FISCAL IMPACT ANALYSIS IN THEORY AND PRACTICE

by

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Date: 4/22, 1976
PREFACE

Several years ago, the author undertook a research project to estimate the costs of residential growth to local government. This research, together with additional inquiry and contemplation distilled over the intervening period, are herein presented. Case studies seldom convey the extent to which researchers (this researcher, at any rate) are confused, in the early stages, by their own research. Goals, methods, and operational constraints are seldom well-defined, initially.

My own experiences, then, have led me to write that which I needed most when first starting my research. What I needed then, and have tried to create in these pages, is a one-volume synthesis of relevant economic data and theory, traditional approaches to the problem, a detailed case study, and a discussion of the ways in which the daily realities of local government influence the conduct of research and the implementation of results. I have not always succeeded in making my views easily accessible, but careful reading should overcome most lapses in my literary craftsmanship.

While some readers may choose a leisurely amble through this material, others no doubt would prefer a short-cut to a particular destination. Here are some road maps. Those familiar with urban economics but less well-versed in practical urban planning may wish to concentrate on the second and third chapters (which features a general discussion of cost-impacts of growth, a review of the literature, and a case study).
Conversely, planners who are unfamiliar with the economics of the local public sector, and with the evidence supporting cost-revenue applications, may want to concentrate on the first chapter. Seasoned cost-revenue analysts may prefer to peruse the section in the second chapter entitled "A Framework for Cost-revenue Analysis", and then proceed directly to the case study, chapter 3. Short-cuts are best left to those with some initial knowledge of the terrain, of course.

Policy research is not conducted in a vacuum, so the author is greatly pleased to acknowledge his debt to many people. My thesis committee greatly aided the style and format of this work. Dr. Gene Woolsey initiated my work with the elected officials of Larimer County and provided unflagging enthusiasm during the drawn out period of time encompassed in this tale. Dr. J. P. Mather helped me undertake my first readings in urban economics, and did much for my understanding of public finance and cost allocation procedures. Dr. H. S. Swanson and Professor W. R. Astle provided careful line-by-line consideration of the work. The unruffled calm of Dr. A. W. Schlecten is greatly appreciated. If this thesis is even vaguely comprehensible, it is largely due to the careful reading, editing, and tact of Dr. Larry MacDonnell. Nobly, he even cast the illusion that reading thesis drafts is singularly entertaining and informative.

Larimer County Commissioners William Manuel and Warren Wolaver didn't agree with my politics, but were always willing to listen. Any relevancy in my work is largely the
result of dialogues with them. Finally, David Golick, William Kane, and Paul Deibel of the Fort Collins, Colorado Planning Office did much to sharpen my insights into fiscal impact analysis.

My thanks to all of them. Needless to say, the responsibility for this research and its conclusions remain mine alone.
ABSTRACT

Over the years, numerous studies have forecast cost and revenue impacts accruing to local government due to growth. Most such studies indicate residential property taxes will exceed the costs of services directly related to the structure (e.g., water taps and sanitation), but there has been little agreement as to whether or not the revenues will also completely offset the costs of other local government services, the provision of which is independent of dwelling location, type, or other attributes (e.g., mental health services, administrative overhead). Methodologies used have been quite similar. Numerous criticisms of cost-revenue research have been made, concerning both the methods employed (per-capita cost allocation) and the implications for land-use policy. Nevertheless, economic theory and empirical analyses suggest that local government expenditures can be approximately forecast as a function of population size and tax base. A case study is presented, highlighting the practical problems in developing and implementing such fiscal analyses. In this study, the author developed a model to forecast the expenditures to service the population housed in a development, and to contrast the expenditures with forecasted property tax revenues. The model played a major role in an important Colorado land use decision. In this application, rezoning for a new town of 11,000 was denied on the basis of a projected fiscal shortfall of over $1,000,000.
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INTRODUCTION

The extent to which urban growth provides tax revenues to offset the costs of local public services is a question which has been of continuous interest to economists, planners, developers, and public officials for many years. Today the interest in this issue is especially keen. Most such studies indicate residential property taxes will exceed the costs of services directly related to the structure (e.g., water taps and sanitation), but there has been little agreement as to whether or not the revenues will also completely offset the costs of other local government services, the provision of which is independent of dwelling location, type, or other attributes (e.g., mental health services, administrative overhead).

During the last twenty years, a fairly extensive literature has been developed which attempts to answer all or part of this question. It is safe to say that this "cost-revenue research" or "fiscal impact analysis" has not distilled any pat answers to the question. Indeed, much of the research is contradictory. That this is so is due in part to the variations in public services and financing that occur among communities. Another culprit is the highly elusive nature of public services, which is not very amenable to traditional "micro" analysis.

An obvious method of attacking the cost-revenue question is to compare historic growth rates with changes in local
government expenditures, and this procedure or something very similar has been adopted by nearly all investigators. Though refinements of various sorts have been made, nearly all of these investigations are couched in simple economic terms. Consider the population served as an index of output, and just as a manufacturing plant may allocate all or part of its total costs to one unit of output, so can local government allocate its costs per capita. Allocated costs may then be applied to the specifications for a proposed development, for a simple, arithmetic cost-revenue methodology: multiply unit costs by the number of units to be serviced (where units may be population, number of dwellings, number of school children, etc.) to arrive at a total cost. There are obvious problems with this approach, and other methodologies have been proposed. The more advanced models use a more complex set of mathematical formulae, and may model a larger segment of the growth process or local economy and may select an optimum action from a set of alternative actions. These more advanced methods still must struggle with problems of correctly identifying unit costs as well as requiring additional data, unneeded for more traditional approaches. The author is unaware of any successful application of these other methods of fiscal impact analysis.

This investigation has several objectives. The first is to undertake an empirical and theoretical scrutiny of the relationships between local government expenditures and population size and fiscal capacity, the two exogenous
variables in most such studies. The adequacy of using population size as a measure of either output or demand for public services has long been a nagging question, and such an analysis is overdue. The second objective is to compile various cost-revenue studies so that methodologies and results can be compared. Third, results are reported of a cost-revenue study undertaken by the author. This study was a major factor in an important land-use decision in Colorado. Finally, the usefulness of cost-revenue research in day-to-day decision making shall be considered.
THE LEVEL AND NATURE OF LOCAL PUBLIC EXPENDITURES

Before the cost-revenue question can be adequately addressed, an understanding of the local public economy is needed. Research along these lines has mostly been a post-World War II phenomenon, and is currently being widely conducted. Most urban economists would probably agree that the research so far undertaken has principally illuminated the conjectural nature of our understanding, and the high degree of heterogeneity of the "the" local public sector. Further improvements in theory, data bases, and statistical methodology offer some hope for the resolution of key issues, but of course can never remove that variability intrinsic to the subject. This chapter will survey the current findings about local government's output of goods and services.

The Magnitude of Local Public Finance

There are more than 80,000 local government units in the Unites States--counties, municipalities, townships, school districts, and special districts. In 1967, they spent $64.5 billion, with municipalities, counties, and school districts accounting for roughly three-quarters of the total. In 1970 local government accounted for 20.6 per cent of total government expenditures, or 24.0 per cent of

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1Information in this section, except where noted, is from Musgrave and Musgrave, 1973.
civilian government expenditures. These figures exclude the role of federal and state grants to local government expenditures, the rate rises to 27.8 and 37.1 per cent, for total and civilian expenditures, respectively. Local government expenditures were about 8.5 per cent of gross national product. Since local government is highly labor-intensive, its direct impact on employment is higher than the 8.5 per cent figure implies, though the multiplier effect is undoubtedly modest. (Data in the test and accompanying tables are from different years, so while they are useful for descriptive purposes, care must be taken in relating information from one source to that from another. Local government finance has not changed greatly during this time span, but some variation may be expected.)

There have not been enough regional income accounts completed to definitively illuminate local government's role in the local economy, but the percentage of gross regional product probably varies a good deal about the 8.5 per cent figure. Urban areas outspend rural areas, and wealthier areas spend proportionately less than less wealthy communities. Of course there are additional impacts of local government on the economy--police powers such as zoning, benefit externalities such as roads and education, and the role of differing tax structures on the location of industry. A point well-taken is that local government plays a larger role in the economy than is commonly appreciated.

How are these fund spent? Table 1 lists the principal
Local Government Expenditures, 1972

(in millions of $)

<table>
<thead>
<tr>
<th>Total Exp.</th>
<th>Transfers</th>
<th>Direct Expenditures</th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Current</td>
<td>Capital</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Operations</td>
<td>Outlay</td>
<td></td>
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<tr>
<td>General Exp.</td>
<td>107,066</td>
<td>567</td>
<td>106,499</td>
<td>81,065</td>
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<td>Education</td>
<td>48,711</td>
<td>50</td>
<td>48,661</td>
<td>43,587</td>
<td>5,073</td>
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<tr>
<td>Highways</td>
<td>6,315</td>
<td>41</td>
<td>6,274</td>
<td>3,932</td>
<td>2,342</td>
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<tr>
<td>Welfare</td>
<td>9,058</td>
<td>189</td>
<td>8,869</td>
<td>3,595</td>
<td>63</td>
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<tr>
<td>Hospitals</td>
<td>5,647</td>
<td>103</td>
<td>5,544</td>
<td>5,024</td>
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<tr>
<td>Health</td>
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<td>22</td>
<td>1,470</td>
<td>1,398</td>
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<tr>
<td>Police</td>
<td>5,107</td>
<td>1</td>
<td>5,106</td>
<td>4,877</td>
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<tr>
<td>Fire</td>
<td>2,581</td>
<td>2</td>
<td>2,579</td>
<td>2,413</td>
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<td>Sewerage</td>
<td>3,269</td>
<td>10</td>
<td>3,259</td>
<td>1,057</td>
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<tr>
<td>Other San-</td>
<td>1,587</td>
<td>*</td>
<td>1,587</td>
<td>1,413</td>
<td>173</td>
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<tr>
<td>itation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parks, Rec.</td>
<td>2,331</td>
<td>13</td>
<td>2,318</td>
<td>1,545</td>
<td>773</td>
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<tr>
<td>Natural</td>
<td>662</td>
<td>9</td>
<td>653</td>
<td>404</td>
<td>249</td>
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<tr>
<td>Resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing and</td>
<td>2,701</td>
<td>1</td>
<td>2,700</td>
<td>1,044</td>
<td>1,656</td>
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<tr>
<td>Urban Renewal</td>
<td>1,135</td>
<td>1</td>
<td>1,134</td>
<td>330</td>
<td>804</td>
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<tr>
<td>Air Trans.</td>
<td>364</td>
<td>*</td>
<td>364</td>
<td>143</td>
<td>220</td>
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<tr>
<td>Water Trans. &amp; Terminals</td>
<td>833</td>
<td>30</td>
<td>803</td>
<td>719</td>
<td>84</td>
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<td>Financial Admin.</td>
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<td>4</td>
<td>1,279</td>
<td>1,253</td>
<td>25</td>
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<td>Gen. Outlay</td>
<td>2,508</td>
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<td>2,507</td>
<td>2,436</td>
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<tr>
<td>Other</td>
<td>11,480</td>
<td>88</td>
<td>11,392</td>
<td>5,895</td>
<td>1,604</td>
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<td>Local Util.</td>
<td>9,715</td>
<td>-</td>
<td>9,715</td>
<td>5,780</td>
<td>3,017</td>
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<tr>
<td>Water Supply</td>
<td>3,740</td>
<td>-</td>
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<td>1,920</td>
<td>1,358</td>
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<td>Elec. Power</td>
<td>3,281</td>
<td>-</td>
<td>3,281</td>
<td>1,864</td>
<td>1,119</td>
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<tr>
<td>Gas Supply</td>
<td>404</td>
<td>-</td>
<td>404</td>
<td>350</td>
<td>44</td>
</tr>
<tr>
<td>Transit</td>
<td>2,290</td>
<td>-</td>
<td>2,290</td>
<td>1,647</td>
<td>493</td>
</tr>
<tr>
<td>Insurance</td>
<td>1,599</td>
<td>-</td>
<td>1,599</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Liquor Stores</td>
<td>188</td>
<td>-</td>
<td>188</td>
<td>188</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: U.S. Bureau of the Census, Census of Governments, 1972

* less than ¼ unit of measurement

Table 1
activities of local government, and the actual level of spending for each activity. For any specific locale, there may be considerable variation from the typical levels, reflecting historic accidents, levels of state activity, socioeconomic conditions (e.g., rural vs. urban communities), and the prevailing political climate. The uniformity of expenditure level differs by function. In the provision of electricity, for example, local government generally has a major contribution, or none at all. On the other hand, education expenditures per capita are fairly uniform, probably due to the role of federal education aid (Sacks, 1971) and statewide tax equalization policies.

How are these activities financed? As already noted, transfers from the state and federal levels are important. The ad valorem property tax, though, is the bulwark of local financing. It constitutes from 80 to 90 per cent of the local financing in some places, such as new England, but in other places may represent less than 60 per cent of the local tax effort (Netzer, 1968a). In Colorado 86 per cent of all 1972 local tax revenues were derived from this tax (Lamont, et.al., 1974). Besides the state-by-state variation, the property tax varies within a single metropolitan area, being less important to central cities than to suburbs. Netzer (1968a) has mentioned that there are really 70,000 or so different property taxes imbedded within 51 distinct legal systems. Peculiarities of the property tax arising from assessment practices will be addressed later in this study. Table 2 displays total assessed valuation by property
tax. The remaining local financing is divided among local income, sales and use, occupation, and real estate transfer taxes, and user's fees and service charges. Of course, the role of these taxes varies depending on the nature of the local government unit\(^2\), population size, and state authorizing legislation.

Debt finance has traditionally played a limited role in local government operations, due to limitations on the amount and time duration of debt, the prohibition of borrowing for noncapital items, and to a general reluctance of local electorates to approve bond issues. To avoid these limitations, local government has increasingly turned from the traditional general obligation bond to forms of nonguaranteed debt. The revenue bond has been the most frequently-used alternative. The interest and principal for such bonds are often payable exclusively from the earnings of a specific enterprise (e.g., hospitals and toll roads) which generates revenue. For projects which generate no income, such as schools, lease-purchase agreements with other public or private agencies may be used. Another method for avoiding debt limits is the creation of new special districts, which as quasi-municipalities may incur additional debt to the same tax base. In 1966, nonguaranteed debt was 35 per cent of total local government indebtedness (Maxwell, 1969). As

\(^2\)Traditionally, the special district has heavily relied on the property tax. Wht the 1972 Federal Water Pollution Control Act came a prohibition of that tax as a user charge. (Morehead, 1975)
<table>
<thead>
<tr>
<th>Reality</th>
<th>Billions of Dollars</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Assessed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single-Family Homes</td>
<td>197</td>
<td>39</td>
</tr>
<tr>
<td>Other (nonfarm)</td>
<td>39</td>
<td>8</td>
</tr>
<tr>
<td>Acreage and Farms</td>
<td>43</td>
<td>9</td>
</tr>
<tr>
<td>Vacant Lots</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Commercial Property</td>
<td>60</td>
<td>12</td>
</tr>
<tr>
<td>Industrial Property</td>
<td>37</td>
<td>7</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>State Assessed</td>
<td>42</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>435</td>
<td>86</td>
</tr>
<tr>
<td>Personal Property</td>
<td>64</td>
<td>13</td>
</tr>
<tr>
<td>TOTAL</td>
<td>499</td>
<td>100</td>
</tr>
</tbody>
</table>


U. S. Property Tax Base by Property Type, 1966 (Assessed Values)
in the private sector, debt finance is an extremely important financial tool. It has not been exploited to its full potential in the public sector, and there its future is clouded by the current problems in New York City. Although New York's problems stem from short term debt, potential lenders may not appreciate the distinction. Revenue sharing exerts an impact on local government capital financing. Because local governments can not precisely determine future income streams from revenue sharing, there is a preference for one-time expenditures to funding on-going programs. As revenue sharing funds are distributed to local government on the basis of population, tax effort, and the inverse of per-capita income (Musgrave and Musgrave, 1973), rapid growth will affect the amount of such funds received. Newspaper reports indicate the current approach to revenue sharing is not popular in Washington, and changes may be forthcoming. Excellent discussions of local debt may be found in Maxwell (1969) and Lamont, et.al. (1974).

Determinants of Public Expenditure Level: Empirical Evidence

Many studies have tried to ascertain the forces that underlie the budget size of local government.\(^3\) Items which have been frequently cited are: income, inter-government transfers, population size, population density, age distribu-

\(^3\)Two early studies representative of much of the later effort are: Scott and Feder (1957) and Brazer (1959). An even earlier study is Colm, et al. (1936). More recent examples are Bhol and Saunders (1966), and Break (1967).
tion, and employment characteristics (Margolis, 1968). Most such studies have relied on a multiple regression methodology, using secondary (published) data. Given the somewhat shaky nature of much published data, the slightly different approaches of investigators, and the enormously complex web of relationship that underlie each city's data, it is not surprising that the conclusions differ. Margolis (1968, pp. 530-1) has put his finger on the trouble:

The major data shortcoming is the absence of measures of product. A larger expenditure figure is always an ambiguous number. Does a higher police expenditure per capita mean a greater preference for law and order via police services; or does it mean that the crime problem is greater and, therefore, the higher expenditures are needed to reach the same service level; or are the greater expenditures necessary because different urban forms make certain services more costly; or is there a shift in the composition of public and private provision of services? Statistical studies recognize these problems and they incorporate characteristics of the communities that are addressed to the issues of the nature of the product, but the analysis is unsystematic and inconclusive.

Added to this is a further complication, the reliability of published figures. More than one finance office has sent the Census Bureau arbitrary information; and even the actual budget data can misrepresent the category of an expenditure. For example, the author's salary was at one time taken from a road department fund, even though his function was much broader. Furthermore, it is usually impossible to determine whether a particular expenditure actually represents a current service, regardless of whether a cash or accrual accounting system is used. The problem of deriving meaningful patterns from local government records
is notorious (see Mace and Wicker, 1968).

Despite all these problems, expenditure studies have managed to extract some "signal" from all of the "noise". Not surprisingly, nearly all expenditure studies have pointed to strong relationships between fiscal capacity—intergovernmental transfer, income, and property tax base—and expenditure level. One might say a sort of "Say's Law" applies: every unit of supply of government funds becomes a unit of demand by government agencies for government expenditures. This phenomenon is not unique to local government; it probably applies wherever there is competition for limited resources. Nor does it imply local government is happily oblivious to financial binds. It may, though, indicate that problems of determining the appropriate budget size confront individual public officials as well as economists.

Does this mean other factors aren't in effect? Perhaps some factors become lost in aggregated data, and no doubt the analytical tools as currently utilized may not be capable of coping with subtly hidden patterns. For example, it would be difficult in the extreme to arrive at an adequate measure of density for entire metropolitan areas. Musgrave (1968) has expressed disappointment at the dearth of meaningful results from expenditure studies, but it could be that the inability to isolate an invisible hand directing the local public economy is itself a major finding. For how is the public sector to achieve an optimum level of output? Tiebout (1956) has suggested that the public "votes with its
"feet", that preference for one package of local public services over another package might be revealed by the population size of each political unit. Tiebout and others believe that over a period of time, local political figures will adopt a fiscal stance representative of their constituents. Obviously, problems exist, for instance the case of voters who are dissatisfied with the local political climate, but choose that location for its strategic position or other feature. Still the approach has merit, and future work along these lines may be insightful. In the mean time, the facts seem to be that we have no marketplace in which to signal demand. One must not lose sight of the way budget decisions are actually made: by very uncertain individuals in political situations where no one has any idea of the cost-effectiveness of current programs, and where it is always easier to budget in light of visceral feelings of community acceptance, the competence of department heads, and last year's budget figure.

Establishing indices of citizen satisfaction and quality of life is an intriguing route for further exploration of the "correct" level and mix of public services. Though it is fraught with obvious data difficulties, early expenditure studies were already exploring this avenue (see Bollens, 1964, for one instance), but use of such measures in actual decision-making has been very limited. The author attempted to move toward such potential sources of "feedback" when
working for local government, but was not very successful. 4

Before moving on, two further points about expenditure levels need be made. The first is an amplification of the relationship between expenditure level and tax effort; the second, the relationship between expenditure level and time. As mentioned, there is a strong positive correlation between tax base and expenditure levels. However, there is a negative correlation between tax rate and expenditure levels. Netzer (1968b, p. 442) has suggested:

The explanation for this appears to lie in the enormous disparities in taxable capacity among the political jurisdictions in the larger metropolitan areas . . . The richer communities--those with extensive concentrations of business property (or non-property tax bases) and those dominated by high-value residential property--do spend a good deal more than the poorer communities, by and large. But they do not spend as much more as their superior tax bases would permit. Therefore, tax rates and tax base tend to be negatively correlated; the richer communities provide superior services at lower tax rates.

This fact suggests that at the local level, at least, the demand for public services (as interpreted by elected officials) as income-inelastic. The "pro-poor" incidence of local public expenditures makes such an interpretation plausible, though income-elasticity is often suggested at the federal level (by Musgrave and Musgrave, 1973, for

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4 Systematic compilation of existing local, state, and federal administrative records seemed an obvious and inexpensive route toward a "growth monitoring system"; but red tape doomed the effort. The potential of "urban indicators" at the applied (i.e., politically useful) level seems attractive, but has not been well-received. These is room for disagreement on the relative amount of money spent evaluating programs rather than providing direct service, of course. A more likely explanation,
example). Mansfield (1970) cites several determinants of elasticity, including the availability and similarity of substitutes, and the importance of the commodity in a consumer's budget. The relative uniqueness of public services and their very basic nature, suggests inelasticity.

In the 1880's, the German economist Adolph Wagner advanced his "law of rising expenditures": real government expenditures increase through time. Wagner's Law is very much in evidence. With reference to total public expenditures (all levels of government), a number of factors have been suggested to explain this increase. Factors advanced include the rising expectations of the public, the "complementary-consumption" nature of some public goods, coupled with rising affluence; and characteristics of bureaucracies, such as the irreversibility of expenditure growth (Sacks, 1971; Strayer, 1959).

The applicability of these "causes" to the case of local expenditures is not clear-cut. Some of these factors are tied to the notion of an income-elastic demand for public services, which seems unlikely. An argument advanced by Baumol (1967) states that the highly-labor-intensive local government is not subject to the rising productivity though, is that such indicators might be double-edged swords. If they vindicate the current political establishment, they may be attacked as blatantly political. If they illuminate deficiencies, they are clearly grist for the political mill. A cross-section of readings in this area is: Stuart (1972); Hirsch (1968); Eastman, Johnson and Kortanek (1970); and Carr (1972).
of the private sector (brought on by improved technology and the substitution of capital for labor). As society's wages to labor increase (reflecting the improved productivity), local government is forced to keep pace with the wages. Thus, local government's expenditures must rise relative to the private sector. Baumol also point out that for every given city, as time progresses so do the forces of population growth and inner-city decay, which in turn create problems which develop at a faster rate than the growth in the tax base. A related issue, that of economies-of-scale in the public sector, which will be treated in the next section.

Determinants of Expenditure Level: Theoretical Constructs

In this section the contribution of economic theory to the cost-revenue question will be explored. The nature of social goods, local government production functions, short- and long-run cost curves will be considered. The theory will not lead to a solution of the problem, but will sharpen some insights into the nature of the problem and point to some inconsistencies that are common in fiscal impact analysis.

In general, economists (such as Musgrave and Musgrave, 1973) have argued that most government services are "social goods", peculiarities of which lead to a different system of provision and payment than that which is most appropriate for private goods. To qualify as a social good, the commodity or service must be such that its consumption can not be rationed. For example, national defense can not be rationed so
that delinquent taxpayers are denied the service which accrues to the rest of the citizenry. For an uncrowded park there is no point in disallowing some its use, as consumption is nonrival. A bus system must incur the same costs to run a schedule whether the bus is full or empty.

A pure social good exists in concept only, but most public services fit the criteria to some degree. If consumption of social goods is nonrival, does this mean that one should expect the cost of providing the social good to remain constant as a community grows? It does not, though it will be demonstrated that nonrival consumption leads to some complications in estimating fiscal impact. A public service can have all the hallmarks of a social good and yet community growth can cause increased delivery costs. Musgrave and Musgrave (1973) point out that a street lamp is a social good—the light shines on all who walk underneath it; their consumption of the light is nonrival; marginal cost (per pedestrian) is zero; and there is no efficient mechanism for allocating the service, even if such rationing were deemed desirable. Yet a street lamp illuminates but a small area, and a new subdivision would require additional lamps. Police protection is another obvious example of a social good of limited areal extent.

Because of nonrival consumption, the market demand curve is derived differently for social goods than for private goods. For private goods at a given price \( P \), if consumer \( A \) demands \( Q_A \) and consumer \( B \) demands \( Q_B \), then
together they will purchase the total output of \( Q_{\text{tot}} = Q_A + Q_B \). For a social good at a given price, if a consumer A demands \( Q_A \) units and consumer B demands \( Q_B \), then they can together purchase a quantity equivalent to the total outlay they are willing to make, \( Q = (P)(Q_A + Q_B) \). As consumption is nonrival, that outlay will purchase more of the social good (for both to consume) than either would buy individually. In this case \( Q_{\text{tot}} = P/O = Q_A + Q_B \) as before, but now each consumer will consume \( Q_A + Q_B \), rather than just one component of the sum. Thus a social good's market demand curve is derived by vertical addition of individual demand curves, instead of horizontal as in the case with private goods. (See Musgrave and Musgrave, 1973, for an amplification of this result).

Suppose that local government is a monopolist providing a single social good. We will consider the most general case first and then add assumptions that data exigencies usually force on fiscal analysts, so that we proceed to a model of local government that can be profitably employed for our work. It shall be assumed throughout that the local government is a perfect competitor for inputs.

Figure 1 shows the case. A monopolists interested in maximizing profit will choose output level \( Q' \), where \( MR = MC \) (Mansfield, 1970), but presumably the elected official will choose output level \( Q^* \), where profit is zero and the unit price equates the marginal benefit received with the total
allocated costs of providing the social good.\footnote{Output level Q' is still appealing from an efficiency point of view, i.e. because the revenue received from the last unit just matches the cost to produce it. But the price is high and the output is correspondingly low. Any attempt to charge lower prices will reduce economic profit, but also shift the MR curve and thus Q'. Of course in a purely competitive industry, the demand curve facing the producer is horizontal so that P = MR and Q' - Q*, thereby resolving any welfare issues.}

Now suppose the community grows. The demand curve will shift vertically, and the output $Q^*$ will rise to a higher level, at the intersection of the average total unit cost (ATUC) curve with the new demand curve (D). If we knew the precise form of the ATUC curve and the quantity of social goods demanded by the average newcomer we could easily derive the change in $Q^*$. Marginal benefit still equals price (see Musgrave and Musgrave, 1973). However, each citizen-consumer will receive more of the social good, but at a higher price (assuming $Q^*$ is in the region of increasing ATUC).

This analysis is a short-run analysis. An increase in population would allow for changes in scale, so that the long-run ATUC curve may shift. This shift may adjust the short-run ATUC curve downward, but would not shift it upward. Thus not only may $Q^*$ increase but it is possible that $P^*$ will decrease, due to population influx. This possibility that increased population may lead to economies-of-scale and lower per capita costs is seldom squarely addressed in fiscal impact analysis. (One reason for this is that capital
Figure 1

Figure 2
costs are usually divided by the theoretical maximum population size which may be service, rather than the actual number of people currently serviced.) It is also possible, though that the short-run ATUC and MC curves will become vertical in the vicinity of $Q^*$ (at $QA$, say). This results from the need to expand capacity. If this expansion parallels the initial plant, the situation is that in Figure 2. $Q^*$ would still be determined by the $D = ATUC$ relationship, but not that if $P\Delta P_I/Q_A$ (as most likely it would), the correct decision is to remain at $QA$. There is no need to increase $P$ by $P\Delta$ as output need not be rationed when consumption is collective; however $P$ will have to rise to the lower end of the discontinuity to fully recover costs.

So far we have assumed that output is indeed measurable. It is time for a harder look at the output of local government (it is still assumed that a single service is provided). Table 1 listed general categories of services provided by the local public sector. Of course during the last two hundred years, services have been brought into the public arena principally due to perceptions among the public that the market place was not properly allocating these services. Market failure occurs with social goods, of course, but also for a variety of other reasons. A common case is that the service leads to a natural monopoly, such as electric utilities or sewage treatment. A natural monopoly is a firm providing a service where the lowest region on the long-run ATUC curve coincides with an output
level that will accommodate most or all of the market demand. Usually, this is due to very high fixed costs relative to marginal costs (see Weiss, 1967, for an excellent discussion). In such a case it is inefficient to provide services at levels below the maximum output (since average costs continually decline), however consumption is rival. Therefore, the market demand curve for such cases is horizontally derived, and shifts in the demand curve due to population growth will be horizontal rather than vertical.

Actual local government services have aspects of both social and nonsocial goods. For example, provision of education is to some degree rival--one teacher can not educate 50 students as effectively as 10 students--and also nonrival--we all benefit from a better educated public. Thus, shifts in the market demand curve must be both horizontal and vertical. Accordingly, the precise quantity of the service is usually impossible to measure, benefit-cost analysis notwithstanding, and in fact it is often difficult to even differentiate between the quantity and quality of service. As one paper has succinctly noted (Bradford, Malt, and Oates, 1969, pp. 224-5):

A number of rather subtle problems in the measurement of output, to some extent common to all commodities, arise in especially acute form in the case of public output. One must spell out carefully the distinction between the services directly produced (the "D-output") and the thing or things of primary interest to the citizen-consumer (the "C-output")...moreover the data suitable for measuring the cost of one sector is largely irrelevant for the other.

The authors suggest that insurance premiums might be useful
in measuring the "C-output" of safety, whereas the police budget might be a measure of "D-output", say police patrols. Clearly D is a function of government inputs alone, while C depends on that and also on a host of environmental factors, whose relationships are impossible to quantify, or even categorize, with our current understanding.

The dichotomy between the good produced and the value attached to it by consumers is generally handled in micro-economics by indifference curves, and indirectly by the demand curve. The output of even direct services (D-output) is usually impossible to define let alone quantify. It goes without saying that if Q is indeterminate, deriving the demand curve is impossible. Margolis (1968, pp. 535-6) identifies an important aspect of the problem:

No matter how difficult it is to estimate demand functions for private goods, we usually have observations of amounts purchased during several periods at a reasonably well-identified set of prices...But how different it is in the public sector. The consumers of the goods are not the purchasers; the purchasers are a mix of elected and appointed officials who pay with tax revenues; the taxpayers may not be the users of the services and decision-makers may be neither taxpayers nor users. Observations on price or quantity are rare; costly surveys are often necessary to tell us who uses the services; and the handful of studies of who pays for the services are highly oversimplified. Not only are there several steps between consumer and payer, but often the consumer may not be part of the political constituency which is doing the paying.

Fortunately shifts in the demand curve are more important for present purposes than movements along it. Given certain assumptions, it will shortly be shown that an analysis
of shifts is possible. Before this can be done, however the issue of measuring output must be resolved.

There are two ways to proceed with developing a proxy for output. A method favored by economists working with input-output tables and income-and-products accounts is to postulate a production function such that the value of outputs is equal to the value of inputs. Then the total value of output is a proxy for the quantity of output. This may be quite useful for some endeavors, but not for fiscal impact analysis. This procedure would make the measure for Q be total cost. But as TC = P·Q, ATUC = TC/Q = P·Q/Q = P and the ATUC curve would not be very meaningful. This procedure would also lead to problems in an important issue related to the cost-revenue question, that of "is there an optimum city size, in terms of municipal efficiency?" That is, what population size results in a minimum per capita expenditure. Alesch and Dougherty (1971, p. 21) contend that many studies pursuing this issue introduce an inconsistency when service output is measured by expenditure level:

By using inputs as measures of output, one makes the implicit assumption that inputs and outputs are the same. The purpose of economies-of-scale analysis is to learn whether size makes a difference in the amount of output obtained for a given amount of input. Therefore, one cannot conclude anything about economies of scale as input measures are used as substitutes for output measures.

Just as the time-series analyst must use time as his independent variable, knowing full well it is but a poor proxy for the unknown causes, so must the cost-revenue
researcher use population-served as his measure of the output of local public services. Until statistical indices of consumer satisfaction (C-output) are widespread, until the citizen surveyed is truly knowledgeable of public service quality, and until a reliable means is found to control for changing expectations, little else can be done. It remains to be seen what sort of error this substitute for Q might introduce into the analysis.

Clearly the adequacy of this measure will depend on:
(1) the uniformity of the local government demands of the population, and (2) the degree to which consumption is nonrival. It will also depend on the relative slopes of the demand and ATUC curves, shown in Figure 4. Linear functions are assumed for convenience. The original demand curve is labelled D, the shift in demand will be Dr for rival consumption and Dnr for nonrival consumption. It is most likely true that the real ATUC curves are relatively flat, so that case 1 or 2 must be the situation. Note that the elasticity of demand is of critical importance in deciding the adequacy of the estimate of output. Earlier it was noted there is evidence that the demand for local public services is income-elastic. If this is true, and if one assumes that income-elasticity and price-elasticity are closely related, then case 2 is most realistic. This is fortunate for forecasters, as a much smaller error is introduced by incorrectly splitting consumption into rival and nonrival components. Using population-served as a proxy for output does not
necessarily imply all consumption is rival, if a correct multiplier is introduced explicitly or is implicit in the data used to derive population-output relationships.  

In summary, when the cost curves are relatively stable and flat, and the demand for services is inelastic, the population to be served is an adequate measure of the output of local government. This theoretical result is in accord with empirical results reported in the previous section.

The procedure commonly employed in fiscal impact analysis is to derive an average unit cost for providing some fixed level of services. This per-capita or unit cost is then multiplied by the forecasted change in population to arrive at the total expenditures required, and contrasted with an estimate of revenues received. Thus the ATUC curve is assumed to be horizontal over the appropriate range (AQ). Usage of per-capita costs is pragmatically appealing, but its economic meaning has been obscured, to this writer at least, by its role as both a measure of demand and of output. Extensive research has been done to quantify per-capita costs and population-per dwelling-unit figures, as will be seen later, but little attention has been paid to the micro-economic issues related to this methodology. It is hoped that this section has identified some of those issues.

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6 Recall that a constant per-capita demand for services is assumes. If (say) 60 per cent of output is rival, then for a population change of "n", an output change of .6n is a first approximation. There is an additional change in output caused by a vertical shift in the demand curve of .4n. The more inelastic the demand curve, the less significant the difference between vertical and horizontal shifts will be.
Case 1
- gently sloping ATUC
- gently sloping D

Case 2
- gently sloping ATUC
- steeply sloping D

Case 3
- steeply sloping ATUC
- gently sloping D

Case 4
- steeply sloping ATUC
- steeply sloping D

-Figure 4-
Local Government Expenditures: a Summary

This chapter has tried to draw together the results and problems of economic investigations which are salient to the fiscal impact question. Besides reviewing the current "state of the art" of urban public economics, its purpose is to show, by way of the economic magnitude of the local government sector, the potential significance of the cost-revenue issue, and to examine the theoretical and empirical underpinnings of why one might expect there to be an association between population growth and the local expenditures. An examination of relevant issues leads one to expect that this association is strong enough to lead to meaningful predictions, but also illuminates that in practice there can never be a truly definitive answer to the cost-revenue question. It has been found that aggregate local government expenditures are strongly influenced by population size and revenues, and that these influences have linear affects on expenditures. An explicit examination was also made of the economic interpretation of the assumptions commonly employed in this type of research. The next chapter will deal with some of these issues more concretely, and will also consider special growth costs and the relationship between social environment and expenditures as well as population and expenditures.
A REVIEW OF CONTEMPORARY COST-REVENUE RESEARCH

In this chapter the abstractions of the previous chapter will be left behind, and a more detailed discussion of the facets of residential growth and the related fiscal effects will be made. An attempt will be made to apply some of the concepts raised in the previous chapter. An attempt will be made to reconcile practical limitations imposed by the operating environment. Examples of such practical limitations are (1) poor records, (2) limited staff resources, and (3) the practical exigencies of land-use planning. In the process, the work will consider various attempts to forecast growth, including published examples of cost-revenue research and some recent mineral-related boom town studies. While reviewing previous fiscal analyses, the author will point to problems which he attempted to surmount in a different manner.

The Fiscal Disparities of Rapid Growth

Rapid growth can be viewed as a decidedly mixed blessing to a community, particularly if the growth is a relatively high fraction of the initial community size. In a rural setting, rapid growth may help force farmers out of business, but may compensate them by driving up the property value of farmland. In such setting, within a few years a farmer may find that he has "moved" further away from his markets, for there may be much more congestion on the country roads. In some
places, he may find his property taxes spiraling as his land is reassessed at inflated residential values. On the other hand, the bank may allow him more credit for precisely the same reason. In much of the western United States, cities require developments to dedicate water rights for residences. This policy may lead to high competition for water—competition which agriculture can not meet.

Rapid growth can mean the passing of a way of life to the older residents of a community, and this can lead to political friction. New residents often expect governmental services the day they arrive, but the new residences won't provide property taxes (in Colorado) for 2 to 2½ years after construction (Lamont, et. al., 1974). Problems in meeting such expectations are compounded because the new residents are often accustomed to an urban level and variety of public services which are not traditional to the community. This level of urban public services is viewed suspiciously by the elected officials, who often will reflect the attitudes of the old timers for years after the change in the profile of the community (Gist and Fava, 1964). Furthermore, many facilities must be planned, designed, and built prior to the growth. Such facilities require local government to float bonds, a situation which is often seen as risky by the elected officials, because there is always some chance the boom will not materialize, and because the old-timers often refuse to approve the bond issues.
Additional fiscal erosion can occur due to a splintering of local government. In rapid growth situations, demands are sometimes met piecemeal by the creation of special districts. A harried tax assessor's office often does not have the staff necessary to keep all parcel assessments up to date, thereby resulting in a lowering of the effective tax rate. The local capital market may not be equal to the demands for funds, and a shortage of permanent housing may lead to mobile homes and dormitory apartments with little property tax revenues to offset the needs of those who dwell in them. A shift from a rural to urban community will also, in some cases, mean a decrease in the relative size of the burden shouldered by federal and state financial aid (Netzer, 1969).

All of these rapid-growth problems are in addition to the normal increased demands for services which were discussed in the previous chapter. There appear to be two major problems to local government facing rapid growth. The first is the need for "front-end" monies for planning and constructing capital facilities. Problems of adequate planning, of obtaining approval for bonds (both from the local electorate and from whatever firm may be rating the issue), of property tax base erosion, and of mill levy limits, are all part and parcel of the front-end problem. The other problem is the growing pain involved in an expanding local government. It is one thing to forecast mathematically an increased agency staff, it may be quite another to adequately administer,
train, and keep a larger staff. Some departments' functions (e.g., building inspection, sanitation inspection, and tax assessment) are directly tied to the rate of growth, rather than merely the total population size. Thus, growing pains may involve not only an increase in budget, but a shift in the nature of the services provided. The very real lack of a strong, sure response on the part of local officials to rapid growth, is a factor which can dilute the usefulness of any cost-revenue analysis. Sternlieb, et. al. (1974) examined the effect of growth rates on per-capita expenditures and found the rate to have a significant impact only if the rate is very high (precise rate unspecified) and the original population base is small (under 1000). The authors were aware that funding lags may have influenced the result.

Measuring the Fiscal Disparities of Growth

Many studies have been undertaken by economists, planners, and other "urbanologists" regarding the impacts of growth. Among the many studies concentrating on impacts on the local economy are those dealing with the effects on the local public sector. These studies, particularly those projecting the net cost to a governmental unit of providing municipal-type services to a specific residential or commercial development may be loosely grouped together as "fiscal impact analyses". Although they may be undertaken to answer different questions, the methods employed are often the same. Mace (1961, p. 15) notes that cost-revenue studies, begun in
the 1930's,

began to turn up in appreciable volume in the early and middle 'fifties... but with /the decade's/ close the epidemic has abated in the face of serious criticisms of the basic assumptions and the research methods that had been employed.

More recently, these studies have begun to surface anew, partly in response to the "no-growth" interest of the early 1970's, and more recently to the concern over mineral-development boom towns. Recent examples include: Mace and Wicker (1968); Muller and Dawson (1972); Stimson (1972); Gale (1973); and Sternlieb, et. al. (1974). In an informal survey of 50 state and local planning agencies, cost-revenue studies were rated as extremely useful, but less than one agency in three had completed such research (Gulley, 1972).

Mace (1961) sees several potential uses of cost-revenue research. One of these is in developing a yardstick for rating the effects and equity of existing fiscal policy (e.g., utility rate structures, school site dedications). Another is weighing the pros and cons of annexations. A third is in capital budgeting and facilities planning. A fourth is in answering land-use planning questions, like the best densities of development and the best mix of land uses. Most often, the potential applications of such analyses are split piecemeal among many agencies (separate school districts and municipalities, public works departments separate from planning departments). This results in less effective communication of the research with correspondingly less cohesive application of the results. Mace (1961) asserts that results from really good cost-revenue research would
advocate changes in the current fiscal structure. It is certainly true that development of the necessary data and dissemination of the results would best proceed under a changed structure of governmental agencies.\textsuperscript{7}

Some cost-revenue studies have attempted an essentially statistical approach to the analysis of net costs, using regression methods not unlike those employed in the expenditure determinants studies previously described. Most, however, have used alternative procedures in which breadth is sacrificed for a more detailed examination of the operations and budget of a single governmental unit or group of units. Mace (1961) studies most cost-revenue research conducted prior to 1961, and her book is an excellent point of departure for anyone interested in such analyses. She noted that three basic approaches to cost measurement have been applied: (1) the allocation of total costs based on factors like property valuation, area, population, or number of dwelling units. (2) Performance budgeting techniques that actually measure in detailed fashion the services provided. (3) Interviews with department heads, using their judgment as a basis for estimating costs.

Each of these methods has strengths and weaknesses. Although a great deal of the cost-revenue literature has been devoted to a discussion of the advantages of one method

\textsuperscript{7}The need to better integrate land-use planning with other local government functions is especially clear in fiscal analysis. Branch (1970) and others prepare a case for making planning more of a city-management tool.
relative to another, it must be emphasized that all of these
methods are cost allocation procedures, albeit the cost
basis may be different. In picking the "best" of these
methods, related issues must be evaluated. These issues may
lead the analyst to a choice among allocation methods or
various models. Equally important, examination of these
issues will temper the analyst's belief that a single
"correct" set of numbers will surely emerge. Some of the
issues are:

(1) Should we forecast what expenditure changes actually
will be, or what the expenditure change should be to
maintain the current service level?

(2) Should we use an average or marginal cost analysis?

(3) Given the quality of records, and given the potential
for disparities between a developer's original plan and
the actual form of the development, at what point does
further detail result in insufficient improvement in
forecasting?

(4) How deeply do we wish to delve into questions
relating to tax shifting and ultimate beneficiaries of
service provision?

(5) How likely is it that previous budgeting patterns
in the government unit will continue into the future?

(6) What staff resources are available, and how soon
do we need an answer?

(7) What is the nature of our cost-revenue questions?
Are we to analyze a single typical but hypothetical development? Are we to develop a data base and methodology to be regularly applied to actual proposals?

(8) What are the actual alternatives to the development? How can we determine a net cost difference between the proposed development and the amorphous alternatives?

(9) Are there any service categories where the decision makers are especially interested (or uninterested) in seeing projections made?

(10) Are we concerned with services to property exclusively, or should we analyze services to the community in general as well?

A few examples will illustrate the overriding importance of some of these questions, and show how they may influence the cost allocation methodology. Answers to these questions made by the author in his own cost-revenue work will be discussed later. As already mentioned, rapid growth may alter the nature of the services provided. Therefore one might need to know the magnitude of potential growth rates.

From that knowledge will come answers 1 and 5. To arrive at that knowledge, of course, questions 7 and 8 must be answered. There is also the question of fairness. To view one aspect of this issue, suppose two identical subdivisions are proposed. There may be room in existing schools for the children of either subdivision, but not enough room for children from both. A marginal analysis might show a positive fiscal
contribution to whichever subdivision first comes before the planning commission, as it allows an already sunk capital cost to be spread among more tax base, resulting in lower total unit costs. But the second subdivision will show much more negative fiscal impact because new school facilities will be needed. 8 Would approval of one subdivision but not both be fair? This issue involves answering question 1, for in practice overcrowding or temporary facilities might be the natural response of school officials. Also it involves questions 2, 4, 8, and even 10, for planning officials are often relatively insensitive to the problem of school officials (Stimson, 1972). As a final illustration, suppose a subdivision is proposed. How many of the people living in the subdivision would have demanded services from the governmental unit in any case (by virtue of already dwelling in that area, or by living outside the taxing jurisdiction, but still using some facilities)?

Selecting A Cost Allocation Basis

Under certain conditions, the complications addressed in the previous section will negate any superiority claimed

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8 This presupposes the the cost-revenue analysis would be based on the understanding that previously-approved subdivisions would impact the school facilities at some unknown point in time. In practice the odds are high that only the current or next year's school population would be considered, thus allowing for an overallocation of the available space. This problem is very difficult to surmount because of the great numbers of platted subdivisions which never see a bulldozer. As it is hard to estimate the eventual construction on currently subdivided land,
for a particular allocation method. Under other conditions, these questions will serve to point to a particular approach to be taken. Often times, different agencies may best be approached via different cost allocation schemes. One sees a certain tendency among cost-revenue analysts to view more complicated procedures as yielding better results. The author, for one, prefers simple procedures for which independent supporting data exist, to complicated procedures which rely exclusively on detailed breakdowns of tasks to support their own reasonableness. The author also prefers to rely on his own judgment of cost allocation to abdication of that responsibility to line personnel. Except for a few highly structured tasks, it is unlikely that a department head can adequately estimate work loads by small geographical areas without launching a detailed study of his own. There is also the question of whether a forecasted budget increase would actually be approved by the budgeting body. Additionally, the analyst must worry about the "Hawthorne effect": the system changes in response to being studied. Asking a department head how much more funds he will need as a result of growth is bound to lead to some inflating of financial needs. Observing a trash collection team to ascertain the number of pick-ups per hour will likewise result in atypical

local government often overallocates schools, sewage treatment, water, and other facilities. Greater use of Planned Unit Development concepts, with planning officials more closely tied in with the development, offers some hope for a remedy, but can not salvage the damage done in already incredibly over-subdivided communities. A continuing theme in this work will be the need to integrate cost-revenue research with a much more ambitious urban information system (see Gulley and Kane, 1974).
collection rates. Mace (1961) makes a point of showing how different allocation methods may distort cost figures. For a hypothetical subdivision, she found that a procedure allocating cost based on simple characteristics (assessed valuation) arrived at a cost figure of $19,000; a performance-budgeting method arrived at a figure of $7,000; and a department-head interview approach led to a figure of $22,440. No matter what cost allocation basis is used, decisions as to how to treat individual budget items can be every bit as crucial. These questions can include the degree to which overhead is variable, and the distinction between services to residents of the development, and those to the community at large.

Deciding what cost items to charge to a new development can be difficult and required considerable understanding of the duties of the department. Distinctions that need to be made when examining cost items are fixed vs. variable, and direct vs. indirect costs (Horngren, 1974, especially chapters 8 and 10). Administrative support and other overhead can be a substantial portion of a department's budget, and it can be difficult to determine the extent to which overhead needs to be allocated. For example, a patrol supervisor in a police agency is an indirect cost of providing police protection, but a variable cost nonetheless, and should be included. Decisions as to allocating capital items will largely depend on whether a marginal or average cost analysis is to be made, and whether or not additional facilities will
be needed. There may be a spectacular difference in the figures depending on the adaptation of a marginal or average viewpoint, but this does not necessarily have to be the case.

Decisions of this sort might have to be changed for different problems being studied. A community might be viewing annexation as a device to spread the debt resulting from recently-built, underutilized schools. Another community might be concerned with the likelihood that additional schools are needed. The first of these communities should use a marginal analysis, for it would be absurd to drop annexation based on previously-sunk capital costs. The second community would prefer an average analysis (at least insofar as including historic fixed costs) because capital costs might be most crucial.

After one has arrived at decisions as to which costs to include in the research, one is left with the task of assigning these cost to residential land usage. As mentioned, an appealing approach is to determine units for cost allocation which correspond to the actual production of governmental services. Examples are police patrols and emergency calls, property appraisals, welfare caseloads, water tap installations, and so on. Obviously, though, these cost bases will be successful only if the analyst can in turn relate such bases to the proposed development. In such cases, one computes the cost per unit of production and then relates units of production on a per-capita or per-dwelling basis. Although
such calculations look fairly sophisticated, no great
improvement may have resulted over the alternative procedure
of directly relating costs per-capita or per-dwelling. Any
superiority will be based on the success of separating
variable or fixed costs, and the improved ability to deter-
mine a meaningful connection between production units and
dwellings or people.

Residential Density and Fiscal Disparities

A major unresolved issue is the extent to which some
costs are more closely tied to the specific physical design
of the development, than to the number of units or total
population within the development. Lot size (area and
frontage) will affect the cost of providing schools (busing),
streets, police and fire protection, and sewerage. But the
relative magnitude of cost differences may be small, parti-
cularly in light of the uncertainties inherent in the data.
A study by Bagby, reviewed in Mace (1961) asserted: "Careful
studies of services costs have proved that a minimum density
of ten persons per acre is required to return sufficient
taxes at a reasonable tax rate to pay the cost of urban
services..." However, the methodology was not documented.
More recently, Lamont, et. al. (1974, pp. 2-3) cites studies
which "have repeatedly shown that costs are greater and can
range up to twice as much, or more for sprawl". Council of
Environmental Quality (1974, p. 9) found:

In terms of total public and private investment costs
to occupants, taxpayers, and municipal governments,
the Costs of Sprawl study found that the high density planned community costs 21 per cent less than the combination mix community and 44 per cent less than the low density sprawl community. The largest savings are in the cost of constructing residential dwellings, although important savings are also attributable to reduced costs for roads and utilities (about 55 per cent lower in the high density than in the low density community).

It is easy to see how some costs to government (which are usually the only costs treated in fiscal analyses), those that fall into the "services to property" category, might increase as residences spread out. However, these types of services form a relatively small portion of the total fiscal impact (Mace, 1961, and others). There are differing opinions as to how density might affect services to people. Some economists, such as Baumol (1967), assert higher densities will lead to more intense social interaction and correspondingly higher costs of government. Other urban observers, such as Jacobs (1961), feel that increased density leads to closer community ties, resulting in less reliance on official caretakers, and correspondingly lower costs. The arguments for and against higher density are highly abstract, and pertain more to entire communities than to a single development.

Not all studies have found that density strongly affects the costs of municipal services to property. One example is the M.I.T. Wetmore, et. al. study, reported in Mace (1961). Another is Kain (1967), who stated:

The dwelling unit or structure distribution system is far less complex and costly in smaller, lower density structures. Since most analyses of the costs of
urban services ignore the distribution system, they create a misleading and inaccurate picture of the impact of residential density on the total costs of providing services, bias the analyses in favor of high-density structures, and exaggerate their economy. (Page 92)

Assertions as to the economy of high density development often appear to be based on the greater ability to channel growth into locations with low service costs, meaning partially developed areas where underused public facilities already exist. Such factors are more expediently treated in cost-revenue research by treating the situation for precisely what it is--better usage of sunk costs--than by making a special case for higher densities in general. Another argument for high-density "savings" is that typically these units have fewer people so that per-dwelling-unit costs are lower. However, per-capita costs remain constant. Insisting on such dwellings won't alter the size of growth pressure, however. It may merely cause overcrowding, which in turn can lead to higher costs for social services. There does appear to be some evidence of a lowering of electric usage in small dwelling units, typical of high-density development. This is because there is less room for bulky kitchen appliances, and few landlords install air conditioning (see Netschert and Weinstein, 1970). However, such savings are minor indeed.

9Since most cost studies deal only with governmental costs, not total costs to the consumer/taxpayer. The "distribution system" referred to is that internal system providing water, waste disposal, electricity, or other utility. The "Costs of Sprawl" study, previously mentioned, did include such costs, however.
As mentioned in the previous chapter, expenditure-determinants studies have been unable to make strong assertions about density (see Sternlieb, et. al., 1974 for the latest attempt). Based on our current understanding, the total costs of providing local government services does not seem to be strongly affected by density. Total development costs for some services (particularly public works) are affected, and insofar as higher density may affect the utilization rates of capital facilities, in certain specific cases higher density will effect some savings. There are telling arguments for higher densities, but the fiscal impact is not among them.

A Framework for Cost-Revenue Analysis

At this point it will be useful to establish a general framework for conducting cost-revenue research. At the outset the author should indicate his answers to some of the issues raised before. This framework could be borne in mind while reviewing other work, to be summarized in the next section, and the author's own work, featured in the next chapter.

(1) Forecasts of expenditure changes were made, rather than forecasts of costs to provide a uniform level of service. This approach—a positive rather than normative forecast—was dictated by the body of empirical evidence supporting the former and a dearth of any
practical way of even measuring existing service qualities, essential to the latter. Walzer (1972) suggests that a "will be" approach to cost forecasting is of greater practical benefit than an "ought to be" approach. An additional consideration is strictly tactical. The purpose of cost-revenue research is to appraise planning officials of the probable consequences of their decisions. The study should not be allowed to become a vehicle for justifying budget requests for line officials.

(2) Marginal cost analysis was used. Despite certain fairness objections (posed earlier), marginal analysis is the best approach to take. Of course, marginal analysis has the weight of much microeconomic theory as a justification (see Mansfield, 1970, especially chapters 6, 8, 9 and 15). Furthermore, a marginal treatment will usually be more realistic in terms of estimating actual costs (this seems plausible, but adequate data needed to rigorously prove the assertion does not exist). Finally, a marginal treatment will usually result in lower cost impacts, and it is wise to give the developer every possible break. Then if severe cost impacts still occur (as they did in the author's case study), any resultant controversy over methodology is lessened. One should bear in mind the potential of lawsuits, and should accordingly work toward a plausible model which is more than fair to the developer. In practice, the difference between an
average and marginal analysis will include both the estimation of unit costs and of the change in quantity of units demanded.

(3) The method developed was usable given the extent and quality of the development data available to planning officials. That is to say, the model was a simple non-stochastic, nonoptimizing "calculator". This seemingly obvious position (that the model must fit available data) dooms many sophisticated approaches. Even if such data were available--and a strong case can be made for restructuring the planning process to provide better information--some models (reviewed later in this chapter) still seem to require a degree of candor, cooperation, and altruism seldom encountered in this imperfect world.

(4) Secondary impacts, such as tax shifting and pinpointing the distribution of costs and benefits within the community, were not treated by the author (or most cost-revenue analysts). As will become apparent, there was trouble enough in determining the direct impact. It was also felt by the author that such impacts, by being less tangible, would only make the projections more open to criticism. One should base one's case only on the strongest arguments one has. Nevertheless, this issue is a prime candidate for further academic research.

(5) The extent to which past budgeting patterns
will continue into the future is unknown. Through time, priorities and felt needs change. Previously undernourished departments are strengthened due to a more sympathetic budgeting body, a more persuasive department head, or public concern. As previously noted, during times of rapid growth, a shift in the nature of public services often occurs. The author therefore opted for a set of projections based on expenditures for a cross-section of local governments (details are provided elsewhere in this work). This approach precluded (due to increased staff time) the use of highly detailed cost breakdowns, but, as mentioned, the meaningfulness of a great deal of detail is open to doubt. Aggregates are more meaningful and stable, due to a tendency to "rob Peter to pay Paul": increasing one department's budget at the expense of another. The author was surprised to learn of only one case reported in the literature, where an effort was made to base projections on something other than an exclusive reliance on historical budgeting patterns, for the community in question.

(6) Staff resources available for this project were: the author's own time, a part-time effort covering approximately nine months; additional data and discussion of methodology was provided by a summer intern, several planners, and several elected officials.

(7) The purpose of the author's research was to develop
a computerized algorithm for interactive cost-revenue impact forecasting. The model had to be designed around the situations (and data availability) that would generally occur.

(8) The model developed projected costs associated with a particular development, rather than the net costs between the proposal and the alternatives. Realistically, there is not practical way to incorporate such considerations within a model that must be of general applicability. This does not mean alternatives had to be considered exogenous to the model. To the extent the alternatives could be formulated as developments, they could be analyzed via a separate model run.

(9) The model developed considered only services for which the planning decision makers were directly responsible (i.e., the county government), and for school districts. The officials indicated most of their interest regarded road costs (the most tangible cost), and that they were not particularly interested in school impacts, or in impacts to other local government units (such as regional service authorities and municipalities).

(10) All services provided by the government units selected for inclusion, were analyzed—not just services to property. There may be an underlying non sequitur in taxing property to pay for people-oriented services, but as long as dwellings form the basis of revenue collection, they must also be the focus for expenditure
analysis, regardless of the location of consumption of public services (providing that consumption takes place within the same jurisdiction). Capital costs were treated, an obvious-sounding point, though Mace (1961) reports the bulk of early studies ignored this cost category.

Details of the above points are provided in the following chapter. The viewpoints expressed above evolved over a period of time, for the author originally had no definite, preconceived notions of precisely how his final work would look. There are some other points the reader may wish to consider in pondering the work of the author and other works to be reviewed here. One of these is that all appropriate revenue sources should be considered. This may include sales taxes and intergovernmental transfers, but only to the extent that the development would cause a change in the revenue. (The author's work assumed per-capita intergovernmental transfers would remain the same; there was no county sales or income tax). Another important point is that an ideal analysis would recognize that short-term responses will differ from long-term solutions. For example, a school district will use temporary structures (or merely overcrowd) until bonds are approved and additional facilities are built. (The author must plead guilty to a less than ideal analysis; this feature seemed impossible to include in the time frame involved in modeling.) Finally, to the maximum extent feasible, the method must be validated from data independent
of those used to develop the estimates. Validation, an essential part of the modeling process, has been badly neglected in nearly all cost-revenue research. Slavish calculations based on a detailed and exhaustive list of government activities are nevertheless little more than conjecture unless there is some corresponding basis in reality. This is not to say that validation will be easy. (The author's approach to validation took the form of independent estimates of some key data, together with the consideration of the theoretical and empirical facts reported in the previous chapter; this will be discussed again).

Probably no fiscal impact analysis has ever fully met these criteria, and in fact these criteria may occasionally conflict. Not every cost-revenue researcher would agree with these points, but the attendant explanations should serve to point out why the author feels they are important. A good case could be made for an eleventh feature—that the analysis explicitly recognizes the uncertainty of the projections. However, a monte carlo approach imposes additional data requirements, and in the author's experience, at least, is not so well-received by the nontechnical user. Some of these points will need to be addressed in the data collection stage, while others are addressed in the general structure of the analysis.

Some Recent Examples of Cost-Revenue Research

Our attention will now turn to actual case studies of cost-revenue research. Later, we will consider several
studies that depart from traditional cost-revenue analysis but are still addressed to the fiscal impacts of growth. These latter studies illuminate alternative ways of viewing the problem and arriving at recommendations, and in some cases are of special interest to Colorado.

In view of the comprehensive nature of Mace's 1961 critique of cost-revenue research, the monograph by Mace and Wicker (1968) is of special interest. A number of recommendations in the earlier work—a review of early research—were not followed in the actual case study that came later. Presumably this acknowledges that practical exigencies may force a departure from a hypothetically ideal approach. Mace and Wicker set out to determine how a hypothetical development might affect local government in three different states—California, New Jersey, and North Carolina.

The fundamental hypothesis that this approach sets out to test then, is: given the same type of development and general agreement on proper allocation of costs to residential use (which should be independent of location), the key element in determining whether residential development will "pay its way" is the specific nature of state and local finance structure, related local development requirements and the financing policies. (Mace and Wicker, 1968, p. 12)

They found that in the localities they studied, virtually all initial public improvement costs (for streets, utilities, etc.) are paid by the developer; that non-educational services are covered (or substantially exceeded) by non-educational revenues; and that in education either the subdivisions "pay their own way over a period of time", or else the educational deficit is "relatively minor". Educational deficits occurred
where there is little state aid, thus forcing the local property tax to assume most of the burden. Mace and Wicker (1968, p.11) cautioned, though: "Because of time and budgetary considerations, this research was projected as exploratory rather than definitive, and the results should be considered as a pilot rather than the last word."

The methodology employed by Mace and Wicker is a quite simple allocation procedure, similar to work Mace (1961) feels is inadequate, as previously discussed. Mace's and Wicker's assertion that "proper allocation of costs...should be independent of location" must be based on an assumption that in all locations the public officials would be faced with identical problems, for as previously noted, the precise nature of the decision may have a bearing on the treatment of costs. With regard to the usage of what Mace (1961) termed "performance budgeting techniques", Mace and Wicker (1968, p. 41) have this to say:

While the process is complicated, it is possible to relate most 'service to property' costs to new development such as the subdivisions herein hypothesized. To do this accurately, however, is an arduous and time-consuming task beyond the time and budget limitations of this study. Since local governments (not excepting those of the study communities) rarely keep their books to pinpoint, or to make possible the pinpointing of the locus or incidence of expenditures, precise cost measurement for this research would have required detailed sub-studies, involving field investigations in each community, of the various governmental activities and how they are performed.

In allocating costs, Mace and Wicker made a crucial decision to allocate to all residences combined only a fraction of the total costs of providing residential services.
This fraction is the fraction of total assessed valuation corresponding to residential property. Putting it another way, before allocating costs, those costs were first reduced by an amount equivalent to the commercial and industrial contribution to the tax base. Thus the revenue contributions of nonresidential development are implicitly recognized in the analysis. The authors note that many cost-revenue studies do something similar.

There can be little quarrel with such an approach for "services to property" which are extended to all types of property and not just residences. But should one charge "services to people" to the commercial/industrial tax base? Mace and Wicker (1968, p.44) feel the answer is yes. Their reasoning is that services to people are "relatively independent of location" and "After all, in most communities, the people who live in houses work in offices and factories or shop elsewhere in town". Land uses do not exist independently of each other. A more telling pragmatic argument is that each portion of the tax base will pick up part of the tab, and this should be recognized. Finally, it is argued that since residents will pick up the commercial/industrial tax bill through shifting, to not subtract that amount out originally is to double charge the development.

This issue is very important, for it is precisely this decision to allocate only a fraction of costs to residences that resulted in Mace and Wicker being able to report that residences pay their own way. The nature of the property tax,
charging structures to pay for services to people, is the main problem here. No really satisfactory procedure is known. Those arguing for an allocation of total costs to residences might rejoin that:

(1) What is at issue, in most cases, is how much the local tax bill will increase, and whether or not the new development will provide revenues to offset that amount. The people in the subdivision will create an additional demand. To reduce the resulting costs on the grounds of "fairness" is nonetheless to underestimate what those costs will be.

(2) If one wishes to include the beneficial aspects of the commercial/industrial tax base, the proper place to do that is in the estimation of revenues, not in projecting costs. Perhaps the appropriate way to include this sector is via a crude estimate of how much commercial/industrial tax base is created for a given residential valuation.10

(3) Allowing the commercial/industrial tax base to implicitly shoulder part of the burden doesn't really answer the question posed in the title of Mace's and

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10 What would be needed in any comprehensive analysis is a breakdown of tax base by residential and then by community-serving, industry-serving, and industrial (export base) business firms. This breakdown corresponds to the export-base theory (see Pfouts, 1960 for a discussion) so that expansion of one sector can be related to growth in other sectors. Also note that in communities with a large export base, the argument concerning double-charging is weakened.
Wicker's work: "Do Single-Family Homes Pay Their Own Way?".

What may be at issue here, is one of the side issues previously enumerated; namely are we trying to arrive at a set of normative or predictive cost assignments. To the author, Mace and Wicker have merely established that new development together with the existing tax base will meet the costs. Since local governments do not have recourse to indefinite debt finance, that fact is obvious from the beginning.

Turning to the actual basis for cost allocation, we find that Mace and Wicker used a combined assessed valuation-dwelling unit count procedure. For services to property and to people, the total cost attributable to residences is derived based on the fraction of total assessed valuation. This resulting cost then is divided by the total number of dwelling units to arrive at per-dwelling cost allocations. For some user-fee services, it is assumed that current charge structures are adequate and hence are ignored in the analysis on the grounds that no net cost or profit would result. The per-dwelling cost allocations are a convenient procedure, and probably make sense for services to property. The usage of this cost basis for services to people is more vulnerable. Chapter 1 concluded that the number of persons served is often as good an approximation to output as one can get. The number of persons, age of persons, and socio-economic profiles of the people may vary with the age, type of structure, price and location of the dwelling unit. Mace and Wicker acknowledge
that if their hypothetical subdivision were actually built, during the subdivision's early life there would be more children per dwelling than would be the case for a dwelling unit of average age. Therefore, school costs will be underestimated by a per-dwelling formula. However, Mace and Wicker contended they were interested in long-range cost impacts, and that in the longer-run, a community-wide average "school children per-dwelling" is more likely to be the correct figure. Most public officials the author has worked with are more interested in short-run predictions.

Mace and Wicker were relying on the assumption that the subdivision homes would be purchased by newcomers to the community.

Were residents of the hypothetical subdivision to move there from other locations within the communities, no additional people service costs would be generated by the development though the locus of consumption of many of these services might be shifted. For purposes of this study, however, it is assumed that purchasers of subdivision houses and their families are in-migrants to the study states and communities. Thus they impose new and additional demands for people services and create added costs for the communities. (Mace and Wicker, 1968, p. 42)

Actually, it seems safe to assume that any residences vacated by current community residents moving to the new development will in turn be taken by people setting up new households, or moving in from outside the community. After all, new homes will be built only when the developer is certain there will be a demand for them. The net effect to the community would in such cases be closer to a persons-per-dwelling figure for an entire community, than to such a figure for new dwellings
in the proposed development. Ideally, then, an allocation scheme would be based on population characteristics relating to some of the proposed housing and to some existing housing, with the balance between the two depending on the analyst's opinion of how much of the new housing would be filled by new residents. In practice, of course, this would be difficult indeed to judge, but any error based on this judgment is likely to be relatively small.

Mace and Wicker appear to use average costs. Without understanding actual community situations, it is hard to gauge the merit of this. For example, consider a fire department: an average cost per dwelling figure should include overhead and equipment charges. If the development requires additional equipment—say, a new fire engine—then an average approach is reasonable. But if not new equipment is needed to cover the development (and this will probably be the case), then the only charges made should be for average variable costs (fire department responses) per dwelling. Some overhead items such as the Chief's salary are indirect costs which may be included as a variable cost. To include fixed costs of equipment depreciation is not only to overcharge the development, but to distort the actual impact. When new equipment is needed, it may then be spread over a broader tax base (if the additional development has been built). Though not necessarily the case, it is conceivable that the decrease in per dwelling unit depreciation costs may actually offset the increased charges of responses to the new development, so that total per dwelling
costs may actually be reduced.

The next case study, Muller and Dawson (1972), is based on an actual proposed development of 800 residential units with 30 acres of commercial property, located in Virginia. The analysis is typical of many cost-revenue studies, and is in many respects similar to that of Mace and Wicker. For example, some services to people are reduced to reflect the contribution of the county's commercial/industrial tax base. Their results were that:

...total county expenditures associated with the proposed development will exceed county revenues from the development by an annual amount of $101,745 (given 30 year bond repayment periods for capital outlays). (Muller and Dawson, 1972, p. iii)

Muller and Dawson provide an interesting discussion of alternative methods of allocating costs. They break expenditures into four categories: demand concentrated among low-income families; demand increases with income; demand increases with size of property or structure; and demand is generally invariable. For most services, costs are allocated per-capita; then these per-capita figures may be adjusted to reflect income or other attributes. They noted that whether one allocated costs by population or by income, the differences were small. The per-capita figures were originally derived by taking a figure of persons per dwelling and adjusting this to reflect larger families in single-family homes vis-a-vis apartments. A similar result is obtained for school children per dwelling unit.

In computing revenues, Muller and Dawson reduced the tax
receipts from the level arrived at by applying the official assessment rate:

In almost all communities, the effective tax rate is lower than the assessed tax rate. Therefore in computing likely revenues from real property, one has to determine the effective tax rate based on recent property sales. (Muller and Dawson, 1972, p. 5)

The authors also go into a fairly detailed analysis of capital costs. Muller and Dawson assume a 5 percent interest rate, and perform calculations for 20 and 30 year bond repayment periods. As with most bonds,

The suggested approach for determining per annum cost involves calculating the straight line amortization of capital over the useful life of the investment and adding the interest on the average balance outstanding. (Muller and Dawson, 1972, p. 65)

Sternlieb, et. al. (1974) reports on a detailed survey-based analysis of population-per-dwelling multipliers, and also includes a sample cost-revenue analysis and an expenditure-determinants and economies-of-scale analysis of many small New Jersey cities.

The principal concern of the study was to provide a methodology for estimating the probable fiscal impact on both a municipality's operating budget and educational expenditures of housing developments characterized by various configurational and demographic patterns. (Sternlieb, et al., 1974, p. 2)

The investigators also hoped to bridge the gap "between the tightly detailed empirical case study...and the broad statistical analysis of secondary data collected on the state or national level." (p.1)

Estimates of population per dwelling, an integral part of virtually every cost-revenue study, received special attention in the Sternlieb study. In general there are several
ways one might develop such multipliers. A single aggregate population-per-dwelling-unit figure might be derived, or one may use different multipliers for different dwelling types (e.g., single-family, garden apartments, etc.). Different multipliers are often developed to estimate total household population, number of school-age children, and occasionally other factors.

Sternlieb et. al. (1974) conducted a door-to-door survey of 7500 dwellings ("one of the largest door-to-door surveys ever conducted") in an effort to determine the size of these multipliers and their sensitivity to a number of factors.

The overwhelming finding is the continued importance of bedroom count as a determinant of the number of school age children and the total household size... At present, however, household size and school attendance data are relatively unaffected by development characteristics. Housing type and bedroom count of the units appear to be the key determinants. (pp. 11-12)

Relative rent or value and development size, age, and location were not significant variables. Only number of bedrooms and type of structure were significant.

In view of the disparity among reported multiplier sizes, some analysis of the natural variability of these multipliers is needed. If a school-children multiplier for a given community's three-bedroom single-family homes is .626 (the figure Sternlieb, et al. arrive at), should we expect the school impact of 100 such units to be between 60 and 66 pupils, or would a range of 50 to 76 be nearer the mark? Unfortunately no estimate of variance is made by Sternlieb, et. al. (1974), and correspondence with the research team indicated that the
standard error of estimate could not be computed, due to the method of collating data. This is a really serious drawback to their research, one that is particularly disappointing in light of the sample size. Even if individual records were not kept, it seems incredible that the sum of squared observations (which together with the mean, would have allowed one to estimate variance) was not computed and recorded.

The number of school-age children in a development is obviously the major influence on educational costs. Sternlieb et. al. handled non-educational costs in this way:

The population introduced locally times per capita cost of local municipal services is an indication of municipal costs introduced by that development. While to a certain degree this approach ignores costs specifically related to a type of development, discussions with municipal officials revealed that local cost variation is so slight for low rise developments...that the per capita figure over time is a more than adequate assessment of costs. In the case of the high rise structure, except for equipment increases in the area of fire service, the development form does not present itself as a unique local cost over and above the local per capita municipal expenditure figure as an estimate of assignable cost, based on the number of local residents a development produces, one must be cognizant of the variation of this index with growth and its relation to both the direction of growth and to the population base upon which growth grafts its effects of change. (Sternlieb, et. al., 1974, p. 33)

The Sternlieb study handled this cost analysis by multiple regression on a cross-section of New Jersey municipalities. Per capita costs were estimated by determining per-capita property tax. These per-capita costs were then related to the population size of the municipality, the growth rate of the municipality, and other factors (such as assessed valuation). It was found that growth rates do influence per-
capita costs, but not by as much as total population size influences per-capita costs. Though it was hard to draw conclusions as to precisely how growth influences the portion of a budget spent for different services, it was determined that "declining and slowly growing communities maintain fairly similar allocation patterns, whereas rapidly growing communities vary expenditure emphasis quite significantly." (Sternlieb, et. al., 1974, p. 36)

The authors also performed a hypothetical cost-revenue analysis. This is done not for any specified development (even an imaginary one) but rather for an individual dwelling unit of each type. This is possible because they adopt an average rather than marginal cost analysis.

An area of growing population which is not planning for eventual expansion of its municipal and school services is living off capital and sooner or later will have to accept further expenditure. Moreover, this necessary cost of expansion should not be blamed on the last straw, but should be attributed as a consequence of long-term growth. Thus, for most situations, average costing is probably most useful as a building block for immediate impact studies. (Sternlieb, et. al., 1974, p. 39)

Other cost-revenue studies are: Stuart and Teska (1970); Holley (1966); Del Guidice (1963); Norcross(1968); and Gale (1973). Additionally, there are numerous unpublished reports, which were written for specific communities, such as Baca (1972). Rather than discuss these basically similar reports, we shall now consider some work which departs somewhat from traditional cost-revenue analysis.
Other Approaches to Fiscal Impact Analysis

A paper by Eastman and Kortanek (1970) explores the possibilities of using mathematical optimization methods (a linear programming model of a Markov process) to relate the decisions made by school planners and developers. Their thesis is that types, sizes, costs, and ages of residences will attract families of differing numbers and ages of children.

This paper develops a model that can predict school facilities needs in a community, given the mix and schedule of construction and the form of natural aging processes. It can also determine the mixes of housing types and the schedules in which to build them to result in desirable patterns of growth in the school population. (Eastman and Kortanek, 1970, p. B-786)

The use of optimization techniques in phased development is indeed intriguing, but there are many practical difficulties which appear insurmountable with current data and the structure of decision making. The schedule of housing development is related to many variables besides long-term growth rates (such as prevailing interest rates) and many of these are difficult to forecast. It is also interesting that Eastman's and Kortanek's paper presumes that certain physical characteristics will impact school population. Sternlieb et. al. (1974) found these to be not very crucial. This simplifies the model, but also makes the model less useful. In most communities, the utility of this model would be dealt a fatal blow by the piecemeal structure of urban development decision-making, with school officials, planning commissions, and private developers each making critical decisions, but seldom working cohesively toward the final goal.
Any fiscal analysis of development is, of course, based on the notion that growth will occur, and public facilities will be needed to accommodate the growth. This position was unchallenged for many years, but during the early 'seventies this began to change. Finkler (1972) noted "now some planners are beginning to wonder whether inflated projections and capital expenditures and projects to meet the projections are not actually causes of growth in themselves", and quoted urban planning professor Stanford Farness:

I can flatly state that unless additional public facilities and services are created here (in Chicago) in the future little population or economic growth can take place...Most planning agencies derive past population trends through a variety of mathematical methods, producing a future growth estimate to some decade in the future which then becomes a benchmark for various kinds of public investment and public facilities. (Finkler, 1972, p.7)

High plant investment fees, justified by cost-revenue research, can be used to effectively lower growth rates in portions of a metropolitan area, for local developers will often prefer to go to more lenient jurisdictions in the same metropolitan area, when confronted with high front end costs. For example, Boulder, Colorado--mentioned by Finkler (1972) as the U.S. city furthest along in public acceptance of a no growth public policy--charges $950 to hook up a water tap and $450 for a sewer hookup, and feels it could economically justify $1500 for a water hookup. Of course, the consumer ultimately pays for such policies, though it may well be worthwhile to him if growth is thereby slackened.

The final two works to be reviewed here are both concerned
with the impact of rapid growth due to mineral development. These studies are concerned with growth in predominantly rural mountain area, in one case the Colorado Oil Shale Region, and in the other case the Rock Springs, Wyoming area. The first of these, dealing with oil shale development, is interesting because its emphasis is not on a precise forecast of eventual fiscal impacts, but rather on developing "a recipe book of financial approaches to aid local officials in their fiscal planning for growth." (Lamont, et. al., 1974, p. v) This study and the following one, are freed of the logical non sequiturs in charging structures for services to people, as they are able to treat the entire growth process. Thus, revenues from the industrial/commercial sectors may be figured in the revenue side, rather than ignored. On the other hand, empirical difficulties of projecting the future growth levels are much worse. Andy Briscoe, a member of the study team, told this writer:

In view of the great deal of uncertainty of the actual extent and timing of oil shale development, it wouldn't be possible to pinpoint the exact costs. And to local officials it wouldn't be that important anyway. Rather we wanted to tell them 'We don't know how much development you can expect, but whatever it is, it'll be big. Here are the revenue tools you can use to cope with it.'

The methodology used by Lamont, et. al. (1974) in projecting the population impacts of oil shale development was quite straightforward. Employment (and from it, population) was projected for three categories--construction, mine and plant, and indirect or support employment. Construction and mine and plant figures were developed from industry-supplied data. It
was assumed that mine and plant employment would generate 0.8 additional indirect jobs, and each construction job would generate 0.4 additional jobs. It was further assumed that each family would contain 3.0 persons, that there would be 1.5 workers per family unit, and that 100 per cent of the mine and plant employment and 20 per cent of the construction employment, would be workers with families. The derivation of these figures is not documented; presumably they are guesstimates. Bender (1975) carefully developed and statistically tested a model to predict service employment impacts, but concluded (page 16) that "Attempting to estimate the ancillary employment impact of a new mine employing 500 workers may be extending the coefficients for mining beyond the limits of the data." Presumably a guess at basic-service multipliers and related data, may be as accurate a method as any.

Revenue and expenditure data is computed by Lamont, et. al. (1974) on a per capita basis, with revenues from people (not direct industrial revenues) estimated at $428 per capita per year and, "an annual operating allocation of $500 per capita is assumed." (p. A-2) The derivation of these figures is likewise not documented. Lamont, et. al. (1974) concluded "Based on currently used revenue sources, public revenues are likely to be insufficient in the oil shale region for the first five to eight years after development is initiated." But thereafter, revenues should exceed expenses. "The basic problem is timing and distribution of tax revenues to support new develop-
ment when and where needed." The long run adequacy of revenues is an interesting result, showing how inclusion of the related industrial tax base offsets residential fiscal impacts, even in a "boom" situation.

The bulk of the work of Lamont, et. al. is devoted to an excellent practical discussion of revenue tools, as previously noted. Nevertheless, it should be noted that the fiscal analysis is quite crude, perhaps to the point of making suspect the conclusions of long-run revenue adequacy. It should be appreciated that the study team was grappling with a highly elusive problem—forecasting growth impacts of a currently nonexistent industry.

The final analysis to be considered here is presented in two papers, Gilmore and Duff (1974a) and Gilmore and Duff (1974b). Unlike Lamont, et. al. (1974), Gilmore and Duff are concerned with private as well as public sector impacts in a boom town setting, the Rock Springs, Wyoming area. In the reports it is estimated that capital investment in the local services sector (including local government) will need to be 5 to 20 per cent of the basic sector capital investment.\footnote{The basic sector is comprised of those firms exporting their output beyond the region. Their service sector provides inputs to the basic sector and to households. See Pfouts, 1960.} In an interview, Jack Gilmore told this writer that this estimate was based on linear per capita needs, figuring population influx from mineral development characteristics. Chief among
these investments were schools and housing.

These papers demonstrate that traditional cost-revenue research addresses a small part of the growth problem. For example, although proposed subdivision developments would create a tax imbalance of roughly $3000 per child (Gilmore and Duff, 1974b), they are still very critically needed—even to the point where governmental assistance in home building is necessary—and the alternative (more mobile homes) is unsatisfactory and even more expensive (less tax revenues). Gilmore and Duff (1974b) also indicate that in a boom period with prices rising, local government has problems competing with private wage rates (a la Baumol, 1967).

The population in and around Rock Springs doubled between 1971 and 1974, due to coal- and soda-ash-development, and the growth was forecast by Gilmore and Duff to continue, though perhaps not at so dramatic rates. Estimates of population influx and related needs are based on simple multiplication of assumed relationships, similar to the method used by Lamont, et. al. (1974). No documentation of the validity of the numbers is included. though the assumptions are stated in an appendix to Gilmore and Duff (1974b). Problems directly related to the local public sector are:

1. School districts are bonded up to the legal limit, but even after the current building program is completed, will fall short of needs by a capital investment of $1 million in one district, and $2 million in another.

2. Competition for labor will continue to result in
skyrocketing construction costs.

(3) Limited school bus transportation exists for sprawling settlements.

(4) Pressure on local government line functions has prevented municipalities from developing an adequate planning department.

(5) Lack of permanent housing prevents residents from even partially offsetting the costs of growth.

(6) Declining tax base (in real terms) decreases current operating funds, the real value of municipal bonds, and the ability to service debt.

(7) Jurisdictional problems abound, with boundaries separating revenue sources from population centers requiring public services; planning efforts are fragmented.

(8) Uncertainty about the permanence of the boom leads local officials to be cautious in expanding capital programs.

Suggested remedies related to the local public sectors include: a nonprofit community development corporation, able to plan and finance housing and provide assistance to local government; a development gains tax to provide funds and reduce land speculation; zoning requirements providing for a fraction of low and moderate income housing for each new subdivision; basing building permit fees on the present value of future costs of supportive services; usage of BLM land to drive down speculation; and industry support to local
government, including lobbying and financial help.

**Forecasting Fiscal Disparities: Summary and Critique**

This chapter has reviewed some of the problems local government encounters in growth situations. Recent examples of studies which have analyzed these growth problems were discussed. Some of these concentrate on cost-revenue projections, while other treat the larger issues of growth. Methods employed in the former are usually crude allocation techniques, and those employed in the latter are often even cruder. Many side issues exist which complicate the treatment of potential fiscal impacts.

There is clear contradiction among these studies as to the importance of certain factors, such as residential form and density, so it is not surprising that the results of these studies also conflict. Mace (1961) pointed out that in past studies the ratio of revenues to expenditures varied from 0.30 to 4.04, and cautioned that even that broad range had little meaning. The desire of cost-revenue researchers to develop a single systematic and consistent treatment of costs is understandable, but actually the impacts of different developments can differ, and so should the methodology.

This leads to the issue of validation, an essential part of any modeling process. One position on validating economic models is "rationalism", which "Holds that a model or theory is simply a system of logical deductions from a series of synthetic premises of unquestionable truth." (Naylor, 1971,
p. 154) Rationalism relies on the obvious truth of the basic assumptions, and the logical strength of the following deductions. A cost-revenue methodology based on detailed direct-indirect cost allocation schemes, in effect, is using the rationalist position on validation, unless some effort is made to develop an independent check on the predictive ability of the method. Few researchers have concerned themselves with this issue, at least in print.

A second position on validation is "empiricism", which refuses "to admit any postulates or assumptions that cannot be independently verified." (Naylor, 1971, p. 155) This view, the polar opposite to rationalism, has never been particularly workable in the physical or social sciences, and as a compromise a third view has evolved. This position is that a model is valid if the predictions of the model hold up to empirical scrutiny. Here the predictions, rather than the assumptions, of the model are the test of validity.

University of Chicago economist Milton Friedman terms this approach "positive economics". As the ideal of "ceterus paribus"--all other things held equal--is never achieved, there is always some question as to the extent to which reality supports or refutes a model.

The large-scale statistical studies reported earlier in this work, provide a great deal of justification for the use of population and fiscal-capacity variables to forecast expenditures (which may not be the same thing as forecasting costs). As shown in chapter 1, per-capita cost allocation
is related to shifts in the demand curve, but heroic assumptions are involved. Here is a case, then, where the assumptions are not valid, but the relationship holds anyway.

The problem with developing an exhaustive set of cost allocation bases, tied to tasks directly associated with new homes and new people, the problem--other than the obvious one of collecting such data--is that future budget decisions will not necessarily parallel the analyst's scenario. For this reason, the author feels there is a danger in an exclusive reliance on historical data for the community in question. The point is that a great deal of variability will always exist, due to the natural tendency to spend funds in the future a little differently than in the past.

The next chapter will treat these issues more concretely. There, a case study performed by the author will be presented.
DEVELOPING A COMPUTERIZED COST-REVENUE MODEL: A CASE STUDY

This chapter described the development of a cost-revenue model for a specific community in Colorado. The model was essentially a computerized algorithm for performing cost-revenue calculations, and as such had to be sufficiently general to be applicable to many possible developments with a minimum of modifications. The major problems encountered were to surmount difficulties in the availability of data, to reconcile the practical constraints imposed by day-to-day realities of local government with the relatively abstract criteria of what makes a model good, and to persuade people to use the model once it was developed.

Background

Larimer County, Colorado encompasses a 2,614 square-mile area of mountains, foothills, and high plains in the north-central part of the state. Currently apart from the Denver Standard Metropolitan Statistical Area, it nevertheless is projected by the Census Bureau to eventually become part of the "Colorado Piedmont" megalopolis, stretching the length of the Front Range.

"Growth" is a word that sparks considerable emotion in Larimer County, and most of the conditions which have been described previously as characteristic or rapid growth may be found in Larimer County. The county seat, Fort Collins,
was the fourth-fastest growing metropolitan area in the United States during the 1970-1974 period, growing by 28 per cent during that time (Denver Post, 1976). The boom appears to have been caused by parallel growth in public institutions (especially higher education) and the industrial export base in Larimer and Weld counties (see Gulley, 1973 and Gulley, 1974). The rapid growth resulted in a much larger construction sector than is typical, indicating that to a degree the growth was feeding on itself, a boom-town characteristic.

In 1970, a new manufacturing plant was established near the Larimer County boundary, in a neighboring county. The ultimate size of this plant is still unknown, but there is no doubt that it is already a major addition to the community export base. As is often the case, there has been much concern among the public and local government officials in Larimer County that employees of this plant will settle in Larimer County, which would therefore have to service the people without benefit of the additional industrial tax base.

The county government is responsible for planning in the unincorporated areas of the county. School districts

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12 The employment location quotient for heavy construction in 1970 exceeded 2.3 for Larimer and Weld Counties. The reporting lapses and separation of office and work location problems, often associated with construction sector statistics, may well mean this figure understates the actual size of this sector. This quotient expresses the percent of the local economy labor force employed by a sector, divided by the percent of the national labor force similarly occupied. Thus this region had 230 per cent of the typical relative employment level.
are separated from county government in Colorado. Counties and municipalities make development decisions which principally impact school districts. As is often the case, school and county officials in Larimer County complained that the other group did not consider their problems carefully when making decisions. Zoning and other planning decisions in unincorporated areas are first considered by a five-member planning commission, and are subject to a final decision by the three-member board of county commissioners. Proposals are subject to review, and recommendations are often made by various planning staffs, including those of school districts, municipalities, other counties, and state and federal agencies.

During the period of June 1972 through July, 1974, the author was employed by Larimer County as Director of Systems Engineering. With the assistance of a small staff, the author was involved in collecting information and performing analytical studies of a variety of public policy problems. These problems included some of the organizational type, frequently addressed by operations research teams, and also included a number of questions regarding the size and nature of local growth rates.

Preliminary Fiscal Impact Attempts

Because of public officials' concern with the Larimer County boom, the author was asked to determine what cost impact might be occurring. The author, only vaguely familiar with regional economic analysis and not at all familiar with
cost-revenue research, originally approached the problem as one of developing an input-output model. This approach, it became apparent, was not at all feasible.

County purchase records were not automated, and the task of manually searching through the records for appropriate data on county inputs would have been Herculean. Additionally, Larimer County, like many small units of local government, was much less formally managed than is the case with large organizations, with the consequence that budget line-items did not necessarily reflect actual expenditures and purchase orders did not necessarily even exist for many disbursements. Difficult as estimating inputs by sectors might have been, the task was at least in principle solvable. There is no theoretically-justifiable procedure for estimating sectoral output, due to nonrival and uneven consumption. Some input-output tables have used a variety of allocation procedures for this purpose, for example by allocating police and fire expenditures according to the total property values of the various sectors. The value of such procedures quickly degenerates when less tangible services (land-use planning or mental health activities, for example) are in question. The author was loath to announce results from any such method as the product of a scientific investigation.

Additional problems exist, some of them quite subtle. There are always problems involved in the inclusion of the households sector in the processing sector of an input-
output table (see Miernyk, 1967, for amplification). In addition to those problems, there would be others relating to the households-local government linkage. Some areas of the local public fisc are tied to the number of persons at or below the poverty level. Changes in this type of output could not be deduced from changes in the dollar-level of the household sector, for it would not be known to what degree this change reflects changes in income distribution or changes due to additional workers, and of course total payroll size does not tell one much about total number of unemployed residents.

A final factor in the decision to abandon this approach was more psychological than economic. A decision-maker need not understand the intricacies of a micro analysis to grasp that more homes mean more people needing services. The same official, though, would probably soon lose interest if the growth-cost issue were phrased in the less tangible framework of interdependence among economic sectors. The author has found that results are more likely to be adopted if couched in terms that are easily related to the intuitive reasoning of the decision maker (his logic need not--often should not--be directly adopted, of course). Thus, this procedure was discarded, though not before considerable effort was directed toward it.

The second approach involved reducing the scope of the model from one which would analyze the entire growth process,
to one which would determine the fiscal impact of residential growth. The approach taken was to see how a proposed subdivision would influence the workload of the county staff—a performance budgeting approach, in the terminology of Mace (1961). The author began with variable costs, mostly man-hours, with the idea of allocating overhead later. As mentioned, the county's budget procedures occasionally bore scant resemblance to the line items in the budget. Thus man-hours seemed one of the few cost items which would be at all definite.

A number of problems occurred with this approach. While some of the difficulties were surmounted, the method was eventually abandoned for most county functions. Without detailing all of the difficulties, they can be generalized as follows:

- Obstruction of the data-collection effort by some elected officials. Questioning workers about the amount of time involved in particular activities apparently appeared to some officials to be a time-and-motion or similar efficiency-oriented investigation. These officials presumably feared that the data was being collected as evidence for future hearings, and refused to cooperate on the grounds that their employees were much too busy to be bothered. Perhaps they were, but 30-45 minute coffee breaks were common. Published accounts of this episode in local newspapers brought grudging approval, but the author felt that any ensuing information would be suspect.
- Inflation of some data elements. Some staff personnel, who accepted the author's explanation of eventual data usage, provided the author with figures which observation of the system seemed to indicate were quite high—perhaps deliberately inflated so as to put development in a poorer perspective.

- Variability of some estimates. Some officials indicated that no cost allocation basis would be meaningful; that costs per unit would vary tremendously under different conditions. Other officials were queried for estimates at different times, and grossly different data was supplied at different times.

- Difficulty in assigning tasks directly to proposed development. This is the old problem of collective goods arising again. For example, what amount of comprehensive planning can be assigned to a new development. It was done prior to the proposal's existence, and is of benefit to the entire community, though it clearly is necessitated by growth pressures of which a proposed development is one manifestation.

- Difficulty in allocating development revenues to costs of general governments and cost-impacts of development. It soon became clear that whatever the costs were that could be directly tied to development, they would be a small fraction of total operating expenses. It was not obvious how one should allocate the revenues received among the services received (and paid for) by all resi-
dents of the county, and the services tied directly to the residential growth.

It is not clear to what extent these problems were unique to Larimer County. Certainly the last two items would occur anywhere, and most likely so would the others. An analyst fresh out of school, like the author at that time, is seldom prepared for the amount of resistance studies often engender. Accountants, economists, operations researchers, and the like view modeling and average costing from a consensus viewpoint which approves of the methods, while appreciating the limitations. Operating personnel do not share this consensus, and see the process as unreasonable and potentially dangerous. Eventually, the author became convinced that overcoming the above problems could be a monumental task and that an alternative procedure was necessary.

Several benefits accrued from this approach to data collection. By immersing himself in a review of daily staff routine, the author was in a much better position to engage staff in a running dialogue about the model's potential uses and limitations. Interest among the staff was kindled, and efforts were made to tailor the model to various suggestions. It is felt that some staff members, who developed an active interest in the model while viewing its gestation, would have been much less inclined toward using it, had they been merely presented with the final product "out of the blue". Learning is a two-way street, and during this process the author developed
a much more intimate understanding of the entire planning process and its relationship to other functions. Indeed, several unrelated studies later resulted as a consequence of contacts initiated during this investigation. Finally, the author's (in retrospect) very undiplomatic approach to data collection raised enough outcry so that the Board of Commissioners was obliged to publicly defend the study. Though the author hardly recommends such an approach, nevertheless this early endorsement engendered a better commitment to the study on the part of the decision makers, which was to pay dividends. Also the commissioners must continually evaluate the accuracy and relevance of on-going research. Being laymen, they must seek non-technical criteria for this endeavor, and intuitively they were prepared to believe that any effort which was so heatedly damned must be relevant and thorough!

An Overview of the Cost-Revenue Model

In the usual case study reported in the literature, problem definition, model formulation, data collection, and implementation follow one another in a logical, even inexorable fashion. One senses an air of inevitability about the process. It should be clear by now that the author did not proceed in so tidy a fashion. Indeed it would be very difficult to convey the frustration extant in building decision models in such an environment. The merit of basing a decision on objective, consistent criteria was somewhat foreign to some officials. The length of time required to
do careful analysis was objectionable to others. Objections
to the study that seem petty or prejudicial in an academic
setting continually threatened to terminate the effort. These
objections were finally overcome, and the model described below
was eventually developed.

The purpose of the model, as it finally evolved, was to
forecast the expenditures to service the population housed
in a development, and to contrast the expenditures with
forecasted property tax revenues from the development. If
the development included commercial property, this aspect of
the proposal was included in the development of revenue pro-
jections, but was assumed to create no service burden, thereby
giving the developer the benefit of the doubt in the trouble-
some area of allocating costs between services to people and
services to property. (Actually some costs—-notably sheriff's
department patrols—should be allocated to commercial property,
but little improvement in forecasting would result, while a
fairly substantial and controversial effort would have been
needed to develop figures.) The model would make projections
for the county government and the school district. Originally
municipal data was to be included, but city officials chose
to work on their own, parallel effort. This simplified the
analysis a great deal, as the burden of projecting net changes
in sales tax revenue was removed. On the other hand, the
approaches of the author and of the city planners were occa-
sionally at odds, a point that will be taken up later. Cost-
revenue forecasts for some services provided by special dis-
tricts (such as sewage treatment) were also neglected, based on a lack of interest by county officials in their impact, and in part, on a belief that these services were currently being charged on a fairly accurate rate structure. Thus, the cost-revenue impact would be negligible.

Because the model was to be used in zoning decisions, the input variables would have to be data commonly available to planning staff, meaning physical design considerations. The key input variables were the number of proposed dwelling units by type and number of bedrooms. Recall that the work of Sternlieb, et. al. (1974) concluded that these two characteristics were of "overwhelming importance" in determining population size. Road data was also input; this will be treated later. From the dwelling unit figures, population size would be determined by multiplying the number of units by population-per-dwelling multipliers. These multipliers would not only be specific for type of unit and number of bedrooms, but also be broken down to give estimates of total family size and number of elementary, junior-high, and senior-high school age children. Private school attendance in Larimer County was sufficiently small as to make a public-private school differentiation unwarranted. The total population size would then be multiplied by a per-capita expenditure to arrive at total county expenditures, less costs of road construction which was determined separately.

School district operating expenditures were estimated
by multiplying the number of school age children by a per-pupil figure, furnished by school district officials. Capital expenditures for schools were computed by subtracting from the projected school-age population the current excess capacity and in the closest elementary, junior- and senior-high schools, and then multiplying the remaining pupils by a per-pupil cost of constructing schools of typical size and amenities. A case can be made for computing construction costs (i.e., allocating overhead) for all pupils, even if there is current excess capacity. This is another manifestation of the choice between a marginal or an average cost analysis, and will be treated later. School construction costs included land acquisition fees over and above the land deeded to schools from the subdivision, which would not cover the land needs in a large subdivision. This cost data was provided by state and local officials.

Estimation of road costs was more complex. The more people in a community, the more automobiles, and the larger one would expect road construction expenditures to be. Still such an allocation scheme seemed to indirect for this expenditure category, which is the category in which the growth-cost relationship is most dramatic. A county commissioner can stand by the side of the road near a new subdivision and plainly see what growth means to his road crews. Transportation planning surveys conducted by Colorado Division of Highways provided data on average vehicle trip-ends per dwelling unit
for various cities in the region. A trip-end is half a round trip, from source to destination. Had these figures been available, stratified for different incomes (to reflect higher auto ownership rates for higher incomes), a further refinement would have been made. However, such was not the case. Total trip-end starting or ending in the subdivision could thus be determined by multiplying total dwelling units by trip-ends per dwelling unit. The model user would input his estimate of the fraction of total traffic using various county roads, and these allocations would be multiplied by total trip-ends to determine the additional burden placed on each road segment. Current traffic levels would be added to these figures and the sum compared to county standards to see if the road would need to be widened or otherwise upgraded.

The crux of this aspect of the model was in estimating the burden the subdivision would place on various roads ("loading the network" in the parlance of transportation planners). This was done exogenous to the model, a source of discomfort to the author and the planners who would use the model. At that time the author was also involved in transportation planning efforts. Seeing first-hand the difficulty in assigning traffic volumes to road networks with various analytical methods (e.g., the gravity-model, the intervening-opportunities method), he decided that many months of model calibration would be needed to develop an algorithm that could even duplicate an experienced planner's visceral judgement. With some reservations, the temptation
to replace this judgement with mathematical calculations was overcome.

Revenue was easy to project. County and school district mill levies for the current year were multiplied by the estimate of total assessed valuation for the development, to arrive at projected revenue. Assessed valuation was determined by multiplying the planner's estimate of market valuation by the official assessment rate of 30 per cent. Because assessments are not annually updated, the general rise in property values over time leads to an actual assessment rate of less than 30 per cent. Some cost-revenue studies have adopted this effective rate, which leads to lower revenue figures. While this approach might be realistic, the author felt a developer could rejoin that assessment rates below the official rate were not his fault, and therefore the official rate should be (and was) used. Total property values were determined by inputting expected selling prices for various fractions of residential property, plus the market value of any commercial property included in the proposal. Information on similar units in comparable locations could be obtained by the planner by referring to the tax assessor's files.

The general form of this model is shown algebraically in Display 1. The model is surprisingly simple; no mathematics beyond elementary algebra is needed to understand its workings. It is possible that even this model is too sophisticated. Input data, it should be remembered, must come from the developer's original plan. However, the developer is under no
Estimation of County Expenditures, less Roads:

\[ C = a \sum_{i=1}^{n} D_i P_i \]

- **C**: county expenditures, less road construction
- **a**: per-capita expenditure
- **D_i**: number of dwellings of ith type
- **P_i**: total population per dwelling of ith type
- **n**: number of dwelling types

Estimation of Road Construction Costs:

\[ T_p = T_E F_p \]

\[ K = \sum_{p=1}^{P} \Theta_p \times L_p \]

\[ \Theta_p = \begin{cases} 0 & \text{if } T_E + C_{T_p} < D_{S_p} \\ 1 & \text{otherwise} \end{cases} \]

\[ T_E = t \sum_{i=1}^{n} D_i \]

\[ A = K \left( \frac{1}{y} + \% \right) \]

- **T_p**: increase in vehicle trip-ends on pth road segment
- **T_E**: total trip-ends starting or ending in development
- **F_p**: percentage of development traffic using pth segment
- **L_p**: length of pth road segment
- **C_{T_p}**: current traffic load on pth road segment
- **D_{S_p}**: design standard, maximum trip-ends for pth segment
- **K**: total construction cost
- **A**: annual construction cost, amortized at \( \% \) per cent for y years

An Overview of the Cost-Revenue Model

-Display 1-
Estimation of School Costs:

\[ S = b \sum_{i} \sum_{j} D_{i} \cdot X_{i,j} \]

\[ E = (1/w + \alpha) \sum_{i} \sum_{j} (D_{i} \cdot X_{i,j} \cdot d_{j} \cdot \beta_{j}) \]

- \( S \) school operating expenditures
- \( b \) per-pupil operating cost
- \( X_{i,j} \) mean number of students in jth age group (elementary, junior and senior high), in ith dwelling type
- \( \alpha \) annual construction cost, amortized for w years at \( \alpha \) per cent
- \( d_{j} \) per-pupil construction cost for jth school type
- \( U_{j} \) unused capacity in closest school of jth type
- \( D_{i} \) number of dwellings of ith type

An Overview of the Cost-Revenue Model

-Display 1b-
obligation to build a subdivision as originally planned, at least in Colorado. Many developer's plans undergo dramatic change, according to changes in the market or in the front-end money at his disposal. If the development is platted as a Planned Unit Development instead of a subdivision, though, the developer must seek approval for any changes. In many cases, the predictive power of the model is open to question as input data is uncertain.

The main efforts in developing this fiscal impact methodology lay in collecting adequate data for the model, in defining the problem, and in determining the validity of the model in Display 1. This work has so far concentrated on the latter two aspects. Some of the problems in determining adequate data will not be addressed.

**Developing Per-Capita Cost Data**

By the time the author had evolved the model just described he had become aware of published cost-revenue research in which per-capita cost allocation was commonly used (see the previous chapter). The author was uncomfortable in using such a procedure. After all, it was obvious that elected officials did not arrive at budget increases by reasoning based on the additional number of people in need of service, relative to the previous year. It was clear that budgets didn't increase by any formula. At any budget time, portions of the total budget were in a process of catching up with previous increases given to other departments. Each year some (different) agencies
would receive relatively greater funds in response to additional
duties required by new state or federal requirements of simply
a felt inequity on the part of the budgeting body. A change
in elected officials might clearly change the county funding
emphasis.

It was decided to check historical data to see if increased
population size did indeed result in increased expenditures.
Due to the potential for dramatic variations from year to year
in a single county's budget, it was decided to compare cross-
sectional rather than time-series data. Selection of other
counties which were most similar to Larimer County in one or
more of three criteria was made on the basis of rank-order
statistics. The criteria were: population size (in case
there really is an economy-of-scale effect, and also because
similar-sized counties might tend to have similar expenditure
patterns); population per square mile (on the belief that
overall density would affect certain county functions, such
as sheriff department patrols); and percent of population
which is urban (because urban populations have cities to
supplement county functions). The two counties above and the
two counties below Larimer County (in terms of rank-order
statistics) were selected for analysis. Counties were weighed
in proportion to the number of criteria they met. Larimer
County, being "most like" itself in all three categories received
a weight of 3, while other received a weight of 1 or 2.

County expenditures were compared, after deducting state
and federal transfer payments, functions performed by some
counties but not Larimer (e.g., a county hospital), and road and bridge functions. As previously mentioned, this latter expenditure item was treated separately. County functions were aggregated because of the difficulties mentioned earlier in predicting individual service-area budgets. The data were regressed against population and assessed valuation. A strong correlation existed between population and assessed valuation. Thus the latter was dropped from the analysis since it contributed little to predictive power. The resulting regression led to a linear equation, $Y = 33.14X + 134.18$, where $Y$ is county expenditures, and $X$ is population. Following Miernyk (1967), we may treat the $134.18$ figure as the fixed cost of providing services and the $33.14$ figure as the variable or per-capita cost. Needless to say, this figure of $33.14$ is an estimate of per-capita costs for the counties used in the analysis. The figure should not be assumed to apply otherwise, particularly if the population size falls outside the range of the data (population exceeding about 250,000). Though this procedure is an admittedly crude method of deriving average variable costs, it is still preferable to the usual approach of dividing total expenditures by total population, which assumes all costs are variable. One reason is that non-capital fixed costs (e.g., administrative overhead) is acknowledged by allowing a positive $Y$-intercept. Another innovation is the use of cross-sectional data to reflect the possibility of changes in attitude toward budget size (due to changes in
political fortunes). Relating annual budget changes to
annual population growth is an appealing alternative approach,
but there are problems. Chief among these is the sizeable
error extant in population estimates for intercensal years.
Another problem is that annual budget allocations depend on
many factors other than growth and therefore, any sort of
empirical budget size-population relationship exists only as
long-run trend.

The data and equation are depicted in Figure 5. The fit
of the line is fairly good—certainly better than the author
had hoped—and gives ample indication there is a real and
meaningful relationship between cost and population, though
considerable variation is possible. The prime cause of this
relationship probably has more to do with the increased tax
base associated with larger population, than to any conscious
attempt at per-capita budgeting. The correlation coefficient
of this regression exceeded .9, but the statistical meaning-
fulness of this measure is null as the variables are not
random and the data points were few. This "correlation
coefficient" does, however, indicate a fairly linear fit.
Other statistical tests, such as a confidence interval on
the X coefficient, would naturally be equally meaningless.
One problem with the analysis may be the use of population
as both the independent variable and a screening or control
variable. In retrospect, it appears a better procedure could have
been devised. The analysis as done did not earn the approval
-Figure 9-
of all. The few staff members who took an interest in this phase of development were mystified as to why the author would "waste" his time determining the reliability of the estimate. Why not just divide total budget by total population and be done with it? Why poke holes in one's own research?

Before proceeding to the next category, a point should be made regarding the difference between a "marginal" and "average" cost analysis. If the only difference between these analyses were in using variable or average per-capita costs, it would have had scant effect. For Larimer County the variable cost is the $ coefficient, or $33.14, and the average total cost is the slope of a chord from the origin to the Larimer County data point (see Figure 5), or $32.70. There are additional departures in technique, though, most notably in the treatment of capital costs for schools, to be discussed later.

This technique was not employed with regard to school operating costs. In the interest of consistency with other agency's analysis, operating and capital costs per pupil were adopted from the figures furnished by state and local school officials. Accumulating adequate data for a more detailed examination of school cost would in some cases have been difficult, anyway.

**Estimating Population by Dwelling Unit**

Developing per-capita costs is one part of a cost-revenue
analysis. Determining the population in the development is another important task. What is needed is a set of multipliers relating total household size and elementary, junior-high, and senior-high pupils, to each type of dwelling unit.

As with per-capita costs, the author did not feel the meaning of such multipliers was obvious. One can always collect data of this sort and divide by the number of observations, but the applicability of such an average relies on the stability of the average through time and on samples of varying size. In other words, to be at all meaningful these multipliers must have a low variance. Unlike per-capita costs, though, no means were available for independently checking the reliability of such figures. Funds were not available to develop a set of multipliers from primary data. Numerous multipliers were available from other sources, but varied by relatively wide margins. Planners advanced all manner of explanations for this phenomenon, but the explanations served mostly to underline the variability one could expect, rather than explaining it away. As mentioned in the previous chapter, the most comprehensive survey the author could find could still not provide an estimate of standard error. The problem was made more sensitive by the fact that one municipality in the county was undertaking its own cost-revenue analysis, and all concerned parties hoped for parallel results.

A variety of methods had been used by various parties to determine the multipliers. A city planning staff within Larimer County had been able to develop a set of multipliers,
based on a household questionnaire. The income data from that same questionnaire was distributed quite differently than the census income information for the same locale. It isn't definite if that implied a skewing of the population multipliers, but it wasn't encouraging. Another statistical analysis for a local area had taken total population for large city areas and divided it by total dwelling units in the same areas to arrive at crude estimates of average household size. These averages were then related to average bedrooms per dwelling unit (total bedrooms divided by total dwellings) for the same areas. Finally, average household size was related to number of bedrooms via a third-order polynomial for good fit. Yet another local study had used relatively hard data--actual dot maps for subdivisions indicating the location of each student--to derive student multipliers for single family residences. This figure looked good, until the author discovered that applying the multiplier to a fraction (roughly three-quarters) of the single family residences in the same school district (and completely ignoring other dwelling types), led

13 Sternlieb et al. (1974) report that the two aren't related, though other studies concluded they are related. It would seem offhand that low incomes might lead to overcrowding, and age of children might be related to income. Also families interviewed could have given misleading responses to income but not to population queries.

14 "Good" until one considers the extent to which these averages of averages probably masked the real variability. The census housing data on which this analysis is based have their own inadequacies. Ideally, these figures should have been based on an average household size for each household-dwelling unit; not for aggregates of hundreds of households. The third order
to a number which rather seriously overestimated the total number of children in the school district. The multiplier was defined as being typical of new subdivisions rather than the entire community (based on sample characteristics), and it was asserted that new subdivisions typically contain more school age children per dwelling than does an entire community. Local data were not available to test that hypothesis. Some surveys have supported the belief, while others (including Sternlieb et. al., 1974) dismissed it.

If this were so, it introduces a further complication. Cost-revenue research is addressed to net fiscal impacts. Assuming new subdivisions do have more children per dwelling, then this higher multiplier is appropriate for families moving to the development from outside the existing community. However, some families will be moving to the new development from inside the community; presumably it is the older housing they vacate which is then filled by new community residents. A lower multiplier should probably be employed to reflect this case.

To bring this episode to a close, a set of multipliers from the Sternlieb et. al. study was eventually selected. largely because of the larger sample size and wider dwelling unit coverage than in other studies. No other source could

equation was selected after it was determined it was the best fit. In defense of the analyst, the data was not so structured as to allow a superior approach. One can, however, be concerned that such studies are glibly passed off as "scientific proof".
provide multipliers for all dwelling types. As a major anticipated usage of the cost-revenue model was in comparing the impacts of alternative dwelling types, consistency (using multipliers from a single sample) seemed of paramount concern. Crude reliability checks (such as multiplying the figures by total housing stock) indicated the multipliers would be fairly representative of Larimer County conditions, even though the sample was from New Jersey communities. The author’s preference for a good sample from New Jersey to a poor sample from Colorado would be difficult to either support or refute without additional, unavailable data.

Treatment of Capital Costs

There are a number of standard ways of analyzing capital costs of financial analysis, such as payback and discounted cash flow rate of return analysis. As in other areas of accounting and operational analysis, these standard methods are conventions for treating costs, and do not necessarily reflect the realities of on-going financing. For instance, while a corporation in all likelihood will include a depreciation charge on the usage of machinery, floor space, and other capital items; it is unlikely that the firm will actually have a fund established where these depreciation charges are accumulated for eventual capital replacement. Larimer County had never used debt finance, a source of considerable pride to the county commissioners, and so the choice of a proper
discount rate was somewhat arbitrary. Even in communities where bonding is used, both the interest rate and the degree of discounting will vary. The author was told by the county treasurer that this variation was sufficiently great to defy meaningful forecasts.

However, if one wishes to compare annual costs with annual revenues, there is little one can do except to amortize the capital costs. Because of governmental use of bonds, the complicated formulae used in the private sector are not needed. The initial sum needed is computed, and if discounting is anticipated, a corresponding amount is added on. This sum is then divided by the length of the issue (say, 20 years) and the annual interest on the principal (perhaps 6 per cent) is added to this installment to determine the final annual cost.

One procedure for charging the development would be to multiply population-served by a per-capita capital cost. This latter figure would simply be the annual capital cost computed above by the maximum number of people the facility could service. A slight alteration of this procedure was made by the author. For the fraction of the development population which could be serviced by existing but undersized facilities, no charge was made. This amounts to acknowledging the sunk nature of previous investments. For logical consistency, one should then charge entire capital costs to the development for any new facilities required (even if these facilities would have excess capacity after the development is built), for they too would be sunk costs. This was not done,
however. Instead per-capita capital costs were used, so that the development was not charged for existing plant, but was charged for the fraction of any new facility that would be used. This procedure, it was felt, amounted to being as even-handed as possible to the developer.

Using the Model for County Decision Making

These cost analyses and population multipliers formed the basis of the computerized algorithm, called "PSIM" (for Public Sector Impact Model). The model is an interactive, time-sharing program, designed so that the user can directly input the necessary information regarding the development; override certain computations if the situation warrants; see the results; and modify the physical plan to see corresponding changes in the fiscal impacts. Input data has already been discussed.

Constructing the model was only part of the task. The most important part, pragmatically, is in using the model to improve local decision making. This aspect of decision model building is often more difficult than any technical aspect. It requires that the analyst be sufficiently involved in actual decision making to have his voice heard, and that he understand the unfolding political and human situations. A shift from analysis to advocacy is necessary, and the clear light of reason is seldom as persuasive as other factors.

When the model was in the final stages of programming,
dialogues were held with the county planning staff on its usage. At that time there was a proposed development of 3601 dwelling units (roughly 11,000 people), plus commercial property, requesting rezoning. This new town would have been located far away from existing population centers, near the edge of the county. It was located there because the developers sensed a good housing market in the future labor force of a major new industrial plant, located just across the border in neighboring Weld County.

Most local citizens were not in favor of such a large increase in the regional population. To make matters worse, the new town was to be located near a small, already-existing town. This community—located in Weld County, site of the growth-inducing plant—had undertaken a school expansion program in anticipation of a housing boom, which had yet to materialize. The new town therefore threatened to siphon off the growth which would enable the community to service its debt. Here was a made-to-order application for the fiscal impact model.

Various fiscal analyses were run on the program, and one was eventually selected as being the most likely scenario (see Display 2 for the output listing from the model). The annual fiscal impact to the county was relatively modest, an annual deficit of $72,000 to $177,000 (depending on assumed property values). The school district impact was staggering, however—an annual deficit of $1,026,000 to $1,439,000. For a county with only about 100,000 people at the time, these were sizeable impacts indeed!
<table>
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<tr>
<th>FEEDER ROAD</th>
<th>CONSTRUCTION COSTS FOR EXPANDING FEEDER ROADS AFFECTED BY SUBDIVISION TRAFFIC</th>
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<td>1</td>
<td>3-LANE, LOW GRADE BITUMINOUS</td>
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ANNUAL MAINTENANCE COST FOR SUBDIVISION ROADS $ 3.5
The county commissioners were originally inclined to approve the new town, despite vehement and widespread condemnation of the proposal. The fiscal impact analysis made them somewhat uncomfortable (particularly since they had originally suggested the model development), but at first they did not budge. The author was one of many who brought what little pressure he could to bear on the decision makers, including demonstrations of the model (with the new town data) at a national conference, to local groups and newspapers, and to other local governments who were intrigued by the model.

By this time, the controversy had attained statewide proportions. A Democratic gubernatorial hopeful seized on the matter as further evidence of the need for a stronger State presence in zoning decisions. In a letter to the Board of Commissioners, he encouraged them to deny the rezoning request. A county commissioner pounced with glee on the letter—which contained several inaccuracies—and with barbed wit alluded to the author's model, inviting the state to take a look at it, and "join the technological Twentieth Century". Nevertheless, the encroachment of the State in the commissioners' hitherto sacrosanct land-use powers, must have rankled. This letter probably had quite an effect, pointing out as it did the obvious political advantages accruing to the opposition party, were an approval made. Certainly, after this date the commissioners took a more active interest in further model refinements. As for the victim of the commissioner's poison pen letter, presumably he can find sufficient
solace in being the current Governor of Colorado.

The new town rezoning was eventually denied, and the official reason for this was the fiscal impact (Display 2) as projected by the author's model. Colorado zoning laws provide that rezoning should be subject to "securing economy in government expenditures"\(^ {15} \), and it was clear the new town wouldn't have that point in its favor. The commissioners tied their case to the fiscal impact on the belief that it was a more tangible and hence defensible argument than, say, esthetic values. The conversational mode of the model was originally adopted to facilitate sensitivity analysis, but as it turned out, its major value was that it allowed "hands on" usage by one of the commissioners. The model had been completed after the formal hearing for a rezoning. In such cases, a staff member such as the author, could not introduce new evidence, but a county commissioner is free to weigh the information in whatever manner he may choose to personally do.

The author was quite gratified by the decision and by his model's role in the process. However, a number of factors were coming to light during various fiscal-impact discussions, which led him to believe that in general such analyses should not play so strategic a role. In the new town case, the alternative to the new town seemed to be the location of that housing market in the county with the corresponding industrial tax base.

\(^ {15} \)Colorado Revised Statute 1973 30-28-115.
In the general case, though, alternatives are not so clear-cut and net impacts, reflecting some settlement irregardless, can be difficult to gauge. The following discussion should service to underlie the problems that would result, should such models be followed too glibly.

During model development it became clear that in Larimer County, at least, residences simply don't pay their own way if there are school children. Was it really valid to deny rezoning when (on a per-dwelling basis) residences would have created similar impacts no matter where in the county they were located? The tab is normally picked up by the commercial/industrial tax base, so in cases where the work force of a neighboring county's industry is to be locally housed, there is a justification. But to the extent that a development merely supplies housing to a growth pressure which is already there, it makes little sense to deny such developments.

Wholesale adoption of a growth-pays-its-own-way criterion would result in what Netzer (1968a) has called "fiscal mercantilism": each planning jurisdiction would try to export people to other areas, and retain and attract new industry.

It should suffice to say that efficient patterns of land use in metropolitan areas, in the broadest sense, are not necessarily those that maximise the current fiscal position of governments in the area. There is more to urban society than the concontemporary public sector and governments are seldom in business to maximise their own welfare. Even if maximization of the public fisc were the overriding criterion for land use planning, the property tax is far from the whole story; moreover, a multiplicity of taxing jurisdictions, each striving to maximize its own cost-revenue combination,
is highly unlikely to maximize for the area as a whole. (Netzer, 1968a, pp. 177-178)

In an excellent critique of cost-revenue research, Margolis (1956, p. 285) adds:

The best illustration of the effects of ignoring interrelations among land uses on the validity of the conclusions is the high rank given in these studies to that very fiscally-productive land use—vacant land.

This is followed by an examination of economic flaws in much cost-revenue analysis, such as the use of average rather than marginal analysis, indivisibilities in plant, and other items treated earlier in this work. Finally;

The difficulties in the use of standards or other average figures computed on any other basis cannot be easily overcome, no matter how urgent the need for those figures for planning purposes. Any attempt to derive causal figures, even on a superficial level, is beset by all the difficulties which confront the analysis of the budgets of any economic unit. In the case of the governments these difficulties are tremendously compounded since the unit is a composite of households and firms and we have few insights as to how to aggregate these units. (Margolis, 1956, pp. 293-294)

Recently, a number of planners have suggested that the appropriate use of cost-revenue research is in arriving at a better mix of dwelling unit types. Such research (PSIM among them) usually show a much reduced impact for apartments and other high density units, than for single-family detached units. But one needs to recall the basis of these computations: a per-capita or per-student cost multiplied by a dwelling unit population multiplier. To handle a real, existing growth pressure via high density units won't make these people disappear.
It will merely overcrowd them or force them elsewhere in the immediate area. A far better case can be made for local government to help guide an imperfect housing market (through a demand analysis) to provide the types of dwellings for which there is a demand, than for local government to force the construction of units which superficially seem more economic to service.

Thus it appears that fiscal analysis should be only one of a number of criteria considered by planning authorities. There is no denying that this information is important and quite valid for governmental financial planning. However, only under special circumstances (such as those in the new town case just described) should it be the basis for approval or denial of a proposed development.
SUMMARY

This paper has touched upon many diverse topics in the general areas of urban economics, regional planning, and operations research. The thrust of the discussion concerned the methodology and theory of fiscal impact analysis, with here and there some general comments about the uses and pitfalls of such methods in actual decision making situations. It is thought many of the comments regarding the rigorous of model building in an operational setting are of general applicability.

One of the major objectives of this work was to close the gap between the economist's and the planner's or accountant's perspective of the cost-revenue question. A theoretical solution of the problem was proposed. The author is unaware of any similar analysis. Empirical generalizations about the expenditure-levels of local government were summarized. The theoretical model and the empirical results were used as a validation of the typical cost-revenue methodology, basically that of allocating expenditures per capita.

There was an extensive treatment of the literature. Methodology is fairly routine, but results differ widely. Residential property taxes appear to be more than sufficient to offset the costs of servicing property, but in most cases deficits were reported concerning the services to people. Care must be taken in using a criterion that growth must pay its own way, for
many other issues are of equal or greater importance. Flaws inherent in any fiscal analysis—especially the inability to come to terms with the alternatives to the development—would by themselves dictate a cautious approach. In any event, as family residences have very seldom done so in the past, forcing fiscal parity now would probably be inequitable. As boom-town studies have noted, the alternatives to permanent homes have even worse impacts.

A case study was presented in considerable detail. The purpose was two-fold. First, it illuminated the central role such an analysis played in a major Colorado land use case. This decision marked the first pre-eminent application of such an analysis in Colorado, and to the author's knowledge, at least, was also the first important hands on application of any computerized decision model in urban decision-making. The second purpose was to present one application in enough detail to serve as an instruction book in performing such work. To such an end, weak points in the analysis were pointed out and weakening assumptions and complications were also addressed. Despite such problems, there were several innovations made in this study, including the development of a conversational model, the cross-sectional approach to estimating variable costs, and the degree to which external verification was sought.

It is traditional for dissertations to end with a call for further research. While cost-revenue analysis is useful and timely information, the author would like to suggest that
at this stage a more rewarding area of endeavor might be urban information systems. Such systems could keep a finger on the community's pulse regarding satisfaction with and incidence of government services (though for some services, this may be infeasible), housing needs, and other information. When a truly adequate data base has been in use over a fairly extensive period of time, it might do much to resolve some of the remaining issues in fiscal impact analysis, and to coordinate the administrative use of such information.

As a side issue, it is hoped the reader has gained a better appreciation for the challenge of applied public policy analysis, where the professional must not only cope with complex and unresolved scientific issues, but also with the sometimes Byzantine realities of decision making. All this and a miniscule budget as well. Rest assured, though, that the rosy glow of successful implementation is more than compensatory!
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