



The impact of population growth on the welfare of a community
by Thomas Vincent OKeefe

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE
in Applied Economics
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Abstract:

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THE IMPACT OF POPULATION GROWTH ON

THE WELFARE OF A COMMUNITY

by

THOMAS VINCENT O'KEEFE, JUNIOR

A thesis submitted in partial fulfillment
of the requirements for the degree

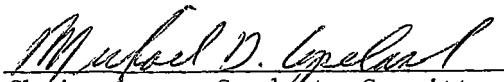
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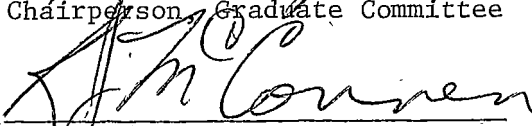
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Abstract

This research addresses the problems of measuring the impact of population growth on the welfare of a community. The purpose of this research is to address the problems of accurately measuring the impact of population growth on the welfare of a community with the intent to assist local government officials in formulating decisions related to population growth.

Chapter 1 is a detailed statement of the problem as well as a literature review of population growth studies. The literature review results in the selection of a cost-revenue analysis as the analytical method most commonly used to measure the impact of population growth on the welfare of a community.

A theoretical analysis of the impact of population growth on the welfare of a community is developed in Chapter 2, emphasizing how a community maximizes its welfare and the possible effects of population growth on the point of welfare maximization. The theoretical approach to measuring welfare changes due to population growth is compared to cost-revenue analysis to determine the problems of measuring the impact of population growth on the welfare of a community. The analysis is limited to the public sector.

Bozeman, Montana was selected for the empirical cost-revenue analysis because it has been experiencing rapid population growth since 1960 and because there is currently debate about the impact of uncontrolled growth in the Bozeman area.

The results of the cost-revenue analysis, calculated in Chapter 3, indicate that population growth generated more revenue than costs. A major reason for these results was that population growth changed the age distribution in the Bozeman area.

In Chapter 4, conclusions are reached on the problems of inferring the impact of population growth on the welfare of a community from a cost-revenue analysis. The major problems involve the failure of the political process to reveal the pure community demand curve for public goods, the inability to assign monetary values to externalities, and the lack of direct pricing in the public sector.

Chapter 1

STATEMENT OF THE PROBLEM AND LITERATURE REVIEW

Statement of the Problem

Local governing bodies are faced with increasingly difficult decisions regarding population growth. Local government officials have difficulty assessing the total impact of population growth on the welfare of the entire community. Many of these difficulties occur because what may be a benefit or loss to one part of the community may not necessarily be a benefit or loss for the entire community. The purpose of this research is to address the problems of accurately measuring the impact of population growth on the welfare of a community with the intent to assist local government officials in formulating decisions related to population growth.

The remainder of Chapter 1 consists of a literature review of population growth studies. The literature review will lead to the selection of an analytical method commonly employed in population studies to measure the impact of population growth on the welfare of a community. The selection of an analytical method will be based on the amount of information each alternative method provides, the practical applications of each method, and the frequency

with which each method is used by local governments.

Chapter 2 consists of a theoretical analysis of the impact of population growth on the welfare of a community. Emphasis is on how a community maximizes welfare and how population growth affects the community's point of welfare maximization. This analysis requires discussions pertaining to the concept of "welfare," the distinction between private and public goods, and the conditions necessary for welfare maximization.

Empirical data from the Bozeman area will be analyzed within the framework of the analytical method in Chapter 3. The analysis of population growth in the Bozeman area will be divided into two sections because the operations of the Bozeman city government and school district are completely independent of one another.

Conclusions will be reached in Chapter 4 concerning the problems of measuring the impact of population growth on the welfare of a community. These problems can be pinpointed by examining how adequately the empirical example reflects changes in welfare due to population growth. These evaluations of the accuracy of the empirical analysis in reflecting welfare changes due to population growth will be based on the theoretical analysis of welfare maximization in Chapter 2. After discovering particular problem areas, recommendations will be made on ways to help alleviate the problems.

Bozeman, Montana has been selected as a case study because it has been the scene of rapid population growth in the recent past. Between 1970 and 1975 this city has grown from 18,600 to 21,700, a rate of more than double the national average. Estimates have been made that Bozeman will continue to grow at a rapid pace through 1990, reaching a total population level estimated at between 29,558 and 42,379.¹ These statistics have generated debate over the impact of uncontrolled growth in the Bozeman area. By using Bozeman as a case study for this research, it is possible to provide direct assistance to local governing officials while simultaneously addressing the problems of measuring the impact of population growth on the welfare of a community.

Literature Review

Researchers have long been concerned with measuring the impact of population growth on the revenues and expenditures of municipal governments.² Using several basic approaches developed

¹Paul Bolton and others, Bozeman Area Growth Study (Bozeman: Bozeman City-County Planning Board, 1975), p. 6.

²Included in these early studies are: Municipal Costs and Revenues Resulting from Community Growth by Isard and Coughlin; City Expenditures in the U.S. by Brazer; Urban Growth and Municipal Services: Uses and Methods of Cost-Revenue Analysis by Esser; Measuring Factors Affecting Expenditure Levels for Local Government Services by Hirsch; Municipal Cost-Revenue Research in the United States by Mace; Factors Associated with Variations in Municipal Expenditure Levels by

in the 1950s and 1960s, their studies have compared public costs with public revenues as affected by population growth. For example, some studies used regression analysis to test the correlation between population growth and related variables. These focused on four primary areas:

1. Possible economies of scale in the provision of public services;
2. Fiscal effects of political fragmentation;
3. Relationship between local expenditures and state and federal aid; and,
4. Expenditure responses to changes in fiscal capacity.³

Examples of the emphasis of these early population growth studies in these areas are the works of Brazer, and Scott and Fender in which most of the variables analyzed were directly related to one of these four areas.⁴

²Scott and Fender; and, The Costs of Municipal Services in Residential Areas by Wheaton and Schlussheim.

³John Weicher, "Determinants of Central City, Expenditures: Some Overlooked Factors and Problems." National Tax Journal, XXIII, No. 4 (December, 1970), p. 379.

⁴Harvey Brazer, City Expenditures in the United States (New York: National Bureau of Economic Research, Inc., 1959), and Stanley Scott and Edward Fender, Factors Associated with Variations in Municipal Expenditure Levels (Berkeley: University of California, 1957), cited by John Weicher, "Determinants of Central City Expenditures: Some Overlooked Factors and Problems," National Tax Journal, XXIII, No. 4 (December, 1970), p. 380.

By the early 1970s, economists such as John Weicher began to point out the disadvantages of limiting the scope of regression analyses to these commonly used variables. Weicher discussed the importance of taste and socio-economic service condition variables as they related to population growth.⁵ Taste variables, as defined by Weicher, include racial and ethnic compositions of a city, adult education levels, and age distribution. Socio-economic service condition variables include population density, average size of retail stores and manufacturers, average number of people per unit, and mean January temperature. Each of these variables partly determines the costs associated with population growth. For example, fewer crimes are committed in colder areas and areas with a high proportion of educated adults. Also, many larger stores and manufacturers provide their own security guards and sprinkler systems. These factors tend to diminish the cost of police and fire protection.⁶

A second type of population growth study common in the 1950s and 1960s focused on the effects of population growth on the expenditures of local governments. These expenditure analyses included the previously cited works of Hirsch, Wheaton, and Schlussheim.

⁵Weicher, op. cit., pp. 380-383.

⁶Ibid.

"With the exceptions of Wheat and Schlussheim in The Costs of Municipal Services in Residential Areas, most of the literature involves some measures of average costs as opposed to marginal costs."⁷

Recent studies, such as The Costs of Sprawl and The Bozeman Area Growth Study, have continued to rely on average cost estimates for measuring monetary changes due to population growth.

Most recently expenditure analysis has been combined with revenue estimates to form cost-revenue analysis. "A cost-revenue analysis has become a powerful tool for answering some of the questions asked in relation to population growth."⁸ Given that the goal of a population growth study is to measure the monetary changes due to population growth, there is not a more commonly used analytical tool.

Recent cost-revenue studies have eliminated some of the weaknesses common in early cost-revenue analyses. For example, the work of Paula Martin and the Connecticut Development Corporation entitled Cost-Revenue Impact Analysis for Residential Developments, documented the importance of using marginal cost estimates as opposed to average cost estimates. They point out that

⁷Paula Martin and others, Cost-Revenue Impact Analysis for Residential Developments (Washington: National Technical Information Service, 1974), p. 231.

⁸Ibid., p. 3.

"it would be quick and easy, but also very inaccurate, to divide the present budget of a given department by the community population to obtain an average cost figure and then to multiply the number by the number of new residents to determine their costs on the community. An average cost figure assumes that the costs of activities will increase in direct proportion to population - an unsatisfactory proposition."⁹

In this sense, cost-revenue analysis has developed to where it can be understood as an attempt to measure the net monetary loss or gain to a community from population growth.

The net annual impact of population growth on the community may be quite different on a per capita basis as compared to an incremental basis.

"These differences generally reflect significant differences between per capita and incremental costs. Whereas incremental costs may be low in communities where unused facilities are available for an increased population, it may be expected that the new residents would assume their proportionate part of the costs associated with these existing unused facilities."¹⁰

For example, the marginal cost of an additional resident to a community may only result in increased costs of \$100 as compared to a pre-existing average per capita cost of \$200. If the new resident generates a proportionate share of revenues, the community has a net gain in revenues.

⁹Ibid., p. 4.

¹⁰Ibid., p. 224.

While cost-revenue analysis has evolved from average cost estimates to marginal cost estimates, this does not mean to imply that it can precisely measure all of the costs related to population growth. As Paula Martin and the Connecticut Development Corporation also pointed out:

"Cost-revenue impact analysis deals only with dollar costs and revenues, the analysis does not identify or measure any of the non-monetary effects of development. It does not involve judgments as to whether the citizens want their community to grow or not. On these and other issues dealing with matters which¹¹ are essentially intangible, the analysis is silent.

Because external effects surround the population growth of any community, a cost-revenue analysis cannot measure the total impact of population growth.

The problems surrounding the non-monetary external effects were commented on by Professors Layton Thompson and Dana Myrick of Montana State University in their study of the economic development of Big Sky, Montana. They pointed out that

"...a net increase in tax revenue over cost of services would presumably be pleasing to most tax payers, but some might well approve a net increase in costs of public services over tax revenues if substantial other kinds of benefits resulted, such as better markets for their

¹¹Ibid., p. 3.

products or wares, more jobs, or access to recreation areas."¹²

However, it should also be suggested that even a large net increase in revenues over costs may not be desirable to most tax payers if substantial other kinds of costs result, such as pollution, noise, crime, privacy loss, and damage to wildlife. Therefore, even if a cost-revenue analysis is a perfect reflection of changes in costs and revenues, it cannot measure all of the changes due to population growth.

Selection of an Analytical Model

The decision criterion for selecting an analytical method includes the amount of information each method provides, its practical applications, and the frequency with which each method is used by local governments. Based on these factors, a cost-revenue analysis is preferred to either a regression or expenditure analysis. For example, a cost-revenue analysis is preferred to an expenditure analysis because it can potentially measure all of the monetary changes due to population growth. Also, local government officials have tended to rely on cost-revenue analysis rather than regression

¹²Layton Thompson and Dana Myrick, "Increased Tax Base and Increased Costs of Public Services Resulting from Economic Development: A Case Study Involving Big Sky, Montana, Inc." (Staff Paper, Montana State University, 1975), p. 1.

analysis because it requires less knowledge of statistical methods.

The advantages of a cost-revenue analysis probably explain why the most recent growth studies in the Bozeman area, such as the "Northeast Annexation" and the Bozeman Area Growth Study, have used cost-revenue analysis rather than expenditure or regression analyses.

Chapter 2

THEORETICAL ANALYSIS OF THE IMPACT OF POPULATION GROWTH ON THE WELFARE OF A COMMUNITY

In Chapter 1, it was stated that the purpose of this research was to examine the problems of measuring the impact of population growth on the welfare of a community. However, welfare was not defined or discussed except to imply that welfare depends upon more than pecuniary income. In this chapter, a definition of welfare will be developed including a discussion of the conditions necessary for welfare maximization. After describing how a community's welfare is maximized, the impact of population growth on the point of welfare maximization will be discussed. In Chapter 4, the theoretical conclusions regarding the proper measurement of community welfare changes due to population growth will be compared with the results of the cost-revenue analysis to determine the problems of using this analytical technique to estimate the impact of population growth on community welfare.

"The objective of welfare economics is the evaluation of the social desirability of alternative economic states. An economic state is a particular arrangement of economic activities and the resources of the economy."¹³

¹³J.M. Henderson and R.E. Quant, Microeconomic Theory (2d. ed.; New York: McGraw-Hill Book Company, 1971), p. 254.

Each particular arrangement results in a certain combination of goods and services that can be divided into two classes; private and public.

Private and Public Goods

Private goods and services are divisible, implying that the consumption of a private good by one individual has no direct effects on the preference functions of other individuals for that good.¹⁴ Conversely, a pure public good such as national defense, is indivisible.

"A public good is one with the property of involving a 'consumption externality'¹⁵ in the sense of entering

¹⁴Paul Samuelson, "Pure Theory of Public Expenditure and Taxation," Public Economics, eds. J. Margolis and H. Grulton (Great Britain: International Economic Association, 1969), p. 102. Preference functions indicate the ranking of alternative bundles of private and public goods and services. Preference functions only show a preference of one bundle of private and public goods and services over another bundle. The level of satisfaction, or utility, from any one bundle cannot be compared with the level of satisfaction from another except to say one bundle results in more satisfaction than another.

¹⁵*Ibid.*, p. 110. Musgrave uses the term "non-rivalness in consumption" for Samuelson's notion of "consumption externality." Samuelson expands on his definition of "consumption externality" by relating it to the difference between private and public goods. The usual approach is to think of two poles representing pure private and public goods and a continuum of various degrees of private and public goods between the poles. (A private good can be further defined as one which once consumed by one person is not available to others for consumption.) Samuelson argues that this is not the case at all. He claims that there is a knife-edge pole of the private domain because of the "consumption externality" associated with these goods.

two or more persons preference functions simultaneously."¹⁶

Most goods and services provided by local governments are not pure public goods and therefore are divisible to some degree. By discussing why some goods and services are provided by a local government rather than privately, even though they are divisible, we will establish the concepts of private and public goods and services that will be used in the remainder of the theoretical analysis.¹⁷

"To 'explain' local government spending in terms of economic theory, therefore, it is necessary to find out why such individuals chose to 'purchase' certain goods and services for purposes of consumption through the auspices of local government rather than in some other way. Why, then, are educational services, police and fire protection, traffic controls, and so on purchased by individuals through the political jurisdictions known as local governments. Or, to put the question the other way around, why do individuals not purchase such goods and services as bread, shoes, houses, and hair cuts through local governments?"¹⁸

Two dominant reasons emerge to explain why local governments provide goods that could be provided privately. First, many goods can be obtained for lower costs through group or community actions.

¹⁶Ibid., p. 102.

¹⁷The discussion of why some goods are provided publicly is from James Buchanan and Marilyn Flowers, "Local Government Expenditures: An Overview," Management Policies in Local Government Finance, eds. J.R. Aronson and Eli Schwartz (Washington, D.C.: International City Management Association, 1975), pp. 25-41.

¹⁸Ibid., p. 27.

"When men and women can secure goods at a lower cost by acting in a group rather than independently, they have a valid economic reason for forming groups."¹⁹

These cost savings consist of both monetary and non-monetary savings. Monetary savings occur because of the efficiency of joint consumption. Non-monetary savings are due to a minimization of the external effects associated with providing certain goods. These external effects include the duplication of sewer and water lines, treatment plants, etc., which would result if several firms were providing these goods.

The second major reason local governments provide goods is because it is difficult to enforce the exclusion principle when goods are provided privately by voluntary arrangements between individuals.

"By 'exclusion' economists mean the prevention of certain individuals from consuming or enjoying goods without necessarily having contributed towards their purchase."²⁰

Many different relationships exist between the relative efficiency of joint consumption and the relative inefficiency in exclusion which explain why particular goods and services are provided by local governments. For example, some goods and services provided by local governments, such as mosquito control, have

¹⁹Ibid.

²⁰Ibid.

no proven efficiencies of joint consumption but are nonexcludable. Other goods and services provided by local governments, such as fire protection, may have large efficiency gains from joint consumption as well as some nonexcludability features. Finally, local governments provide certain goods and services because of equal benefits from joint consumption and nonexcludability, such as police protection.

"While relative efficiency of joint consumption and relative inefficiency in exclusion explain why many goods and services are provided by a local government, local governments provide other goods that are neither nonexcludable nor efficiently consumed through joint consumption."²¹

Many of these goods and services, such as water, sewage, etc., are financed by direct user charges.

In discussing welfare changes, private goods will be equated with those purchased in the market place and public goods with those purchased from the local government. Since most goods provided by local governments are divisible and excludable to some degree, this divergency from the approach of Samuelson's analysis of pure public goods poses no problems.

Income Constraint

The total number of private and public goods and services a

²¹Ibid., p. 28.

community can consume is limited by its budget constraint.

The community budget constraint represents the total amount of income that is available to a community for purchasing private and public goods. (The budget constraint of the local government is less than the community budget constraint.) Many decisions by local government officials rely on the amount of monies a community can generate in the form of tax revenues, etc. As population growth occurs, the community budget constraint enlarges. Population growth may also expand the budget constraint of the local government. This is significant because many public goods that might be financially impractical for a smaller community become feasible as the budget constraint of the local government expands.

The community budget constraint consists of the summation of all individual budget constraints and intergovernmental revenues. To simplify the analysis, the income of each individual is assumed to equal his monetary income in each year. This means that other sources of income, such as accumulated assets or ability to borrow, will not be included in an individual's budget constraint. Intergovernmental revenues consist of state and federal shared revenues and grants. State shared revenues are a function of the population level while state and federal grants and federal revenue sharing are highly variable items, dependent on many

variables inherent in the operation of state and federal governments.²² Assuming each individual spends his entire income in each year on private and public goods in an attempt to gain as much satisfaction as possible, the community's budget constraint can be written as follows:

$$B^i = \sum_{i=1}^s (P_1 X_1^i + \dots + P_n X_n^i) + \sum_{i=1}^s (P_{n+1}^i X_{n+1}^i + \dots + P_{n+m}^i X_{n+m}^i) + R(p) + R(g)$$

where $i = 1 \dots s$ denotes the number of individuals in the community, $P_1 \dots P_n$ are the prices of private goods, $P_{n+1} \dots P_{n+m}^i$ are the prices of public goods to individual i , $X_1^i \dots X_n^i$ are the private goods available to individual i , $X_{n+1}^i \dots X_{n+m}^i$ are the public goods available to individual i , $R(p)$ are state shared revenues, $R(g)$ are all other intergovernmental revenues, and B^i is the total community budget constraint for i individuals.

In the community budget constraint, individual i pays the same price for private goods as all other individuals but is charged a different price than other individuals for public goods. This is because private goods are purchased independently in the economy whereas many public goods often are purchased collectively. The amount each individual pays for public goods is primarily

²²Paul Bolton and others, Bozeman Area Growth Study, op. cit., p. 46.

dependent on his level of income and the amount of taxes he is obligated to pay. Because of this, some individuals pay more for public goods than others while everyone pays the same prices for private goods. Also, different individuals have different private and public goods available for consumption depending on such factors as their income level.

The inclusion of intergovernmental revenues in a community's budget constraint changes the slope of the budget constraint. The budget line does not shift in a parallel manner because all intergovernmental revenues must be spent on public goods thereby decreasing the price of public goods relative to the price of private goods. Figure 1 shows the effect of intergovernmental revenues on the community's budget line.

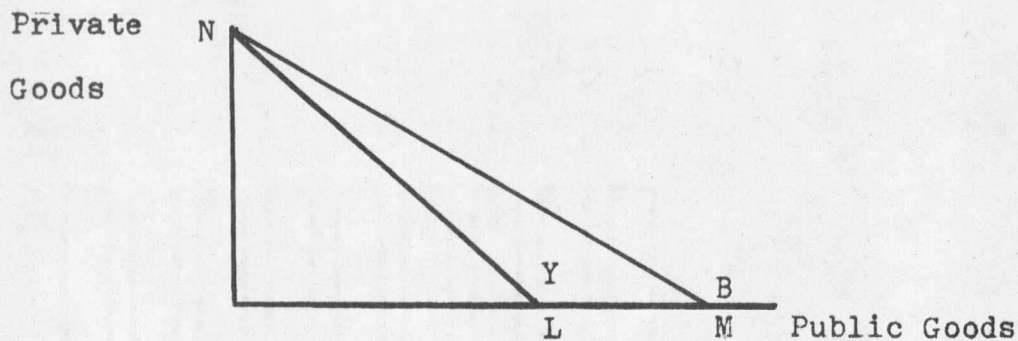


Figure 1: Affect of Intergovernmental Revenues
on the Community Budget Constraint

In Figure 1, Y is the summation of individual incomes and B is the summation of individual incomes plus intergovernmental revenues. The community can still only afford to purchase N private goods but can increase its consumption of public goods from L to M public goods.

Social Indifference Curves

A social indifference curve is a locus of combinations of private and public goods from which the community derives a given level of satisfaction.²³ The use of indifference curve analysis depends on the following three assumptions:

1. Communities want more than they have of many goods;
2. There is some amount of a good that is sufficient to induce a community to give up some of another good; and,
3. A community's marginal evaluation of a good declines as the amount it has of that good increases.²⁴

These assumptions result in a series (map) of indifference curves, each of which represents a given level of satisfaction. While a community is indifferent to choosing among points on a

²³Robert Awk, Microeconomics: Theory and Applications (New York: John Wiley and Sons, Inc., 1976), p. 447.

²⁴Charles Baird, Prices and Markets: Microeconomics (New York: West Publishing Company, 1976), pp. 16-18.

single indifference curve, it is not indifferent to choosing among points on various indifference curves. Figure 2 illustrates a community's map of social indifference curves. In Figure 2, the community prefers point A to points B and C and is indifferent between points B and C.

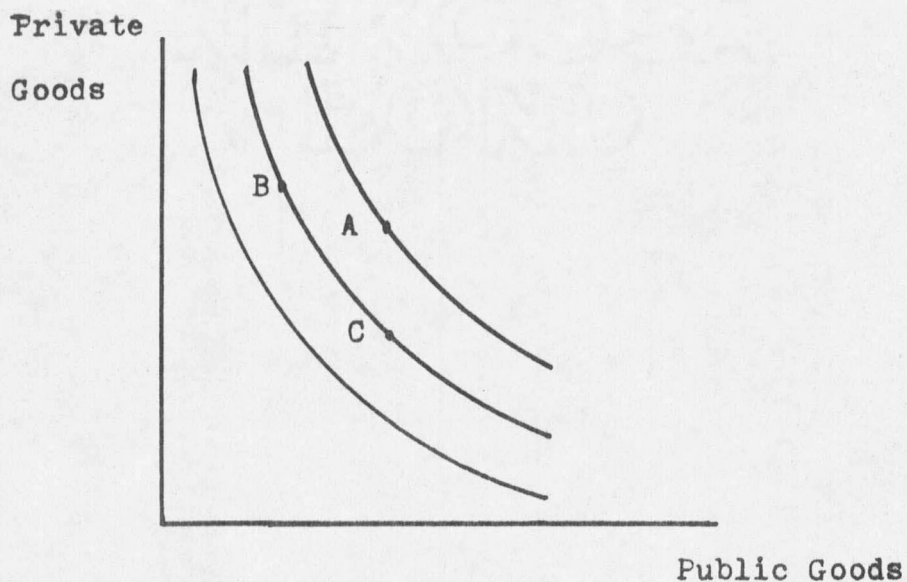


Figure 2: Map of Social Indifference Curves

Community indifference curves do not have to be smooth, as pictured in Figure 2. However, no two indifference curves in an indifference map can intersect, for what would imply that the combination of goods represented by the intersection point would

be preferred to itself.²⁵ (The difficulties associated with social indifference curves that are not parallel are discussed in Appendix A.) The fact that indifference curves are downward sloping reveals that the acquisition of more of one good normally requires a decrease in the consumption of another good if the community is to remain at the same level of satisfaction. The marginal rate of substitution of good X for good Y measures the number of units of Y that must be sacrificed per unit of X gained to maintain a constant level of satisfaction. The marginal rate of substitution is equal to the slope of the social indifference curves. The slope of indifference curves become steeper as they get closer to the Y axis and flatter as they approach the X axis because the marginal evaluation of a good declines as more of that good is acquired.

Point of Welfare Maximization

A community maximizes its social welfare at the point of tangency between its budget constraint and a social indifference curve. This is illustrated in Figure 3. In Figure 3, W^* is the point where social welfare is maximized, S.I.¹, S.I.², and S.I.³ are social indifference curves representing different levels of

²⁵Ibid., p. 19.

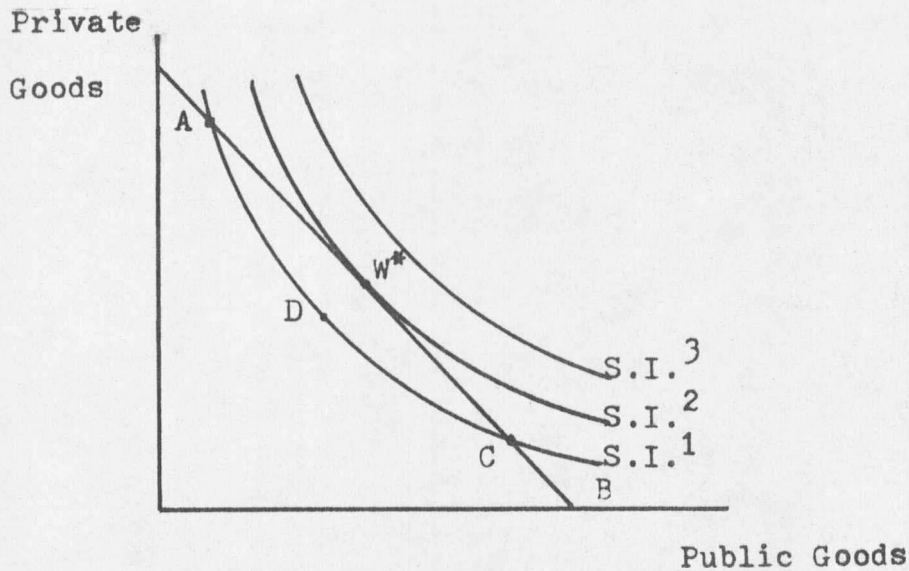


Figure 3: Point of Welfare Maximization

satisfaction, and B is the community budget constraint. Social welfare is maximized at point W^* because the community is on the highest indifference curve subject to its budget constraint. Also, at point W^* , the ratio of the marginal utility of each good over its price is equal for all goods (Appendix B). If the marginal utility/price ratio of one good was greater than the ratios of other goods, resources should be shifted to the good with the higher ratio to maximize welfare. This is because a community's resources could yield a higher satisfaction level if they were shifted to the good with the greater marginal utility/price ratio.

While points A and C are also on the community's budget constraint, social welfare is not maximized at either point. This is because they are on an indifference curve that has a lower level of satisfaction associated with it than the one W^* is on. In fact, the community would be equally satisfied at point D even though it is within the community budget constraint. The community can move from point A to W^* by trading off some private goods for more public goods. Conversely, the community can move to W^* from point C by trading public goods for private goods. Each of these trading schemes results in net gains. A trading scheme which results in a net gain is one that achieves a potential Pareto improvement.

"A potential Pareto improvement is a change that produces gains that exceed in value the accompanying losses; a change, therefore, such that gainers can (through costless transfers) fully compensate all of the losers and remain themselves better off than before."²⁶

The only point at which no further gains from trade can be realized is W^* -- the combination of public and private goods which therefore maximizes community welfare.

²⁶E.J. Mishan, Economics For Social Decisions (New York: Praeger Publishers, 1972), p. 14.

Demand Curve for Public Goods

The demand curve for public goods can be derived from the community's budget constraint and map of social indifference curves. The demand curve indicates the quantities of public goods the community is willing to purchase at various prices. The price of public goods to the community is equal to the cost incurred by the local government in providing those goods. Assuming constant tastes and preferences, i.e. the community's map of indifference curves is constant, the community demand curve for public goods can be calculated by holding the community's budget constraint constant and allowing the price of public goods to change. The community demand curve for public goods can be plotted from the points of tangency between social indifference curves and the changing budget lines, as shown in Figure 4. In Figure 4a, $I^1 \dots I^4$ are the map of social indifference curves, B is the original budget line, and b^1 , b^2 , and b^3 are the budget lines resulting from an increase in the price of public goods. In Figure 4b, D is the demand curve for public goods as calculated from the tangency points in Figure 4a.

The community demand curve for public goods represents fully revealed preferences of each individual. To the extent that consumer willingness-to-pay indicates relative preferences, changes in satisfaction levels can be measured by changes in the community demand curve. These changes can be in the form of a movement along

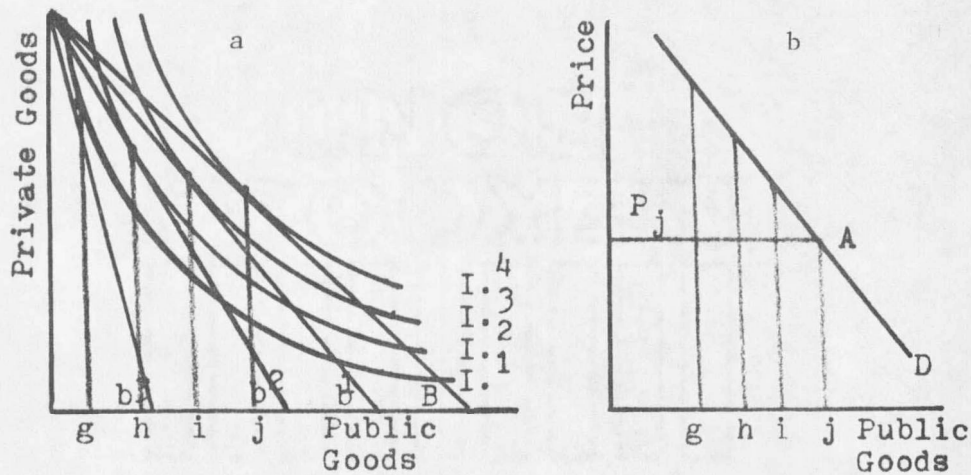


Figure 4: Derivation of the Community Demand Curve

the demand curve or a shift of the demand curve.

The concept of consumer willingness-to-pay is based on the belief that individual residents are willing to pay a certain amount for each good and that their willingness-to-pay reflects their relative preferences for each good. The benefit to a community of consuming j amount of public goods is measured by the area under the demand curve. Community revenue from the sale of this amount of public goods equals total community benefits only when the local government acts as a perfect discriminating monopolist and charges each resident exactly what he is willing to pay for public goods. By doing this, the local government generates revenues from its residents equal to the area under the community demand curve

to the left of its level of output. As shown in Figure 5, the local government produces J public goods and collects revenues equal to the area of OP_jAJ .

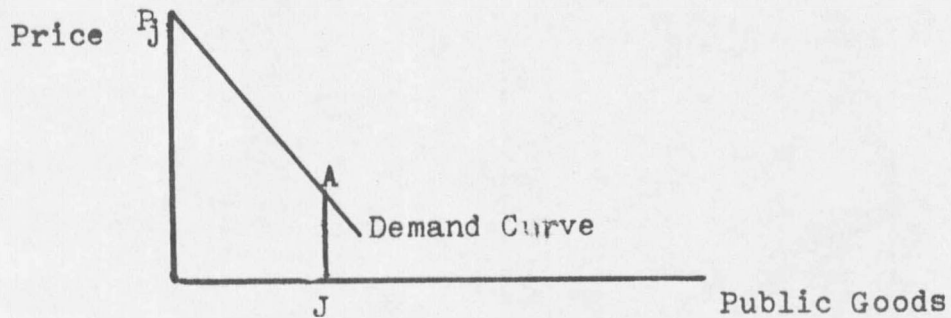


Figure 5: Consumer Willingness-to-Pay

The remainder of this research, including the cost-revenue analysis in Chapter 3, will involve only the public sector. The interesting policy questions outlined in Chapter 1 relate to the public rather than the private sector.

Changing Social Indifference Curves

Population growth in a community will change the combination of public goods which maximizes community welfare. One possible impact of population growth on the point of welfare maximization is that it can change the slope of the community's social

indifference curves. These changes are the result of changes in the marginal utility (level of satisfaction) from consuming public goods that occur because most goods provided by local governments are not pure public goods. For example, the level of utility (satisfaction) that an individual gains from using a recreation area is not independent of the number of other individuals using that area. As more people make use of parks and recreation, some individuals may find that they now receive less utility than before from the use of that area.

Changing marginal utility levels associated with certain public goods may actually reflect a change in the nature of those goods. For example, a 1970 resident may no longer consider the use of Lindley Park in Bozeman as the same good in 1975 that it was in 1970. The fact that more people are now consuming that good has actually changed the good. It has lost the quiet, private and unlittered aspects previously available for consumption and in doing so has been transformed to an entirely different good. The result of these types of changes is that social indifference curves in 1975 relate to different goods than in 1970. Therefore, the changing nature of public goods can lead to different sets of social indifference curves as population increases. In turn, these different sets of social indifference curves change the community's demand curve for public goods.

Changes in Production Costs

The second possible impact of population growth on the point of welfare maximization is that as more goods are produced to satisfy the demands of new residents, changes can occur in the production costs of alternative bundles of public goods. Population growth can have several possible effects on the costs of providing additional public goods to new residents. First, economies of scale can exist, causing a decrease in the average per capita cost of certain public goods.²⁷

²⁷The existence of economies of scale has been well documented by James M. Henderson in "Local Government Expenditures: A Social Welfare Analysis" and John Weicher in "Determinants of Central City Expenditures: Some Overlooked Factors and Problems." Henderson noted that "the reduction of per capita local expenditures with population increase is very marked for the nonmetropolitan counties. This may be the result of decreasing costs in the provision of public services. A small community must provide many public services at relatively high per capita costs which decline as population increases. Education, hospitals, police and sewage removal normally are examples. In each case marginal cost is below average cost as total service level increases." Source: James M. Henderson "Local Government Expenditures: A Social Welfare Analysis," The Review of Economics and Statistics, 50 (May, 1968), 156-163. Weicher, in his analyses of the 1960 per capita expenditures of 206 central cities of Standard Metropolitan Statistical Areas, calculated that economies of scale accompanied population growth in fire protection with slight economies of scale for highways. However, Weicher found no economies of scale for police protection or sanitation. Source: Weicher, op. cit., pp. 379-383. Conflicts between Weicher's findings and Henderson's findings are likely due to the different type of areas which were studied; nonmetropolitan vs. central city. This view is supported by Observations and Judgements, Pikes Peak Area Council of Governments, 1973 in which

Economies of scale may only last for a limited number of new residents or may not occur until the community reaches a certain population level. They occur as long as the marginal per capita cost of providing additional public services is less than the average per capita cost. In Figure 6, MC is the marginal cost curve and AC is the average cost curve. If the local government

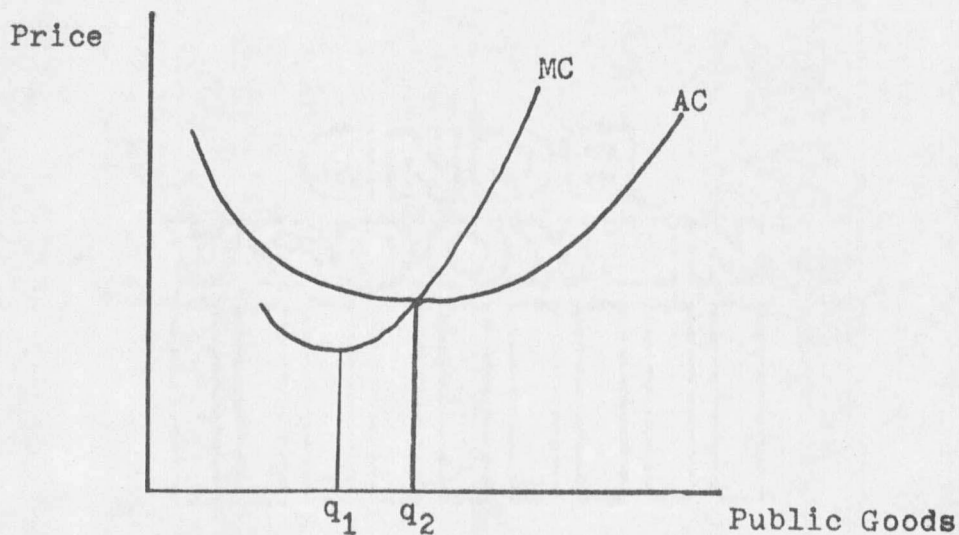


Figure 6: Economies of Scale

²⁷ it was stated that "small cities are relatively less expensive per capita to operate than big cities, that small, sparsely populated counties are relatively more expensive, and that all things considered, county areas that have a population of about 25,000 people cost their residents the least amount of money per capita. One conclusion from this is that there are some economies of scale in local governments for communities smaller than 25,000 but apparently none for communities larger than this." Source: Paul Bolton and others. Bozeman Area Growth Study (Bozeman: Bozeman City-County Planning Board, 1975), p. 15.

were producing q_1 public goods prior to population growth, it can enjoy economies of scale until the level of production exceeds q_2 . After q_2 , the marginal cost is greater than the average per capita cost and pulls the average cost of producing public goods upward.

The second possible effect of population growth on the production costs of public goods is that there are no economies of scale. This occurs as long as the marginal costs of additional public goods are equal to or greater than the average per capita cost. In this case, the local government has already surpassed the q_2 level of output discussed in Figure 6.

Finally, population growth can change the intergovernmental revenues of a community since some intergovernmental revenues, such as state shared revenues, are highly dependent on the population level. An increase in intergovernmental revenues does not affect the amount of private goods a community can consume because all of these monies must be spent on public goods. This decreases the price of public goods relative to private goods.

As shown in Figure 7, the effects of economies of scale, no economies of scale, and increases in intergovernmental revenues can be examined as they change the slope of the community budget constraint. B is the original budget constraint and $S.I.^1$, $S.I.^2$, and $S.I.^3$ are the community indifference curves. When economies of scale accompany population growth, the average tax price of public

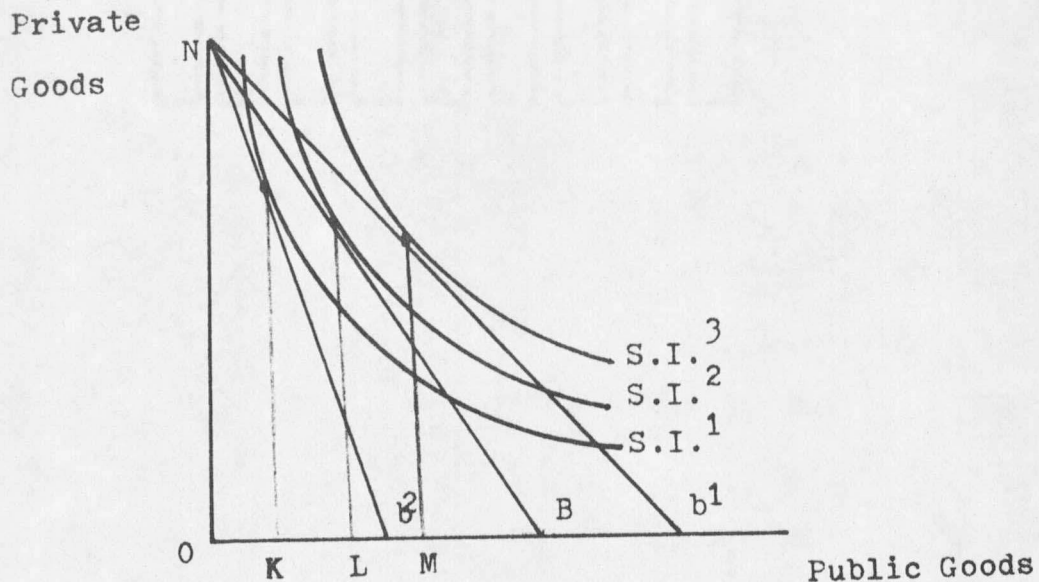


Figure 7: Changes in the Slope of the Community Budget Constraint

goods falls relative to the price of private goods. This is reflected in a change in the slope of the community budget constraint from B to b^1 . The community can now consume as many as M public goods.

Once the local government exceeds the q^2 output level shown in Figure 6, there will be no economies of scale. In this case, the average tax price of public goods will increase relative to the price of private goods. This will cause the budget constraint to become steeper, as illustrated by the change in the slope of the

budget constraint from B to b^2 in Figure 7. Without increasing its tax rates, the community would be forced to consume less public goods relative to private goods as a result of population growth.

The effective tax price of public goods falls relative to the price of private goods when population growth increases the intergovernmental revenues. The effect of increased intergovernmental revenues due to population growth is represented by the change in the slope of budget constraint from B to b^1 in Figure 7. As was the case with economies of scale, the community can increase its consumption of public goods without increasing its average tax price.

Summary

In this chapter, the concept of welfare was developed as it relates to the social desirability of alternative economic states. The level of satisfaction associated with a given economic state depends on the private and public goods available in that state. A community's budget constraint limits the number of private and public goods a community can consume in each economic state. Community welfare is maximized at the point of tangency between a community's budget constraint and a social indifference curve.

Population growth can shift a community from the point of welfare maximization. First, population growth can change the community's social indifference curves. A community may no longer receive the same level of satisfaction from a given bundle of public

goods because of population growth. Second, population growth can change the community budget constraint. Assuming that population growth expands the community budget constraint, the bundle of public goods that maximizes the community's welfare consists of more public goods. It is likely that the production costs of the local government change as more public goods are provided in response to population growth. As production costs change, individual tax prices can change.

The theoretical arguments outlined in this chapter indicate how a community can maximize its welfare and how population growth can change community welfare. In Chapter 3, the monetary impact of population growth will be determined by completing a cost-revenue analysis. By comparing the methods used in the cost-revenue analysis with the theoretical propositions of this chapter, the problems of measuring the impact of population growth on the welfare of a community using the cost-revenue analytical tool can be pinpointed (see Chapter 4).

Chapter 3

COST-REVENUE ANALYSIS OF POPULATION GROWTH IN THE BOZEMAN AREA

The purpose of completing a cost-revenue analysis of population growth in the Bozeman area is to measure the monetary impact of population growth. Information describing the effects of population growth on public costs and revenues is useful for local government officials. Assuming their goal is to be re-elected, government officials tend to consider effects on revenues and costs so long as these changes are consistent with the development of the private sector.

"One of the major criticisms of most cost-revenue analyses made in the past was that they were incomplete."²⁸ For example, some analyses only measured the effects of population growth on one or two sources of costs and revenues, such as schools and property taxes. To avoid such criticisms, this cost-revenue analysis of population growth in the Bozeman area attempted to measure changes in all of the pecuniary costs and revenues. To accomplish this, the community was defined by the local political entities that have jurisdiction over the public goods provided within its geographical

²⁸Ibid., p. 16.

area.²⁹

Two local political groups are responsible for providing services and collecting revenues in the Bozeman area, the Bozeman city government and the Bozeman school board. The Bozeman city government is responsible for all local public services except for education. However, the operations of the Bozeman school district are no less significant since its annual budget for educational services is greater than the budget of the city government for all other services. This is partly because the Bozeman school district serves a greater geographical area, although most of its students come from within the Bozeman city limits.

The cost-revenue analysis of population growth in the Bozeman area consists of two sections. The first is an analysis of the impact of population growth on the costs and revenues of the Bozeman city government. The second section is a similar analysis of the changes in the costs and revenues of the Bozeman school district. The analyses were performed separately because their operations were independent.

The format of the procedures in the cost-revenue analyses relies heavily on two earlier population growth studies employing cost-revenue analysis, the Bozeman Area Growth Study and the Cost-Revenue

²⁹Ibid., p. 23.

Impact Analysis for Residential Developments. The Bozeman Area

Growth Study developed relationships between costs and revenues and population growth in the Bozeman area that were applicable to this research. For example, costs were considered as a function of population alone and population density while revenues were analyzed as a function of population alone, costs, or some combination of the two. Costs that were considered a function of population alone included law, finance, planning, cemetery, engineering, library, airport, inspection, police, and park. Costs that were considered a function of population density were fire, sewage, street, and street lighting. These costs were divided into operating and capital expenditures. Revenues consisted of property taxes, user charges, state shared revenues, and fees, fines, permits, etc. Revenues that were considered a function of population alone included state shared revenues and fees, fines, permits, etc. User charges were considered a direct function of costs while property taxes were considered a function of both population and costs.³⁰ The Bozeman Area Growth Study distinguished between costs and revenues that were a function of population alone and population density because its goal was to analyze the different cost and revenue impacts of contained growth versus peripheral growth in the Bozeman area.

³⁰Paul Bolton and others, op. cit., pp. 23, 44-46.

The major contribution of the Bozeman Area Growth Study to this research was that it concluded that costs that are a function of population density are offset by revenues that are a direct function of costs. This means that population growth results in a zero net monetary change in these costs and revenues. Therefore, this cost-revenue analysis concentrated on costs that are a function of population and revenues that are a function of population or some combination of population and costs.

The Cost-Revenue Impact Analysis for Residential Developments contains the first set of published standardized forms and procedures for assessing the impact of new residential developments on the costs and revenues of a community. Appropriate descriptive materials were included along with step by step procedures and instructions for completing a cost-revenue analysis. Briefly, the procedures involve calculating the operating budget prior to a given development, the number of new residents, the capital and operating expenditures for providing additional public goods, and the revenues generated by new residents. Specific instructions describe how to obtain these estimates.³¹

Despite the advantages of the relationships developed in the Bozeman Area Growth Study and the procedures listed in the Cost-Revenue

³¹Paula Martin and others, op. cit., pp. 25-175.

Impact Analysis for Residential Developments facilitating a cost-revenue analysis of population growth in the Bozeman area, two major assumptions were needed:

1. The costs of providing public goods to 1970 residents were assumed to be constant; and,
2. All increases in the taxable valuation of land were assumed to be related to population growth.

Due to a lack of direct pricing in the public sector, these assumptions were necessary to establish 1970 costs and revenues as base-year figures. A lack of direct pricing means that individual residents are not charged an amount equal to the costs of the public goods they consume. Since no system of direct pricing is used to disperse many public goods, some residents receive benefits without making equal payments and vice versa.

"Many products of the public sector bear low or zero prices, not because the introduction of a price system is impossible, but because of wider objectives."³²

For example, families of students could be forced to pay the full costs of their education, but many people feel that the social benefits of education are greater than the private benefits. The lack of direct pricing for many public goods made it difficult to distinguish which changes in costs and revenues were due to population

³²Robert Millward, Public Expenditure: Economics (London: McGraw-Hill Book Company, 1971), p. 280.

growth and which changes were due to changing demands of old residents.

The use of assumptions in cost-revenue analyses to avoid the problem of a lack of direct pricing is not uncommon. For example, the Bozeman Area Growth Study employed a similar assumption using 1974 as their base year.³³ The varying degree of direct pricing for public goods in each community explains why there were no published standardized forms and procedures for completing a cost-revenue analysis until the Cost-Revenue Impact Analysis for Residential Developments was published in 1974.³⁴

The assumptions of constant costs for public goods and constant taxable valuation of property belonging to 1970 residents resulted in certain biases. These biases will be discussed at the end of this chapter to evaluate their direction and magnitude. The evaluation should assist in determining the accuracy of this analysis in reflecting the changes in costs and revenues due to population growth.

Cost-Revenue Analysis of the Bozeman City Government

In 1970, the Bozeman city government consisted of five major

³³Paul Bolton and others, op. cit., p. 23.

³⁴Paula Martin and others, op. cit., p. IV. These procedures have not solved the problem of a lack of direct pricing. Certain problem areas are avoided by the use of assumptions and estimates based on information gathered from local government officials.

departments: law, finance, public safety, public services, and public welfare. By 1974, the number of major departments increased to six with the addition of the general government department. The cost-revenue analysis attempted to calculate the increased costs and revenues of these major departments due to population growth.

Cost and revenue sources existed between 1970 and 1975 that were not included in this analysis. These costs and revenues were excluded because they offset one another (See Appendix C). For example, the excluded costs consisted of large capital project expenditures for sanitation and park facilities and special improvement district bonds. These costs were matched by federal revenue sharing, state and federal aid, and special improvement district revenues.

Impact of Population Growth on The Costs of the Major Departments

Operating and capital expenditures constitute the cost of major departments. Operating expenditures are the costs associated with the maintenance and operation of existing facilities. Capital expenditures are the costs of constructing new facilities.

Costs that are a function of population density are matched by identical user charges. These costs are financed by the individual residents receiving the direct benefits of the public goods provided with those expenditures. For example, street lighting costs depend on the number of streets as well as the number of

lights per street. When a new subdivision is added, it generally results in additional street lighting costs. However, each street lighting district is charged an amount equal to the costs of street lighting in that district.³⁵ Other districts do not have to worry about financing the street lighting costs, as well as the water, sewage, street, and fire costs, of new residents. Therefore, costs that are a function of population density do not result in any inequities in which the existing community subsidizes new residents by paying part of their costs.. (Costs that are a function of population density were included in the annual totals.)

Costs that are a function of population alone do not have corresponding revenues from individual residents receiving the direct benefits of the services they provide. These costs are largely financed by property taxes, state shared revenues, and fees, fines, permits, etc. Since no direct billing is used for these public services, it is unlikely that new residents pay the exact costs resulting from their added demands for public services.

In calculating the costs due to population growth, costs were deflated by the consumer price index to cancel out increases due solely to inflation. The deflated costs are listed in Table 1. It was necessary to assume that the costs of public goods due to 1970

³⁵Statement by Arthur Van't Hull, City Engineer, Bozeman City Government, May, 1976.

Table 1

Deflated Costs of the Major Departments of the
Bozeman City Government, 1970 to 1975³⁶

Year	Total Costs	C.P.I.	Deflated Costs
1970	1,486,350	1.00	1,486,350
1971	1,656,204	1.043	1,587,950
1972	1,845,779	1.077	1,713,818
1973	2,341,121	1.144	2,046,435
1974	2,873,766	1.27	2,263,014
1975	2,723,547	1.39	1,959,380

residents (deflated) were constant. This assumption established 1970 as a base-year figure for calculating the changes in costs due to population growth. This assumption was based on the belief that the tastes and preferences of 1970 residents would have remained constant had there been no population growth, thereby resulting in a constant demand for public goods.

The increases in the deflated costs of the Bozeman city government represented the increase in costs due to population growth. Table 2 lists the change in deflated costs from 1970 to 1975. The

³⁶See reports of Grant Murie, General Records of the Bozeman City Government, Department of Finance, Annual Budget Documents.

Table 2

Change in Deflated Costs Due to Population
Growth, 1970 to 1975³⁷

Year	Change in Deflated Costs
1970	---
1971	101,600
1972	125,868
1973	332,617
1974	216,579
1975	- 303,634
Total	473,030

majority of the increased costs were the result of increased salaries, wages, and related benefits. Deflated salaries, wages, and related benefits increased by \$582,483 from 1970 to 1975 (See Appendix D). The major reason for these increases was that the number of employees of the local government increased from 116 to 203.³⁸

The year with the most startling results was 1975. In 1975, the deflated costs of the Bozeman city government fell \$303,634, despite a \$246,441 increase in salaries, wages, and related benefits.

³⁷Ibid.

³⁸Statement by Grant Murie, Director of Finance, Bozeman City Government, July 1976.

This decrease in costs can be understood by analyzing changes in the expenditures of the department of public services.

The department of public services had fairly regular increases in expenditures from 1970 to 1973. However, in 1974, the expenditures of the department of public services nearly doubled the expenditures of 1973. These increased expenditures resulted from the development of the water utility system and the sewer treatment plant. Despite the increase of almost \$800,000 in 1974, the deflated total costs of the Bozeman city government only increased by \$216,579. By 1975, the expenditures of the department of public services returned to a level more in keeping with its past expenditures, roughly \$700,000 less than in 1974. These expenditure changes explain why the costs of the Bozeman city government decreased by \$303,634 in 1975.

Impact of Population Growth on the Revenues of the Major Departments

The revenues of the major departments are a function of costs, population alone, or some combination of the two. Revenues consist of user charges, property taxes, state shared revenues, and fees, fines, permits, etc. (See definitions in Appendix E). Revenues that are a function of costs result in a zero net monetary change due to population growth. For example, user charges are a direct function of costs. These revenues consist of monies for water, sanitary

disposal and water rents, sewers, garbage, etc. Any increases in the costs of these services are matched by identical increases in user charges. User charges were included in the annual revenues since the costs corresponding to these revenues were included in the total cost estimates for each year. User charges were deflated to be consistent with the deflation of the corresponding costs and are shown in Table 3. User charges increased due to population growth. However, prior to 1974 the deflated user charges had a very inconsistent pattern, increasing in one year and falling in the next. These irregular changes could be due to economies of scale or changes in the level of consumption of these public goods. For

Table 3
Deflated User Charges, 1970 to 1975³⁹

Year	C.P.I.	User Charges Revenues	Adjusted Revenues
1970	1.00	617,000	617,000
1971	1.043	616,000	590,604
1972	1.077	713,000	662,024
1973	1.144	735,000	642,482
1974	1.27	881,000	693,700
1975	1.39	1,185,594	852,945

³⁹See reports of Grant Murie, loc. cit.

example, the amount of water consumed in any year has some relation to the average temperature, the amount of precipitation, as well as the number of residents. In cold, rainy years, it is possible that fewer showers are taken and less clothes are washed than in hot, dry years. This can affect the use of water treatment plants and the sanitary disposal system.

Revenues that are a function of population alone are not matched by identical costs. These revenues include state shared revenues and fees, fines, permits, etc. Each of these revenue sources would be expected to expand as population growth occurs. For example, state shared revenues are generated from taxes on liquor, beer, and gasoline as well as from motor vehicle license plate and title fees. A larger population would be expected to consume more of these goods and generate greater state shared revenues.

Empirical difficulties surrounded the actual state shared revenues from 1970 to 1973. These difficulties existed because state shared revenues were never totaled as a revenue source in the Annual Budget Documents of the Bozeman city government prior to 1974.⁴⁰ Because of this problem, estimates of state shared revenues were

⁴⁰ Statement by Grant Murie, loc. cit..

entered from 1970 to 1973.⁴¹ (The estimates of state shared revenues from 1970 to 1973 were \$211,310, \$220,000, \$230,000, and \$238,167.)

A final source of increased revenues due to population growth were property tax revenues. Property tax revenues are based on the taxable valuation of property within the city limits and mill levy rate. For example, each parcel of land and its attached improvements has a taxable valuation based on its assessed value. Local government officials then select the mill levy rate to meet the revenue needs of the local government.

In Table 4, the increased property tax revenues from 1970 residents due to increased mill levy rates were subtracted from the total property tax revenues in each year. The purpose of this adjustment was to be certain that these increased revenues were not attributed to population growth. This was accomplished by calculating the percentage increase in property tax rates on 1970 residents for each year and by multiplying it by the total property tax revenues generated in 1970. For example, by 1975 the property tax rate on 1970 residents had increased thirty-six percent. Thirty-six percent of

⁴¹Paul Bolton and others, op. cit., p. 51 State shared revenues were derived according to the procedures outlined in the Bozeman Area Growth Study. The average state shared revenues generated by each resident were calculated to equal \$11.29 in 1974. Assuming that state shared revenues are a direct function of population growth, this amount was multiplied by the number of residents in each year to determine the total state shared revenues.

Table 4

Adjusted Property Tax Revenues, 1970 to 1975⁴²

Year	Property Tax Levy	Property Tax Revenues	Increased Revenues Due To Increases In Property Tax Rates	Adjusted Property Tax Revenues
1970	54	608,450	---	608,450
1971	56.6	701,500	29,295	672,205
1972	61	760,596	78,873	681,723
1973	62	863,996	90,140	773,856
1974	64	978,748	112,675	866,073
1975	73.5	1,306,849	219,718	1,087,131

\$608,450 equals \$219,718. This amount was then subtracted from the total property tax revenues of \$1,306,849 in 1975 to determine the adjusted property tax revenues.

The taxable valuation of land in the Bozeman area did not change after 1970 unless it was sold, rezoned, or had attachments added. Property that was rezoned and property that was sold after 1970 was reassessed on its market value.⁴³ If 1970 residents remained in their same homes and did not add any attachments, then the assessed

⁴²See reports of Grant Murie, loc. cit.

⁴³Statement by Twila Harrington, Clerk, Gallatin County Assessor's Office, April 1977.

value (and taxable valuation) of their property did not change. In this case, the adjustment for increased mill levy rates subtracted all of the increased revenues from 1970 residents. Therefore, all other increases in property tax revenues were due to population growth. (The direction and magnitude of the bias created by this assumption will be discussed later in this chapter.)

By adding each revenue source from 1970 to 1975, the total adjusted revenues of the major departments and the increased revenues due to population growth were calculated in Table 5. The \$519,241 increase in revenues in 1975 accounted for a majority of the total increased revenues. This large increase in revenues accompanied a decrease in costs of over \$300,000. Without this large net gain in revenues in 1975, the increased costs and revenues would have been almost equal from 1970 to 1975.

Property tax revenues were responsible for the largest increase in revenues. The steady increase in these revenues offset all the increased expenditures from 1970 to 1975. Fees, fines, and permits increased by nearly \$60,000 from 1974 to 1975, largely because of \$71,000 from swimming pool fees.⁴⁵ In total, the increase in revenues more than doubled the increased costs due to population growth.

⁴⁵See reports of Grant Murie, loc. cit.

Table 5

Total Adjusted Revenues of the Major Departments and
Increases Due to Population Growth⁴⁴

Revenue Source	1970	1971	1972	1973	1974	1975
Fees, fines, permits	133,160	152,575	199,000	177,500	184,000	242,840
State shared	210,784	220,000	230,000	238,167	281,167	354,765
User charges	617,000	590,604	662,700	693,700	693,700	852,945
Property taxes	608,450	672,205	681,723	773,856	866,073	1,087,131
Total	1,569,394	1,635,484	1,772,747	1,832,005	2,024,940	2,614,425
Increase	---	65,900	137,363	59,258	192,935	519,241
Total Increase						974,697

⁴⁴See reports of Grant Murie, loc. cit.

Cost-Revenue Analysis of the Bozeman School District

The Bozeman school district is composed of an elementary school district and high school district. The expenditures and revenues of these two districts were added to derive the total expenditure and revenue estimates. Expenditures consist of operating and capital expenditures while revenues include mill levy revenues and state and federal assistance.

Population growth in the Bozeman school district has a surprising effect on the total number of students. Generally, an increase in the total population would be expected to increase the number of school age children. The additional students would then cause the costs of the school district to increase. Ideally, these increased costs are matched by increases in mill levy revenues from the new families in the area. However, from 1970 to 1975, the number of students actually decreased despite an increase of over 3,030 residents (See Appendix F). These new residents increased the mill levy revenues. The following sections will discuss the changes in costs and revenues due to population growth.

Impact of Population Growth on the Costs of the Bozeman School District

The costs of the Bozeman school district are a function of the number of students and the per student costs. Costs consist of operating and capital expenditures. Operating expenditures include debt service, retirement, food service, adult education, transportation

and general fund expenditures for employees, supplies, etc. Capital expenditures are the costs of constructing new schools or of additions to existing schools. Since population growth did not increase the number of students, the only way that population growth could have increased the costs of the Bozeman school district was by raising the per student costs.

Per student costs are a function of the number of employees, the capital expenditures, and the state regulations governing the educational standards of the Bozeman school district. Assuming that the quality of education were constant, a decrease in student enrollment would be expected to decrease the number of employees and decrease deflated capital expenditures since no capital expenditures would be necessary for new schools, etc., and fewer teachers would be needed if the same student/teacher ratio was maintained. Therefore, changes in per student cost were related to changes in the state regulations for education.

Changes in state regulations for education can be equated with changes in technology. An increase in the standards of education is the equivalent of changes in the production processes of private firms. Changes in state regulations cause the Bozeman school district to implement two major improvements in their production of education from 1970 to 1975. First, the special education program was added in 1974. Second, there were state ordered improvements in

library facilities. These changes caused major increases in the costs of the Bozeman school district. As shown in Table 6, the deflated costs of the Bozeman school district increased \$1,126,833 despite a decrease of 200 students from 1970 to 1975. The majority of this increase was attributed to changes in state regulations. For example,

Table 6

Deflated Costs of the Bozeman School District and the
Increased Costs from 1970 to 1975⁴⁶

Year	Operating Expenditures	C.P.I.	Adjusted Expenditures	Increased Cost
1970	3,873,822*	1.00	3,873,822	---
1971	4,137,026	1.043	3,966,467	92,645
1972	4,132,941	1.077	3,837,456	129,011
1973	5,031,803	1.144	4,398,429	560,973
1974	5,921,850	1.27	4,662,874	264,445
1975	6,950,911	1.39	5,000,655	337,781
Total				1,126,833

*An approximate estimate

⁴⁶See reports of Esther Nelson, General Records of the Bozeman School district, Montana School District No. 7, Business Office.

the special education costs were \$470,101 and \$954,751 in 1974 and 1975, respectively.⁴⁷ Instruction costs were especially high for this program because of low student/teacher ratios. Also, library improvements in 1975 were approximately \$200,000.⁴⁸ Combined, these increased costs due to changes in state regulations accounted for the majority of the increased costs of the Bozeman school district from 1970 to 1975.

The special education program and library improvement were not a response to population growth in the Bozeman school district, especially since the number of students decreased. These changes in the quality of education resulted from state-wide efforts to upgrade educational standards and would have occurred with, or without, population growth in the Bozeman area.⁴⁹ Therefore, population growth did not increase the costs of the Bozeman school district. (Many of the increased costs resulting from changes in state regulations were

⁴⁷Ibid.

⁴⁸Ibid. Another important source of increased costs was for transportation. In 1970, 1,358 of the 4,517 students were bussed to school. By 1975, this ratio had risen to 1,870 of the 4,317 students. However, it is unlikely that the increased transportation costs are any burden of 1970 residents because the state reimbursement schedule for transportation covers a majority of these costs.

⁴⁹Statement by Esther Nelson, Business Manager, Bozeman School District, January 1976.

matched by increased state equalization payments.)

To conclude that population growth did not increase the costs of the Bozeman school district does not imply that population growth had no effects on the costs of the Bozeman school district. It is likely that if no population growth had occurred from 1970 to 1975 that the costs of the school district would have been lower because there would have been an even greater decrease in the number of students. However, the goal of this section is to determine increases in the costs of the school district resulting from population growth. Since major increases in costs were due to improvements in the quality of education, population growth had little or no impact on the budget requirements of the Bozeman school district.

Impact of Population Growth on the Revenues of the Bozeman School District

The revenues of the Bozeman school district consist of school mill levies, state equalization payments, and federal assistance. (Other revenue sources, such as returns on investments and school bonds, also existed but were not related to population growth from 1970 to 1975.) The only revenue source which the school district has direct control over are revenues from mill levies. School mill levy revenues are based on the taxable valuation of the property within the school district. For example, each parcel of land and its attached improvements had a taxable valuation based on its assessed

value. School district officials then select the mill levy rate to meet the revenue needs of the district. The demand of new residents for homes and building sites increased the value of property and caused greater development of land near town. This resulted in a much larger taxable valuation base for the Bozeman school district (See Appendix G).

The Bozeman school district has much less control over federal assistance revenues and state equalization payments. Federal assistance revenues consist of educational grants, federal funds in lieu of taxes, and monies for Federal Title programs. Educational grants in any one year are dependent on a number of highly variable factors in the operations of the federal government while monies for Federal Title programs depend on both the number of students and the number of Title programs in each year. Table 7 illustrates that there was no pattern in federal assistance revenues from 1970 to 1975. In Table 7, federal assistance revenues were deflated by use of the consumer price index. This adjustment was similar to the one on the costs of the Bozeman school district. Deflated federal assistance revenues were included in the total revenues in each year since they were partially dependent on the student enrollment in each year.

State equalization revenues are derived from twenty-five percent of the state income and corporate taxes as well as from rents and royalties on state land. A school district does not necessarily

Table 7

Deflated Federal Assistance Revenues, 1970 to 1975⁵⁰

Year	Federal Assistance	C.P.I.	Deflated Federal Assistance Revenues
1970	238,539	1.00	238,539
1971	184,664	1.043	177,050
1972	169,914	1.077	157,766
1973	329,715	1.144	288,212
1974	262,756	1.27	206,894
1975	263,497	1.39	189,566

receive an amount of state equalization payments equal to the state equalization revenues it generates. The amount of state equalization payments each school district receives is determined by Montana school authorities and is based on the revenue needs of each school district. The purpose of state equalization payments is to guarantee that each school district is able to offer a given level of education regardless of its taxable valuation base and the incomes of its residents. State equalization payments are commonly used to assist school districts in implementing new programs or other improvements due to changes in state regulations.

⁵⁰See reports of Esther Nelson, loc. cit.

Most of the increases in state equalization payments for the Bozeman school district were in response to changes in state regulations which imposed additional costs on the Bozeman school district.⁵¹ Table 8 indicates that increases in deflated state equalization revenues approximately offset \$833,000 of the nearly \$1,200,000 increase in the costs of the Bozeman school district due to changes in state regulations. These increased revenues alleviated most of the burden of the special education program and library improvements on the residents of the Bozeman school district. Since increases in state equalization payments were in response to changes in state

Table 8

Deflated State Equalization Payments, 1970 to 1975⁵²

Year	State Equalization Revenues	C.P.I.	Deflated State Equalization Revenues
1970	967,373	1.00	967,373
1971	1,232,187	1.043	1,181,387
1972	1,437,745	1.077	1,334,953
1973	1,820,410	1.144	1,591,267
1974	2,058,261	1.27	1,620,677
1975	2,502,468	1.39	1,800,336

⁵¹Statement by Esther Nelson, loc. cit.

⁵²See reports of Esther Nelson, loc. cit.

regulations, none of these increased revenues were attributed to population growth.

One major adjustment and assumption was necessary before 1970 revenues were established as a base-year figure. First, increases in school mill levy revenues were adjusted for increases in the mill levy rates. In Table 9, the mill levy rate adjustments were identical to the property tax rate adjustments for the Bozeman city government. These adjustments ensured that the increased tax revenues from 1970 residents due to increased tax rates were not attributed to population growth.

Table 9

Adjusted Mill Levy Revenues of the Bozeman⁵³
School District, 1970 to 1975

Year	Mill Levy	Tax Revenues	Revenues Due to Increases in Mill Levy Rates	Adjusted Revenues
1970	136.83	2,535,698	---	2,535,698
1971	139.34	2,741,380	46,514	2,694,866
1972	140.46	2,974,754	67,270	2,907,484
1973	146.63	3,455,397	181,611	3,273,786
1974	146.69	3,895,051	192,507	3,702,544
1975	151.19	4,369,605	266,155	4,103,490

⁵³Ibid.

Finally, taxable valuations on the property of 1970 residents were assumed to have been constant. This assumption is similar to the assumption in the section examining the impact of population growth on the revenues of the Bozeman city government and is supported by the same arguments, i.e. no property has been assessed since 1970 unless it was sold, rezoned, or had attachments added. Therefore, the fifty-six percent increase in the taxable valuation base was entirely due to the more than 3,030 new residents and their demand for land and homes. Having stated all the adjustments and assumptions separating the non-population effects from the increase in revenues, the total adjusted revenues of the Bozeman school district were calculated as well as the increase in revenues due to population growth. In Table 10, no increases in state equalization payments were included, federal assistance revenues were deflated, and mill levy revenues were adjusted for increased tax revenues from 1970 residents due to increased tax rates. The \$1,418,819 represented the monetary gain to the Bozeman school district due to population growth. Increased mill levy revenues accounted for nearly all of this gain.

Comparisons of the Increased Costs and Revenues of the Bozeman City Government and School District due to Population Growth

Tables 11 and 12 reflect the net monetary impact of population on the Bozeman city government and school district.

Table 10

Total Adjusted Revenues of the Bozeman School District and the
Increased Revenues due to Population Growth, 1970 to 1975⁵⁴

Revenue Source	1970	1971	1972	1973	1974	1975
Mill Levies	2,535,698	2,694,866	2,907,484	3,273,786	3,702,544	4,103,490
State Equaliz.	967,373	967,373	967,373	967,373	967,373	967,373
Federal Assist.	238,539	177,050	157,766	288,212	206,894	189,566
Total	3,741,610	3,839,289	4,032,623	4,529,371	4,876,811	5,260,429
Increased Revenues due to Population Growth	---	97,679	193,334	496,748	347,440	383,618
Total Increase						1,418,819

⁵⁴Ibid.

Table 11

Adjusted Increased Costs and Revenues of the Major Departments
Of the Bozeman City Government Due to Population Growth,
1970 to 1975

Year	Increased Costs	Increased Revenues	Net Change
1970	---	---	---
1971	101,600	65,900	- 35,700
1972	125,868	137,363	11,495
1973	332,617	59,258	-273,089
1974	216,579	192,935	- 23,644
1975	-303,634	519,241	822,875
Total	473,030	974,697	501,667

Table 12

Adjusted Increased Costs and Revenues of the Bozeman School District
Due to Population Growth, 1970 to 1975

Year	Increased Costs	Increased Revenues	Net Change
1970	0	---	---
1971	0	97,679	97,679
1972	0	193,334	193,334
1973	0	496,748	496,748
1974	0	347,440	347,440
1975	0	383,618	383,618
Total	0	1,418,819	1,418,819

Tables 11 and 12 indicate that population growth in the Bozeman area from 1970 to 1975 resulted in a net monetary gain for both the Bozeman city government and school district. As far as the Bozeman city government was concerned, the pivotal year was 1975. In 1975, the difference between the change in costs and revenues was approximately \$800,000. The reason that costs decreased from 1974 to 1975 was that expenditures in the Department of Public Services dropped from \$1,638,131 to \$911,941. These expenditures dropped because the Department of Public Services had abnormally high expenditures in 1974 for water and sewer utility systems. The 1975 expenditures were more representative of the normal expenditures of the Department of Public Services.

While the deflated 1975 expenditures of the Bozeman city government were nearly \$300,000 less than in 1974, revenues increased by \$519,241. Of this amount, over \$220,000 were from increased property tax revenues and \$160,000 were from user charges. Another source of increased revenues not included in the cost-revenue analysis of the major departments was the net available cash at the beginning of each fiscal year. These revenues increased by nearly \$2,000,000 from 1970 to 1975, with \$1,000,000 from the sewer replacement/depreciation allowance in 1975.⁵⁵

⁵⁵See reports of Grant Murie, loc. cit.

The Bozeman school district did not have a pivotal year, especially since population growth was not responsible for any increases in the expenditures of the Bozeman school district from 1970 to 1975. Because of this, any increases in revenues due to population growth represented pure monetary gains.

The large monetary gains of the Bozeman school district were indicated in the beginning balance of the school district in each fiscal year. The beginning balance increased from \$590,000 in 1971 to \$1,813,406 in 1975.⁵⁶ (The 1970 amount was not available; however, it was most likely less than the 1971 amount.)

Evaluations of the Assumptions Necessary in the Cost-Revenue Analyses

Three assumptions were postulated in the cost-revenue analyses:

1. The costs of the local government for providing goods to 1970 residents were constant;
2. The taxable valuation of land in the Bozeman city limits belonging to 1970 residents was constant; and,
3. The taxable valuation of land in the Bozeman school district belonging to 1970 residents was constant.

These three assumptions were necessary for establishing the costs and revenues of 1970 as base-year figures. Each of these assumptions will

⁵⁶See reports of Esther Nelson, loc. cit.

be evaluated to determine if they created any biases and, if so, what were the direction and magnitude of the biases.

The assumption of constant costs due to 1970 residents for goods provided by the local government depended on the argument that 1970 residents were satisfied with the bundle of public and private goods available in 1970. They would not have demanded any changes in that bundle given that all things were held constant; i.e., population level and tastes and preferences. The validity of this assumption could not be tested because population growth did occur changing the tastes and preferences of the community. There was no way to determine if the changes in tastes and preferences of 1970 residents resulted in increased or decreased public costs. However, it can be speculated that the costs of public goods due to 1970 residents increased because 1970 residents realized that the community tax base expanded due to population growth. With a larger tax base, 1970 residents could initiate public actions for facilities that were previously economically infeasible, i.e. public swimming pool, improved streets and water systems, etc.

The direction of the biases of the assumptions for constant taxable valuation of property belonging to 1970 residents can be determined although their magnitude can not. In both cases, the assumption of constant taxable valuation of property belonging to 1970 residents understated the revenues generated by 1970 residents.

1970 residents added improvements to their property thereby increasing its taxable valuation. Also, some 1970 residents invested in land increasing the upward pressures on the price of land. Therefore, the increase in property tax and mill levy revenues attributed to population growth contains some revenues generated by 1970 residents. However, the exact magnitude of the bias can not be calculated. (The magnitude of the biases would have to be extremely large to have concealed a net monetary loss due to population growth, especially given that population growth did not increase the costs of the Bozeman school district.)

Chapter 4

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Population growth is becoming an important issue for many communities. Should population growth be encouraged? If so, is population growth beneficial to the community? One of the most noticeable, and perhaps most important, effects of population growth from the perspective of local government officials is the change in expenditures and revenues which accompany it. These expenditure and revenue changes are commonly measured using cost-revenue analysis, as demonstrated in Chapter 3.

Population growth can also change the welfare of a community. Welfare changes occur because population growth can alter a community's demand curve for public goods and the production costs of public goods. By discussing why changes in expenditures and revenues do not reflect welfare changes due to population growth, conclusions can be reached concerning the problems of measuring the impact of population growth on the welfare of a community.

There are three major reasons why observed expenditures and revenues do not reflect community welfare. First, the political process does not always formulate a demand curve for public goods that represents the fully revealed preferences of individual residents. Second, the method of taxation used by local governments does not

generate revenues which equal the dollar value that the community places on the public good. Third, externalities are not included in the production costs of public goods resulting in a marginal cost curve that does not represent marginal social costs. In discussing these three issues in greater detail, it will become clear that changes in costs and revenues, when population growth occurs, do not measure changes in community welfare.

Failure of the Political Process

If individual preferences were fully revealed and communities acted to maximize social welfare, then the community's demand curve for public goods would be the vertical summation of individual demands.⁵⁷ (The community demand curve for public goods is derived from the community's map of social indifference curves and from the price of public goods relative to private goods as depicted by the slope of the community budget constraint.⁵⁸) However, individual preferences are seldom completely revealed, resulting in a demand curve for public goods that depends on the voting process rather than the summation of individual demands. It is likely that a voting

⁵⁷James Ohls and Terrence Wales, "Supply and Demand for State and Local Services," Review of Economics and Statistics, LIV, 4 (November 1972), p. 424.

⁵⁸The community demand curve for public goods was derived in Figures 4 and 5 in Chapter 2.

system fails to reconcile differing individual preferences for public goods.⁵⁹ This is significant because it implies that the community demand curve as revealed by the political process can be far from the actual community demand curve for public goods.

There are three reasons for the divergence between the community demand curve for public goods derived by the political process and the true community demand curve. First, there is a lack of voter incentive to acquire adequate information to help cast an intelligent vote. This is referred to as the "rational ignorance effect."⁶⁰ Each voter realizes that a single vote is seldom decisive in the outcome of any issue, especially when there are a large number of voters. Because of this, individual voters have no incentive for gathering information to be certain that they vote "correctly."

The second reason the political process fails to reveal the true community demand curve relates to special interest issues.

"A special interest issue is one for which a small number of voters individually acquire large gains at the expense of a large number of citizens who individually suffer small losses."⁶¹

⁵⁹J.R. Aronson and Eli Schwartz, "Financing Public Goods and the Distribution of Population in a System of Local Governments," National Tax Journal, XXVI, No. 2 (June 1973), pp. 137-160.

⁶⁰James D. Gwartney, Economics: Private and Public Choice (New York: Academic Press, Inc., 1976), pp. 532-533. This entire discussion of the political process is based on Gwartney's book, pp. 532-556.

⁶¹Ibid., pp. 550-554.

If the locally elected official is a vote maximizer, he would be expected to favor the special interest issue. The large group of people who have little concern for the outcome of the vote on a special interest issue will not decide to re-elect their representative on the basis of the outcome of the special interest issue. Instead, they will base their decisions on issues more crucial to their own welfare. Concurrently, the official realizes that he will lose votes on his constituents in the special interest group if he votes contrary to their wishes. Therefore, the demand of a few are favored over the interests of the majority.

Finally, the political process fails to derive the true community demand curve for public goods and services because perverse incentives induce vote-maximizing politicians to promote economic inefficiency.⁶² Politicians promote economic inefficiency in two ways. They favor public actions that offer immediate and easily identifiable current benefits at the expense of future costs that are complex and difficult to identify. Simultaneously, they are against actions that involve easily identifiable costs while yielding future benefits that are complex and difficult to understand. These incentives encourage vote-maximizing politicians to favor economically inefficient proposals, and lead to actual demand curves for public goods that differ from

⁶²Ibid.

true community demand curves.

The Inequality of Revenues and Economic Benefits

Revenues derived by local governments can not be equated with economic benefits because local governments do not act as discriminating monopolists. Discriminating monopolists charge each resident precisely what he is willing to pay for public goods. If local governments were discriminating monopolists, then they could generate revenues equal to the area under the community demand, or marginal social benefit, curve for public goods.

There are many reasons which explain why government taxation policy is not discriminatory. Included among these are the fact that:

1. Many public goods are not subject to any pricing system, not because the introduction of a price system is impossible, but because of wider objectives; and,
2. The expense of collecting sufficient information to act as a discriminating monopolist is prohibitive.

Education is a common example of a public good which is not subject to any pricing system because of wider objectives. Local governments can not afford to determine the true community demand curve for public goods because of frequent changes in individual preferences. These changes can result from population growth and the subsequent impact on the actual nature of a public good. Therefore, any attempt to

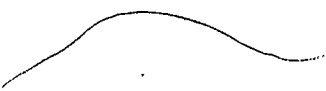
equate increased revenues with welfare gain is doomed.

The Externality Problem

An externality is said to exist when the actions of an individual or group harm or benefit others and the individual or group that causes the externality is not forced to pay for its harmful effects nor do they receive compensation for beneficial effects (See Appendix H for a more detailed discussion of externalities). When externalities exist, it is likely that the production costs for public goods incorrectly measure the total social costs. Social costs consist of the private costs borne by consenting parties and the external costs imposed on others.⁶³ Because of this, the marginal cost curve that the local government relies on for measuring changes in costs due to population growth ignores some social costs. Since all of the social costs of production are not included, local government decisions result in inefficient allocation of the community's resources.

Externalities also limit the use of social indifference curves. Population growth and the increased production of public goods can cause spillover effects that change individual levels of satisfaction from consuming public goods. This is because the level of satisfaction one individual obtains from consuming a good provided by the local

⁶³Ibid., p. 512.



government is not independent of the number of other individuals consuming that good. In this manner, external effects accompanying population growth can alter the slope of social indifference curves. If the change in the slope of social indifference curves is of such a nature that the new social indifference curves intersect with the community's social indifference prior to population growth, then it is impossible to determine if the community is better off in one economic state or another.

Conclusions Concerning the Problems of Measuring the Impact of Population Growth on Community Welfare

Population growth can change the expenditures and revenues of a local government and the welfare of a community. Given that there are no data limitations from a lack of direct pricing in the public sector, a cost-revenue analysis is an adequate indicator of the monetary changes due to population growth.

The arguments noting the failure of the political process, the lack of congruence between tax revenues and economic willingness-to-pay for public goods, and the problem of externalities demonstrate that there can be no predictable relationship between the results of a cost-revenue analysis and changes in community welfare. The problems of measuring the impact of population growth on community welfare result in large part because demand and marginal cost curves for public goods do not reflect true community demand and marginal

cost curves. The following graphical analysis examines the consequences of not using the true community demand and marginal social cost curves. However, it should be pointed out that these problems are common to all types of population or welfare analyses. In this regard, a cost-revenue analysis is not inferior to other analytical methods.

The point of welfare maximization discussed in Chapter 2 (the point of tangency between the community budget constraint and a social indifference curve) indicated that the quantities of private and public goods that maximized community welfare. The community demand curve for public goods, referred to as the marginal social benefit curve, depicts the fully revealed preferences of each individual in the community. The marginal social benefit curve measures the benefit to the community of each additional good provided by the local government. The marginal social cost curve represents all of the costs to the community and the local government of producing additional public goods. The point of intersection of the community's marginal social benefit and marginal social cost curves indicates the quantity/price relationship of public goods that maximizes community welfare. This optimal quantity/price relationship for public goods corresponds to the quantity of public goods reflected by the tangency point of the community budget constraint and a social indifference curve.

The optimal output/price level of public goods is shown in

Figure 8. MSC is the marginal social cost curve and MSB is the marginal social benefit curve. Community welfare is maximized when Q_s public goods are produced. Social welfare is not maximized at outputs different than Q_s . For example at output Q_d , the marginal social benefits of additional public goods are greater than the marginal social cost of their provision, indicating that output should be expanded. At Q_c , output should be contracted since the production of $Q_c - Q_s$ uses resources with a value greater than the benefits from consuming the goods.

As noted, the failure of the political process and the problem of externalities result in demand and marginal cost curves that do not

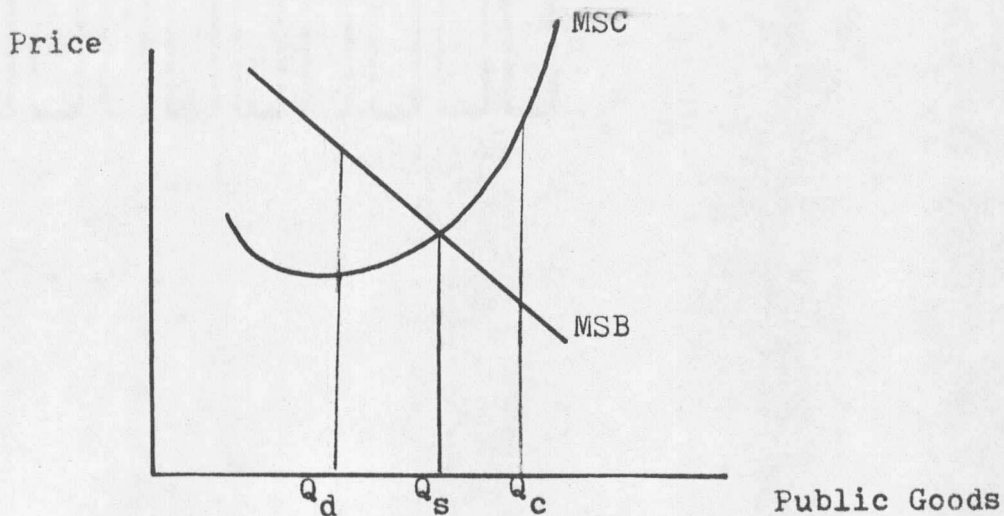


Figure 8: Optimal Output of Public Goods

reflect the true marginal social benefit or marginal social cost curves. The possible harm of not using the correct demand and marginal cost curves for reaching welfare decisions pertaining to population growth (assuming that a discriminating tax policy could be devised), is demonstrated in Figure 9 where MPC is the marginal private cost curve and MPB is the marginal private benefit curve. The opportunity cost of production beyond Q_s exceeds the social benefits. This is because the marginal private cost curve does not reflect the external costs of production, nor does the marginal private benefit curve reflect the true demand for public goods.

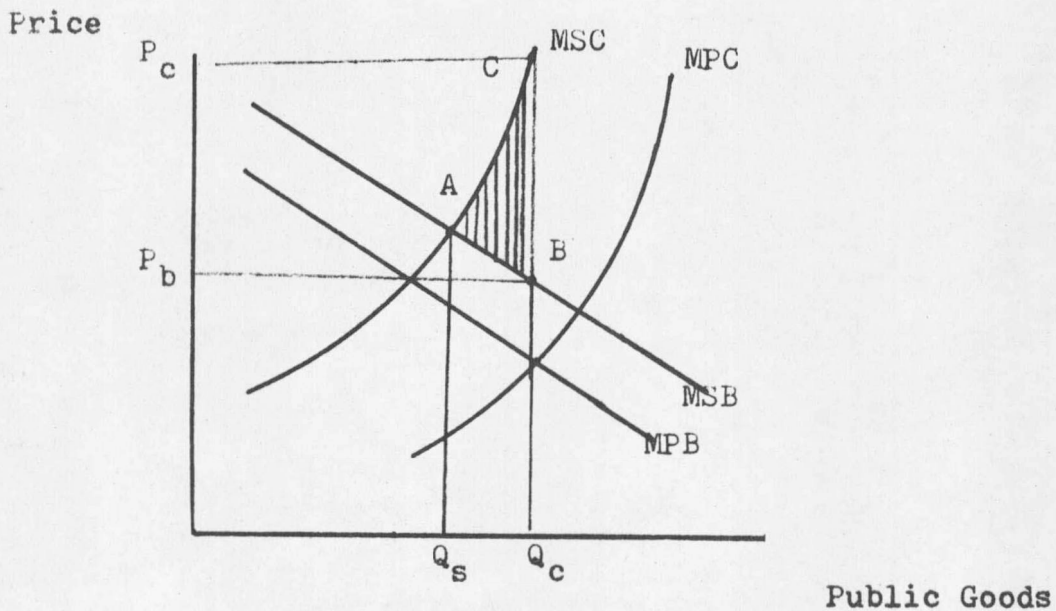


Figure 9: Use of Incorrect Demand and Marginal Cost Curves

For output Q_s in Figure 10, the marginal social costs equal the marginal social benefits and community welfare is maximized. At output Q_c , marginal social costs exceed marginal social benefits. Production at Q_c results in marginal social costs equal to P_c and marginal social benefits equal to P_b . In this case, use of incorrect curves by the local government results in an overproduction of public goods. The net social welfare loss of producing Q_c public goods is equal to the area of triangle ABC.

Other cases are possible in which the positions of the marginal social cost and marginal social benefit curves are on the opposite sides of the marginal private cost and marginal private benefit curves. The marginal social benefit curve can be within the marginal private benefit curve when the voting process overestimates the benefits from public goods. The marginal social cost curve can be less than the marginal private cost curve if the value of positive externalities exceeds the value of negative externalities. While this case is less likely, it can be better understood by examining Figure 10. Social welfare is maximized at production level Q_c , where marginal social costs equal marginal social benefits. Conversely, at Q_s , marginal social benefits exceed marginal social costs. The social welfare loss from producing at output Q_s instead of output Q_c equals the area of triangle EFG.

The area of the welfare loss triangle is equal to the difference

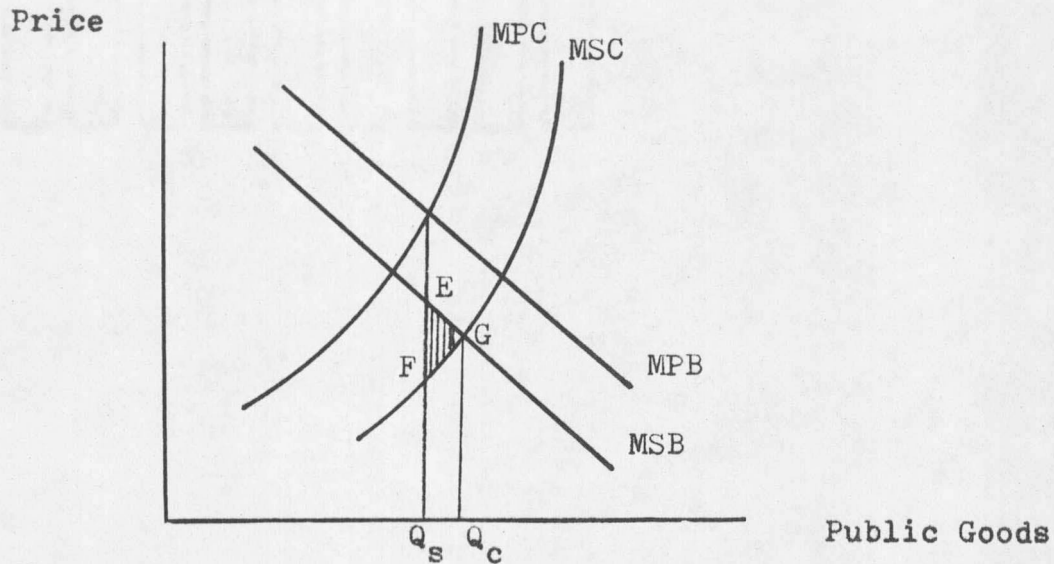


Figure 10: Another Example of Using the Incorrect Demand and Marginal Cost Curves

between the marginal social benefit and marginal social cost curves at each output level. The further a given output level is from the optimal production level, the greater the area of the welfare loss triangle. If population growth decreases the area of the welfare loss triangle, then it follows that population growth has benefited the community. Unfortunately, the area of the welfare loss triangle can not be measured because of the difficulties in deriving the true community marginal social benefit and marginal social cost curves. These difficulties, due to externalities and the failure of the political process, eliminate the ability to measure welfare

changes due to population growth.

Summary

Population growth resulted in a net monetary gain for the Bozeman city government and school district. Increases in expenditures were due to the added demands of new residents for public goods. The impact of these added demands were reflected in the production costs of the local government and school district. Revenues change for a number of reasons. Some revenues increased as population growth occurred, such as state shared revenues and fees, fines, permits, etc. Other increased in response to corresponding increases in costs, such as user charges. Finally, property tax revenues increased as the taxable valuation of land in the Bozeman area increased and as the mill levy rates were increased to meet local revenue needs. Each of these changes in expenditures and revenues were measured by completing a cost-revenue analysis of population growth.

Population growth also changed the level of community welfare in the Bozeman area. Changes in community welfare were partly dependent on the monetary changes that accompanied population growth. These monetary changes were measured by the cost-revenue analysis that indicated that the community received net monetary gains from population growth. However, actual revenues did not measure accurately total economic benefits to the community from increased consumption of

public goods, since local governments do not discriminate in their taxing policies. Also, community welfare depended on non-monetary changes such as the impact of population growth on externalities and the accuracy of the political process. As the local government increased its production of goods, the likelihood of externalities was enlarged. These external effects could have occurred in either the production or consumption of the additional public goods. Concurrently, a larger population level may have lowered the voter incentive for casting an intelligent vote, since each vote had less meaning due to the increased number of voters.

In summary, local policy makers should not place undue emphasis on the value of cost-revenue analysis when evaluating the potential impact of population growth. Such an analysis can provide only a limited amount of information. Even if the costs of population growth exceed additional revenues, community welfare may be enhanced by the growth. Conversely, projected revenues which exceed the costs of population growth do not provide sufficient justification for "pro-growth" policies.

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APPENDIXES

APPENDIX A

Indifference Curve Analysis when Indifference
Curves are not Parallel

The first set of graphs demonstrate the effects of a decrease in the per capita cost of public goods resulting from economies of scale. This set of graphs assumes that the marginal rate of substitution of private goods for public goods changes from pre-growth to growth time periods reflecting changes in the tastes and preferences (See Figure 11). In Figure 11, the costs of public goods relative to private goods fell. Depending on the marginal rate of substitution of private goods for public goods from the pre-growth period with indifference curve I^1 to the period including population growth with indifference curve I^2 , the consumption of public and private goods can change in one of four ways:

1. Consume more private goods and less public goods;
2. Consume more public goods and the same number of private goods;
3. Consume more private goods and the same number of public goods; or,
4. Consume more public goods and less private goods.

The second set of graphs demonstrates the effects of population growth on the costs of producing public goods when there are no

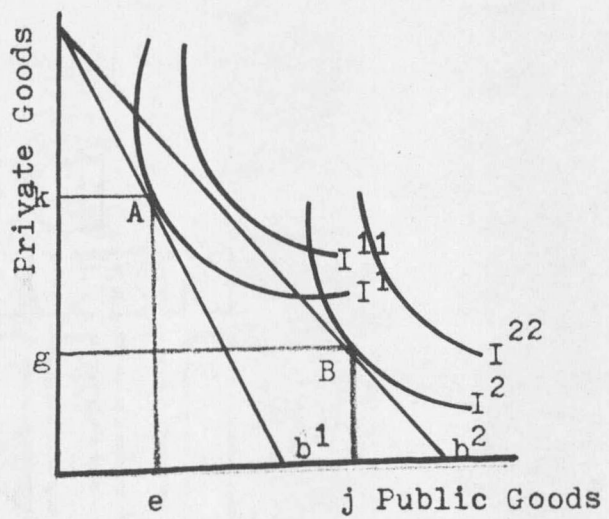
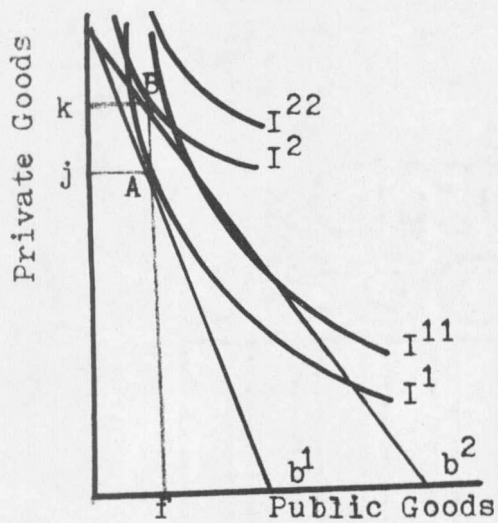
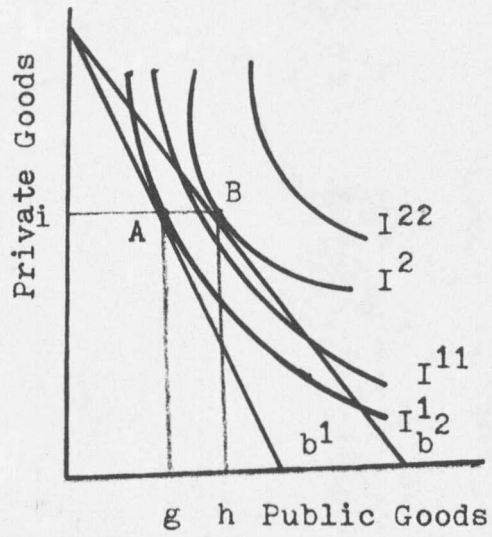
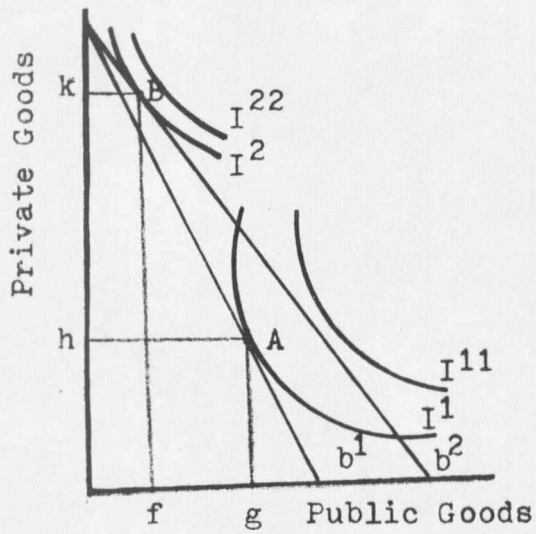


Figure 11: Economies of Scale and Nonparallel Indifference Curves

economies of scale and the marginal cost of producing additional goods is greater than the pre-growth per capita cost. This set of graphs allows the marginal rate of substitution to change reflecting changes in ordinal preference functions and the prices of public goods (See Figure 12). In Figure 12, the price of public goods relative to private goods increased. Depending on the marginal rate of substitution from one time period to another, any one of four possibilities exists:

1. Consume less public goods and the same amount of private goods;
2. Consume less public goods and more private goods;
3. Consume less private goods and the same amount of public goods; or,
4. Consume less private goods and more public goods.

The final set of graphs indicate the effects of population growth on the costs of producing public goods when the marginal costs of producing additional public goods for new residents is exactly equal to the per capita cost before population growth. In this case the budget constraint would be identical and the only changes would be in slopes of the indifference curves from one time period to another. The only changes in the level of satisfaction of the entire community will be the result of changes in ordinal preference functions which are not independent of the number of people consuming public

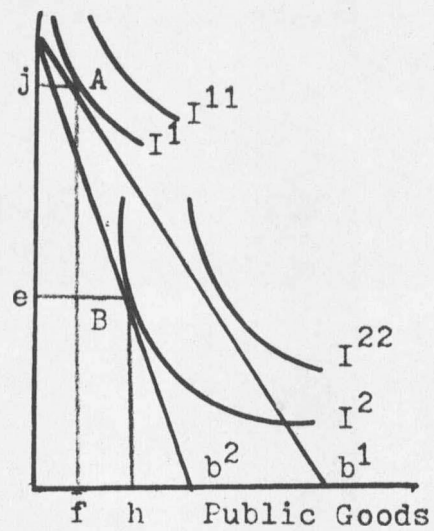
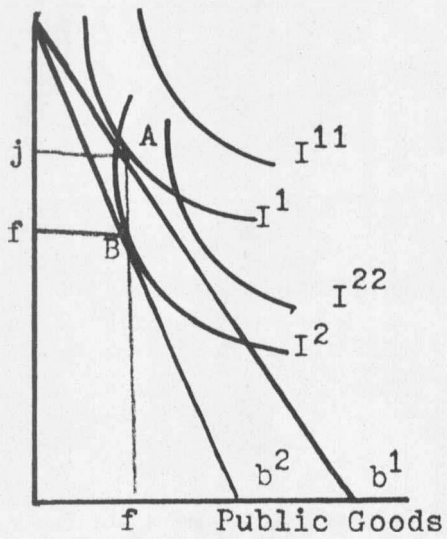
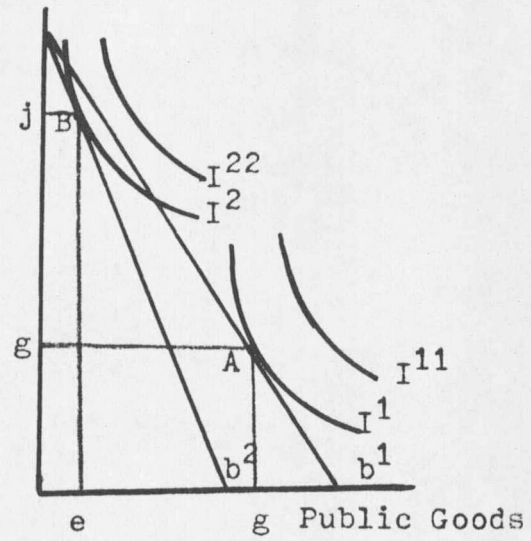
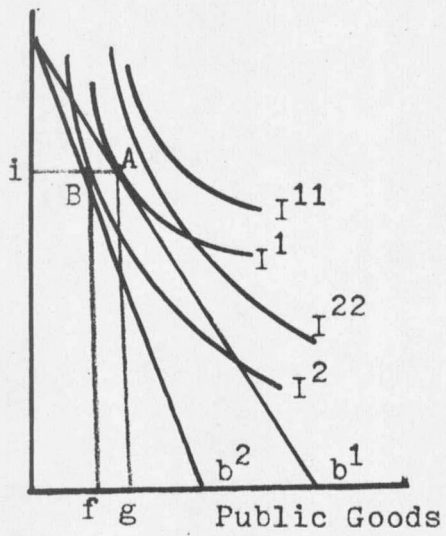


Figure 12: No Economies of Scale and Nonparallel Indifference Curves

goods. In Figure 13, the costs of public goods relative to private goods remained constant. Depending on the marginal rate of substitution in the pre-growth as compared with the growth time period, one of two possibilities exists:

1. More private goods are consumed and less public goods; or
2. Less private goods are consumed and more public goods.

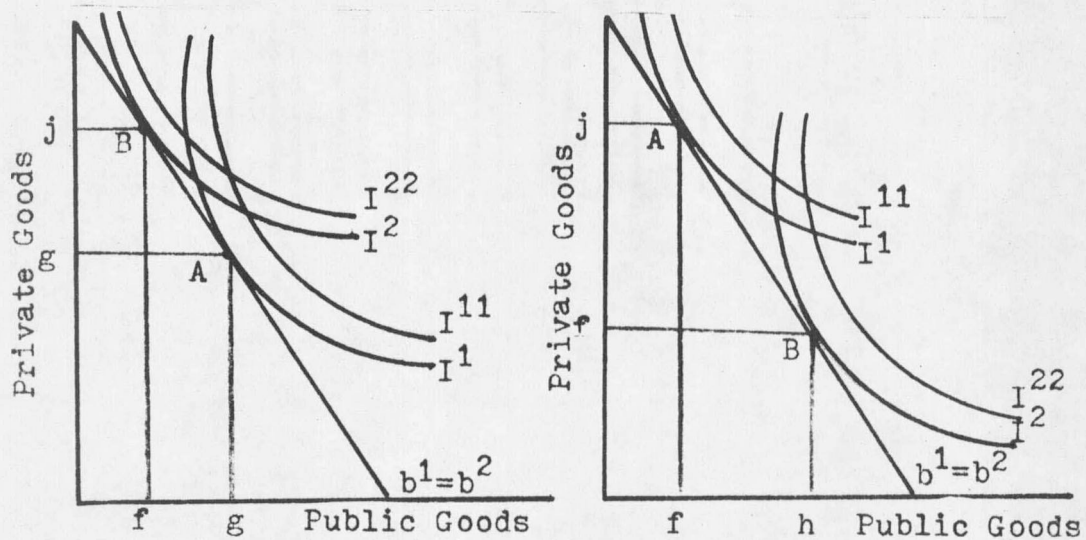


Figure 13: Equal Costs and Nonparallel Indifference Curves

APPENDIX B

Mathematical Derivation of the Point of Welfare Maximization⁶⁴

A community attempting to maximize its social welfare wants to maximize its community ordinal preference function subject to the community budget constraint. The community ordinal preference function is a function of individual ordinal preference function. The ordinal preference function for individual i can be written as follows:

$$w = u^i(x_1^i \dots x_n^i, x_{n+1}^i \dots x_{n+m}^i, u^j),$$

where bundles are ranked from most preferred to least preferred and u^j is the utility level of all other individuals from each bundle, $j = 1 \dots s$ but $j \neq i$. The community ordinal preference function can be written as follows:

$$w_c = g(u^1(x_1^1 \dots x_n^1, x_{n+1}^1 \dots x_{n+m}^1, u^j), \dots, u^s(x_1^s \dots x_n^s, x_{n+1}^s \dots x_{n+m}^s, u^j)),$$

where the community consists of s residents.

The community budget constraint is the summation of all individual budget constraints plus intergovernmental revenues. If it is

⁶⁴The decision framework developed in this Appendix is similar to the approaches of Paul Samuelson in "Pure Theory of Public Expenditure and Taxation." Public Economics, eds. J. Margolis and H. Grulton (Great Britain: International Economic Association, 1969), pp. 100-102, and of J.M. Henderson and R.E. Quant in Microeconomic Theory (2nd ed., New York: McGraw-Hill Book Company, 1971), pp. 280-281.

assumed that individuals spend all of their incomes in any given year attempting to maximize their level of satisfaction, then the budget constraint for the i^{th} individual can be written as follows:

$$Y = (P_1 X_1^i + \dots + P_n X_n^i) + (P_{n+1}^i X_{n+1}^i + \dots + P_{n+m}^i X_{n+m}^i),$$

where $P_1 \dots P_n$ are the prices of private goods, $P_{n+1}^i \dots P_{n+m}^i$ are the prices of public goods to individual i , $X_1^i \dots X_n^i$ are the private goods available to individual i , and $X_{n+1}^i \dots X_{n+m}^i$ are the public goods available to individual i , and Y is income. The community budget constraint can be written as follows:

$$B = \sum_{i=1}^s (P_1 X_1^i + \dots + P_n X_n^i) + \sum_{i=1}^s (P_{n+1}^i X_{n+1}^i + \dots + P_{n+m}^i X_{n+m}^i) + R(g) + R(p),$$

where $R(p)$ are the state shared revenues, $R(g)$ are all other inter-governmental revenues, and s is the number of residents in the community.

The Lagrangian function which the community must maximize can be written as follows:

$$W^* = g(u^i(x_1^i \dots x_n^i, x_{n+1}^i \dots x_{n+m}^i, u^j)) + \lambda(B - (\sum_{i=1}^s P_1 x_1^i + \dots + P_n x_n^i) + \sum_{i=1}^s (P_{n+1}^i x_{n+1}^i + \dots + P_{n+m}^i x_{n+m}^i) + R(p) + R(g)).$$

The first order conditions for welfare maximization of minimization are satisfied where the ratio of the marginal utilities for bundles of private and public goods and services are equal to the price ratios of those bundles. (This can be rewritten as where the ratio of the marginal utility of one good over the price of that good

is equal to the marginal utilities of all other goods over the prices of those goods.) This corresponds to the point of tangency between the community's budget constraint and a social indifference curve.

To simplify the first order conditions for welfare maximization, it will be assumed that each person's level of utility from bundles of public and private goods and services is independent of the utility levels of other individuals. This means that the $\frac{du^i}{du^j} = 0$ for all individuals. Examples which are likely to conflict with this assumption are the relationships between the utility levels of parents and their children, husbands and wives, and close friends. However, the assumption is necessary to avoid the problems of measuring the utility levels associated with interdependent utility functions.

The first order conditions can now be stated as a function of the utility levels from consuming private and public goods and the prices of those goods. The first order conditions can be restated as follows:

$$\frac{g_1^{u_1}}{p_1} = \dots = \frac{g_n^{u_n}}{p_n}, \frac{g_1^{u_{n+1}}}{p_{n+1}} = \dots = \frac{g_1^{u_{n+m}}}{p_{n+m}}.$$

The purpose of solving for the second order conditions for welfare maximization is to be certain that is is actually a point of maximization as opposed to a point of minimization. The second order conditions are maximized when the second derivatives are less than zero reflecting that the rate of commodity substitution falls as one

moves down the indifference curve because of the concepts of relative scarcity and opportunity cost. This guarantees that the indifference curves are concave from above and that it is a point of maximization.

APPENDIX C

Costs and Revenues Excluded from the Accounts of
Six Major Departments, 1970 to 1975⁶⁵

Costs	Amount
Construction Fund and Special Projects	1,069,057
Capital Projects Park Construction	1,108,903
Total Costs	2,177,960
Revenues	Amount
Federal Revenue Sharing	732,078
Federal and State Grants	1,488,000
Total Revenues	2,220,078

⁶⁵See reports of Grant Murie, loc. cit.

APPENDIX D

Salaries of the Six Major Departments of the
Bozeman City Government, 1970 to 1975⁶⁶

Year	Salaries, Wages, and Related Benefits	C.P.I.	Deflated Salaries	Deflated Increases in Salaries, Wages and Related Benefits
1970	782,824	1.00	782,824	---
1971	867,521	1.043	831,755	48,931
1972	970,912	1.077	901,496	69,741
1973	1,083,429	1.144	947,053	45,557
1974	1,298,897	1.27	1,022,753	75,700
1975	1,897,772	1.39	1,365,307	342,554
Total Increases				582,483

⁶⁶Ibid.

APPENDIX E

Definitions of Revenue Sources⁶⁷

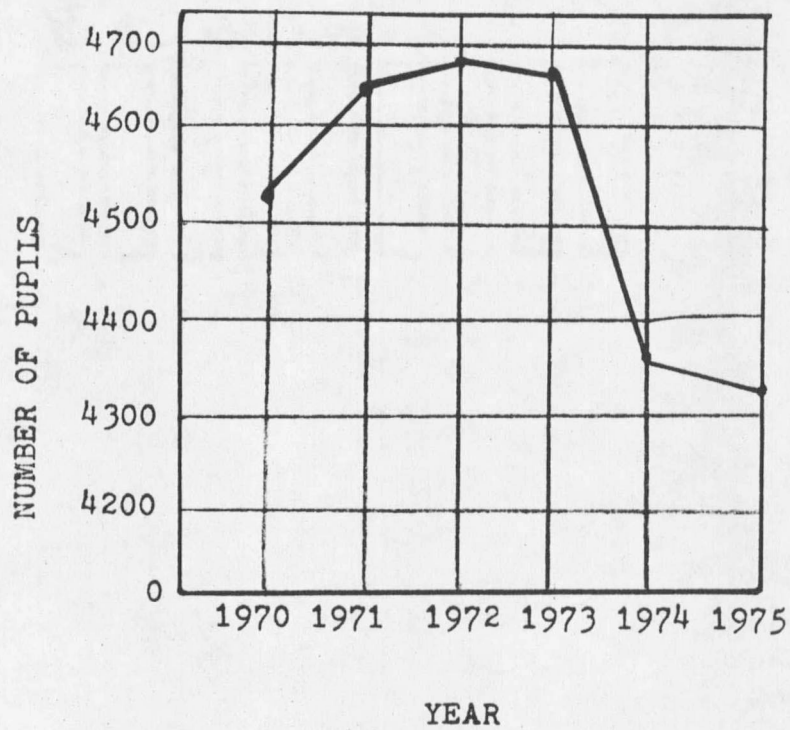
1. Fees, fines, permits, etc. are a function of the population level. It would be expected that the larger the population, the greater the revenues. Fees, fines, permits, etc. include all various revenues collected in the form of building, grave, and inspection permits, dog, business, and non-business licenses, police court fines, fines and forfeitures, and ticket sales.
2. State shared revenues are a function of the population level. State shared revenues are monies collected by the state government and distributed to the cities. State shared revenues are generated by liquor, beer, and gasoline taxes and motor vehicle license plate and title fees.
3. User charges are monies collected for water, streets, and street light services. User charges are a direct function of costs. User charges include sanitary disposal system and water rents, rates and irrigation, sewer rentals, miscellaneous water and garbage charges, and rents for recreation complexes.
4. General property tax revenues are all monies collected through general property tax assessments. The property tax is a tax upon all wealth that has exchange value. Property taxes are

⁶⁷Paul Bolton and others, op. cit., pp. 44-46.

based on the assessed taxable valuation of land and improvements. The Montana State Department of Revenue and Taxation is charged with the responsibility of classification and appraisal of all real property throughout the state. Estimated market values of real property are the basis from which assessed and taxable valuations are derived. Subsequent local mill levies are then used to arrive at property taxes for each parcel of land and its improvements.

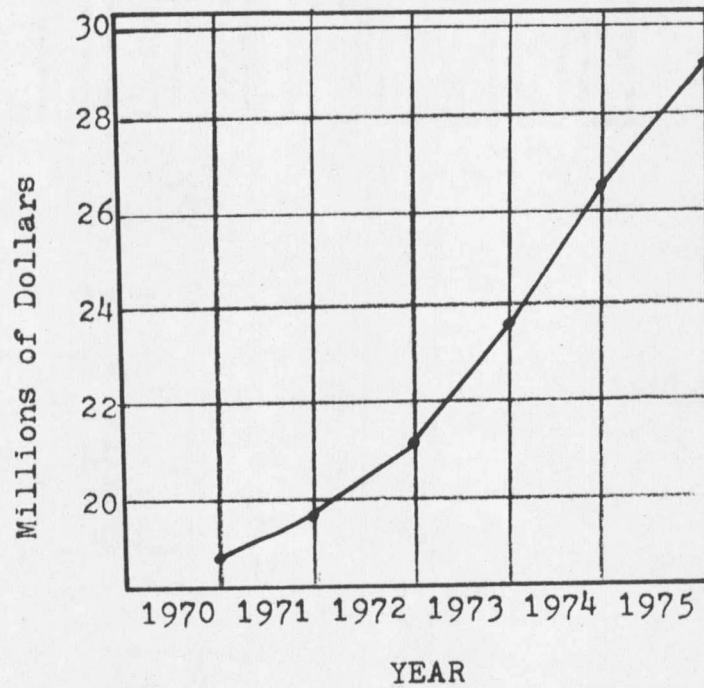
APPENDIX F

Public School Enrollment Record, 1970 to 1975⁶⁸



⁶⁸See reports of Esther Nelson, loc. cit.

APPENDIX G

High School Taxable Valuation Record⁶⁹

⁶⁹ Ibid.

APPENDIX H

A Discussion of Externalities

The fountainhead of modern economic analyses of the externality problem is Piquou's Economics of Welfare which deals with the divergencies between social and private net products. These divergencies occur when

"one person A, in the course of rendering some service, for which payment is made, incidentally also renders services or disservices to other persons, of such a sort that payment cannot be extracted from the benefited parties or compensation enforced on behalf of the injured parties."⁷⁰

Ronald Coase, in "The Problem of Social Cost," feels that

"analysis in terms of divergencies between private and social products concentrates attention on particular divergencies in the economic system and tends to nourish in the belief that any measure which will remove the deficiency is necessarily desirable. Because of this, when an economist is comparing alternative social arrangements, the proper procedure is to compare the total social product yielded by each different arrangement."⁷¹

Coase maintains that

"the question is not whether to increase pollution standards or disallow operations with large, negative externalities but instead the real question of importance is whether the

⁷⁰Ronald Coase, "The Problem of Social Costs," Microeconomics, Selected Readings, ed. Edwin Mansfield (New York: W.W. Norton and Company, 1975), p. 412, citing A.C. Piquou, Economics of Welfare (4th ed.; London: Macmillan, 1948).

⁷¹Ibid., p. 417.

government will enforce a system in which the individual or firm which causes a negative externality has to compensate those who suffer the side effects of their operations."⁷²

This would also be a system where the individual or firm would have to be compensated by others in the case of beneficial externalities.

The reasoning behind the theory of compensation is that without such a system, producer A, because he is not forced to pay for his negative side effects of production, will over-produce from society's viewpoint. Because of this reasoning, it is generally accepted that the enforcement of a system of compensation for externalities would result in a reduction in city size. However, recent arguments such as the one by J.V. Henderson, question the legitimacy of this theory.

J.V. Henderson, in "Optimum City Size: The External Diseconomy Question," discussed whether market achieved city size is greater than or less than the optimum city size when externalities are present. Henderson states that

"optimally pricing pollution will lead to a reordering of production priorities in cities and the economy away from goods responsible for pollution. Within the city, the adverse effect of reduced production of the polluting good will be more than offset by the increase in output of other goods and the decline in pollution."⁷³

⁷²Ibid.

⁷³J.V. Henderson, "Optimum City Size: The External Diseconomy Question." Journal of Political Economy, 82, No. 2, pt. 1, (March/April, 1974), 374.

Ultimately, Henderson concludes that this will increase the welfare of city residents which will induce more people to move to the city.

Henderson's system of optimally pricing externalities is really not so different from Coase's system of compensation. The major problems of each system are similar. How can monetary values be assigned properly to externalities? If these monetary values can be calculated, then it would be possible to include the problem of externalities into the decision framework of local governments for determining the impact of any given change. Until such time, the crucial question is, should local governments continue to rely on monetary analyses, such as a cost-revenue analysis, for reaching decisions on population growth?

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