 1981 - 1995

Variables	*Large*	*Small*	*SE Michigan*	*Rest of State*	*All*
Expenditure	287	161	206	144	174
Total Population	67,523	19,768	33,986	16,048	24,708
Pop Growth . Rate	1.6	1.8	2.0	1.6	1.8
Pop Density	2,193	658	1,144	511	816
Property Value	20,277	18,220	18,933	17,966	18,432

5.5 Regressions and Model Specification

This study uses a fifteen-year panel data set utilizing the *Fixed Effects* regression method. The amount of data used in this study is so large that it was necessary to be concerned about the existence of possible statistical problems in the model. For example, there could be a significant change in the regression coefficients if one adds or omits an independent variable in the process of model specification. As a result, the estimated standard errors of the fitted coefficients would be inflated, or the estimated coefficients of the explanatory variables may not be statistically significant even though a statistical relation exists between the dependent and independent variables. Therefore, before embarking on the actual regression analysis a diagnostic regression is performed on all data sets. The diagnostic regression employed is primarily focused on the problem of correlation between the independent variables and the test showed the existence of multicollinearity problem in the initial model of the study.

5.5.1 Diagnostic Regression

One of the frequent problems observed in several studies like this one is when the explanatory (independent) variables are highly correlated (multicollinearity). Two of the independent variables (square of total population and total land area) that were initially included in the model specification are detected by the diagnostic regression to have caused such a problem in the regression analysis of this study.

Square of total population was included in the model for the purpose of adjusting for the non-linearity that may exist between total population and expenditures. Total land area was included because many of the prior researchers have used it. Even some of them, Shapiro (1961) for example, had found it to be the most significant variable in explaining the expenditures of local governments.

Variance of Inflation Factor (*vif*) analysis is utilized following the diagnostic regression in order to measure the degree of multicollinearity between the independent variables and to calculate the level of tolerance for each of the variables in the model. Most analysts rely on informal rules of thumb applied to the *vif* (Chatterjee and Price, 1991). Some use the *vif* value of 30 and others use the more restrictive value of 10. The diagnostic linear regressions and the corresponding *vif* values of this study are presented below in Tables 5.12 A - 5.14 B

5.5.1.1 Results of Diagnostic Regression for all Communities

When all communities are considered together, the maximum *vif* values for the total population and population density in the diagnostic linear regression that incorporates both square of population and land area are 28.7 and 14.14 respectively (Table 12 A). This is mostly because of the high correlation between these two variables and the square of population (0.95 and 0.8 respectively, see Appendix B). When square of population is removed from the model, the *vif* value of total population improved significantly (by 47%) and its t-statistics (which indicates its explanatory significance) doubled (jumped from -2.32 to -4.83, see Table 12 B). However, the change in *vif* value and t-statistics of population density is not significant. This indicates that although the correlation between square of population and population density is very high, the impact of this variable on the explanatory significance of population density is insignificant. The dramatic change in the *vif* vale and t-statistics of population density comes when the total land area is removed from the model; *vif* improves by 78% and t-statistics changes from 10.61 to 27. 10. As expected, since population density is calculated from total population and land area, the result reveals that the explanatory significance of population density is much affected by total land area.

The removal of both variables from the model improves the mean and individual *vif* values of all variables without any impact on the explanatory ability of the model. Furthermore, results of the diagnostic regression indicate that significance of square of population as an explanatory variable in the model is very low. It has a t-statistics of -1.7 or less at 0.05 confidence level confirming that its contribution in explaining the variations in expenditure of the study communities is insignificant.

In summary, when the two variables are removed from the model, three remarkable results are observed: (1) the mean and individual *vif* values of all variables in the model declined significantly and fall in the range of the acceptable threshold ; (2) the t-statistics of all of the independent variables improved; and (3) the adjusted R^2 of the model did not decline because of a loss of the variables. These results confirm that square of population and land area are not useful variables in the model.

Table 5.12 (A): Results of Diagnostic Regressions, Cities and Townships

	Variance Inflation Factor			
	With Land Area		Without Land Area	
Variables	With Pop²	Without Pop²	With Pop²	Without Pop²
Total Pop.	28.70	15.30	11.50	3.26
Pop. Density	14.14	13.92	3.17	3.12
Sq. of Pop.	10.61	----	10.16	----
Pop. Gr. Rate	1.03	1.03	1.03	1.03
Resid. Prop.	2.71	2.70	2.53	2.48
Total Property	2.53	2.53	2.37	2.36
Land Area	5.83	5.58	----	----
Mean VIF	9.36	6.84	5.13	2.45

Table 5.12: (B) The t-statistics the Diagnostic Regressions, Cities and Townships

	t-statistics			
	With Land Area		Without Land Area	
Variables	With Pop²	Without Pop²	With Pop²	Without Pop²
Total Pop.	-2.32	-4.83	-7.24	-15.47
Pop. Density	10.29	10.58	27.10	27.14
Sq. of Pop.	-1.77	----	-1.19	----
Pop. Gr. Rate	2.47	2.54	2.46	2.51
Resid. Prop.	-16.75	-16.64	-18.05	-18.05
Total Property	21.56	21.51	22.91	22.87
Land Area	-2.96	-2.65	----	----
Adjusted R^2	0.70	0.70	0.70	0.70

5.5.1.2 Results of Diagnostic Regression for Cities

The individual and combined impacts of square of population and land areas become more clear when the communities are classified by types of government. Inclusion or omission of these variables in the model have dramatic impacts for cities. Total population, as an explanatory variable for expenditure patterns of cities, would be rendered useless if the two variables are included in the model. The *vif* value of 117.89 (Table 5.13 A) is very far from the tolerance threshold of even the most generous cutting point of 30. There would be a serious multicollinearity problem that will drop all the contributions of population variable in the analysis. Just removing square of population will bring down the *vif* near the 30-point threshold indicating that the multicollinearity problem in the model is significantly reduced. Although the magnitude is not the same, the *vif* values of all the remaining explanatory variables have improved or have remained the same.

However, unlike in the case of all communities combined, removing the square of population from the model reduced the explanatory significance of all the variables (excepting that of population growth rate, which is not significant in the model anyway) and reduced the explanatory ability from 44% to 43% (see Table 5.13. B).

This trend is reversed when land area is removed. The *vif* values of all variables improved significantly (with only population and its square being in excess of the 10 points threshold). Leaving the explanatory ability of the model at 43%, the explanatory significance of all the variables (with a small exception of population growth rate again) improved dramatically.

The omission of both variables assures near complete absence of any multicollinearity problem in the analysis. All variables have *vif* value of less than 3.1 and the mean drops to 2.49 from 27.79. Again with the small exception of population growth rate, the significance of all explanatory variables improves substantially. However, the model's ability to explain the variations in expenditures of cities declines by 4%.

Table 5.13 (A): Results of Diagnostic Regressions, Cities

	Variance Inflation Factor			
	With Land Area		*Without Land Area*	
Variables	*With Pop²*	*Without Pop²*	*With Pop²*	*Without Pop²*
Total Pop.	117.89	30.09	12.05	2.24
Pop. Density	16.61	12.48	3.40	2.86
Sq. of Pop.	26.04	----	13..15	----
Pop. Gr. Rate	1.28	1.28	1.27	1.26
Resid. Prop.	3.49	3.48	3.20	3.05
Total Property	2.66	2.58	2.29	3.04
Land Area	26.58	13.43	----	----
Mean VIF	27.79	10.56	5.89	2.49

Table 5.13: (B) The t-statistics of the Diagnostic Regressions, Cities

	t-statistics			
	With Land Area		*Without Land Area*	
Variables	*With Pop²*	*Without Pop²*	*With Pop²*	*Without Pop²*
Total Pop.	-1.67	0.25	-7.99	-9.03
Pop. Density	2.16	1.29	6.62	8.66
Sq. of Pop.	2.08	----	3.85	----
Pop. Gr. Rate	0.89	0.90	0.80	0.44
Resid. Prop.	-3.99	-3.86	-4.45	-5.28
Total Property	7.64	7.34	8.61	9.01
Land Area	-0.93	-3.35	----	----
R^2	0.44	0.43	0.43	0.40

5.5.1.3 Results of Diagnostic Regression for Townships

The impacts of the two variables in the case of townships is considerably different from that of cities. Indeed, removal of population square or land area or both improves the *vif* values of all the variables (Table 14. A). However, the t-statistics of all variables (excepting population growth rate) decline with a removal of any of the variables. Likewise, the explanatory ability of the model declines by 5%. Although there is no strong case in itself for removing square of population and land area from the model for townships, because there is no variable with a *vif* value that is significantly greater than the liberal 30 points threshold of tolerance, the need to use uniform analysis for both cities and townships in this study necessitate the omission of these variables.

Table 5.14 (A): Results of Diagnostic Regressions, Townships

	Variance Inflation Factor			
	With Land Area		*Without Land Area*	
Variables	*With Pop²*	*Without Pop²*	*With Pop²*	*Without Pop²*
Total Pop.	30.78	21.03	16.14	6.91
Pop. Density	22.79	22.55	7.57	7.23
Sq. of Pop.	13.41	----	13.41	----
Pop. Gr. Rate	1.07	1.05	1.07	1.05
Resid. Prop.	5.00	4.89	4.91	4.79
Total Property	4.71	4.68	4.67	4.63
Land Area	3.21	3.21	-----	----
Mean VIF	11.57	9.57	7.96	4.92

Table 5.14(B): The t-statistics of the Diagnostic Regressions, Townships

	t-statistics			
	With Land Area		*Without Land Area*	
Variables	*With Pop²*	*Without Pop²*	*With Pop²*	*Without Pop²*
Total Pop.	10.36	6.70	9.14	4.93
Pop. Density	1.14	0.30	9.00	7.12
Sq. of Pop.	-7.89	-----	-7.56	-----
Pop. Gr. Rate	-1.58	-2.63	-1.33	-2.37
Resid. Prop.	-9.55	-7.91	-10.05	-8.45
Total Property	15.54	13.97	15.66	14.17
Land Area	-5.14	-4.65	-----	-----
R^2	0.77	0.74	0.76	0.72

5.5.2 *Fixed Effects* Regression

Fixed Effects regressions are performed for each sub-class of cities and townships with the five explanatory variables (as developed in chapter three) using equation 5 in chapter four:

$$y_{it} - y_i' - y'' = \alpha + (x_{it} - x_i' - x'')\beta + (\varepsilon_{it} - \varepsilon_i' + v') + \varepsilon''$$

The preliminary regression analysis of the data indicated that while industrial, commercial, and personal properties have positive association with expenditures, residential and agricultural properties, as expected, show negative association. Because the share of agricultural properties in the study communities is very small and its ability to explain variations in expenditures of communities is insignificant, it is decided not to treat it as a different variables from the rest. Residential property, however, has to be treated as a separate variable because of its large share in total property and very significant explanatory power in the model.

5.5.2.1 Regression Results[7]

The regression results presented in Tables 5.15 for cities and 5.16 for townships show: (1) the expenditures of the two classes of analysis (cities and townships) are affected differently by each of the explanatory variables; (2) the different sub-groups within the same class of analysis have different sets of ranking of the independent variables in accordance with their contributions in explaining the variations in expenditures of their respective sub-groups; (3) while almost all variables are significant in explaining the variations in the expenditures of cities (last column of Table 5.15), it is only the total property variable in the model that is significant for townships (last column of Table 5.16); (4) the regression model does a better job in explaining the variations in expenditures of townships than cities.

5.5.2.2 Regression Results for Cities

The regression model explains 68% of the variations in expenditures of all fast growing cities in Michigan. Total property, followed by residential property, is the most significant variable with the highest explanatory power. While both population growth rate

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[7] It should be noted that the values that are used for total property and residential property are different. While per capita value is used for total property, proportion of residential property as percentage of total property is used for the later. Therefore, the interpretation of the coefficients of the two variables are different. Take the regression result for cities as an example: The β value for total property is 0.17. That means, a 1% change in per capita value of total property is followed by $0.17 change in per capita total expenditure. In the case of residential property, the coefficient of -734.8 is stating that if the proportion of residential property as a percentage of total property changes by 1%, the per capita total expenditure will change by $7.35.

and density have some statistical relation with expenditures, total population is the third significant variable in the model that explains the variations in expenditures of cities.

The empirical finding from the regression analysis of all cities combined does not support the hypothesis of a positive correlation between population size and expenditures. The hypothesis developed in chapter three states that the higher the population size, the higher the expenditures will be. This statement does not make any distinction between government types, city or township.

Table 5.15: *Fixed Effects* Regression Results, Cities

	Large		Small		SE Michigan		Rest of State		All	
Variable	Coeff	t stat	Coef.	t stat	Coef.	t stat	Coef.	t stat	Coeff.	t stat
Total Population	-0.01	-1.8	-0.02	-4.0	-0.01	-4.7	0.00	0.2	-0.01	-4.8
Pop Growth Rate	-103	-0.3	2003	2.7	1407	2.0	2.5	0.0	953.7	1.8
Residential Property	-169	-1.4	-621	-5.5	-753	-6.7	-326	-1.1	-735	-7.8
Total Property	0.01	7.7	0.02	10.6	0.02	9.5	0.01	5.2	0.17	11.1
Population Density	0.51	1.9	0.02	0.3	0.14	2.0	-0.09	-0.4	0.122	2.0
Constant	221	2.0	533	7.6	679	8.3	409	1.7	659.3	9.5
R^2		0.77		0.74		0.72		0.54		0.68

Total population, excepting in the case of the six cities outside of Southeast Michigan, is negatively correlated with expenditures of all classes of cities. These six cities outside of Southeast Michigan are Grandville, Walker, Holland, Kentwood, Portage, and Wyoming. Scatter diagrams, showing the trend of correlation between average population and expenditures over the fifteen years period, for all classes of cities are presented. Cities outside of Southeast Michigan indicates the positive association between population and expenditures while all classes of cities show negative

(see Chart 5.2).

Public service expenditures are driven not only by the quality and quantity of services provided, but also by the infrastructures and agencies that make the services possible. Overhead expenditures for running and maintaining the service infrastructures are part of fixed costs in the public service production function of local governments. Total average cost of producing and maintaining certain units of public services will be relatively higher in those communities that have smaller population size because there are fewer people among whom the expenditures could be distributed.

Furthermore, if the service boundaries of a local government are greater than its political boundaries, its expenditures will be overstated because the effective population served is greater than the population by which the expenditures is computed. For instance, Schmid reports that the City of Lapeer extends its fire protection service to adjoining townships. This will increase Lapeer's fire protection expenditures figure. If the computation of the per capita fire protection expenditures does not count the actual number of population served and it is only divided by those who consider Lapeer as a place of their abode, the expenditures of Lapeer is bound to be overstated. Similarly, if all residents of a political jurisdiction are not served, but the computation of the per capita expenditures of that service does not exclude those not served, the expenditures of that community is bound to be understated. In general, disparity between effective population that gets the service and the population by which the per capita is computed could cause misrepresentation of the expenditures figures and change the sign of association.

Chart 5.1 Average Population and Expenditures, all Cities, 1981 - 1995

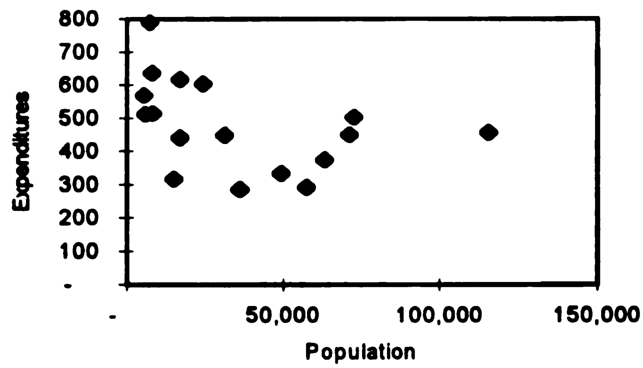


Chart 5.2 Average Population and Expenditures of Cities Outside of Southeast Michigan, 1981 - 1995

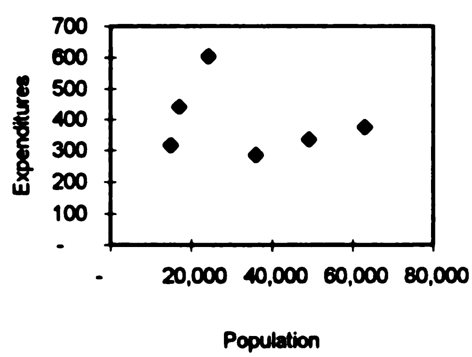


Chart 5.3 Average Population and Expenditures of Cities in Southeast Michigan, 1981 - 1995

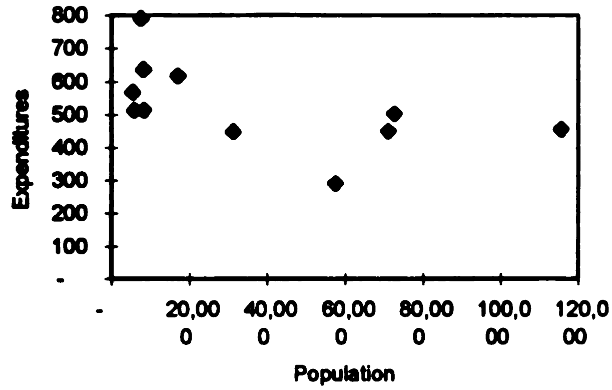


Chart 5.4 Average Population and Expenditures, Large Cities, 1981 - 1995

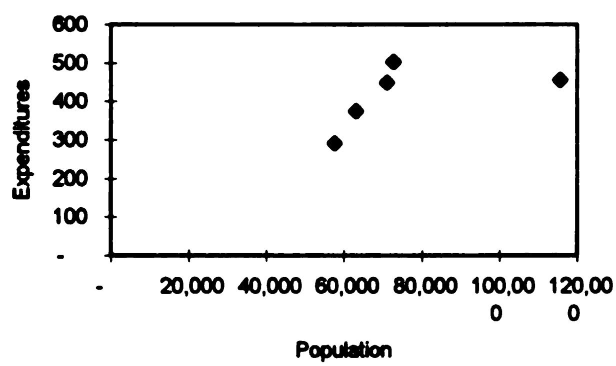
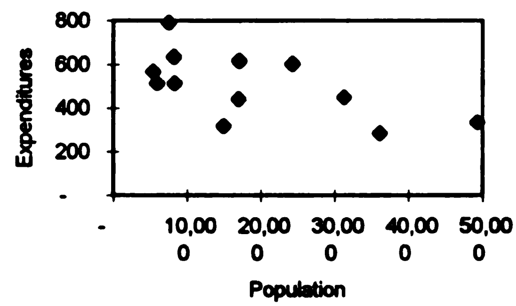


Chart 5.5 Average Population and Expenditures of Cities with Smaller Population size, 1981 - 1995



It is generally observed from the descriptive statistics that smaller cities are associated with higher per capita expenditures and the larger cities with lower expenditures. This inverse relationship between population size and level of expenditures is captured by the regression results as well. In cases of both larger and smaller population size groups, signs of the estimated β coefficients and the t-statistics are negative. This confirms the association of high population with lower expenditures and low population with higher expenditures.

Five of the six cities that show negative association between total population and expenditures belong to the smaller population size group. Then, why do the cities outside of Southeast Michigan, that are predominantly in the smaller size group, show positive correlation between size of population and expenditures? Indeed, these cities as a group spend less than cities in Southeast Michigan. But, does this positive correlation indicate that expenditures increase as a result of secular growth of population, as stated in the hypothesis, or are there diseconomies of scale that result from sheer increase of residents to be served? Unambiguous answers for this question may not be drawn from the data at hand. Thus, this analyst proposes further inquiry in this area.

Although population density shows positive association with expenditures of all cities combined, the variable is found to be inconclusive when all the sub-classes of cities are treated separately. Population growth rate, however, not supporting the hypothesis that it will have an inverse relationship with expenditures, shows a positive statistical relationship. this suggests that the rate at which residents of a community is increasing has a direct effect on changes in services provided, thereby causing increase in expenditures.

The independent variable with the highest explanatory ability at all levels of classification of the cities is the per capita value of total property. The regression results support the hypothesis that total property and expenditures are positively associated while residential property and expenditures are inversely related. This finding is a confirmation of the hypothesis that total property, as a proxy of real wealth and income, enables residents to demand and pay for more and improved public services. The finding regarding residential property is consistent with the explanation of the hypothesis in chapter three in that the estimated inverse relationship between residential property and expenditures is evidence that expenditures may not need to rise as residential development increases. New residential development may not require significant financial outlays for new public services because of the existing economies of scale in some of the infrastructures and the types of its service requirements. In fact, the data shows that most of the cities and townships with high value of residential properties have very low per capita expenditures.

A significant portion of total property consists of business properties (commercial, industrial, and personal). Business developments will affect public service expenditures in two ways. The first one is through the expanded tax base they create for a community. More government revenue will be generated from new business developments and can be used for more or improved public services. The second is that new business activities may require new services and infrastructures that may duplicate the already existing ones thereby causing increase in expenditures. Both scenarios contribute to the positive association between total property and expenditures.

With a clear exception of total property, which invariably is the most significant variable for all classes of cities, the degree of impact of each variable on expenditures of communities vary significantly. Population density, for example, is the second most important variable in explaining the expenditures of larger cities while it is actually the least significant variable in the case of smaller cities. See Table 5.15 for details.

The overall regression estimate, which is the estimated per capita public service expenditures equation for all cities combined, can be represented as:

$$Y_{it} = 659.3 - (.01)X_1 + (953.7)X_2 - (734.8)X_3 + (0.016)X_4 + (0.12)X_5$$ [8]

where Y_{it} = Expenditure
X_1 = Total Population
X_2 = Population Growth Rate
X_3 = Residential Property as % of Total Property
X_4 = Total Property
X_5 = Population Density
α = Constant (659.3)

[8] Similar per capita public service expenditures equation for cities with large and small population size and in Southeast Michigan and the rest of the state can be obtained from Table 5.14

Table 5.16: Ranking of Independent Variables by Level of Significance, Cities

Large	*Small*	*SE Michigan*	*Rest of State*	*All*
Total Property	Total Property	Total Property	Total Property	Total Property
Population Density	Total Population	Total Population	Total Population	Residential Property
Total Population	Residential Property	Residential Property	Population Density	Total Population
Residential Property	Population Growth Rate	Population Density	Residential Property	Population Density
Population Growth Rate	Population Density	Population Growth Rate	Population Growth Rate	Population Growth Rate

Although it was not possible to include geographic location in the model as an independent variable, a multiple regression that treats each year's observation as an independent record was used to just see how expenditures of communities would be affected by location. It was found that it was statistically significant with estimated β value of 90. 26. This indicates that if the variable was to be used in the model, it would contribute a value of 90.26 to the α constant in the estimated expenditure equation of fast growing cities in Southeast Michigan. The same analysis was done for townships and it was found to be statistically significant with β value of 0f -10.67. This would reduce the α constant of the estimated expenditure equation of fast growing townships in Southeast Michigan by 10.67

5.5.2.3 Regression Results for Townships

The regression model does a better job in explaining the variations in expenditures of fast growing townships in Michigan than for cities. It has an adjusted R^2 of 0.72 for all townships combined, which is 4% more than that of the cities. This comparison is more obvious when it is done between the sub-groups of both cities and townships. For instance, the adjusted R^2s of townships with larger population size, townships in Southeast Michigan, and townships in the rest of the state are greater than the R^2s of cities of similar categories by 15, 6, and 17 percent respectively. Nonetheless, it should be noted that this model performs slightly better (by 5%) in explaining the expenditures of smaller population size cities than townships with comparable population size.

Total property is very significant in explaining the variations in expenditures of townships. (1) It is the only statistically significant variable in explaining variations in the expenditures of townships when all the twenty-nine townships are grouped together. (2) It is the variable with the highest contribution to the R^2 regardless of the class of townships.

All of the other variables are not significant when all the townships are combined. This is indicated by their respective t-statistics (see Table 5.17). However, this observation changes when the townships are classified by a broad geographic location. The significance of almost all variables improves when townships are classified by location. Classification by population size, however, did not improve the statistical significance of the variables.

Table 5.17: Fixed Effects Regression Results, Townships

	Large		Small		SE Michigan		Rest of State		All	
Variable	Coeff	t stat	Coeff	t stat	Coeff	t stat	Coeff	t stat	Coeff	t stat
Total Population	-0.02	-1.6	0.00	1.1	0.01	2.7	-0.03	-3.9	0.002	0.9
Pop. Growth Rate	-15	-0.0	96	0.7	-193	-1.2	369	1.9	56.5	0.4
Residential Property	-77	-0.4	-35	-0.8	134	2.3	-117	-1.7	-28.1	-0.7
Total Property	0.01	4.8	0.01	14.9	0.00	8.3	0.01	10.9	0.006	17.4
Population Density	0.63	2.1	0.09	1.1	-0.01	-0.1	1.1	4.3	0.093	1.3
Constant	26	0.1	-31	-1.0	-178	-3.9	9	0.2	-38.04	-1.2
R^2		0.92		0.69		0.78		0.71		0.72

The regression results displayed in Table 5.17 support most of the hypothesis: total population, population growth rate, and total property show positive association with expenditures; residential property confirms the inverse relationship. Total population, which is negatively related to expenditures of all cities combined, has positive association with expenditures of all townships. This positive association may be explained by the fact that many townships are not required to have all types of service facilities, but can contract from others. The services purchased from other units of government and fees paid for the service may be proportional to the number of people served. Or, the townships may decide to acquire new service facilities in response to new demand arising from growing population. In general, economies and diseconomies of scale of service facilities may not play a role to force an inverse relationship between population and expenditures.

An inverse relationship between population size and expenditures is obtained in communities with larger population size and those outside of Southeast Michigan when townships are broken down into different classes. Those in smaller population size and the rest of the state show positive association and are consistent with all the communities combined. The general trends of the relationship between population and expenditures of different classes of townships are shown with the help of the charts below.

Chart 5.6 Average Population and Expenditures of all Townships, 1981 - 1995

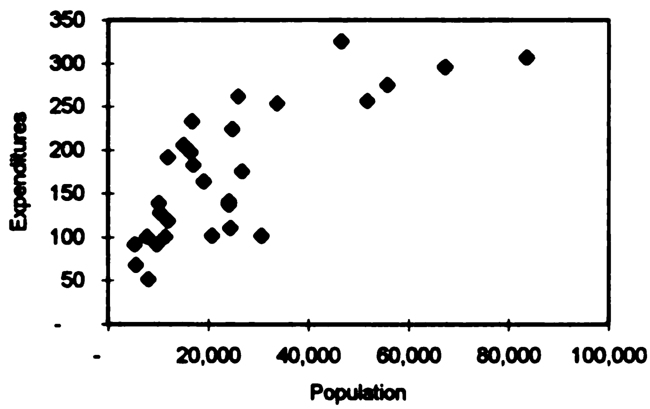


Chart 5.7 Average Population and Expenditures of Townships in Southeast Michigan, 1981 - 1995

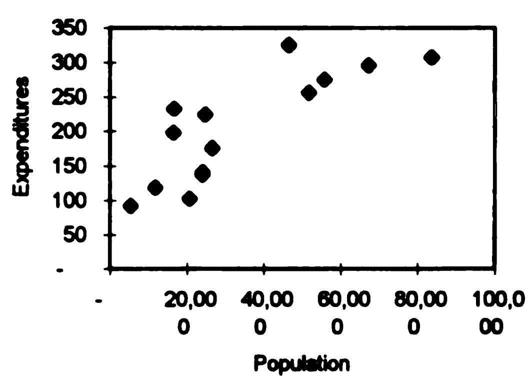


Chart 5.8 Average Population and Expenditures of Townships Outside of Southeast Michigan, 1981 - 1995

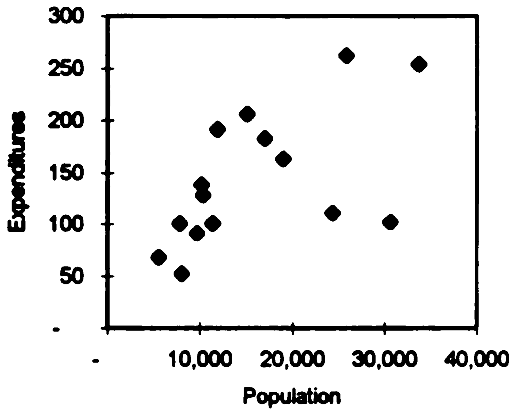


Chart 5.9 Average Population and Expenditures of Townships with Large Population Size, 1981 - 1995

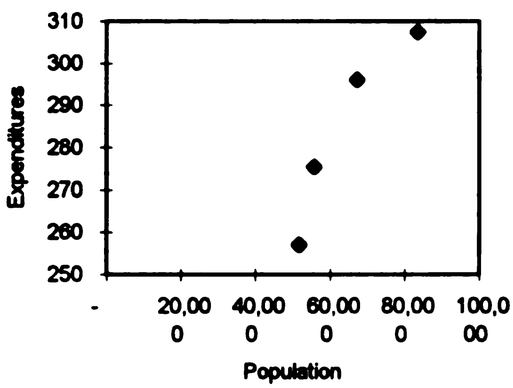


Chart 5.10 Average Population and Expenditures of Townships with Small Population Size, 1981 - 1995

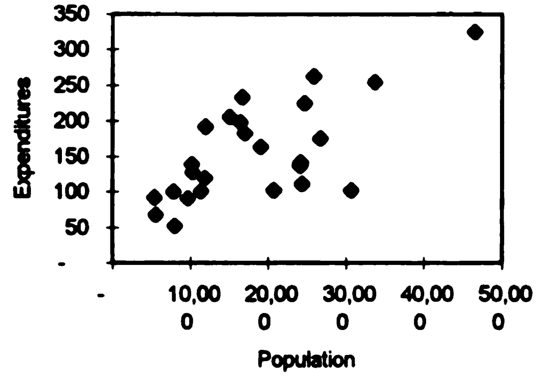


Table 5.18: Ranking of Independent Variables by Level of Significance, Townships

Large	*Small*	*SE Michigan*	*Rest of State*	*All*
Total Property	Total Property	Total Property	Total Property	Total Property
Population Density	Total Population	Total Population	Population Density	Population Density
Total Population	Population Density	Residential Property	Total Population	Total Population
Residential Property	Residential Property	Population Growth Rate	Population Growth Rate	Residential Property
Population Growth Rate	Population Growth Rate	Population Density	Residential Property	Population Growth Rate

The independent variable that had the highest explanatory ability in the model at all levels of classification of the townships was the per capita value of total property. Variables that were least important in the model varied by class of townships: (1) population growth rate was the least significant for all townships grouped together and classified by population size, and (2) population density and residential property were the least important variables for townships classified by location. Finally, there was no observable pattern of ranking of the rest of the variables for the second, third, and fourth places in accordance to their contribution to the R^2.

The estimated per capita public service expenditures equation for all townships grouped together can be represented as:

$$Y_{it} = -38 + (.002)X_1 + (56.5)X_2 - (28.1)X_3 + (0.05)X_4 + (0.09)X_5$$

5.6 Comparison of Regression Results by Type of Government

Cities and townships are basically different in many respects. On average, cities spend $301 per person more than the townships; have 10,000 or more residents than townships; have population density of almost double that of townships; and have about $3,000 more in per capita state equalized value of total properties, $5,500 more in business property, and $2,500 less in residential property.

While total property and rate of population growth variables were the highest and the least in terms of statistical significance in their contributions to the R^2 for both aggregated classes of communities, the ranking of residential property, total population, and population density vary by classification. Moreover, total population plays different roles in determination of city and township expenditures. It was observed that increase in population size decreases expenditures for cities while it increases expenditures of townships.

Table 5.19: Comparison of Ranking of Independent Variables, by Types of Government

Cities		*Townships*	
Total Property	(+)	Total Property	(+)
Residential Property	(-)	Population Density	(+)
Total Population	(-)	Total Population	(+)
Population Density	(+)	Residential Property	(-)
Population Growth Rate	(+)	Population Growth Rate	(+)
Adj R^2 68		Adj R^2 72	

Further observation into the regression results of both class of communities revealed that almost all independent variables, excepting total property, were statistically significant for cities but not for townships. Yet, the R^2 for cities was less than that of townships. This finding suggests that more explanatory variables in addition to the ones used in the model are needed to find the unexplained factors that determine city expenditures. On the other hand, the relatively higher R^2 of townships suggests that total property, with little contribution from the other variables, is the single most important variable in shaping expenditures in townships. The significance of this variable is further observed when townships are sub-divided by population sizes. Townships with larger population size have an R^2 of 0 .92 with only total property having a significant value of t-statistics. The importance of total property in determining the expenditures of townships becomes more marked with smaller population size where it is the only significant explanatory variable with t-statistics of 14.9.

5.7 Impact of Location on Expenditures

It should be remembered that location was not treated as independent variable in the model because (1) individual level covariates can not be used in a fixed effects model, and (2) it will be dropped grom the regression results if entered because it is a constant within the panel (see Appendix F). Therefore, for a purpose of showing the significance of location on expenditures, a multiple regression of the Generalized Linear Model was performed using dummy variables (1 for Southeast Michigan, 0 for the Rest of the State). It was found to be statistically significant for both cities and townships with β values of 90.3 for cities and -10.7 for townships (see Appendix E).

5.8 Reliability Test of the Model

Ten cities out of seventeen and twenty four townships out of the twenty nine were arbitrarily and randomly selected to test the validity of the estimated equation of the model. The 1995 data on expenditures and the independent variables were selected purposefully for the validity test because all expenditure and property data were all in constant 1995 dollars.

The estimated equations used for cities and townships were respectively:

$$Y_{it} = 659.3 - (.01)X_1 + (953.7)X_2 - (734.8)X_3 + (0.016)X_4 + (0.12)X_5$$

and

$$Y_{it} = -38 + (.002)X_1 + (56.5)X_2 - (28.1)X_3 + (0.05)X_4 + (0.09)X_5$$

where:

Y_{it} = Expenditure
X_1 = Total Population
X_2 = Population Growth Rate
X_3 = Residential Property as % of Total Property
X_4 = Total Property
X_5 = Population Density
α = Constant

Over all, for adjusted R^2s of the model (0.68 for cities and 0.72 for townships), the reliability test showed that the equations have estimated the variations of expenditures within the bound of 32% under or over the actual expenditures for cities and 28% for townships. Excepting in the case of the cities of Wyoming and Walled Lake (two out of ten) and townships of Fruitport, Alpine, and Ira (three out of twenty four), the ability of the equations in estimating expenditures was very impressive. In sum, given the length of time considered in the study and the nature of the data, this validity test has shown the strength and accuracy of the model (see Tables 5.19 & 5.20).

Table 5.20: Results of the Reliability Test, Cities, 1995

City	*Actual Expenditure*	*Estimated Expenditure*	*Over/Under Estimated (%)*
Troy	569	456	-0.20
Wyoming	438	261	-0.40
Novi	519	627	0.21
Holland	684	449	-0.34
Walker	530	669	0.26
Auburn Hills	974	988	0.01
Marysville	698	819	0.17
Lapeer	779	721	-0.07
Walled Lake	498	679	0.37
Brighton	665	881	0.33

Table 5.21: Results of the Reliability Test, Townships, 1995

Township	*Actual Expenditure*	*Estimated Expenditure*	*Over/Under Estimated (%)*
Waterford	332	373	0.12
Canton	382	334	-0.13
W. Bloomfield	340	417	0.23
Meridian	285	241	-0.15
Delta	295	207	-0.30
Delhi	188	130	-0.31
Commerce	255	253	-0.01
Chesterfield	215	202	-0.06
Macomb	171	182	0.06
Holland	236	180	-0.24
Harrison	214	270	0.26
Plainfield	193	164	-0.15
Orion	182	203	0.11
Northville	269	228	-0.16
Fruitport	110	70	-0.36
Cascade M	325	293	-0.10
Alpine	139	92	-0.34
Grand Rapid	211	182	-0.14
Garfield	181	153	-0.16
Sparta	56	60	0.08
Milford	184	163	-0.11
East Bay	140	105	-0.25
Long Lake	73	72	-0.02
Ira	107	69	-0.35

CHAPTER SIX

CONCLUSIONS, IMPLICATIONS AND FUTURE RESEARCH

6.1 Introduction

The main objective of this study was to identify the significant factors that determine the variations in per capita public service expenditures of local governments in the State of Michigan. Public services considered in the study include general government, public safety, public works, public services, health and welfare, and recreation and culture. The impacts of selected explanatory variables (total population, population density, population growth rate, per capita state equalized value of total property, and per capita value of residential property as percent of total property) on per capita expenditures were investigated in the context of different types of government (city or township), population size groups (large or small), and geographic location (Southeast Michigan or the rest of the state). The conceptual framework of the analysis was formulated as an expenditure decision model of local governments. A rigorous method of data preparation and management for the purpose of such analysis was developed and an econometric model using *Fixed Effects* regression was employed to analyze fifteen-year panel data sets.

6.2 Conclusions

The conclusion of this study focuses on three important aspects. First, the overall empirical results are summarized. Then, findings regarding the impacts of each independent variable on per capita expenditures of communities and their explanatory power in the model are discussed. Finally, the impact of geographic location variable is discussed separately.

6.2.1 General

One of the important findings in this study was the confirmation of the existence of identifiable patterns of variations in expenditures (all reference to expenditures and property values are in per capita unless stated otherwise) of fast growing communities in the State of Michigan. On average: (1) per capita public service expenditures of fast growing communities in Michigan vary widely (between \$34 and \$1,029 in terms of 1995 constant dollars); (2) cities and townships categorized by different population sizes have different expenditure patterns. While cities with smaller population size spend (\$120 per person) more than cities with larger population size, townships with larger population size spend (\$126 per person) more than smaller townships; (3) cities spend considerably more (\$305 per person) than townships; and (4) communities located in Southeast Michigan spend more than those in the rest of the state (\$143 per person for cities and \$62 for townships).

6.2.2 The Independent Variables

With exception for the total property variable, the significance of the independent variables considered in this study vary across groups of communities. Variables that are statistically significant in expenditures of cities are not for townships; or variables that are significant for cities in Southeast Michigan are not for cities in the rest of the state. Likewise, a variable that has a positive association with expenditures of cities may have an inverse relationship with expenditures of townships; and the variable that was inversely related to expenditures of townships in Southeast Michigan may be positively associated with expenditures of townships in the rest of the state. In sum, the ranking of the significance of the independent variables and their impacts in explaining the expenditures of local governments vary by types of government, population size, and geographic location of the communities. Therefore, results pertaining to each independent variable are discussed separately.

6.2.2.1 Total Property Value

The most important factor that explained the variations in the expenditure patterns of all classes of communities was the per capita value of total property. The values of industrial and commercial properties (collectively called business properties) have positive association with expenditures. Business properties affect expenditures in two ways: (1) they create expanded tax base for communities. More tax revenues generated from these properties and business related activities make more expenditures on public services possible; and (2) new developments may require new and improved public services and infrastructures that may replace or duplicate existing ones In general, the value of total property was statistically significant in the expenditure model and the value of its estimated coefficient was very large such that any change in its value will be followed by significant change in expenditures of local governments.

6.2.2.2 Mix of Land Use

Mix of land use can affect the demand and need for services. For example, residential property, as percentage of total property, was found to be inversely related with expenditures of most of the communities. That means, new residential developments may not require as much new infrastructure of public services as business developments. Accordingly, it was observed that most of the communities with high residential property value have very low expenditures (less than $200).

Nevertheless, it should be noted that the regression results for townships indicated that the residential property variable and expenditures of townships in Southeast Michigan were positively associated. Although the data sets used in this study do not help to firmly determine the reasons as to why such relationship was observed, the differences between types of residential properties in Southeast Michigan and the rest of the state could be considered as a starting point for further study. In addition to the costs of settlement congestion that characterize Southeast Michigan, the preponderance of multi-family multi-story residential properties may contribute to increasing expenditures in certain types of public services. For instance, high rise multi-family dwellings and office buildings in

Southeast Michigan require an aerial fire truck equipped with more sophisticated equipment which may not be needed in single family residential communities that are outside of Southeast Michigan.

6.2.2.3 Population

The population variable impacts expenditures of cities and townships differently. Expenditures in cities decrease as total population increase and expenditures increases in townships as population increase. Public service expenditures are driven not only by the quality and quantity of the flow of services, but also by the costs of the infrastructures of the services. In addition to the day to day cost of running the services and agencies that provide the services, communities incur considerable overhead expenditures to maintain existing service infrastructures. These expenditures could be considered as fixed costs in the public service production function. In smaller population size cities the per capita cost of producing certain units of public services will be higher because there are fewer people among whom the fixed costs could be distributed.

In the case of townships, however, increasing and discontinuous jumps in public service expenditures could be observed as a result of increase in demand for better quality and quantity of services as population increases. Most of the more populated townships produce their own public services such as police and fire protection and have higher associated expenditures compared to the less populated townships that may contract such services from other units of governments like county sheriff and state police or may do with whatever general level of service is provided by the county government.

Finally, it should be noted that this population-expenditure relationship could be misleading due to the incongruity that may exist between service and political boundaries of communities. If the service boundaries are greater than the political boundaries, the expenditures of the community will be overstated because the effective population served is greater than the population by which the per capita expenditures are computed. For instance, the City of Lapeer extends its fire protection service to adjoining townships. This will obviously increase Lapeer's fire protection expenditure. However, if the computation of the per capita expenditure for the City of Lapeer does not count the actual number of people served and is only based on those who consider Lapeer as a place of their abode, then, the expenditure will be overstated. To sum up, disparity between effective population receiving the service and the number of people by which the per capita is computed will cause over/understatement of the expenditures because data on population of service areas is not generally available.

6.2.2.4 Population Density

Population density, while statistically significant for cities, was found to be not significant for townships. However, care must be taken in interpreting results of this variable. First of all, the computation of density itself has a serious problem. Dividing the total population by the total land area of a local government does not tell how the population is distributed across the landscape of the jurisdiction. Two communities with equal population size and land area may have a different distribution of settlement. One may distribute all its residents on all the land under its jurisdiction and the other may only confine its residents to a certain portion of its area. These different types of population distribution will have different impacts on expenditures in that constructing and maintaining service infrastructures over the entire land area or over a limited section will have different service and associated expenditure requirements.

Second, types of service categories for which the impact of density is being investigated do matter. Different classes of services will be impacted differently by increasing population density. In the case of road construction and maintenance, for instance, the per capita expenditures would be expected to decrease with increasing density of population up to a point because increased volume of traffic is not expected to offset the average cost advantage that arises from increased density. On the other hand, fire and police expenditures could rise if congestion (as a result of increasing density) sets in. Hence, the overall impact of density will be determined by the share of each service category in the expenditures of local government.

In this study, population density was found to be negatively associated with expenditures of cities outside of Southeast Michigan and Townships in Southeast Michigan when communities are disaggregated by geographic location. But, it was found to have positive association when all cities and townships were aggregated in their respective types of government. A negative β coefficient in the former case indicates that increasing population density will decrease expenditures of local governments because economies of scales are captured in the infrastructures of the services. Most of the cities outside of Southeast Michigan, generally small in population size, have full infrastructures and services. If these communities are able to increase their population density, it is very likely that they could reduce their expenditures.

All of the large townships are in Southeast Michigan and have long grown over the threshold of getting by with services provided counties. Indeed, excepting for Meridian Township, all the townships, big or small, that have their own police departments are in Southeast Michigan. If these communities are able to increase their density, it is possible that they would also be able to reduce their expenditures because they would achieve economies of scale in several service categories up to a point.

The finding regarding these two sub-classes of communities was in agreement with a recent study of eighteen communities in Michigan. Burchell (1997) estimated that there would be considerable savings in four major areas (land consumption, infrastructures, housing cost, and fiscal impact) if new growth were added in a greater density than the existing level. The more people along a mile of water or sewer pipeline, the lower the cost per person. The study by Burchell utilized a single year cross sectional data and was based on synthetic projections that included formulas for the costs of roads and water and sewer. But the current study used actual historical data sets of fifteen years and did not include expenditures of water and sewer for all the forty six study communities and expenditures of roads for the twenty nine townships. Therefore, the positive sign of the population density coefficient for other classes of communities should not be considered as a conflicting result because the studies were conducted with different sets of data and purpose. For instance, if water and sewer were omitted from Burchell's study, the remaining expenditures, including those for police and fire, are for services where density is associated with congestion and greater expenditures instead of economies.

The regression results indicated that cities in Southeast Michigan have statistically significant positive association between density and expenditures. It was also observed that this association was positive when all cities were all grouped together. This was because eleven of the seventeen cities are in Southeast Michigan and the negative correlation for cities in the rest of the state was counterbalanced or lost because of larger aggregation of cities.

Although the data set used in this study does not show congestion thresholds, the positive association between density and expenditures of these communities could be seen from a settlement congestion perspective. All the larger cities in the study groups are located in Southeast Michigan. It is possible that most of these large cities may have passed over the threshold for economies of scale and are experiencing high costs associated with congestion in some service categories. For example, the conditions of road, police, and fire services in Southeast Michigan are very different from those in the rest of the state. Frequency of calls for police protection and fire emergencies require many patrol officers and fire fighters on duty, more police vehicles, jails, and fire trucks. All these are costs associated with congestion resulting in a positive correlation between population density and expenditures.

6.2.2.5 Population Growth Rate

The population growth rate variable was found to be statistically not significant for either cities or townships when they all are grouped in their respective types of government. However, when communities were analyzed in their respective sub-groups, a closer look at the regression results of cities in Southeast Michigan and smaller population size group indicated that the variable was statistically significant and the sign of the estimated coefficient of the variable was positive.

The implication of the observed positive correlation between expenditures of these communities and population growth rate is that it is the rate at which the population grows that contributes to the increase in expenditures rather than the actual number of residents (since actual population size is inversely related with expenditures). This is because faster population growth will be accompanied with increasing demands for expansion of services and infrastructures. The faster the population grows, the higher the service expenditures will be.

6.2.3 Impact of Location

The role of geographic location in driving expenditures of cities and townships was captured by the Single Factor Analysis of Variance (Table 5:9), summary statistics (Tables 5:10 & 11), and the regression results of the Generalized Linear Model presented in Appendix E. It should be remembered that location was not treated as independent variable in the model because individual level covariates can not be used in a *Fixed Effects* model alone and all constant within the panel will be dropped from the regression results if entered (see Appendix F). Therefore, Ordinary Least Square regression was performed for the purpose of showing the significance of location on expenditures. The variable was found to be statistically significant for both cities and townships. However, it showed different signs of correlation with the expenditures of cities and townships in Southeast Michigan. It was positive for cities and negative for townships. According to this result, controlling for all the variables in the model, location alone will make the expenditures of cities in Southeast Michigan higher than those in the rest of the state by $90 and the expenditures of townships in Southeast Michigan lower than those in the rest of the state by $11. The finding for cities was confirmed by the summary statistics of cities (see Table 5:10). The summary showed that cities in Southeast Michigan spend $134 more than those in the rest of the state. But townships in Southeast Michigan, despite the inverse relationship between expenditures and location, spend $62 more than those in the rest of the state (see Table 5:11).

Why would townships in Southeast Michigan have higher expenditures when they are having cost advantage related to their location? The *Fixed Effects* regression results showed that total population and residential property variables in the estimated expenditures equation have positive association with expenditures of townships in Southeast Michigan. In the case of the current study, the positive β values of these two variables in the equation had outweighed the negative correlation of location and expenditures such that the expenditures of the townships in Southeast Michigan became higher than the expenditures of townships in the rest of the state. Analogously, because these two variables are inversely related to the expenditures of the townships in the rest of the state (see Table 5:16), their negative β values in the equation had made the expenditures of townships in the rest of the state less than the expenditures of townships in Southeast Michigan. In sum, the reasons why expenditures of townships in Southeast Michigan are more than the expenditures of townships in the rest of the state are better explained by variables other than location.

6.3 Policy Implications

Many people in Michigan are concerned about population settlement patterns. The Michigan Society of Planning Officials is currently conducting a series of studies and conferences dealing with the impacts of settlements. Two major studies by academics (Burchell, 1997; Schmid, 1997), for instance, were recently commissioned. Furthermore, there is enough evidence from news media that indicate citizens of different communities are very much concerned about the increasing costs of public services provided by their local governments. Therefore, one could cautiously conclude that both the local and state policy makers on the one hand and the citizens of different communities on the other share common concerns relating to population settlement patterns and their impacts on costs and resources in Michigan.

The basic assumption of this study was that the objective behind local government expenditures is providing the best public services with minimum per capita costs. Hence, the regression estimates of the per capita public service expenditures equations that emerged from the analysis in Chapter 5 present the opportunity for policy makers to identify the important policy instruments that could be used to control expenditures.

According to the empirical results, whether all communities were grouped only by their respective types of governments or different sub-classes of population size and geographic location, the most significant factor that emerged to explain expenditures was the per capita value of total properties as measured by the state equalized value. In the case of townships, for example, it was only this variable that was statistically significant in the model (see Table 5:16). Yet, the model did a good job of explaining 72 percent of the variations in public service expenditures of the twenty-nine townships. This was a very strong finding and clearly calls for a further study. It appears that communities that have wealth to tax do so and spend the revenue. At the same time, wealthier communities demand more and higher quality services. No one would advocate becoming poor or rejecting high valued land use in order to hold down expenditures. To the contrary, communities try to attract high valued land uses. They offer reduced taxes now to get more wealth in the future.

Michigan has created eleven tax-free Renaissance Zones (six urban, three rural, and two military bases) located throughout the State where businesses and residents pay virtually no taxes up to fifteen years. This tax waiver includes the single business tax, personal income tax, real property tax, utility users tax, state education tax, local income tax, and local personal property tax (Michigan Job Commission, 1997). Such measures are expected to attract more commercial and industrial developments that could utilize existing infrastructures and achieve economies of scale. While an increase in tax base will increase spending, it may help to keep the tax burden of the established residents lower in the future than it might otherwise be. Therefore, the statistical significance of total property does not warrant land use regulations as policy instruments to hold down expenditures. What matters is not the level of expenditures but the ability of residents to pay for the services they demand.

Most of the communities with high expenditures are the smaller cities. Almost all cities provide most of the services (excepting water and sewer in a few cases) on their own, while smaller townships do not. Because of the lumpy nature of many of the services, underutilization of the existing public service infrastructures results in high public service expenditures. Consistent with the findings of Burchell (1997) and Schmid (1997), such a population-expenditure relationship implies that more people could be added to the existing smaller communities and spending per capita would decrease. A small city following a dense settlement policy has two things going for it that can reduce per capita expenditures. (1) If small cities were to grow to achieve economies of scale it need not contribute to sprawl since sprawl refers to low density development, not growth in population whether it be around a metro or non-metro area. (2) City population is negatively correlated with expenditures. This finding supports a policy to increase the number of residents of existing communities. If this is to take place in smaller size communities, the savings that could be obtained from the joint impact of increased population and a dense new residential development could be substantial.

Settlement, nonetheless, follows jobs. Currently most of the jobs in the State are concentrated in cities and townships of Southeast Michigan where per capita expenditures are the highest (the exception is the Grand Rapids area). The projected future job growth is also in Southeast Michigan. But, if local governments outside of Southeast Michigan could use different policy instruments to promote job opportunities in their areas by attracting new businesses, it could mean that expenditures would drop in outstate cities (that are in a sense now too small) and Southeast Michigan cities (that are or will be too large). Growth outstate could benefit Southeast Michigan by removing some of the pressure for increased spending. Outstate regions need new and coordinated growth strategies that will direct businesses and settlement into their areas. But, such strategies are unlikely to materialize if growth efforts are not coordinated at regional or state levels and if Southeast Michigan can not see that it is also to their advantage.

6.4 Future Research

This research was conducted using fifteen-year data sets that include population, expenditures of public services, and state equalized value of properties. However, it remains desirable if data on other variables like measures of congestion, quality of services, income and employment in minor civil divisions (MCDs), water/sewer expenditure, and county supplied roads were available. The paucity of these types of data sets could be considered as shortcomings of this research.

The lack of measures of quality of service creates problems of quantifying the actual benefits that may arise from population growth for some communities and the actual costs of population congestion for others. In many of related studies, congestion has been identified as a variable that increases the costs of public services. On the other hand, higher population density is suggested as a variable that could reduce these costs. Then, the question becomes what level of congestion will offset the benefits of higher population density, or what level of population density brings in congestion. The major service categories in this study that are affected by these countervailing effects of congestion and population density are water and sewer systems, fire and police protections, and roads and highways. The questions posed above can be answered only if it is possible to measure quality of services at different level of population density and obtain relevant data of these service categories.

Public service expenditures largely depend on the resources available in a community. Household income and place of employment of residents of a community make up the larger share of resources available for public services. But, household (family) income and employment information are not available at a lower MCD (city or township) level. The census data of these variables is only available at a county level. That is not that much helpful for this type of research that focuses to the lowest level of government structure because there is no way of knowing the exact share of employment and income in the community of interest. A city or a township is only a part of a county.

Expenditure data on water and sewer service areas need to be included to obtain the whole picture of expenditures of local governments. But these data are very difficult to collect. The political boundaries of communities and the service areas covered by the system are often different.

Finally, expenditure on roads and major streets is one of the problems encountered in this study. Cities provide their own construction and maintenance of roads and streets while townships are served by county road commissions. Counties do not keep expenditure records by townships, but by road or street that may run through several townships. Thus, because it is difficult to assign the exact amount of expenditure to the share of road miles in a particular township, expenditure data for this service category is not available for townships.

Collecting and adjusting most of the data mentioned here may not be an easy task. However, it may be possible to reduce the magnitude of the problem through survey and primary data collection methods if reasonable financial and technical supports are available.

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APPENDICES

APPENDIX A:

SUMMARY STATISTICS

(A.1.1) All Cities

Variable	Obs	Mean	Std. Dev.	Min	Max
expend	255	479.3843	167.8211	182	1029
poptotal	255	35633.17	30755.33	4410	119929
popgrwth	255	.0195294	.0115941	0	.05
bsnsprp	255	10675.96	5362.874	2668	25945
rsdntprp	255	10746.93	4128.837	5107	21801
totalprp	255	21477.8	7459.293	10902	45238
lndar	255	21.41176	12.21877	3	38
denst	255	1546.898	658.1756	567	3331

Note:

- expend = Per Capita Public Service Expenditures
- poptotal = Total Population
- popgrwth = Population Growth Rate
- bsnsprp = Per Capita State Equalized Value of Business Property
- rsdntprp = Per Capita State Equalized Value of ResidentialProperty
- totalprp = Per Capita State Equalized Value of Total Property
- lndar = Total Land Area of Local Governmnet
- denst = Population Density (persons/square mile)

(A.1.2) Cities in Southeast Michigan

Variable	Obs	Mean	Std. Dev.	Min	Max
expend	165	526.6061	171.2933	182	1029
poptotal	165	36439.71	35936.42	4410	119929
popgrwth	165	.022	.0122574	0	.05
bsnsprp	165	11819.25	6028.344	2668	25945
rsdntprp	165	11680.6	4789.045	5107	21801
totalprp	165	23579.53	8164.963	10902	45238
lndar	165	19.90909	13.85545	3	36
denst	165	1613.588	680.7925	689	3331

(A.1.3) Cities in the Rest of the State

Variable	Obs	Mean	Std. Dev.	Min	Max
expend	90	392.8111	120.8198	209	684
poptotal	90	34154.52	17787.19	12733	66635
popgrwth	90	.015	.008644	0	.04
bsnsprp	90	8579.933	2872.106	4061	15611
rsdntprp	90	9035.2	1345.584	6836	12302
totalprp	90	17624.61	3570.186	11962	26847
lndar	90	24.16667	7.77673	14	38
denst	90	1424.633	599.0804	567	2563

(A.1.4) Cities With Larger Population

Variable	Obs	Mean	Std. Dev.	Min	Max
expend	90	401.9667	92.48206	182	594
poptotal	90	71573.17	22041.66	39695	119929
popgrwth	90	.0188889	.0131921	0	.05
bsnsprp	90	9757.467	5066.736	2668	24661
rsdntprp	90	13331.34	4709.928	6836	21801
totalprp	90	23084.03	8513.484	13030	45238
lndar	90	34.16667	3.955511	26	38
denst	90	2118.533	634.8137	1045	3331

(A.1.5) Cities With Smaller Population

Variable	Obs	Mean	Std. Dev.	Min	Max
expend	165	521.6121	184.106	209	1029
poptotal	165	16029.54	10287.19	4410	40414
popgrwth	165	.0198788	.0106489	0	.04
bsnsprp	165	11176.96	5467.762	4061	25945
rsdntprp	165	9337.248	2949.444	5107	20622
totalprp	165	20601.67	6682.388	10902	37261
lndar	165	14.45455	9.206609	3	31
denst	165	1235.097	418.4413	567	2297

(A.2.1) All Townships

Variable	Obs	Mean	Std. Dev.	Min	Max
expend	435	173.6874	85.74049	34	420
poptotal	435	24707.8	19068.91	4038	94719
popgrwth	435	.0176322	.0120541	-.01	.06
bsnsprp	435	5477.791	3797.805	789	24088
rsdntprp	435	12542.77	5454.457	5342	34706
totalprp	435	18432.45	7391.811	8558	58331
lndar	435	31.65517	8.344301	14	57
denst	435	816.4621	634.9118	112	3383

(A.2.2) Townships in Souteast Michigan

Variable	Obs	Mean	Std. Dev.	Min	Max
expend	210	205.9857	87.14825	67	420
poptotal	210	33986.11	22534.51	4443	94719
popgrwth	210	.0198095	.0117372	0	.06
bsnsprp	210	5134.581	2627.174	1177	15251
rsdntprp	210	13379.87	5534.534	5936	32767
totalprp	210	18932.6	5891.494	11369	36726
lndar	210	31.14286	10.08711	14	57
denst	210	1143.638	750.2909	234	3383

(A.2.3) Townships in the Rest of the State

Variable	Obs	Mean	Std. Dev.	Min	Max
expend	225	143.5422	72.56991	34	328
poptotal	225	16048.05	8642.24	4038	36274
popgrwth	225	.0156	.0120164	-.01	.05
bsnsprp	225	5798.12	4614.308	789	24088
rsdntprp	225	11761.47	5271.886	5342	34706
totalprp	225	17965.64	8545.41	8558	58331
lndar	225	32.13333	6.284192	16	41
denst	225	511.0978	248.5437	112	1099

(A.2.4) Townships With Larger Population

Variable	Obs	Mean	Std. Dev.	Min	Max
expend	45	286.8889	50.23681	197	392
poptotal	45	67523.11	14074.41	43217	94719
popgrwth	45	.016	.0103133	0	.03
bsnsprp	45	3942.756	1136.065	2108	6039
rsdntprp	45	16317.44	7856.308	8802	32767
totalprp	45	20277.18	7806.725	11369	36726
lndar	45	31.33333	3.437758	28	36
denst	45	2192.533	595.1855	1441	3383

(A.2.5) Townships With Smaller Population

Variable	Obs	Mean	Std. Dev.	Min	Max
expend	390	160.6256	79.13873	34	420
poptotal	390	19767.57	12114.13	4038	63286
popgrwth	390	.0178205	.0122367	-.01	.06
bsnsprp	390	5654.91	3954.973	789	24088
rsdntprp	390	12107.23	4936.898	5342	34706
totalprp	390	18219.59	7323.043	8558	58331
lndar	390	31.69231	8.736808	14	57
denst	390	657.6846	406.6335	112	1894

APPENDIX B:

CORRELATION ANALYSIS OF THE VARIABLES

(B.1) Correlation of the Independent Variables, Cities

	expend	poptotal	popsq	popgrwth	rsdntprp	totalprp	lndar
expend	1.0000						
poptotal	-0.2985	1.0000					
popsq	-0.1782	0.9499	1.0000				
popgrwth	0.0108	-0.1840	-0.2459	1.0000			
rsdntprp	-0.1024	0.5054	0.4212	0.2259	1.0000		
totalprp	0.2149	0.2181	0.1681	0.2039	0.7063	1.0000	
lndar	-0.4966	0.8051	0.6392	0.0105	0.4791	0.2431	1.0000
popdenst	-0.0276	0.7832	0.8211	-0.2615	0.3728	0.0508	0.3135

(B.2) Correlation of the Independent Variables, Townships

	expend	poptotal	popsq	popgrwth	rsdntprp	totalprp	lndar
expend	1.0000						
poptotal	0.7221	1.0000					
popsq	0.6448	0.9586	1.0000				
popgrwth	-0.1782	-0.0926	-0.0586	1.0000			
rsdntprp	0.3393	0.1624	0.1146	0.0350	1.0000		
totalprp	0.3791	0.0269	-0.0064	-0.0078	0.8719	1.0000	
lndar	-0.1100	0.1064	0.0546	0.0807	0.0247	0.0511	1.0000
popdenst	0.7225	0.9238	0.9040	-0.1342	0.1753	0.0164	-0.2151

APPENDIX C:

DIAGNOSTIC REGRESSION RESULTS

(C.1.1) Diagnostic Regression, With All Variables, Cities

Source	SS	df	MS
Model	3116285.22	7	445183.604
Residual	4037351.11	247	16345.5511
Total	7153636.34	254	28163.9226

Number of obs =	255
F(7, 247) =	27.24
Prob > F =	0.0000
R-squared =	0.4356
Adj R-squared =	0.4196
Root MSE =	127.85

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	-.0047309	.0028321	-1.670	0.096	-.0103091	.0008472
popsq	2.54e-08	1.22e-08	2.083	0.038	1.38e-09	4.95e-08
popgrwth	695.0465	782.8249	0.888	0.375	-846.817	2236.91
rsdntprp	-.0144809	.0036314	-3.988	0.000	-.0216333	-.0073285
totalprp	.0133838	.0017527	7.636	0.000	.0099317	.0168359
lndar	-3.157295	3.384564	-0.933	0.352	-9.823581	3.508991
popdenst	.1075062	.0496774	2.164	0.031	.0096608	.2053516
_cons	347.5944	77.39148	4.491	0.000	195.163	500.0258

Variable	VIF	1/VIF
poptotal	117.89	0.008482
lndar	26.58	0.037628
popsq	26.04	0.038405
popdenst	16.61	0.060196
rsdntprp	3.49	0.286268
totalprp	2.66	0.376502
popgrwth	1.28	0.781199
Mean VIF	27.79	

(C.1.2) Diagnostic Regression, Without Square of Population, Cities

Source	SS	df	MS
Model	3045397.15	6	507566.192
Residual	4108239.18	248	16565.4806
Total	7153636.34	254	28163.9226

Number of obs	= 255
F(6, 248)	= 30.64
Prob > F	= 0.0000
R-squared	= 0.4257
Adj R-squared	= 0.4118
Root MSE	= 128.71

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	.000359	.0014403	0.249	0.803	-.0024779	.0031958
popgrwth	707.9893	788.0489	0.898	0.370	-844.1326	2260.111
rsdntprp	-.0140781	.0036505	-3.856	0.000	-.0212681	-.0068882
totalprp	.0127716	.0017394	7.342	0.000	.0093456	.0161975
lndar	-8.115349	2.421753	-3.351	0.001	-12.88517	-3.345524
popdenst	.05589	.0433412	1.290	0.198	-.0294738	.1412538
_cons	417.066	70.30076	5.933	0.000	278.6033	555.5286

Variable	VIF	1/VIF
poptotal	30.09	0.033235
lndar	13.43	0.074483
popdenst	12.48	0.080146
rsdntprp	3.48	0.287083
totalprp	2.58	0.387402
popgrwth	1.28	0.781249
Mean VIF	10.56	

(C.1.3) Diagnostic Regression, Without Land Area, Cities

Source	SS	df	MS
Model	3102061.13	6	517010.188
Residual	4051575.21	248	16336.9968
Total	7153636.34	254	28163.9226

Number of obs =	255
F(6, 248) =	31.65
Prob > F =	0.0000
R-squared =	0.4336
Adj R-squared =	0.4199
Root MSE =	127.82

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	-.0072343	.0009051	-7.993	0.000	-.0090169	-.0054516
popsq	3.34e-08	8.67e-09	3.854	0.000	1.63e-08	5.05e-08
popgrwth	619.9988	778.4763	0.796	0.427	-913.2691	2153.267
rsdntprp	-.0154586	.0034759	-4.447	0.000	-.0223047	-.0086126
totalprp	.0139935	.0016258	8.607	0.000	.0107912	.0171957
popdenst	.1488303	.0224769	6.621	0.000	.1045604	.1931001
_cons	286.4175	41.08225	6.972	0.000	205.5029	367.3321

Variable	VIF	1/VIF
popsq	13.15	0.076021
poptotal	12.05	0.083008
popdenst	3.40	0.293889
rsdntprp	3.20	0.312284
totalprp	2.29	0.437304
popgrwth	1.27	0.789538
Mean VIF	5.89	

(C.1.4) Diagnostic Regression, Without Square of Population and Land Area, Cities

Source	SS	df	MS
Model	2859377.53	5	571875.505
Residual	4294258.81	249	17246.0193
Total	7153636.34	254	28163.9226

Number of obs =	255
F(5, 249) =	33.16
Prob > F =	0.0000
R-squared =	0.3997
Adj R-squared =	0.3877
Root MSE =	131.32

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	-.0042176	.000467	-9.032	0.000	-.0051372	-.0032979
popgrwth	346.9014	796.521	0.436	0.664	-1221.876	1915.679
rsdntprp	-.0184071	.0034837	-5.284	0.000	-.0252685	-.0115458
totalprp	.0148919	.0016532	9.008	0.000	.0116358	.018148
popdenst	.1833932	.0211761	8.660	0.000	.1416861	.2251003
_cons	217.1787	37.96024	5.721	0.000	142.4146	291.9428

Variable	VIF	1/VIF
rsdntprp	3.05	0.328182
poptotal	3.04	0.329209
popdenst	2.86	0.349526
totalprp	2.24	0.446483
popgrwth	1.26	0.796134
Mean VIF	2.49	

(C.2.1) Diagnostic Regression, With All Variables, Townships

Source	SS	df	MS
Model	2468967.96	7	352709.709
Residual	721553.52	427	1689.82089
Total	3190521.48	434	7351.43198

Number of obs	=	435
F(7, 427)	=	208.73
Prob > F	=	0.0000
R-squared	=	0.7738
Adj R-squared	=	0.7701
Root MSE	=	41.107

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	.0059452	.0005741	10.356	0.000	.0048169	.0070736
popsq	-3.62e-08	4.59e-09	-7.886	0.000	-4.52e-08	-2.72e-08
popgrwth	-267.8235	169.6324	-1.579	0.115	-601.242	65.59499
rsdntprp	-.0077243	.0008089	-9.550	0.000	-.0093141	-.0061344
totalprp	.0090039	.0005794	15.540	0.000	.0078651	.0101427
lndar	-2.178844	.4239883	-5.139	0.000	-3.012208	-1.34548
popdenst	.016835	.0148375	1.135	0.257	-.0123285	.0459986
_cons	52.91757	15.71485	3.367	0.001	22.02949	83.80565

Variable	VIF	1/VIF
poptotal	30.78	0.032492
popdenst	22.79	0.043874
popsq	13.41	0.074547
rsdntprp	5.00	0.200032
totalprp	4.71	0.212272
lndar	3.21	0.311074
popgrwth	1.07	0.931239
Mean VIF	11.57	

(C.2.2) Diagnostic Regression, Without Square of Population, Townships

Source	SS	df	MS
Model	2363874.11	6	393979.018
Residual	826647.37	428	1931.41909
Total	3190521.48	434	7351.43198

Number of obs =	435
F(6, 428) =	203.98
Prob > F =	0.0000
R-squared =	0.7409
Adj R-squared =	0.7373
Root MSE =	43.948

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	.0033976	.0005073	6.697	0.000	.0024004	.0043948
popgrwth	-470.8409	179.2533	-2.627	0.009	-823.1672	-118.5145
rsdntprp	-.0067628	.0008549	-7.911	0.000	-.0084431	-.0050825
totalprp	.0086217	.0006173	13.968	0.000	.0074084	.0098349
lndar	-2.105631	.4531768	-4.646	0.000	-2.99636	-1.214902
popdenst	.0046914	.0157771	0.297	0.766	-.0263188	.0357015
_cons	86.77203	16.16171	5.369	0.000	55.00583	118.5382

Variable	VIF	1/VIF
popdenst	22.55	0.044351
poptotal	21.03	0.047549
rsdntprp	4.89	0.204682
totalprp	4.68	0.213768
lndar	3.21	0.311223
popgrwth	1.05	0.953192
Mean VIF	9.57	

(C.2.3) Diagnostic Regression, Without Land Area, Townships

Source	SS	df	MS
Model	2424342.26	6	404057.043
Residual	766179.224	428	1790.13837
Total	3190521.48	434	7351.43198

Number of obs	=	435
F(6, 428)	=	225.71
Prob > F	=	0.0000
R-squared	=	0.7599
Adj R-squared	=	0.7565
Root MSE	=	42.31

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	.003911	.0004279	9.139	0.000	.0030699	.0047522
popsq	-3.57e-08	4.73e-09	-7.555	0.000	-4.50e-08	-2.64e-08
popgrwth	-232.6655	174.453	-1.334	0.183	-575.5566	110.2256
rsdntprp	-.0082862	.0008249	-10.045	0.000	-.0099075	-.0066649
totalprp	.009294	.0005935	15.659	0.000	.0081274	.0104605
popdenst	.0791574	.0087984	8.997	0.000	.061864	.0964509
_cons	-16.09906	8.398802	-1.917	0.056	-32.60709	.4089664

Variable	VIF	1/VIF
poptotal	16.14	0.061943
popsq	13.41	0.074583
popdenst	7.57	0.132179
rsdntprp	4.91	0.203755
totalprp	4.67	0.214306
popgrwth	1.07	0.932756
Mean VIF	7.96	

(C.2.4) Diagnostic Regression, Without Square of Population and Land Area, Townships

Source	SS	df	MS
Model	2322177.01	5	464435.401
Residual	868344.474	429	2024.11299
Total	3190521.48	434	7351.43198

Number of obs	=	435
F(5, 429)	=	229.45
Prob > F	=	0.0000
R-squared	=	0.7278
Adj R-squared	=	0.7247
Root MSE	=	44.99

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	.0014659	.0002977	4.925	0.000	.0008808	.002051
popgrwth	-434.0473	183.3252	-2.368	0.018	-794.3746	-73.71994
rsdntprp	-.0073194	.0008665	-8.447	0.000	-.0090225	-.0056162
totalprp	.0089074	.0006288	14.167	0.000	.0076716	.0101432
popdenst	.0651161	.0091446	7.121	0.000	.0471423	.0830898
_cons	19.57543	7.385476	2.651	0.008	5.059209	34.09165

Variable	VIF	1/VIF
popdenst	7.23	0.138353
poptotal	6.91	0.144739
rsdntprp	4.79	0.208781
totalprp	4.63	0.215911
popgrwth	1.05	0.955056
Mean VIF	4.92	

APPENDIX D:

FIXED EFFECTS REGRESSIONS

(D.1.1) Fixed-effects (within) regression, All Cities

sd(u_x)	= 274.3876	Number of obs =	255
sd(e_x_t)	= 59.86757	n =	17
sd(e_x_t + u_x)	= 280.8428	T =	15
corr(u_x, Xb)	= -0.8658	R-sq within =	0.6813
		between =	0.2298
		overall =	0.2508
		F(5, 233) =	99.60
		Prob > F =	0.0000

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	-.010263	.0021385	-4.799	0.000	-.0144763	-.0060498
popgrwth	953.7204	520.3563	1.833	0.068	-71.48421	1978.925
rsdntprp	-734.8218	93.96698	-7.820	0.000	-919.9553	-549.6883
totalprp	.0165517	.0014931	11.086	0.000	.01361	.0194934
popdenst	.1216082	.0596871	2.037	0.043	.0040129	.2392035
_cons	659.3128	69.12164	9.538	0.000	523.1295	795.4961
x		F(16,233) =	58.532	0.000	(17 categories)	

(D.1.2) Fixed-effects (within) regression, Large Cities

```
sd(u_x)                   =  142.9667           Number of obs =        90
sd(e_x_t)                 =  27.82715                       n =         6
sd(e_x_t + u_x)           =  145.6497                       T =        15

corr(u_x, Xb)             =   -0.7948           R-sq within   =    0.7734
                                                     between  =    0.1050
                                                     overall  =    0.1781

                                                F(   5,    79) =    53.94
                                                     Prob > F  =   0.0000
```

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	-.0139113	.0077229	-1.801	0.075	-.0292833	.0014606
popgrwth	-102.6204	382.4081	-0.268	0.789	-863.7846	658.5438
rsdntprp	-168.8904	117.0794	-1.443	0.153	-401.931	64.15032
totalprp	.0082523	.0010735	7.687	0.000	.0061156	.010389
popdenst	.5130661	.2771342	1.851	0.068	-.0385557	1.064688
_cons	220.7693	111.0503	1.988	0.050	-.2708759	441.8094
x		F(5,79) =	10.393	0.000	(6 categories)	

(D.1.3) Fixed-effects (within) regression, Small Cities

```
sd(u_x)                  =  254.7211           Number of obs =      165
sd(e_x_t)                =   63.8909                       n =       11
sd(e_x_t + u_x)          =  262.6117                       T =       15

corr(u_x, Xb)            =   -0.7788           R-sq within   =   0.7412
                                                    between  =   0.1138
                                                    overall  =   0.2016

                                               F(  5,   149) =    85.34
                                                    Prob > F =   0.0000
```

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	-.0180694	.0044878	-4.026	0.000	-.0269372	-.0092015
popgrwth	2002.933	729.4205	2.746	0.007	561.589	3444.278
rsdntprp	-621.378	113.8592	-5.457	0.000	-846.3652	-396.3908
totalprp	.0244323	.0023148	10.555	0.000	.0198582	.0290063
popdenst	.0230682	.0688709	0.335	0.738	-.1130216	.1591581
_cons	533.6468	70.29753	7.591	0.000	394.738	672.5557
x		F(10,149) =	72.552	0.000	(11 categories)	

(D.1.4) Fixed-effects (within) regression, Cities In Southeast Michigan

```
sd(u_x)                    =   379.453        Number of obs =     165
sd(e_x_t)                  =  66.81461                    n =      11
sd(e_x_t + u_x)            =  385.2905                    T =      15

corr(u_x, Xb)              =   -0.9316        R-sq within   =  0.7159
                                                   between  =  0.2964
                                                   overall  =  0.2691

                                              F(  5,   149) =   75.08
                                                  Prob > F  =  0.0000
```

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	-.0121669	.0025687	-4.737	0.000	-.0172426	-.0070911
popgrwth	1406.859	703.5551	2.000	0.047	16.62459	2797.093
rsdntprp	-752.5316	111.8925	-6.725	0.000	-973.6326	-531.4305
totalprp	.0176052	.001851	9.511	0.000	.0139477	.0212628
popdenst	.1401436	.0704069	1.990	0.048	.0010187	.2792685
_cons	679.1292	82.22317	8.260	0.000	516.6552	841.6033
x		F(10,149) =	37.479	0.000	(11 categories)	

(D.1.5) Fixed-effects (within) regression, Cities In The Rest Of The State

```
sd(u_x)                   =  174.1558          Number of obs =        90
sd(e_x_t)                 =  40.40474                      n =         6
sd(e_x_t + u_x)           =  178.7814                      T =        15

corr(u_x, Xb)             =   -0.7174          R-sq within   =    0.5377
                                                    between  =    0.2428
                                                    overall  =    0.0510

                                               F(  5,    79) =     18.38
                                                    Prob > F =    0.0000
```

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	.0009921	.0058529	0.170	0.866	-.0106577	.012642
popgrwth	2.462257	640.082	0.004	0.997	-1271.589	1276.514
rsdntprp	-326.24	285.3269	-1.143	0.256	-894.1689	241.6889
totalprp	.0142678	.0027472	5.194	0.000	.0087997	.0197359
popdenst	-.0916778	.208614	-0.439	0.662	-.5069135	.323558
_cons	408.4734	235.4125	1.735	0.087	-60.1035	877.0503
x		F(5,79) =	88.708	0.000	(6 categories)	

(D.2.1) Fixed-effects (within) regression, All Townships

```
sd(u_x)                   =   56.8364          Number of obs =     435
sd(e_x_t)                 =  21.39988                      n =      29
sd(e_x_t + u_x)           =  60.73163                      T =      15

corr(u_x, Xb)             =   -0.6222          R-sq within   =  0.7205
                                                    between  =  0.6943
                                                    overall  =  0.6818

                                               F(  5,   401) =  206.70
                                                    Prob > F =  0.0000
```

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	.0020959	.0024047	0.872	0.384	-.0026316	.0068234
popgrwth	56.51377	127.6502	0.443	0.658	-194.4334	307.4609
rsdntprp	-28.07982	42.21079	-0.665	0.506	-111.0619	54.90226
totalprp	.005525	.0003178	17.384	0.000	.0049002	.0061498
popdenst	.0934648	.0728535	1.283	0.200	-.0497576	.2366872
_cons	-38.03864	30.70527	-1.239	0.216	-98.40206	22.32477
x		F(28,401) =	53.592	0.000	(29 categories)	

(D.2.2) Fixed-effects (within) regression, Large Townships

```
sd(u_x)                    =  202.1994          Number of obs =        45
sd(e_x_t)                  =  14.33903                      n =         3
sd(e_x_t + u_x)            =  202.7072                      T =        15

corr(u_x, Xb)              =   -0.9594          R-sq within   =    0.9155
                                                     between  =    0.0011
                                                     overall  =    0.0533

                                                F(  5,    37) =     80.21
                                                     Prob > F =    0.0000

------------------------------------------------------------------------------
  expend |      Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
poptotal |  -.0177926   .0110458     -1.611   0.116      -.0401736    .0045885
popgrwth |  -15.29543   382.4206     -0.040   0.968      -790.1532    759.5623
rsdntprp |  -77.09176   184.6153     -0.418   0.679      -451.1578    296.9743
totalprp |   .0068965   .0014501      4.756   0.000       .0039583    .0098347
popdenst |   .6309416   .3041374      2.075   0.045       .0147007    1.247183
   _cons |   25.60831   173.8438      0.147   0.884      -326.6326    377.8492
------------------------------------------------------------------------------
       x |             F(2,37) =      3.541   0.039           (3 categories)
```

(D.2.3) Fixed-effects (within) regression, Small Townships

```
sd(u_x)                 =  41.51583        Number of obs =       390
sd(e_x_t)               =    22.007                    n =        26
sd(e_x_t + u_x)         =    46.988                    T =        15

corr(u_x, Xb)           =   -0.2956        R-sq within   =    0.6933
                                                between  =    0.6906
                                                overall  =    0.6865

                                           F(  5,   359) =    162.29
                                               Prob > F  =    0.0000
```

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	.0027243	.0025714	1.059	0.290	-.0023326	.0077812
popgrwth	95.85895	137.8094	0.696	0.487	-175.1561	366.874
rsdntprp	-35.13909	45.6991	-0.769	0.442	-125.0107	54.73248
totalprp	.0054268	.0003645	14.890	0.000	.0047101	.0061435
popdenst	.0917373	.0833399	1.101	0.272	-.0721584	.2556331
_cons	-30.50829	30.90514	-0.987	0.324	-91.28614	30.26956
x		F(25,359) =	40.177	0.000	(26 categories)	

(D.2.4) Fixed-effects (within) regression, Townships In Southeast Michigan

```
sd(u_x)              =  101.4405        Number of obs =     210
sd(e_x_t)            =   20.0556                    n =      14
sd(e_x_t + u_x)      =  103.4041                    T =      15

corr(u_x, Xb)        =   -0.8628        R-sq within   =  0.7800
                                             between  =  0.6562
                                             overall  =  0.6284

                                        F(  5,   191) =  135.43
                                             Prob > F =  0.0000
```

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	.0066837	.0024642	2.712	0.007	.0018232	.0115442
popgrwth	-192.9878	164.9659	-1.170	0.244	-518.3768	132.4011
rsdntprp	133.5062	58.96156	2.264	0.025	17.20674	249.8056
totalprp	.0042184	.0005095	8.280	0.000	.0032135	.0052233
popdenst	-.0106907	.0731057	-0.146	0.884	-.1548888	.1335074
_cons	-178.1696	45.37463	-3.927	0.000	-267.6693	-88.66987
x		F(13,191) =	58.766	0.000	(14 categories)	

(D.2.4) Fixed-effects (within) regression, Townships In The Rest Of The State

```
sd(u_x)              =   106.869         Number of obs =     225
sd(e_x_t)            =  20.95942                     n =      15
sd(e_x_t + u_x)      =  108.9049                     T =      15

corr(u_x, Xb)        =   -0.8330         R-sq within   =  0.7074
                                              between  =  0.2823
                                              overall  =  0.3013

                                         F(  5,   205) =   99.11
                                              Prob > F =  0.0000
```

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	-.0274088	.0071387	-3.839	0.000	-.0414835	-.013334
popgrwth	369.4363	196.2024	1.883	0.061	-17.39691	756.2696
rsdntprp	-116.5602	69.646	-1.674	0.096	-253.8745	20.75411
totalprp	.0056838	.0005227	10.875	0.000	.0046534	.0067143
popdenst	1.066333	.2456398	4.341	0.000	.5820288	1.550638
_cons	8.710335	54.21959	0.161	0.873	-98.1892	115.6099
x		F(14,205) =	42.298	0.000	(15 categories)	

APPENDIX E:

GENERAL LINEAR MODEL REGRESSIONS

(E.1) General Linear Model Regression, All Cities

```
. regress expend poptotal popgrwth rsdntprc totalprp loctn denst

  Source |       SS       df       MS                  Number of obs =     255
---------+------------------------------               F(  6,   248) =   35.47
   Model |  3303923.46     6  550653.91                Prob > F      =  0.0000
Residual |  3849712.88   248  15523.0358               R-squared     =  0.4619
---------+------------------------------               Adj R-squared =  0.4488
   Total |  7153636.34   254  28163.9226               Root MSE      =  124.59

------------------------------------------------------------------------------
  expend |      Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
poptotal |  -.0036915   .0004541     -8.129   0.000      -.0045858   -.0027971
popgrwth |  -542.8689   789.0247     -0.688   0.492      -2096.913    1011.175
rsdntprc |  -465.1939   78.55045     -5.922   0.000      -619.9049   -310.4828
totalprp |   .0032702   .0013332      2.453   0.015       .0006443    .0058961
   loctn |   90.26203   19.23172      4.693   0.000       52.38371    128.1404
   denst |   .1535365    .021278      7.216   0.000        .111628    .1954451
   _cons |    493.703   52.26172      9.447   0.000       390.7696    596.6365
------------------------------------------------------------------------------
```

(E.2) General Linear Model Regression, All Townships

. regress expend poptotal popgrwth rsdntprc totalprp loctn denst

Source	SS	df	MS
Model	2328170.64	6	388028.44
Residual	862350.84	428	2014.83841
Total	3190521.48	434	7351.43198

Number of obs =	435
F(6, 428) =	192.59
Prob > F =	0.0000
R-squared =	0.7297
Adj R-squared =	0.7259
Root MSE =	44.887

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	.0015841	.0002992	5.294	0.000	.000996	.0021722
popgrwth	-416.1993	186.9083	-2.227	0.026	-783.5717	-48.82694
rsdntprc	-153.5715	17.8482	-8.604	0.000	-188.6526	-118.4905
totalprp	.0040236	.0002926	13.752	0.000	.0034485	.0045986
loctn	-10.6674	5.199812	-2.051	0.041	-20.88775	-.4470588
denst	.0653278	.0091558	7.135	0.000	.0473319	.0833238
_cons	124.1993	13.51284	9.191	0.000	97.63952	150.7591

APPENDIX F:

FIXED EFFECTS REGRESSION WITH LOCATION VARIABLE

(F) Fixed-effects (within) regression, With Location Variable, Cities

sd(u_x)	= 274.3876	Number of obs =	255
sd(e_x_t)	= 59.86757	n =	17
sd(e_x_t + u_x)	= 280.8428	T =	15
corr(u_x, Xb)	= -0.8658	R-sq within =	0.6813
		between =	0.2298
		overall =	0.2508
		F(5, 233) =	99.60
		Prob > F =	0.0000

expend	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
poptotal	-.010263	.0021385	-4.799	0.000	-.0144763	-.0060498
popgrwth	953.7204	520.3563	1.833	0.068	-71.48421	1978.925
rsdntprc	-734.8218	93.96698	-7.820	0.000	-919.9553	-549.6883
totalprp	.0165517	.0014931	11.086	0.000	.01361	.0194934
location	(dropped)					
density	.1216082	.0596871	2.037	0.043	.0040129	.2392035
_cons	659.3128	69.12164	9.538	0.000	523.1295	795.4961
x		F(16,233) =	52.569	0.000	(17 categories)	

APPENDIX G:

SAMPLE REGRESSION DATA

(G.1) Sample Regression Data, Cities

City	Year	Expend.	Tot Pop.	Pop. Gr. Rate	Res. Propty	Tot. Propty	Pop Density
FARMINGTON HILLS	1981	363	59,716	0.03	0.72	19,676	1,810
	1982	357	61,423	0.03	0.73	21,091	1,861
	1983	351	63,178	0.03	0.71	20,168	1,914
	1984	372	64,985	0.03	0.70	20,064	1,969
	1985	372	66,842	0.03	0.66	20,678	2,026
	1986	389	68,753	0.03	0.63	22,094	2,083
	1987	434	70,718	0.03	0.57	26,016	2,143
	1988	512	72,740	0.03	0.59	28,141	2,204
	1989	474	73,819	0.03	0.60	30,144	2,237
	1990	490	74,652	0.03	0.61	32,565	2,262
	1991	517	75,775	0.02	0.61	33,897	2,296
	1992	508	76,915	0.02	0.61	34,399	2,331
	1993	594	78,072	0.02	0.62	34,297	2,366
	1994	514	79,144	0.02	0.63	33,889	2,398
	1995	504	80,267	0.02	0.64	33,545	2,432
WYOMING	1981	343	60,044	0.00	0.50	13,806	2,309
	1982	325	60,471	0.01	0.49	14,586	2,326
	1983	332	60,899	0.01	0.50	14,993	2,342
	1984	344	61,326	0.01	0.49	14,973	2,359
	1985	364	61,754	0.01	0.48	14,859	2,375
	1986	412	62,181	0.01	0.47	15,150	2,392
	1987	384	62,609	0.01	0.46	15,893	2,408
	1988	384	63,036	0.01	0.46	15,934	2,424
	1989	382	63,464	0.01	0.47	16,393	2,441
	1990	358	63,891	0.01	0.47	17,376	2,457
	1991	352	64,440	0.01	0.49	18,495	2,478
	1992	386	64,989	0.01	0.47	19,159	2,500
	1993	407	65,537	0.01	0.49	20,042	2,521
	1994	422	66,086	0.01	0.49	19,674	2,542
	1995	438	66,635	0.01	0.49	19,380	2,563

(G.2) Sample Regression Data, Townships

Township	Year	Expend.	Tot Pop.	Pop. Gr. Rate	Res. Propty	Tot. Propty	Pop Density
W. BLOOMFIELD	1981	197	43,217	0.00	0.91	23,633	1,441
	1982	197	44,473	0.03	0.92	25,461	1,482
	1983	209	45,728	0.03	0.91	23,846	1,524
	1984	203	46,984	0.03	0.91	23,471	1,566
	1985	200	48,239	0.03	0.90	23,036	1,608
	1986	218	49,494	0.03	0.89	24,280	1,650
	1987	235	50,750	0.03	0.88	27,123	1,692
	1988	275	52,005	0.02	0.87	29,850	1,734
	1989	279	53,261	0.02	0.86	32,148	1,775
	1990	278	54,516	0.02	0.87	33,459	1,817
	1991	287	55,477	0.02	0.88	35,019	1,849
	1992	295	56,438	0.02	0.88	35,257	1,881
	1993	314	57,398	0.02	0.89	36,490	1,913
	1994	329	58,359	0.02	0.89	36,726	1,945
	1995	340	59,320	0.02	0.89	36,507	1,977
MERIDIAN	1981	210	29,443	0.00	0.71	13,970	892
	1982	228	30,132	0.02	0.71	15,670	913
	1983	220	30,821	0.02	0.69	15,712	934
	1984	229	31,510	0.02	0.70	15,443	955
	1985	241	32,199	0.02	0.69	15,136	976
	1986	242	32,888	0.02	0.69	15,090	997
	1987	235	33,577	0.02	0.70	16,035	1,017
	1988	231	34,266	0.02	0.69	18,008	1,038
	1989	242	34,955	0.02	0.71	19,626	1,059
	1990	255	35,644	0.02	0.71	21,150	1,080
	1991	287	35,770	0.00	0.70	23,233	1,084
	1992	308	35,896	0.00	0.70	23,804	1,088
	1993	307	36,022	0.00	0.71	24,928	1,092
	1994	290	36,148	0.00	0.71	24,722	1,095
	1995	285	36,274	0.00	0.71	25,484	1,099