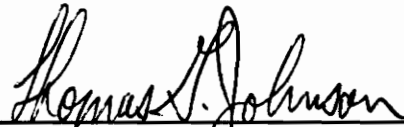


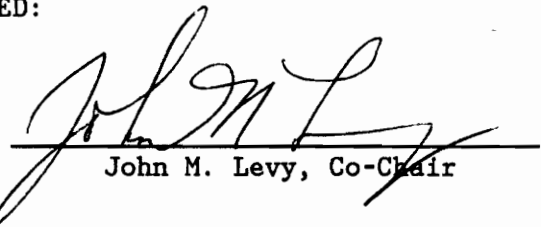
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A Method of  
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the Services of Local Governments

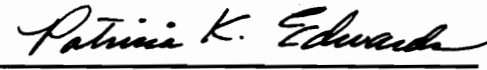
by  
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A Method of  
Evaluating the Impact of Economic Change on  
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by

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(ABSTRACT)

This study seeks a method of evaluating the local impact of changing economic conditions (such as employment, per capita income, *et cetera*). Specifically, measures of the impact of changing economic conditions on the services of local governments will be formulated. These measures provide a means for comparing the impact of a project (or of alternative projects) to conditions that would prevail in its (their) absence.

The data used is drawn from the Virginia Impact Projection (VIP) Model in the form of statistically derived equations representing the relationships for eleven different categories of public services. The analytical framework was developed based on theories of public decision-making, public finance, and local government expenditures and services. This framework was used to analyze the per capita expenditure relationships (functions) to obtain the information required in formulating the impact measures.

For individual categories of services, a SERVICE VALUE INDEX was devised to indicate changes (including shifts) in the demand for the services, and the level of provision thereof. The NET PUBLIC SERVICE BENEFIT

is a measure of the overall increase (decline) in public services provision, and balances the change in levels of service on the individual categories against each other. This measure reflects the net benefits derived by the consumer-voter following her/his reallocation of expenditures given the new cost conditions, budget constraints, *et cetera*, as a consequence of the project.

Keywords: local government expenditures and services, fiscal impact analysis, public services

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# 1

## Introduction

Local government decision-makers studying the implications of changing economic activity -- real estate development, plant closings, *et cetera* -- are concerned with a variety of ecological, economic, fiscal, and social impacts [Canter, Atkinson, and Leistriz]. Applications for land-use permits must be evaluated on the basis of this diversity of criteria. Also, planning departments in local government need to thoroughly analyze the impacts of plant closings on the locality, in order to anticipate changes in the demand for services, and in the revenue base. This study seeks to improve local governments' ability to respond to changing economic activity by providing a method of estimating the *fiscal impact* of such change on the locality. The method and the measures of fiscal impact developed herein are designed to improve local decision-makers' understanding of the specific impacts of changes in employment, per capita income, *et cetera* on public services.

## 1.1 Analytical Framework

Canter, Atkinson, and Leistritz define the purpose of fiscal impact analysis as being ".....to determine whether project-induced changes will generate enough taxes and revenues to pay for the added public services and required expenditures" (p. 211). Throughout this document, the term *project* is used to describe any activity which affects the local economy. While it is common to describe only those activities which bring new construction to the locality, and the associated jobs, income, and so on as projects, the definition adopted here will include plant closings, mainly in the interest of generality. It is of note that there are instances in which a plant closing, which is generally regarded as "negative" due to the loss of jobs and income associated with it, might actually have a positive fiscal impact because the plant (or other business) which closed demanded more services than it paid for through local taxes. Thus it is appropriate to adopt the broad definition of the term project, and to let the analysis reveal the *fiscal* impacts of the changes.

Emphasis is placed on the term fiscal to point out the scope of the analysis. As pointed out earlier, the impacts of changing economic activity are diverse, affecting the locality in many ways. An industrial plant, for example, brings jobs and income with it, pays taxes to the locality and increases the demands for public services. It also has important social and ecological impacts: the increased employment opportunity reduces out-commuting and migration. The demand for labor may increase high school graduation rates. Industries requiring highly

skilled labor offer an incentive for the entire labor-force to improve its skill level, as workers move from low skilled to higher skilled types of jobs. These industries also tend to have a higher ripple (multiplier) effect on the rest of the economy because the higher wages generate greater retail sales and services in the local economy. Industrial plants also release effluent into the air and water systems, creating bio-physical impacts due to increased levels of toxic materials, for example. The method of analysis here designed does not propose to tackle all of these impacts. It is narrowly focussed on the fiscal, and the purpose of this document is to explain what kind of information the analysis does reveal. The appropriate use of the method is illustrated in Chapter 3, by way of example, while the limitations of the method are further discussed in the concluding chapter. Thus the method described herein provides for a partial analysis of the impacts of projects. Used in a broad evaluation context including consideration of important social economic, and ecological objectives, along with the fiscal, the method facilitates would effective responses from local decision-makers.

## **1.2 The Context of Local Government Planning**

Until the 1970s, the federal government had played a prominent role in financing local governments [Aronson and Hilley]. Since then however, federal involvement in financing local governments has been steadily declining. The "New Federalism" introduced by the Nixon Administration gave

states and localities greater fiscal freedom and also greater fiscal responsibility. In the late 1970s, the Carter Administration halted the trend towards decentralization somewhat, but President Reagan reduced federal funding for the lower levels of government [Walzer and Chicone]. During the Reagan Administration, most federal programs for funding local government services were either frozen, cut back, or completely eliminated. As a result, local governments now have to raise a large proportion of revenues from local sources such as property and sales taxes, and user fees, licenses and permits.

Due to the unpopularity of tax-rate increases, local governments' have been increasingly constrained in their taxation powers. Several localities, and even entire states, have adopted ordinances and legislation limiting the power of the state and of local governments therein to raise taxes. (California's Proposition 13 is the most famed of these efforts.) Faced with high resistance to increases in taxation, local authorities have had to seek alternatives to raising taxes to increase revenues. This has led to a variety of devices for maintaining and expanding services which include contracting out certain of them to private enterprises, resorting to volunteer rescue squads and other citizen action committees to provide some services (for example, crime watch programs), and stimulating economic growth to expand the tax base. The use of other devices such as proffers (conditional zoning), linkage programs (requiring a developer to provide certain public facilities as a condition for the approval of her/his proposal), and impact fees (levies against developments which require inordinate increases in certain local services) have gained

popularity as a means for holding real-estate developers responsible for the negative impacts of their projects [Nelson; Leitner and Strauss].

However, analysis of the incidence of these "development exactions" [Kaplan] suggests that their burden is simply shifted along to the prospective tenants of the offices or residences developed, instead of penalizing the developer's returns [Huffman, *et al.*]. Therefore, impact fees are beginning to look more like a tax on real estate ownership, and are likely to become just as unpopular as property taxes.

Due to the constraints on local revenues, local government officials must be able to anticipate the changing demand for public services. Planning departments must be able to forecast future demographic, economic, and social conditions so as to understand which services would need expansion. Fiscal impact analysis is a further important element of the planning function. By analyzing the impact of a project on revenues and on expenditure demands, it informs local officials of the project's effect on plans for service provision.

The need for proactive local government will only become more important in this decade. The prospects for the 1990s indicate the need for intensive planning: new environmental legislation proposed by the President will carry with it new priorities for ecological management. The AIDS epidemic is expected to affect an increasingly large number of Americans. Local governments, and also the state and federal governments, must make every effort to cope with this epidemic, along with the medical community, until a cure is found: much is expected of government at all levels in alleviating the suffering that AIDS wreaks. Other social

problems which demand attention are drug abuse, the large number of homeless persons, and the high rates of illiteracy and of unwanted teenage pregnancies, among others. On the economic front, there is the danger of recession due to the prevalence of a trade deficit and of the national budget deficit. Skillful management by the Federal Reserve Board has been successful in holding off a recession but its threat is by no means past. As Aronson and Hilley point out, "the health of state and local finances depends heavily on the performance of the American economy". Further, the size of the budget deficit and the need for its speedy removal, bode ill for the future of federal programs for assisting local governments.

In this difficult and complex environment, local governments are expected to provide a variety of services. They are responsible for the public safety, public health, education, recreation, and social welfare programs. They are also responsible for public works such as water and sanitation, roads, and other public facilities. The ability to provide these services, at the level demanded, is affected by the changing social, political, and legal conditions. It is also affected by changes in economic conditions caused by new projects. This study seeks to improve information about how project-induced changes in the local economy affect the provision of local governments' services.

### 1.3 Objectives of the Study

Theories of local government decision-making, public finance, and local government expenditures and services describe the processes in which levels of public services are determined. These processes are first reviewed, and a model of public expenditure decisions presented. Based on this model, per capita expenditure functions for local governments are analyzed toward compiling evaluative measures of fiscal impact. These measures will indicate (a) the impact of a project on individual services, and (b) the "bottom-line" impact of the project on the locality's public services. While the former indicates the relative impact of the project on individual services, the latter describes how these separate impacts are balanced in the aggregate.

The measures of fiscal impact are constructed using per capita expenditure functions obtained from the Virginia Impact Projection (VIP) Model. These measures thus provide a means of evaluating the fiscal impact projections of the VIP Model. The model of public decision-making upon which the measures are based can also be used to interpret other per capita expenditure projections.

This study is designed to address the information needs of local decision-makers faced with evaluating the desirability of alternative projects from the *fiscal* standpoint. Thus, the focus is on measuring the *fiscal* impacts of projects on the community. It is therefore important that the method of analysis developed be used within a broader evaluation context which includes consideration of the appropriate ecological, cul-

tural, social, and economic variables that are important to the process of project appraisal. It should be extremely useful as a component of a comprehensive environmental impact assessment.

#### **1.4 Data and Information Used**

As indicated earlier, the theoretical basis for this study is developed from the fields of public decision-making, public finance, and local government expenditures. The method of analysis and the measures of fiscal impact are then designed based on the theoretical model of public decision-making developed herein.

The per capita expenditure functions are obtained from the county version of the Virginia Impact Projection (VIP) Model [Keeling; Johnson and Keeling]. Per capita expenditure functions based on cross-sectional analysis of 91 Virginia counties are specified in this model. The actual equations representing these functions are described in the chapter 3 of the text, and in the appendix.

#### **1.5 Organization of the Study**

The literature survey and research methodology are discussed in the following chapter (Chapter 2). It includes a discussion of the assumptions drawn from the theory, upon which the model of decision-making is based.

In Chapter 3, the per capita expenditure functions specified in the VIP model, and their implications, are discussed. The actual analysis and findings are then described. The raw results are enumerated in the appendix. The application of the measures is illustrated by example.

Finally, concluding remarks and suggestions for further research are included in Chapter 4. The end-matter includes a bibliography of references, the appendices, and the author's vita.

## Local Government Outputs and Expenditures

In this chapter, a model of public decision-making is developed. The model is based on a reconciliation of the Tiebout Hypothesis [Tiebout, 1956] and the Median Voter Model [Bergstrom and Goodman] of public expenditure selection, each of which yields useful insight into the process by which levels of public expenditures are determined. The model is then used to interpret the results of fiscal impact projections -- per capita expenditure projections -- as costs and benefits, and to measure the utility obtaining to the locality as a result of industrial and resource development projects, *et cetera*.

As pointed out in the introduction, the measures developed herein are based specifically on the Virginia Impact Projection (VIP) Model, but the analytical framework is more generally applicable to the results of per capita expenditure projections for local governments.

### 2.1 Voter Preferences and Local Government Expenditures

In 1956, Tiebout wrote that

The consumer voter may be viewed as picking that community which

best satisfies his preference pattern for public goods.....Given these revenue and expenditure patterns, the consumer-voter moves to that community whose local government best satisfies his set of preferences.

This hypothesis suggests that -- given time, and a sufficiently large and varied number of localities -- the consumer-voter will be able to realize, fully, his preference patterns. In his article, Tiebout discussed the limitations imposed by the assumptions, but went on to point out the useful information that the hypothesized model still does provide. He wrote: "While the solution may not be perfect due to institutional rigidities, this does not invalidate its importance. This solution, like a general equilibrium solution for a private spatial economy, is the best that can be obtained given preferences and resource endowments." Further, Johnson [1985] suggests that, in the long run, voter preferences will lie within a narrow range, assuming that they remain fixed.

In their study of the demand for public goods, Bergstrom and Goodman offer a voter model of expenditure and output selection. Tiebout [1956] has suggested that the consumer of public goods votes with her/his feet; i.e., she/he expresses preferences (demand) for public goods by moving to a locality which provides the requisite mix of expenditure and revenue patterns; if the consumer-voter does not move, she/he is expressing satisfaction with the present existing mix. (In the private market, of course, demand is expressed by the explicit action of purchasing, or not purchasing, the good in question, which action is easily observed.) On the other hand, Bergstrom and Goodman argue that "by employing rather simple assumptions about the political process in each municipality" the decisions made by individual municipalities can be used to understand the

residents' -- consumers' -- demand for their outputs. They then present a *median voter model* of local government decision-making. According to their model,

- o every consumer pays a fraction of the total cost of provision -- her/his "tax-share" -- and this cost is determined by the individual's wealth, income, and other characteristics
- o the product of the above "tax-share" and the total cost of provision gives the individual's "tax-price." Given this, she/he would determine the optimal level of outputs by balancing the tax-price against a linear budget constraint
- o finally, "In each municipality, the quantity supplied of the municipal commodity is the median of the quantity demanded by its citizens"

(Their model draws heavily on the previous work of Howard Bowen on voter preferences and provision of public goods.)

This model suggests that the voter who demands the median of all the quantities demanded is representative of the community's prospective voting choices. The political process by which the consumer-voter maximizes his preferences is described by Borcharding and Deacon. They suggest that the consumer-voter maximizes his preferences by selecting those policies, and politicians who espouse them, as are most closely aligned with her/his preferences. Further, Breton contends that, politicians seek to maximize their chance of re-election by providing the mix of expenditures and taxes which are preferred by their constituents. Thus,

political competition among elected officials improves the ability of the citizen to attain her/his preference position.

Tiebout [1956] argues that the "typical voter" theories of local expenditure decisions are not satisfactory because they do not reveal the consumer-voter's true preferences. He contends that the voter's preferences must be revealed, these preferences must be satisfied just as they are in a private market, and that she/he should be taxed for the good, in order to attain a satisfactory theory of public finance. He suggests that the model of consumer behaviour hypothesized by him comes closest to revealing the consumer-voter's true preferences. Since the community has fixed revenue and expenditure patterns, the consumer-voter's choice of community represents her/his preferred mix. He argues that consumers do not influence local governments' selection of the mix of revenue and expenditure patterns, they simply move to the one which is providing that mix which matches their own preferences [Tiebout, 1956].

This study takes the position that both the economic and the political processes are relevant to the choice of local expenditures. The political process of voting to maximize one's preferences, and of politicians espousing popular policies to maximize their chance of reelection, and also the economic process of moving to a preferred location, co-exist. Therefore it follows that, on the one hand, communities are formed by individuals choosing to live there (or move away) due to the perceived patterns of revenue and expenditures; while on the other hand, citizens do influence the expenditure and revenue patterns through the political process. A pattern of voter resistance to high rates of taxation --

heralded in by California's Proposition 13, and continuing through recent ordinances in Northern Virginia localities -- bear this out. Further support to this point is lent by the way in which communities regulate all manner of activities -- from low-income housing to hazardous wastes movements -- through zoning. (Evidence of this is constantly seen in the pages of today's newspapers.) Thus, the model of decision-making about local government outputs used in this study is based on a reconciliation of the Tiebout Hypothesis and the voter models of public service selection. Accordingly, the model proposed makes the following salient assumptions:

- o Localities are made up of consumer-voters whose preferences lie within a frequency distribution (after Tiebout [1956] and Johnson [1985])
  
- o Local elected officials seek to maximize their chance of re-election by forwarding those policies which best match their constituents' preferences (after Breton). This implies that elected officials seek means of providing the services demanded at the lowest possible average cost. This also relates to Tiebout's [1956] assumption that local officials seek to provide the bundle of services at lowest possible average cost, given the size (population) of the locality. In other words, local officials choose the optimal level of production.

o Consumer-voter's, of which each locality is composed, are aware of their preferences, their budget constraints, and their tax-price. Thus, they are able to maximize those preferences through their voting decisions (After Bergstrom and Goodman; and Borcharding and Deacon).

This model of local government decision-making suggests that elected officials seek to harmonize their decisions to the consumer-voter's preferred mix of expenditures and revenues. Since there is no profit -- or economic rent -- to be had from the outputs of local governments, it is argued that local officials seek to provide the services demanded at lowest possible cost, thereby increasing the citizen's satisfaction with their performance. The chosen model of local government decision-making suggests that voters and officials act in concert to choose the optimal level of expenditures.

## **2.2 The Per Capita Expenditure Function**

Per capita expenditure functions for local governments are used to model the demand and/or supply of the outputs of local governments. These functions are hypothesized based on the literature on public sector economics, public decision-making, public finance, and public expenditures and services. The hypothesized theoretical relationships are then validated using statistical analysis of data for a representative sample of localities. Borcharding and Deacon, Bergstrom and Goodman, and Keeling have estimated per capita expenditure functions in this manner.

As Bergstrom and Goodman point out, there is an important assumption underlying cross-sectional analysis. Observations in the data set are first obtained by surveying a sample of different localities. In conducting the statistical analysis, however, these observations are treated as if they belong to one representative locality under different conditions, these being the conditions facing the different localities. This assumption allows the statistically estimated relationships to be treated as the long-run functions for the localities in the sample. This assumption requires, in turn, that the localities be faced with a similar cost structure, so that as conditions change from locality to locality, costs change in a similar manner.

Now, the general form of the per capita expenditure function can be written, in polynomial form, as

$$e = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n$$

where

$e$  = per capita expenditures

the  $X$ s = the hypothesized exogenous variables

$\beta_0$  = the intercept

$\beta_1$  through  $\beta_n$  = the coefficients of the polynomial.

This study uses per capita expenditure functions specified in the county version of the Virginia Impact Projection (VIP) Model [Keeling]. As reported earlier, the VIP Model was estimated by econometric analysis of data for 91 Virginia counties. (For details about the construction of the Model please see Keeling, or Johnson and Keeling.) The empirical

relationships for per capita expenditures, under the eleven different categories, are in the reduced form, that is they contain variables describing supply and demand factors, whose coefficients were estimated by statistical analysis. In the following sections, these variables are grouped under four different *components of change*. The types of variables included under each component, and the rationale for the classification, are discussed below. Evaluative measures of the fiscal impact of the project are then compiled based on this classification. In the following chapter, the per capita functions are analyzed individually, and the variables therein are discussed under the classification scheme introduced here.

Choosing population as the unit of output for local government services, the per capita expenditure is equated to the average expenditure per unit of output. The reduced form per capita equation thus represents the set of equilibria which would result as supply and demand change.

### **2.2.1 Changes due to Population, N - Size Economies**

The presence of the population term,  $N$ , in the relationship for per capita expenditures,  $e_j$ , implies that per capita expenditures change with population. This implies that, as the output -- population served -- changes, per unit costs (reflected in per capita expenditures) change. If the unit cost *decreases* with *increasing* output, *size economies* are said to exist. Such a change implies that efficiencies of production may be gained from going to a higher level of output: these efficiencies lower unit costs,

and thus the price the consumer pays. In contrast, a loss of efficiency could also occur in which case the unit cost would *increase* as output increased. In the latter instance, size *diseconomies* or *negative* size economies are said to exist. The coefficients of the individual equations indicate whether a gain or loss of efficiency occurs with changing output.

Bergstrom and Goodman have studied the demand function for municipal commodities. Included in this study is an analysis of changes in tax-price with changing population. Fox provides a review of the research on size economies in the *supply* of local government services, and of the findings of this research. The above studies identify the impact of changes in population on the per capita expenditure function. These findings are used to perform the analysis of size (dis)economies for the per capita expenditures.

Fox classifies local government services as 1)"labor-intensive, user-oriented services" under which he includes education, fire protection, police protection, and refuse collection; and as 2)"capital-intensive services" under which he includes roads and highways and sewer and water utilities. The findings reported in this review suggests that size economies do exist for both classes of services. For labor-intensive services, the reduction in unit cost with increase in output is small. The greatest economy is realized in going from partial provision of services to full provision of services. For this reason, smaller communities realize significant economies of size while larger metropolitan area cannot realize any significant size economies. For capital intensive services, the range over which size economies can be realized was found

to be larger and to include metropolitan areas also. However, Fox warns that the estimation of costs was not always exhaustive and so this later finding must be used with some caution.

In examining the expenditure function for local government services, Bergstrom and Goodman found that estimates of the "crowding parameter" were one or greater. They interpret this to mean that as population increases, causing the tax-share to decrease, there is a countervailing effect on the consumption of the good due to crowding. Thus the net effect of rising population on per capita expenditures is insignificant for cities in the study (1960 population between 10,000 and 150,000, located in 10 states). Nevertheless, they suggest that public goods are probably provided collectively due to the existence of substantial economies of size for smaller cities, which become insignificant after the city passes a critical size.

When size economies are indicated for the locality, one or the other of these effects is seen to prevail over the other. If the size economies are positive, the prevalent effect yields a gain in efficiency, while if they are negative it is causing loss of efficiency. If, on the other hand, no economies are indicated, the two effects are either non-existent or cancel each other out largely.

### **2.2.2 Shifts in Demand, $D_j$**

The consumer's per capita income and wealth are argued to shift her/his demand for public goods. The theory of consumer demand tells us that

changes in income shift the consumer's budget line, and thus her/his demand equilibrium is also shifted. For example, if income increases, the consumer is willing and able to consume a larger market basket of goods, and thus her/his expenditures increase [Mansfield, pp. 65-71, and pp. 83-86].

Changes in wealth are here argued to produce a similar effect on the demand for public goods. When the consumer's wealth, indicated by the value of real and personal property per capita, increases she/he will demand a larger market-basket of government services, which include public safety, education, recreation, *et cetera*. As wealth increases, the citizen-voter becomes more interested in ensuring the safety of her/his property, in providing a good education for her/his child(ren), and in spending a leisurely afternoon at the zoo or other park. Thus wealth shifts the demand for public goods and services.

### 2.2.3 Changes in the Quality Indicators, $Q_j$

The quality of a public good influences consumer's demand for the good: the consumer is willing to pay more for improving the quality of public goods and services, and not as much when the quality declines.

Consider the example of public safety. The ratio of volunteer to professional firemen is an indicator of the quality of fire and rescue services: volunteer fire-fighters are not as extensively trained or experienced as are professionals, and are hence less effective in fire and rescue operation. Since fire-fighting is a *beneficial* good, greater ef-

fectiveness provides higher satisfaction. Thus, the lower the ratio of volunteer to professional fire-fighters, the higher the willingness to pay for fire and rescue services. Similarly, the higher the number of instructors per 1000 pupils, the higher the willingness to pay for education.

#### 2.2.4 Changes in the Cost Conditions, $C_j$

Service conditions, such as crime per capita, population density, unemployment, *et cetera*, determine the cost of providing a given level of services. For example, if the number of crimes per capita increases the locality must spend more on police, fire protection, and related services to maintain the level of public safety. Similarly, if unemployment rises, the locality must spend more on welfare services.

It was argued earlier that as the service conditions change, and as size (dis)economies appear, the cost (price) of public goods changes. A change in the price of any good or service affects the amount of that good or service which the consumer can afford, all else remaining fixed, and will hence affect her/his demand for that good. For example, if the cost of fire services is reduced due to size economies, the savings in price increases the consumer's purchasing power, and thus he could buy more of all goods and services including fire and rescue. This is known as an *income effect* of a price change.

In this study, the income effect is treated as negligible for the changes being analyzed. Since the per capita expenditure functions used

are in the reduced form, the demand and supply factors need to be distinguished. However, when a variable affects the cost of a good or service, it affects its price, and this in turn affects the quantity demanded, through the price effect. The assumption that the income effect is negligible allows clear distinction between the demand- and supply-related components of change. Because the changes in cost tend to be small, and because only a small fraction of the price savings is reinvested in public goods, the deviation from reality which is caused by this assumption will not significantly weaken the conclusions which are drawn from the results. Also, since utility is measured only in the ordinal sense within this model, the distortion would have to be significant, as well as non-uniform across expenditure categories and for different scenarios, before it could affect the reliability of the conclusions. It is thus argued here that the income effect can be ignored.

Using the symbols for the components of change above, the general form of the per capita expenditure function can be written as

$$e_j = \beta_{0j} + \beta_{1j}N + \beta_{2j}D_j + \beta_{3j}Q_j + \beta_{4j}C_j$$

where,  $e_j$  = per capita expenditures for category  $j$  of services,

the  $\beta$ s = the coefficients of the polynomial,

$N$  = the population of the locality,

$D_j$  = the demand shifters for the services  $j$ ,

$Q_j$  = the quality indicators for the services  $j$ , and, finally,

$C_j$  = the cost conditions governing the supply of services  $j$ .

Given the assumptions about preference maximization in the choice of levels of expenditures, it follows that the consumer-voter is aware of the utility he obtains from spending a dollar on the quality of services, say, versus that which he achieves from spending it on changing costs. The change in  $e_j$  due to change in any category of independent variables, is thus the change in dollar value of the utility obtaining to the consumer-voter, from that category. Therefore these dollar values can be summed to give composite measures of the change in utility expressed in dollars.

## **2.3 The Measures of Fiscal Impact**

The synthesis of the components of change into measures of fiscal impact is discussed in the following sections. Also discussed is the rationale behind this synthesis. It is important to note that these are ordinal measures only (since no cardinal measure of utility exists) and can thus only be used for the comparison and ranking of alternative projects.

### **2.3.1 Service Value Index (SVI)**

The *Service Value Index* is used to describe the impact of projects on consumer-voters' valuation of individual categories of public services. As argued in the previous section, this valuation determines the

level of expenditures which the citizen chooses through the voting process.

The consumer-voter's valuation of public services is, in other words, her/his *demand* for these services. The demand for public services is, in turn, determined by the consumer-voter's wealth and income, and by the perceived quality of services, as measured by the quality indicators,  $Q_j$ . If quality is perceived as being below some acceptable level, the citizen-voter would spend more to improve quality, while she/he would spend less if she/he perceived quality to be above that level.

The SVI for service  $j$  is computed as

$$SVI_j = \beta_{2j}\Delta D_j + \beta_{3j}\Delta Q_j$$

In measuring the impact of the project, the focus is on the *changes* caused by it. This is why the SVI is calculated as the *change* in utility from public services. In conducting the fiscal impact analysis, the SVI is calculated for the baseline, the project, and with the project over the baseline as the difference of the first two. This last calculation gives the impact of the project on individual services, and is the one which is referred to as the "Service Value Index".

### 2.3.2 Net Public Service Benefits (NPSB)

This measure is used to indicate the net impact of the project on the community's public services. As such, it is a "bottom-line" measure which

can be used to compare the desirability of a project or to compare alternative projects.

The NPSB is calculated as

$$\left( \sum_{j=1}^{11} (SVI_j) \right) \times N + (\text{Change in Non-Local Aid})$$

where N is the population of the locality. While the sum of the changes due to the SVI represent the change in consumer demand for public services, the Change in Non-Local Aid yields a savings or loss in public expenditures due to transfers from higher levels of government. This amount thus changes the net value of public services, and adds to the NPSB if positive, or detracts from it if negative.

The unit of measure for the Net Public Service Benefits is in dollars. It is important to note that the estimation procedure yields per-capita expenditure relationships which explain how citizen-voters reallocate their expenditures under changing economic conditions. The estimation procedure also takes into account the simultaneous nature of these decisions across expenditure categories [Keeling]. The Net Public Service Benefits is a measure of how much more the consumer-voter is able to afford as a result of the project.

### 2.3.3 Change in the Cost of Constant Service

The Change in the Cost of Constant Service is a measure of the impact of the project on the cost of maintaining a given level of satisfaction

from public services. It is calculated for individual services -- and aggregated to give the total -- as the sum of the changes in expenditures caused by population (size economies) and the other socio-economic variables which represent the underlying service conditions.

As cost conditions change, the consumer-voter must reallocate her/his expenditures between public and private goods and services, and across categories of public services in order to maintain her/his level of utility. Neglecting the income effect, it is concluded that as cost conditions change, the consumer is able to reallocate her/his expenditures so as to remain on the same *indifference curve*, thus maintaining the same level of utility in the absence of any change in the SVI and the NPSB. Thus in comparing projects, only the NPSB is used to rank projects for their desirability.

In the next chapter, the VIP Model is reviewed. The analysis and findings are then discussed, and the raw results presented. An example of the use of the measures estimated in this study is included for illustration purposes.

## 3

# Analysis and Findings

The per-capita expenditure functions used in the analysis are drawn from the Virginia Impact Projection (VIP) Model [Keeling; Johnson and Keeling]. This chapter begins with an overview of the model. The per-capita expenditure functions specified in the model are then described, after which the results of the analysis are reported. The use of the measures of fiscal impact is demonstrated using an example.

### 3.1 The Virginia Impact Projection (VIP) Model

The VIP Model comprises two stages. The first stage uses *economic base analysis* to determine changes in total employment from changes in base employment. The change in total employment is then used to estimate changes in population, enrollment, unemployment, the total labor-force, incommuting, and outcommuting. In the second stage, the input data and the estimates of the first stage are used to estimate changes in the revenues and expenditures of the locality over the simulation period. These changes are compared to the baseline projections for the same project in order to estimate the impact of the projects. (For full details regarding

the construction of the model -- and about the procedures used to estimate and validate the various statistical relationships -- please see Keeling.)

Economic base studies are predicated on the "export base model" [Tiebout, 1962]. According to this model, the local economy is made up of two sectors: "(1) firms and individuals serving markets outside the community; and (2) firms and individuals serving markets within the community" [Cited in Keeling]. The former -- the "export" or "base" sector -- is held to drive the "non-base" or "residential" sector. Further, each level of base activity determines a unique level of non-base activity.

Changes assumed from the project are entered into the model at the relevant data entry screen. The model is constructed so that these changes are added over the baseline, and the new revenue and expenditure patterns are simulated. These new patterns are then compared to those simulated in the baseline, and saved, to measure the impact of the project on revenues and expenditures, and also the economic variables such as commuting, unemployment, *et cetera*. The evaluation technique developed in this study attempts to provide interpretive information about the fiscal impact of changes in expenditures to the citizen-voter.

The per capita expenditures specified in the VIP Model are enumerated in the section below, along with a discussion of the arguments contained therein. The discussion is intended to highlight the implications of the different variables in the functions to the consumer. These implications are related to the components described in the previous chapter: population, demand shifts, quality indicators, and cost conditions. The

measures of fiscal impact are then constructed by summing the appropriate change components. Finally, the use of the Model, and the measures formulated herein are illustrated by example.

### 3.2 The Per-Capita Expenditure Functions

The general form of the per-capita expenditure function, as reported in the preceding chapter, is

$$e_j = \beta_{0j} + \beta_{1j}N + \beta_{2j}D_j + \beta_{3j}Q_j + \beta_{4j}C_j$$

where,  $e_j$  = per capita expenditures for category  $j$  of services,  
the  $\beta$ s = the coefficients of the polynomial,  
 $N$  = the population of the locality,  
 $D_j$  = the demand shifters for the services  $j$ ,  
 $Q_j$  = the quality indicators for the services  $j$ , and, finally,  
 $C_j$  = the service conditions governing the supply of services  $j$ .

In this section, the individual per capita expenditure relationships are enumerated, and their implications discussed.

#### Public Works Expenditures:

Public works expenditures are denoted by the symbol  $e_{PW}$ . The relationships specified in the VIP Model can thus be written as

$$\begin{aligned} e_{PW} = & 5.886138 + 0.000350555 \text{ (Real Property Per Capita)} \\ & + 0.001486275 \text{ (Personal Property Per Capita)} \\ & - 0.171077 \text{ (Percentage Change in Population)} \\ & + 39.308394 \text{ (Square Miles Per Capita)} \end{aligned}$$

Comparing this to the general form of the equation representing per capita expenditures in category  $j$ , for

$$j = PW,$$

$$e_j = e_{PW}$$

$$\beta_{0j} = 5.886138$$

$$\beta_{1j}N = 0$$

$$\begin{aligned} \beta_{2j}D_j &= 0.000350555 \text{ (Real Property Per Capita)} \\ &+ 0.001486275 \text{ (Personal Property Per Capita)} \end{aligned}$$

$$\beta_{3j}Q_j = 0$$

$$\begin{aligned} \beta_{4j}C_j &= -0.171077 \text{ (Percentage Change in Population)} \\ &+ 39.308394 \text{ (Square Miles Per Capita)} \end{aligned}$$

The absence of a significant relationship between per capita public works expenditures and population for both cities and counties suggests that there are no significant size (dis)economies for public works.

The positive relationship with real and personal property suggests that the citizen-voter's wealth increases her/his demand for public works (water supply, sewage handling, *et cetera*). No measure of quality is reported as having been tested.

Percentage change in population is a service condition. The negative relationship is indicative of the fact that public works are capital intensive services whose level of production cannot easily be adjusted with demand [Keeling]. Thus, in the short run, the locality is locked into a

certain level of expenditures for these services. As the population increases, the locality falls behind in its capacity to provide these services and thus the per capita public works expenditures are lower than required by demand; when the population declines, the opposite occurs. The larger the change, the larger the discrepancy between the demand for the services and the actual service provision. The variable "Square Miles Per Capita" is used to measure the effect of the dispersion of the population on per capita expenditures for public works. The cost of providing public utilities to a widely dispersed population is higher than for a less dispersed population, as indicated by the positive sign of the coefficient.

**Police Expenditures Per Capita:**

Police expenditures per capita are denoted by the symbol  $e_{PO}$ . The relationships specified by the VIP Model are,

$$\begin{aligned}
 e_{PO} = & 0.49388 + 0.001271824 (N) \\
 & - (1.6411E - 10 (N)^2) \\
 & + 0.002010805 (\text{Income Per Capita}) \\
 & + 3.813033 (\text{Solved Crimes Per Capita}) \\
 & - 0.098389 (\text{Percentage of Population in Towns}) \\
 & + 16.050905 (\text{Incommuters Per Capita}) \\
 & - 0.072272 (\text{Miles to SMSA})
 \end{aligned}$$

Thus, for

$$j = PO,$$

$$e_j = e_{PO}$$

$$\beta_{0j} = 0.49388$$

$$\beta_{1j}N = 0.0001271824 (N) - (1.6411E - 10 (N)^2)$$

$$\beta_{2j}D_j = 0.002010805 (\text{Income Per Capita})$$

$$\beta_{3j}Q_j = 3.813033 (\text{Solved Crimes Per Capita})$$

$$\begin{aligned} \beta_{4j}C_j = & - 0.098389 (\text{Percentage of Population in Towns}) \\ & + 16.050905 (\text{Incommuters Per Capita}) \\ & - 0.072272 (\text{Miles to SMSA}) \end{aligned}$$

The presence of the population term in the expression for police expenditures per capita indicates size economies in the provision of police services. As can be seen from the figure, (Figure 1 on page 33) police expenditures per capita rise at a decreasing rate. The *rising* curves indicate that there are *diseconomies* for polices protection over the range of community size encountered in the sample (4,000 to 250,000), while the decreasing rate suggests that the positive effects of increasing size are moderating the loss of efficiency. Since the equation is in the reduced form, the diseconomies may be due to the technology of production; or due to the crowding of the service overwhelming the savings in tax-share; or both of the above.

No variables describing the technology of the production process, and its impact on cost, were tested in specifying the model. Rather, it is argued [Keeling] that local government officials -- politicians and bureaucrats -- choose the level of expenditures given consumer demand, population, and changing socio-economic conditions; along with personal motives such as the chance of reelection, leadership qualities, etc.

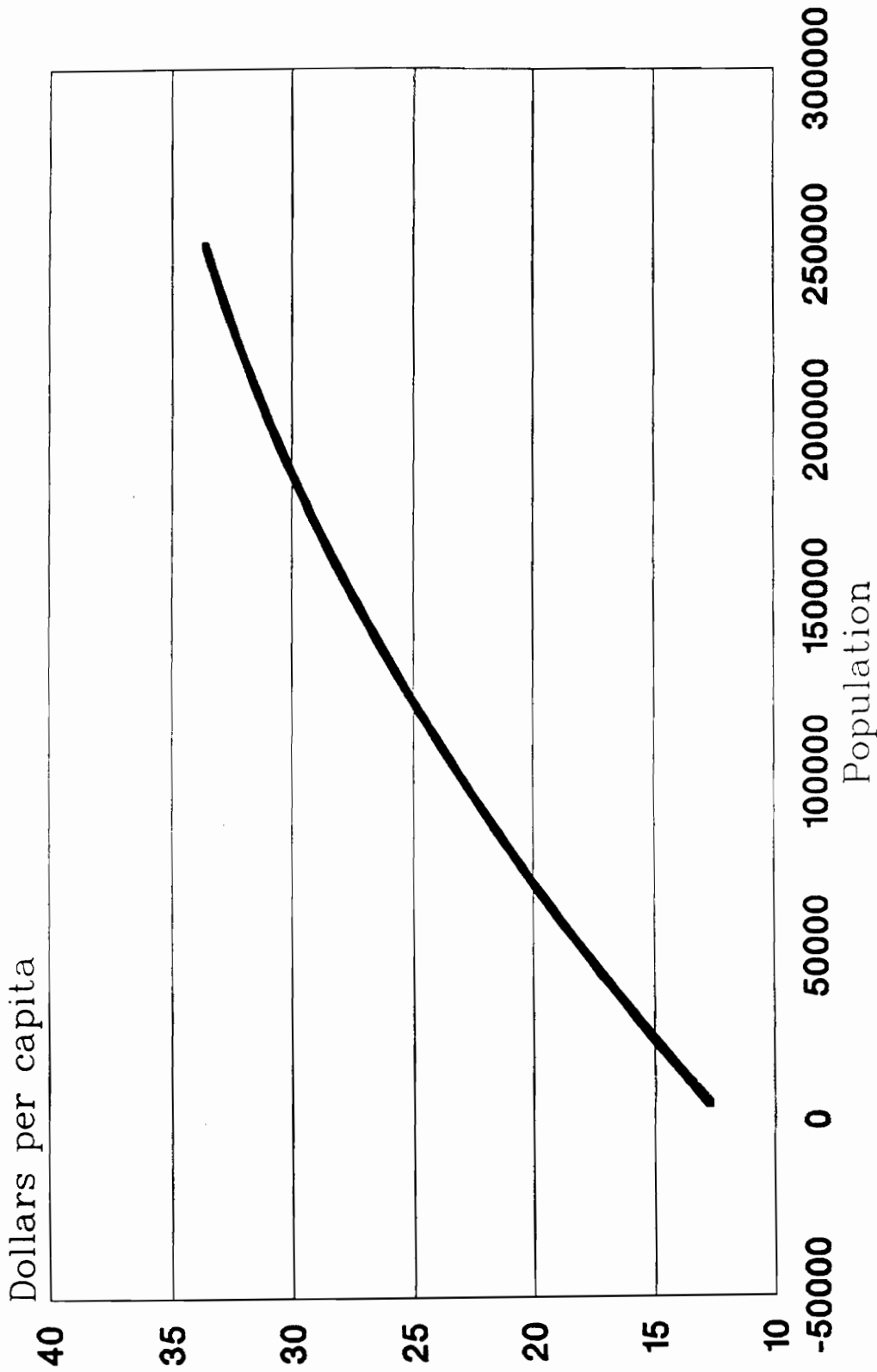


Figure 1. County Police Expenditures Per Capita: Plotted against population, all the other variables having been fixed at their mean

(after Breton's theory of representative government). Indirectly then, the production technology does impact the level of expenditures, and thereby per capita expenditures, by affecting the cost of providing a given level of services.

In summary, police expenditures per capita rising with population are due to one or both (probably both) of the following:

1. A production technology which causes unit cost to rise as population served rises.
2. Crowding of the output, offsetting the savings in the tax-price, which latter results from the increase in population. Crowding causes the locality to have to spend more per capita at the higher population in order to leave its citizens indifferent to the change.

The positive relationship between per capita expenditures and income per capita implies that the citizen-voter's demand schedule for police protection shifts upward with rising income.

Solved crime per capita is a measure of the effectiveness (quality) of police protection services, and the positive coefficient for this term indicates a willingness to pay for improved police protection. Higher total crime per capita increases the cost of to maintain a given level of public safety. Thus higher crime per capita increases the citizen-voter's willingness to pay for police protection.

The percentage of population in towns is a measure of the concentration of population in towns. This concentration has a two-fold effect

on the cost of provision of municipal services. Firstly, incorporated towns provide a certain level of services separately from the county. Thus, the larger the number of towns, the higher the level of provision of services therein. This decreases, in turn, the provision of services by the county resulting in lower *county* per capita expenditures. Second, the concentration of the population can provide an efficiency effect because as the population becomes more concentrated, the physical provision of services becomes more efficient.

Incommuting increases the cost of provision of local government services such as traffic control because the number of in-commuters reduces the number of individuals paying for the services provided by the county without decreasing the need for these services.

The distance to a SMSA is a service condition which reflects the higher incidence and/or threat of crime in metropolitan areas; thereof its negative coefficient. Thus, proximity to a metropolitan area raises the need for (and thereby the cost of) police protection.

Court Expenditures Per Capita:

County court expenditures per capita are denoted by the symbol  $e_{CT}$ . The relationships specified in the VIP Model for court expenditures per capita are,

$$\begin{aligned}
 e_{CT} = & 12.253770 - 0.0000741959 (N) \\
 & + (1.944E - 10 (N)^2) \\
 & - 0.047267 (\text{Percentage of Population in Towns}) \\
 & - 3.154271 (\text{Solved Crimes Per Capita}) \\
 & + 56.19402 (\text{Crime Per Capita})
 \end{aligned}$$

Thus, for

$$j = CT,$$

$$e_j = e_{CT}$$

$$\beta_{0j} = 12.153770$$

$$\beta_{1j}N = -0.0000741959 (N) + (1.944E - 10 (N)^2)$$

$$\beta_{2j}D_j = 0$$

$$\beta_{3j}Q_j = 0$$

$$\begin{aligned} \beta_{4j}C_j = & -0.047267 \text{ (Percentage of Population in Towns)} \\ & -3.154271 \text{ (Solved Crimes Per Capita)} \\ & +56.19402 \text{ (Crime Per Capita)} \end{aligned}$$

As seen in Figure 2 on page 37 county per capita expenditures decrease with population, implying the presence of size economies. It will also be seen that expenditures decrease throughout the range, and so counties within the sample all enjoy increased efficiency with increasing size.

The absence of a relationship between per capita court expenditures and any indicator of wealth indicates that changes in the citizen-voter's wealth do not shift his demand schedule for court services. Similarly, the absence of a relationship between per capita court expenditures and any indicator of quality suggests that there are no measures of quality of court services of concern to the citizen-voters. The linear relationship with "Percentage of Population in Towns" suggests that there

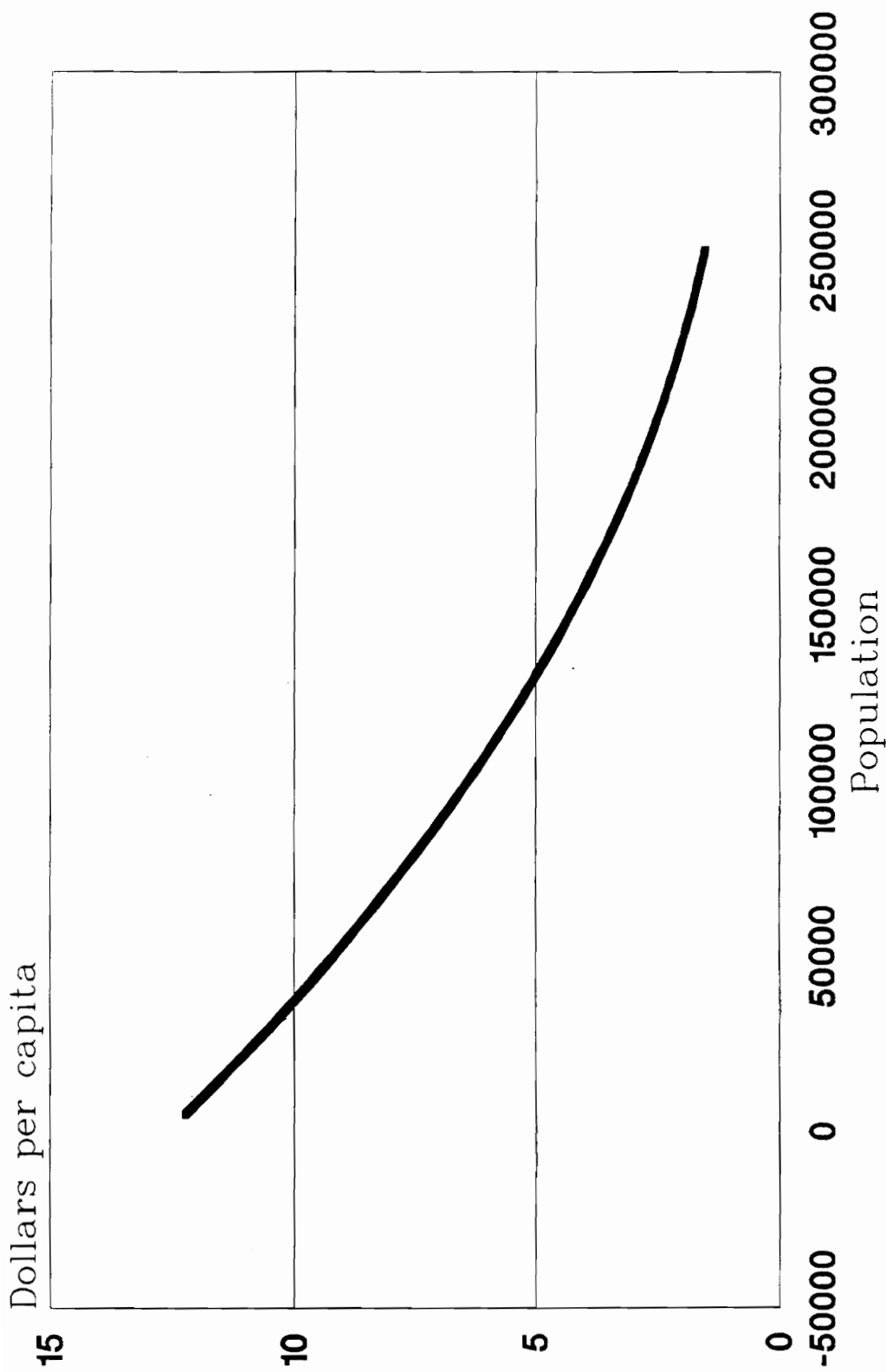


Figure 2. County Court Expenditures Per Capita: Plotted against population, all the other variables having been fixed at their mean

is a savings in the provision of court services due to the provision of these services by incorporated towns within the community.

In a study of the supply and demand factors for court services of localities, Johnson, Swallow, and Deaton found that as the effectiveness of the police increases, court expenditures per capita decrease. This explains the negative relationship between solved crimes per capita, a measure of the quality of police services, and court expenditures per capita. On the other hand, the number of crimes per capita determines the number of cases referred to the judicial system and, as this number rises, court expenditures per capita also rise. Finally, incommuting increases the cost of provision of local governments' court services because the number of in-commuters reduces the number of individuals paying for the services provided by the county without decreasing the need for these services.

**Jail Expenditures Per Capita:**

County jail expenditures per capita are denoted by the symbol  $e_{JA}$ . The relationships specified by the VIP Model are

$$\begin{aligned}
 e_{JA} = & - 4.998387 + 0.000104201 (N) \\
 & - (1.66221E - 10 (N)^2) \\
 & + 0.0002438624 (\text{Real Property Per Capita}) \\
 & + 0.0008397571 (\text{Personal Property Per Capita}) \\
 & + 0.212183 (\text{Percentage of Population in Towns}) \\
 & - 0.00334077 (\text{Percentage of Population in Towns})^2 \\
 & + 27.559091 (\text{Square Miles Per Capita})
 \end{aligned}$$

Thus, for

$$j = JA,$$

$$e_j = e_{JA}$$

$$\beta_{0j} = -4.998387$$

$$\beta_{1j}N = 0.000104201 (N) - (1.66221E - 10 (N)^2)$$

$$\beta_{2j}D_j = 0.0002438624 \text{ (Real Property Per Capita)} \\ + 0.0008397571 \text{ (Personal Property Per Capita)}$$

$$\beta_{3j}Q_j = 0$$

$$\beta_{4j}C_j = +0.212183 \text{ (Percentage of Population in Towns)} \\ - 0.00334077 \text{ (Percentage of Population in Towns)}^2 \\ + 27.559091 \text{ (Square Miles Per Capita)}$$

The form of the curves for county jail expenditures is similar to that for county police expenditures per capita. It follows that the relationship with population for  $e_{JA}$  and  $e_{PO}$  are similar. So, in the case of  $e_{JA}$  the savings from increasing the population served (output) can be seen to slow down the rise in the expenditures due to loss of efficiency.

The relationships with real and personal property per capita suggest that as wealth increases so does the demand for jails. This demand is interpreted as arising out of a perception that jails contribute to the public safety by providing for the incarceration of criminals.

As crime per capita increases, the need for corrections facilities increases thus raising the costs of providing these services. No measure of quality was tested. The quadratic relationship with the percentage of population in towns implies that as the population of the county be-

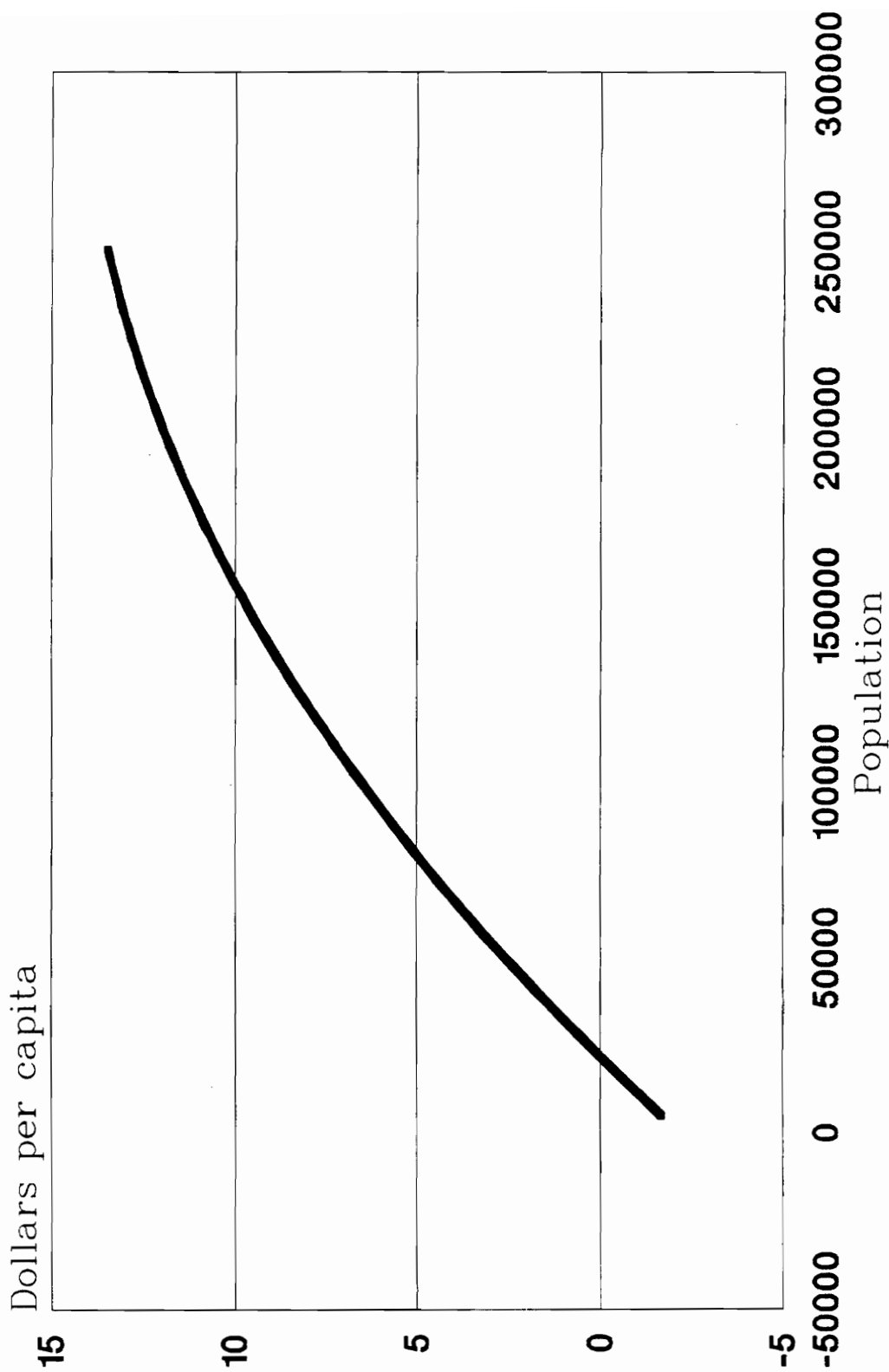


Figure 3. County Jail Expenditures Per Capita: Plotted against population, all the other variables having been fixed at their mean

comes concentrated in towns, there are efficiencies to be gained in the operation of jails; thereby reducing costs. The positive relationship with square miles per capita is due to the effect of dispersion of the population on the cost of providing corrections services. Accordingly, the cost of jail services increases with square miles per capita. Increasing dispersion of the population increases the cost of placing individuals in corrections and detention facilities which tend to be centralized.

**Fire Expenditures Per Capita:**

County fire expenditures per capita are denoted by the symbol  $e_{FI}$ . The relationships specified by the VIP Model are,

$$\begin{aligned}
 e_{FI} = & - 4.406513 + 0.002591856 \text{ (Income Per Capita)} \\
 & + 0.00001631653 \text{ (Real Property Per Capita)} \\
 & - 1.331907 \text{ (Fire Protection Rating)} \\
 & - 0.097040 \text{ (Percentage of Population in Towns)} \\
 & + 13.912284 \text{ (Square Miles Per Capita)} \\
 & + 149.314783 \text{ (Crime Per Capita)}
 \end{aligned}$$

Now, for

$$j = FI,$$

$$e_j = e_{FI}$$

$$\beta_{0j} = - 4.406513$$

$$\beta_{1j}N = 0$$

$$\begin{aligned}
 \beta_{2j}D_j = & + 0.002591856 \text{ (Income Per Capita)} \\
 & + 0.00001631653 \text{ (Real Property Per Capita)}
 \end{aligned}$$

$$\beta_{3j}Q_j = -1.331907 \text{ (Fire Protection Rating)}$$

$$\begin{aligned} \beta_{4j}C_j = & -0.097040 \text{ (Percentage of Population in Towns)} \\ & + 13.912284 \text{ (Square Miles Per Capita)} \\ & + 149.314783 \text{ (Crime Per Capita)} \end{aligned}$$

The absence of a relationship with population suggests that the provision of county fire services is not affected by the size of the population served.

The relationship with real property per capita and income per capita imply that the citizen-voter's demand schedule for fire expenditures is shifted upward with increasing wealth.

Fire protection rating is an indicator of the quality of fire services; it is compiled by the Insurance Services Office in Richmond, VA. Its value ranges from 10 (for poorest quality) to 1 (for highest quality). Factors which determine the fire protection rating include number of professional fire fighters, number of volunteer fire fighters, the extensiveness of a hydrant system, response time, *et cetera*. The relationship with the fire protection rating is indicative of the fact that the consumer's preferences for fire protection are subject to the quality of protection. (The negative sign is due to the fact that a lower number means better quality.)

The linear relationship with the percentage of population in towns is indicative of the fact that incorporated towns in Virginia provide some public safety services, and thus the overall per capita expenditures on fire protection services decreases as the concentration of population in

towns increases. Square miles per capita measures the effect of dispersion of the population within the locality upon per capita expenditures. As this dispersion increases, the cost of providing services increases. Finally, incommuting increases per capita expenditures for the same reasons enumerated in the previous public safety related categories -- police and courts.

Education Expenditures Per Capita:

County education expenditures per capita are denoted by the symbol  $e_{ED}$ . The relationships specified by the VIP Model are in terms of per *pupil* expenditures. Conversion to per *capita* expenditures is performed by multiplication with the quotient of population over enrollment.

Thereby,

$$\begin{aligned}
 e_{ED} \times \frac{N}{E} = & - 613.662719 \\
 & - 0.00619055 \text{ (Enrollment)} \\
 & + (6.76432E - 08 \text{ (Enrollment)}^2) \\
 & + 0.099167 \text{ (Income Per Capita)} \\
 & + 26.17411 \text{ (Instructors Per 1000 Pupils)} \\
 & - 2.171051 \text{ (Percentage Change in Enrollment)}
 \end{aligned}$$

Thus, for

$$j = ED,$$

$$e_j = e_{ED}$$

$$\beta_{0j} \times \frac{N}{E} = - 613.662719$$

$$\beta_{1j}N \times \frac{N}{E} = -0.00619055 \text{ (Enrollment)} \\ + (6.76432E - 08 \text{ (Enrollment)}^2)$$

$$\beta_{2j}D_j \times \frac{N}{E} = 0.099167 \text{ (Income Per Capita)}$$

$$\beta_{3j}Q_j \times \frac{N}{E} = 26.17411 \text{ (Instructors Per 1000 Pupils)}$$

$$\beta_{4j}C_j \times \frac{N}{E} = -2.171051 \text{ (Percentage Change in Enrollment)}$$

County education expenditures per capita plotted against enrollment exhibit classic size economies (see Figure 4 on page 45). Here, per capita expenditures initially fall until a critical size is reached; beyond that size, they begin to rise. Over the declining part of the curve, the efficiencies prevail, but after a certain size, the negative effects of increasing size overtake efficiency gains, and the cost increases.

The positive relationship between education and per capita income suggests that increases in the citizen-voter's income shift her/his demand schedule for education upward, and *vice versa*. She/he is also willing to pay for higher quality education as measured by the variable "Instructors per 1000 pupils."

As percentage change in enrollment increases, the gap between the level of education expenditures necessary to maintain the level of education services per pupil and the actual per pupil expenditures increases. This short-fall is indicated by the negative relationship between per pupil education expenditures and percentage change in enrollment.

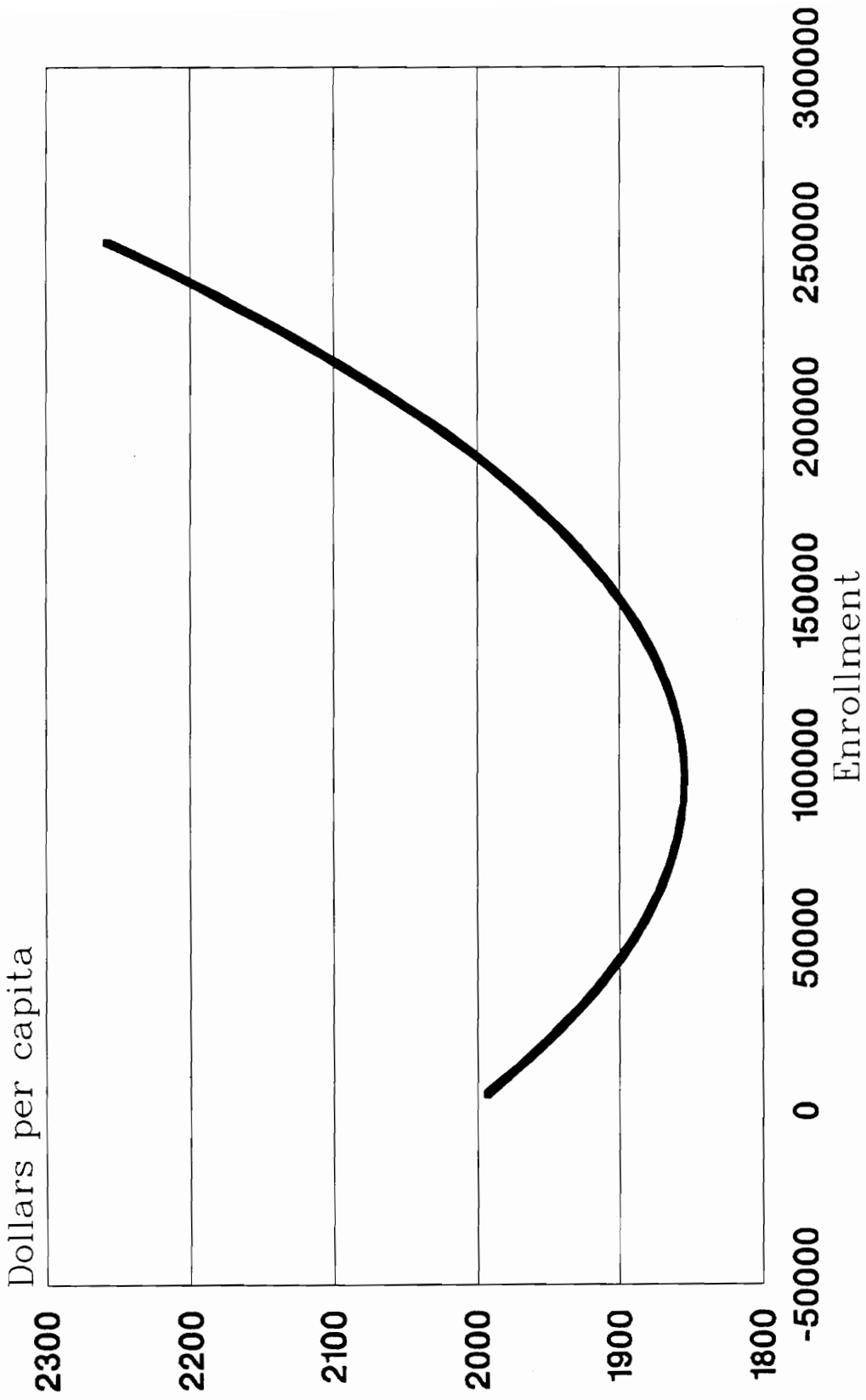


Figure 4. County Education Expenditures Per Capita: Plotted against enrollment, all the other variables having been fixed at their mean

Welfare Expenditures Per Capita:

County welfare expenditures per capita are denoted by the symbol  $e_{WE}$ .

The relationships specified by the VIP Model are

$$\begin{aligned} e_{WE} = & - 5.561685 + 0.002011037 \text{ (Income Per Capita)} \\ & + 0.778011 \text{ (Percentage of Unemployed Labor)} \\ & + 0.106110 \text{ (Percentage of Non-whites)} \\ & + 22.270258 \text{ (Incommuters Per Capita)} \end{aligned}$$

Thus, for

$$j = WE,$$

$$e_j = e_{WE}$$

$$\beta_{0j} = - 5.561685$$

$$\beta_{1j}N = 0$$

$$\beta_{2j}D_j = 0.002011037 \text{ (Income Per Capita)}$$

$$\beta_{3j}Q_j = 0$$

$$\begin{aligned} \beta_{4j}C_j = & 0.778011 \text{ (Percentage of Unemployed Labor)} \\ & + 0.106110 \text{ (Percentage of Non-whites)} \\ & + 22.270258 \text{ (Incommuters Per Capita)} \end{aligned}$$

No size economies are indicated for county welfare expenditures:

$\beta_{1,j}$  equals zero.

No quality variable was tested for welfare services. The positive relationship with per capita income and with personal property per capita

suggest that increases in wealth shift upward the citizen-voter's demand schedule for welfare services.

The need for social welfare services has been found to be higher in localities with larger populations of ethnic groups - Hispanics, Afro-Americans, *et cetera*. The variable "Percentage of Non-Whites" is used as a measure of the impact of ethnicity on the need for - and thereby cost of - providing welfare services.

Percentage unemployment is an indicator of the number of people on the welfare rolls and thus is related to the cost of providing welfare services. Incommuting increases the burden of providing services on residents of the locality, thus increasing per capita expenditures.

Health and Mental Health Expenditures Per Capita:

County health and mental health expenditures per capita are denoted by the symbol  $e_{HM}$ . The relationships specified by the VIP Model are

$$e_{HM} = - 13.932778 + 0.002500554 (\text{Income Per Capita})$$

Thus, for

$$j = HM,$$

$$e_j = e_{HM}$$

$$\beta_{0j} = - 13.932778$$

$$\beta_{1j}N = 0$$

$$\beta_{2j}D_j = 0.002500554 (\text{Income Per Capita})$$

$$\beta_{3j}Q_j = 0$$

$$\beta_{4j}C_j = 0$$

The absence of a relationship with population signifies the absence of size economies for health and mental health services. No quality indicator was tested. No cost conditions were found to significantly impact per capita mental health and health expenditures for Virginia counties. Thus, for counties, mental health and health expenditures per capita are a linear function of per capita income alone.

**Recreation Expenditures Per Capita:**

County recreation expenditures per capita are denoted by the symbol  $e_{RE}$ .

The relationships specified by the VIP Model are,

$$\begin{aligned} e_{RE} = & -15.132641 + 0.0001710995 (N) \\ & - (2.31999E - 10 (N)^2) \\ & + 0.001910197 (\text{Income Per Capita}) \\ & - 0.09704 (\text{Percentage of Population in Towns}) \\ & + 36.085287 (\text{Incommuters Per Capita}) \end{aligned}$$

Thus, for

$$j = RE,$$

$$e_j = e_{RE}$$

$$\beta_{0j} = -15.132641$$

$$\beta_{1j}N = 0.0001710995 (N) - (2.31999E - 10 (N)^2)$$

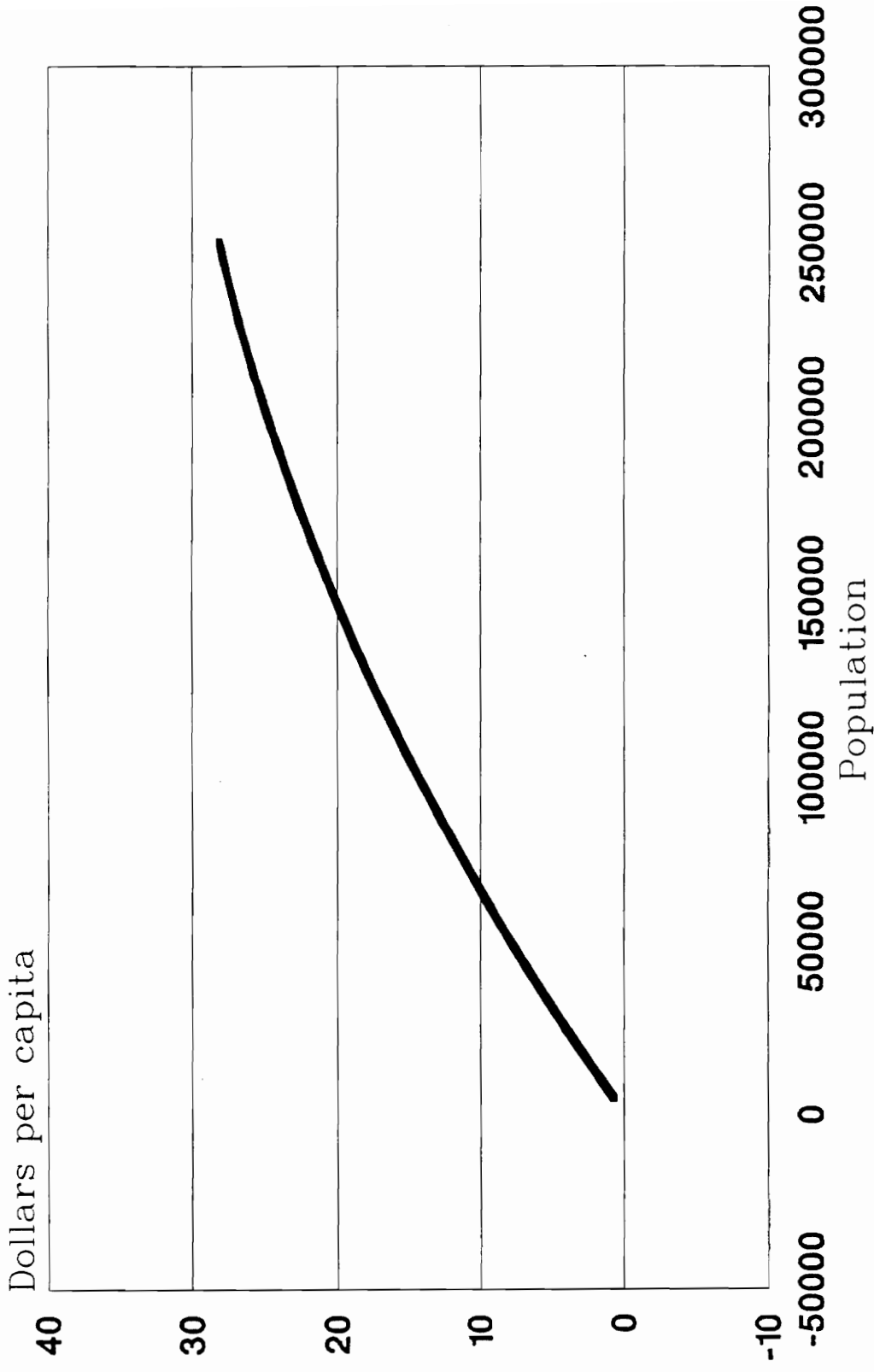


Figure 5. County Recreation Expenditures Per Capita: Plotted against population, all the other variables having been fixed at their mean

$$\beta_{2j}D_j = 0.001910197 \text{ (Income Per Capita)}$$

$$\beta_{3j}Q_j = 0$$

$$\beta_{4j}C_j = -0.09704 \text{ (Percentage of Population in Towns)} \\ + 36.085287 \text{ (Incommuters Per Capita)}$$

The quadratic relationships with population of  $e_{RE}$  is similar to that of  $e_{PO}$ . Explanations for these relationships are included in the section on police expenditures per capita.

The positive relationships with income per capita reflects the increased demand for recreation facilities resulting from improved financial well-being. No measure of the quality of recreation services was tested.

The linear relationship between percentage of population in towns is, again, because of the provision of recreation services by the towns which lowers the burden of providing these services on the city or county. Commuters are likely to avail of the recreation facilities available in the locality in which they work. Thus, incommuting increases the usage of, and thus the expenditures on, local recreation services.

Development Expenditures Per Capita:

County development expenditures per capita are denoted by the symbol  $e_{DE}$ . The relationships specified by the VIP Model are,

$$e_{DE} = -26.367969 + 0.003598843 \text{ (Income Per Capita)} \\ + 2.148730 \text{ (Development Group)} \\ + 23.067825 \text{ (Outcommuters Per Capita)} \\ + 37.227099 \text{ (Incommuters Per Capita)}$$

Thus, for

$$j = DE,$$

$$e_j = e_{DE}$$

$$\beta_{0j} = -26.367969$$

$$\beta_{1j}N = 0$$

$$\beta_{2j}D_j = 0.003598843 \text{ (Income Per Capita)}$$

$$\beta_{3j}Q_j = 2.148730 \text{ (Development Group)}$$

$$\begin{aligned} \beta_{4j}C_j = & + 23.067825 \text{ (Outcommuters Per Capita)} \\ & + 37.227099 \text{ (Incommuters Per Capita)} \end{aligned}$$

No size economies are indicated for development services. The relationship with per capita income indicates that increases in the citizen-voter's wealth shift upward her/his demand for development planning; while the existence of a development group is argued to improve the effectiveness of planning, and is thus a measure of the quality of planning services.

Incommuting is an indicator of the level of economic activity in the locality. As the level of economic activity increases, the need for planning and managing the resulting effects such as increases in traffic volume, re-zoning commercial, industrial, and residential areas, *et cetera* increases; and thus the development expenditures per capita increase.

### Administration Expenditures Per Capita:

County administration expenditures per capita are denoted by the symbol  $e_{AD}$ . The relationships specified by the VIP Model are,

$$e_{AD} = - 29.968964 + 69.760091 (\text{Outcommuters Per Capita}) \\ + 0.312964 (\text{Total Expenditures Per Capita})$$

Thus, for

$$j = AD,$$

$$e_j = e_{AD}$$

$$\beta_{0j} = - 29.968964$$

$$\beta_{1j}N = 0$$

$$\beta_{2j}D_j = 0$$

$$\beta_{3j}Q_j = 0$$

$$\beta_{4j}C_j = 69.760091 (\text{Outcommuters Per Capita}) \\ + .312964 (\text{Total Expenditures Per Capita})$$

This last category of expenditures is different from the others in the sense that it does not provide services directly to the residents of the locality as do the others. Instead, this department includes the chief administrative officer of the locality and staff. Thus, expenditures on this category may be regarded as an overhead in the operation of the locality. Thus all changes in expenditures on administration

should be some function of total expenditures. However, we see that outcommuting per capita increases administration expenditures.

Outcommuting per capita is a descriptive variable: high outcommuting describes a community in which people reside who, largely, choose to work elsewhere. (The choice of residence is, according the Tiebout Hypothesis, based on the mix of services available in the locality.) So, high outcommuting is characteristic of affluent, suburban - "bedroom" - communities. Accordingly, the positive relationship with outcommuting per capita is argued to reflect the higher cost of doing business in suburban areas as compared to inner cities.

### 3.3 Results of the Analysis

The raw results of the analysis are reported in Appendix A. Having determined the relationships for per capita expenditures in each category, the partial derivatives were taken to measure the relative change in per capita expenditures with respect to population  $N$ , the demand shifters  $D_j$ , quality indicators  $Q_j$ , and service conditions  $C_j$  in turn, all else held constant. This process is discussed below.

In order to facilitate the analysis, the partial derivative of  $e_j$ , with respect to the argument in the right hand side (R.H.S.) of the expression, is approximated to the ratio of individual changes<sup>1</sup>. Mathematically,

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<sup>1</sup> This "increment approximation" is discussed in Thomas and Finney.

$$\frac{\partial e_j}{\partial x} \approx \frac{\Delta e_j}{\Delta x},$$

where  $x$  is an argument in the per capita expenditure function.

Accordingly,

$$\frac{\partial e_j^N}{\partial N} \approx \frac{\Delta e_j}{\Delta N} = \beta_{1j} \Rightarrow \Delta e_j^N = \beta_{1j} \times \Delta N$$

i.e., the change in per capita expenditures on category  $j$  due to changes in population,  $\Delta e_j^N$ , is the product of the change in population,  $\Delta N$ , and the coefficient of the population term,  $\beta_{1,j}$ .

Similarly,

$$\frac{\partial e_j^D}{\partial D_j} \approx \frac{\Delta e_j}{\Delta D_j} = \beta_{2j} \Rightarrow \Delta e_j^D = \beta_{2j} \times \Delta D_j$$

$$\frac{\partial e_j^Q}{\partial Q_j} \approx \frac{\Delta e_j}{\Delta Q_j} = \beta_{3j} \Rightarrow \Delta e_j^Q = \beta_{3j} \times \Delta Q_j$$

$$\frac{\partial e_j^C}{\partial C_j} \approx \frac{\Delta e_j}{\Delta C_j} = \beta_{4j} \Rightarrow \Delta e_j^C = \beta_{4j} \times \Delta C_j$$

Therefore,

$$\Delta e_j^{Total} = \beta_{1j} \times \Delta N + \beta_{2j} \times \Delta D_j + \beta_{3j} \times \Delta Q_j + \beta_{4j} \times \Delta C_j.$$

---

The increment approximation for functions of 1 variable is discussed in section 2.5 (p. 125), for functions of 2 variables in section 15.3 (p. 806), and for functions of more than 2 variables in section 15.8 (pp. 851, 852).

When any of the above arguments is a composite of two or more each is treated just as these are. In this way the change in per capita expenditures is treated as the sum of the net changes in population-related, wealth-related, quality-related, and cost-related terms.

### 3.4 The Measures of Fiscal Impact

Once the components of change had been estimated, the measures of fiscal impact were compiled. The procedure used is explained using the above mathematical notation.

#### 3.4.1 Service Value Index (SVI)

As discussed in the section "Service Value Index (SVI)" on page 23, the SVI is the change in expenditures due to changes in the quality indicators and the demand shifts. It is calculated as

$$SVI_j = (\beta_{2j}\Delta D_j + \beta_{3j}\Delta Q_j)$$

#### 3.4.2 Net Public Service Benefits (NPSB)

$$NPSB = \sum_{j=1}^{11} (\beta_{2j}\Delta D_j + \beta_{3j}\Delta Q_j) + (\text{Change in Non-Local Aid})$$

It was pointed out (in section "Net Public Service Benefits (NPSB)" on page 24) that the Net Public Service Benefits is used toward evaluating the desirability of the project. If the NPSB is greater than zero, the project has a positive net benefit, if it is equal to zero it has no net benefit, and if it is less than zero it has a negative net benefit. Only the first outcome is considered desirable. Also, in comparing projects, the one which affords the higher NPSB is regarded as the more desirable one.

### 3.4.3 Change in Cost of Constant Service

As discussed in section "Change in the Cost of Constant Service" on page 25, the cost of service is determined by the level of output, and by the service conditions. Changes in expenditures due to these changes only serve to maintain the consumers' utility, but do not change it. In economic terms, the consumer remains on the same *indifference curve*, after the change in expenditures. Thus,

$$\text{Change in Cost of Constant Service} = \beta_{1j}\Delta N + \beta_{4j}\Delta C_j$$

$$\text{Total Change in the Cost of Constant Service} = \left( \sum_{j=1}^{11} (\beta_{1j}\Delta N + \beta_{4j}\Delta C_j) \right) \times N$$

The use of these measures is demonstrated in the example below.

## 3.5 The Measures of Fiscal Impact - An Illustration

### 3.5.1 The Impact of Closing the AT&T Plant in Fairlawn

In January 1990, AT&T announced that they would close the Fairlawn plant in Pulaski County, Virginia. County officials requested the Virginia Cooperative Extension Service to estimate the economic and fiscal impacts of the closing. They were interested in using this information for designing a response to the loss of jobs, revenues, *et cetera*.

Information on the plant closing was obtained from AT&T. This information was then analyzed to determine the direct impacts of the closing [Johnson and Kambhampaty, 1990]. The direct impacts of the closing were then entered into the VIP Model. Table 1 on page 58 shows how this data is entered into the VIP Model.

The change in the county total employment is the number of jobs that would be lost in Pulaski County as a result of the plant closing. Similarly, the change in the personal property assessment and in personal income are changes that would result in Pulaski County as a result of the plant closing. AT&T will retain ownership of the land and buildings, and hence will continue to pay real property taxes. Thus there is no direct change in the *real* property assessment. The change in the personal income is calculated as the loss of income to residents of Pulaski County. All of the changes take place in the year 1990, which is the earliest that the plant would close.

Table 1. Direct changes in Pulaski County due to the AT&T plant closing

VIRGINIA IMPACT PROJECTIONS (VIP) MODEL COUNTY VERSION Pulaski County	1988	1989	1990	1991
Change in County Pop.				
Change in County Area				
Change in County Base Employment			-1475	
Change in Total Employment				
Change in Town Population				
Change in Contiguous City Employment				
Change in Contiguous City Laborforce				
Change in School Enrollment				
Change in Real Property Assessment				
Change in Personal Property Assessment			-13,596,960.00	
Change in Personal Income			-11,356,466.88	
Change in Graduates per 100 Population				
Change in Teacher/Pupil Ratio				
Change in Retail Sales				
Change in Mortality Rate				
Change in Percent Nonwhite				
Change in Fire Protection Rating				
Change in Crime Percapita				
Change Solved Crime Percapita				
Change in Prof/Volunteer Firefigther Ratio				

Table 2. Summary of Impacts - Service Value Index

SERVICE VALUE INDEX	1988	1989	1990	1991	1992	1993
Public Work Exp per capita	.00	.00	-2.82	-2.82	-2.82	-2.82
Court Exp per capita	.00	.00	.00	.00	.00	.00
Police Exp per capita	.00	.00	-.63	-.63	-.63	-.63
Admi Exp per Capita	.00	.00	.00	.00	.00	.00
Recreation Exp per Capita	.00	.00	-.60	-.60	-.60	-.60
Welfare Exp per Cap	.00	.00	-.63	-.63	-.63	-.63
Education Exp per Pupil	.00	.00	-6.27	-6.26	-6.25	-6.25
Development Exp per Capita	.00	.00	-1.13	-1.13	-1.13	-1.13
Jail Exp per Capita	.00	.00	-1.61	-1.61	-1.61	-1.61
MenHlth and Hlth/cap	.00	.00	-.79	-.79	-.79	-.79
Fire Exp per Capita	.00	.00	-.82	-.82	-.82	-.82
TOTAL	.00	.00	-15.31	-15.30	-15.29	-15.29

Table 3. Summary of Impacts - Totals

Change in Total Expenditures -- With project, over baseline -- due to: Dollars	1988	1989	1990	1991	1992	1993
CHANGE IN PUBLIC EXPENDITURES	0	0	-679,220	-695,456	-699,195	-702,980
NET PUBLIC SERVICE BENEFITS	0	0	-695,434	-711,736	-716,722	-721,761
REDUCTION IN BURDEN ON PTB	0	0	-82,103	-90,568	-96,447	-102,077
CHANGE IN COST OF CONSTANT SER	0	0	-127,576	-140,430	-140,741	-141,049

Table 4. Summary of Impacts - Economic and Fiscal Impacts

The Impact of the AT&T Plant Closing  
Pulaski County

				1990	1996
Population	Baseline			36281	37607
	Change			-645	-1971
Commuting	--	out	--	5107	5567
				-220	-680
	--	in	--	3066	3280
				-101	-314
Laborforce			17273	18001	
			-354	-1082	
Employment			14015	14459	
			-1475	-1475	
Unemployment (#)			1016	1053	
			369	382	
Unemployment (%)			5.88	5.85	
			2.30	2.63	
Income per capita			9,085.57	9,794.44	
			-318.68	-318.68	
Retail Sales			88,665,355	90,855,950	
			-538,317	-2,728,912	
Property Tax-base	--	Real	--	662,538,600	721,434,572
				-27,444,779	-86,340,751
	--	Pers	--	66,496,165	72,235,555
				-16,281,346	-22,020,737
Revenues	--	Aid	--	14,483,726	14,886,183
				-233,690	-636,148
	--	Sales-tax	--	886,654	908,559
				-5,383	-27,289
	--	Other-tax	--	3,812,532	4,427,125
				-278,497	-893,090
	--	Tax-burden	--	1,956,526	2,476,899
				-262,082	-782,455
Total Expenditures				21,139,438	22,698,767
				-679,220	-714,654
Reduction of Tax-burden				-82,103	-116,703
Net Benefits to Consumption				-695,434	-737,232

Once the direct changes are entered, the model is run to determine the fiscal and economic impacts. Table 2 on page 59 and Table 3 on page 60 show the results of the model run for the impact measures designed here. The latter shows that the closing has an overall negative impact on public services, while the former shows that education was the most badly affected category, followed by public works and jails. The measures are designed to be cumulative i.e., if a change occurs in 1990, it remains in effect into the future. Thus it can be seen that the Service Value Index was affected only in the year of the closing 1990. The increasing value of the Net Public Service Benefits over time shows that as population increases with time, the overall impact increases. Table 4 on page 61 was included to show some of the other economic and fiscal impacts predicted by the VIP Model. These provide further detail on the impacts of the project; they were not a part of this study. The last item in this table will be seen to be the Net Public Service Impacts, and is the one that comes out of this study.

## 4

# Conclusions

Fiscal impact analysis is an important tool for helping local government understand the impacts of projects upon the community. As pointed out by Canter, Atkinson, and Leistritz, a fiscal impact analysis produces information on how industrial, real estate and resource development projects affect the locality's ability to meet the demand for public services. The provision of public services being an important function of local government, a fiscal impact analysis is essential to determining the desirability of projects to the locality.

This study has been concerned with extending the fiscal impact projections of the Virginia Impact Projections (VIP) Model to give evaluative measures of the benefit of a project to the community. These measures describe how a project affects the utility (satisfaction) that citizen-voters derive from the local government's services; they are used to analyze the relative impact on the various categories of services, and the impact on the net benefits derived from public services overall. While the latter is useful in ranking projects for their relative desirability to the community, the former can be used to determine those categories of services which would require expansion as a result of the

project. This information could also be used in designing an impact fee program. The "rational nexus test" [Leitner and Strauss], which is used to determine the validity of impact fee programs, requires that the fees be used specifically for those services which are adversely affected as a direct consequence of the development project. Thus, the disaggregated information on the impact of the project on the various services can be used in selecting the various services at which impact fee programs may be directed.

In using the measures of fiscal impact -- the Service Value Index and the Net Public Service Benefits -- the analyst must be aware of the assumptions used, and of how the assumptions affect the results. The more important of these considerations are discussed below.

1. The Tiebout Hypothesis is based on the assumption, among others, that the consumer of public services "votes with his feet" i.e., she/he maximizes his preference by moving to that locality which provides the mix of services and taxes matched with those she/he desires. In reality, not all residents will be able to move, nor find a locality that matches their preferences exactly. However, since citizen-voters can indeed use the political system to vote for those revenue and expenditure patterns which they desire, they can move the community's mix of services and taxes in this direction.
2. Voting decisions are not perfect representations of the community's preferences either. Lobbying by special interest groups distorts the

process, but it is assumed that the outcome is a close approximation to the median voter's preferences.

3. Individual voters may not follow the same economic rationale as is described in the model of public decision-making formulated herein. However, in aggregate, their decisions do exhibit this kind of behavior as evidenced by the close match between the VIP Model's predictions and observed outcomes [Keeling].

Thus, while the assumptions do lead to the restrictions above, the measures developed provide a useful means of ranking the impact of projects in an ordinal sense. Yet this is strictly a tool for analyzing the *fiscal* impacts of projects, and is thus limited to providing information on the locality's ability to meet changed public service demands. The measures of fiscal impact do not account for important ecological, cultural, and social concerns that arise when there are changes in economic activity. For example, a project which shows a positive Net Public Service Benefit might well have large detrimental impacts on the biophysical environment. It is the responsibility of local governments to ensure that all of the relevant impacts be considered in appraising the project.

In conclusion, the measures produced by this study give a useful, evaluative capability to the Virginia Impact Projection (VIP) Model. Accordingly, they allow local decision-makers to measure the effects of a project(s) upon a locality in *ordinal* terms, thus answering the question "Does the project improve our ability to provide public services?"

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# Appendix A

## Results of the Analysis

### Public Works Expenditures

$$\Delta e_{PW}^N = 0$$

$$\begin{aligned} \Delta e_{PW}^D &= 0.000350555 \times \Delta(\text{Real Property Per Capita}) \\ &\quad + 0.001486275 \times \Delta(\text{Personal Property Per Capita}) \end{aligned}$$

$$\Delta e_{PW}^Q = 0$$

$$\begin{aligned} \Delta e_{PW}^C &= -0.171077 \times \Delta(\text{Percentage Change in Population}) \\ &\quad + 39.308394 \times \Delta(\text{Square Miles Per Capita}) \end{aligned}$$

### Police Expenditures Per Capita

$$\Delta e_{PO}^N = 0.0001271824 \times \Delta(N) - 2 \times 1.64110E - 10 \times \Delta(N)$$

$$\Delta e_{PO}^D = 0.002010805 \times \Delta(\text{Income Per Capita})$$

$$\Delta e_{PO}^Q = 3.813033 \times \Delta(\text{Solved Crimes Per Capita})$$

$$\begin{aligned} \Delta e_{PO}^C &= -0.098389 \times \Delta(\text{Percentage of Population in Towns}) \\ &\quad + 16.050905 \times \Delta(\text{Incommuters Per Capita}) \\ &\quad - 0.072272 \times \Delta(\text{Miles to SMSA}) \end{aligned}$$

### Court Expenditures Per Capita

$$\Delta e_{CT}^N = -0.0000741959 \times \Delta(N) + 2 \times 1.944E - 10 \times \Delta(N)$$

$$\Delta e_{CT}^D = 0$$

$$\Delta e_{CT}^Q = 0$$

$$\begin{aligned} \Delta e_{CT}^C &= -0.047267 \times \Delta(\text{Percentage of Population in Towns}) \\ &\quad - 3.154271 \times \Delta(\text{Solved Crimes Per Capita}) \\ &\quad + 56.19402 \times \Delta(\text{Crime Per Capita}) \end{aligned}$$

### Jail Expenditures Per Capita

$$\Delta e_{JA}^N = 0.000104201 \times \Delta(N) - 2 \times 1.66221E - 10 \times \Delta(N)$$

$$\begin{aligned} \Delta e_{JA}^D &= 0.0002438624 \times \Delta(\text{Real Property Per Capita}) \\ &\quad + 0.0008397571 \times \Delta(\text{Personal Property Per Capita}) \end{aligned}$$

$$\Delta e_{JA}^Q = 0$$

$$\begin{aligned} \Delta e_{JA}^C &= +0.212183 \times \Delta(\text{Percentage of Population in Towns}) \\ &\quad - 2 \times 0.00334077 \times \Delta(\text{Percentage of Population in Towns}) \\ &\quad + 27.559091 \times \Delta(\text{Square Miles Per Capita}) \end{aligned}$$

### Fire Expenditures Per Capita

$$\Delta e_{FI}^N = 0$$

$$\begin{aligned} \Delta e_{FI}^D &= +0.002591856 \times \Delta(\text{Income Per Capita}) \\ &\quad + 0.00001631653 \times \Delta(\text{Real Property Per Capita}) \end{aligned}$$

$$\Delta e_{FI}^Q = -1.331907 \times \Delta(\text{Fire Protection Rating})$$

$$\begin{aligned}\Delta e_{FI}^C &= -0.097040 \times \Delta(\text{Percentage of Population in Towns}) \\ &\quad + 13.912284 \times \Delta(\text{Square Miles Per Capita}) \\ &\quad + 149.314783 \times \Delta(\text{Crime Per Capita})\end{aligned}$$

#### Education Expenditures Per Capita

$$\begin{aligned}\Delta e_{ED}^N \times \frac{N}{E} &= -0.00619055 \times \Delta(\text{Enrollment}) \\ &\quad + \times 6.76432E - 08 \times \Delta(\text{Enrollment})\end{aligned}$$

$$\Delta e_{ED}^D \times \frac{N}{E} = 0.099167 \times \Delta(\text{Income Per Capita})$$

$$\Delta e_{ED}^Q \times \frac{N}{E} = 26.17411 \times \Delta(\text{Instructors Per 1000 Pupils})$$

$$\Delta e_{ED}^C \times \frac{N}{E} = -2.171051 \times \Delta(\text{Percentage Change in Enrollment})$$

#### Welfare Expenditures Per Capita

$$\Delta e_{WE}^N = 0$$

$$\Delta e_{WE}^D = 0.002011037 \times \Delta(\text{Income Per Capita})$$

$$\Delta e_{WE}^Q = 0$$

$$\begin{aligned}\Delta e_{WE}^C &= 0.778011 \times \Delta(\text{Percentage of Unemployed Labor}) \\ &\quad + 0.106110 \times \Delta(\text{Percentage of Non-whites}) \\ &\quad + 22.270258 \times \Delta(\text{Incommuters Per Capita})\end{aligned}$$

#### Health and Mental Health Expenditures Per Capita

$$\Delta e_{HM}^N = 0$$

$$\Delta e_{HM}^D = 0.002500554 \times \Delta(\text{Income Per Capita})$$

$$\Delta e_{HM}^Q = 0$$

$$\Delta e_{HM}^C = 0$$

#### Recreation Expenditures Per Capita

$$\Delta e_{RE}^N = 0.0001710995 \times \Delta(N) - 2 \times 2.31999E - 10 \times \Delta(N)$$

$$\Delta e_{RE}^D = 0.001910197 \times \Delta(\text{Income Per Capita})$$

$$\Delta e_{RE}^Q = 0$$

$$\Delta e_{RE}^C = -0.09704 \times \Delta(\text{Percentage of Population in Towns}) \\ + 36.085287 \times \Delta(\text{Incommuters Per Capita})$$

#### Development Expenditures Per Capita

$$\Delta e_{DE}^N = 0$$

$$\Delta e_{DE}^D = 0.003598843 \times \Delta(\text{Income Per Capita})$$

$$\Delta e_{DE}^Q = 2.148730 \times \Delta(\text{Development Group})$$

$$\Delta e_{DE}^C = +23.067825 \times \Delta(\text{Outcommuters Per Capita}) \\ + 37.227099 \times \Delta(\text{Incommuters Per Capita})$$

#### Administration Expenditures Per Capita

$$\Delta e_{AD}^N = 0$$

$$\Delta e_{AD}^D = 0$$

$$\Delta e_{AD}^Q = 0$$

$$\begin{aligned} \Delta e_{AD}^C &= 69.760091 \times \Delta(\text{Outcommuters Per Capita}) \\ &\quad + .312964 \times \Delta(\text{Total Expenditures Per Capita}) \end{aligned}$$

## Vita

S. Murthy Kambhampaty was born on 28 October 1964 in Visakhapatnam, India.