The Fiscal costs of local economic growth for Montana county governments

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THE FISCAL COSTS OF LOCAL ECONOMIC GROWTH
FOR MONTANA COUNTY GOVERNMENTS

By

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A median voter model is used to test the hypothesis that changes in the level of employment in a political jurisdiction—in this case, Montana counties—will positively affect the quantity of public goods demanded by the decisive voter in that jurisdiction. The theoretical and empirical development of the median voter model is traced over its half-century life and the theory's assumptions are made explicit.

In order to test the maintained hypothesis, a "demand function" for the median (decisive) voter was formulated with county expenditures acting as proxy for the quantity demanded. This quantity was posited as a function of several variables, including the employment change variables needed to test the maintained hypothesis, demographic variables, and the more "traditional" demand function variables median income and tax price. A number of other "price" variables were included in the model in order to more accurately capture the true marginal cost of public goods. The costs of such goods are borne both by members of the community, who can vote for those who levy taxes to finance public goods, and by nonresidents, who can not vote and, presumably, have little say in determining their tax bills. Of particular importance were variables intended to reflect the cost of public goods paid by someone other than the median voter.

No empirical evidence was found to support the hypothesized relationship between the quantity of public goods demanded and changes in the community's employment level. However, the results of the model indicated that the median voter formulation most often used in other studies of public expenditures is incomplete and should be augmented with the additional "price" variables (or improved versions of those variables) introduced in this study.
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CHAPTER ONE
INTRODUCTION

The purpose of this paper is to test the maintained hypothesis, which is, briefly stated, that a change in the type and level of employment in a political jurisdiction will positively affect that jurisdiction's level of public expenditures. There are a number of reasons to believe this to be true. The primary reason is that economic activity, measured by employment growth, necessitates greater public spending. As business activity increases, one would expect growing political pressures placed on local government to expand spending on business- and residential-related services.

A number of economists and other social scientists have attempted to measure the marginal costs to the public sector of growth in employment. Such studies have most often utilized the statistical tool of multiple regression. The authors of these studies have all recognized, either explicitly or implicitly, that in order to properly test the role of employment growth in the determination of public expenditures, a model of public expenditure determination must exist. In other words, employment growth is not the only determinant of the level of public expenditures, and measures of that growth must not be the only independent variables in such a regression model. Thus, a necessary first step in testing the relationship between employment growth and public spending is the construction of a model of public expenditures which both "explains" the variation in public expenditures.
in a statistical sense and provides a reasonable behavioral explanation for their variation. Such a model would, if itself adequate to "explain" a sufficient portion of this variation, provide a context for testing any additional effects employment changes might have on expenditures.

Testing of the employment-spending relationship has been the primary purpose of this study. However, it soon became apparent that the construction of the behavioral and statistical models with which to test this relationship was the more challenging and theoretically interesting portion of the project. Thus, the bulk of this paper, and the most theoretically significant conclusions reached, concern the continuing developments of appropriate theories and techniques for the modeling of public expenditures; the role of employment in determining such expenditures seems of secondary importance.

Chapter Two outlines the major features of the behavioral model chosen as a context for testing the maintained hypothesis, the median voter model. Researchers had examined the determinants of public expenditures long before the theoretical outlines of this model were delineated. However, models constructed without the aid of the median voter model (or any other broad theoretical construct) were statistically inferior to those constructed according to the median voter theory.

With such results in mind, and with the firm conviction that statistical testing should not be done without reference to a guiding theory, this researcher chose to test the maintained hypothesis in the context of the median voter model. This decision does not reflect
acceptance of the median voter model as a "true" representation of the process that determines the level of public spending; it merely results from a recognition that median voter models have been among the most successful of public expenditure models (as judged by statistical criteria).

Chapter Three outlines the evolution of public expenditure analysis and demonstrates some of the reasoning used, tested, and abandoned by past researchers. Chapter Four outlines the functional form and the independent and dependent variables used in the regression equations. Chapter Five gives the results of those regressions. Chapter Six contains a discussion of theoretical implications of the regressions and the conclusions reached.

A more complete and accurate model of public expenditures is important. This paper seeks to improve upon existing public expenditure models. An improved model could be of great practical importance as well as theoretical interest. Taxpayers, for instance, will want to know whether and to what extent their tax bills will be affected by employment growth. The regressions presented here will not address such a question directly, but they will lead toward greater understanding of the process which determines both taxing and spending.

Government planners will want to have a better model for predicting expenditure levels. These regressions should be of direct application to such questions. The planners will want to know, in effect, whether employment growth will pay for itself by expanding the local tax base enough to cover expenditure growth. Because multiple regression models effectively hold all other variables in the equation constant while
estimating the coefficients for each variable, these regressions will address the planners' questions about both taxing and spending.
In recent years, economists have modeled political behavior 'as if' it were driven by the same narrow self interests used in the purely economic models of producer and consumer behavior. In other words, they began to develop an economic, as opposed to a political, theory of collective decision making which has come to be known as public choice.

THE THEORY OF PUBLIC CHOICE

The theory of public choice attempts to explain the outcomes of collective decision making by modeling society as if it were composed of rational, self-interested voters and politicians. Although government taxing and spending decisions are essentially political decisions made through a group process, public choice theory attempts to analyze such policies through an examination of the motivations of the individuals which make up that group, rather than an exploration of the dynamics of the collective.

Voters and politicians, it is assumed, attempt to maximize, respectively, their utility and votes, just as consumers and producers in the private marketplace attempt to maximize utility and profits. With this model, economists have attempted to explain how voters actually "choose" the basket of public goods and services they receive from government. Economists using this model have met with limited but significant success in attempting to explain, in both theoretical and
statistical senses, the variations in public expenditures across political jurisdictions.

POLITICIANS, VOTERS, AND THE MEDIAN VOTER

The model assumes that the politician, qua politician, sees his or her personal welfare as linked with holding office and thus seeks to maximize the votes he or she receives by adopting policies and positions which will appeal to as many voters as possible. The politician is thought to accomplish this by appealing to the so-called "median voter."¹

In order to model the outcome of political processes, public choice theorists assume that collective decisions will be determined by the outcome of a vote, with the preference of the majority, i.e. fifty percent of the electorate plus one, prevailing. It is assumed that voters are aware of the tax schedule and the public goods and services for which they pay. It is also assumed that voters 'sincerely' (i.e. sincerely)

¹Howard R. Bowen, "The Interpretation of Voting in the Allocation of Economic Resources," Quarterly Journal of Economics 53 (February 1943): 27-48. In this ground-breaking theoretical work, Bowen referred to the "modal" rather than the "median" voter. However, he had assumed a normal distribution of voter preferences, so the two were identical. Many public finance texts contain detailed and somewhat more tractable discussions of what is today called the median voter. For instance, see the public choice chapters in Musgrave and Musgrave (1984) and Buchanan and Flowers (1980). All voters are assumed to be both consumers of public goods, to some extent, and taxpayers who will pay a share of the cost of producing and providing the goods. The rational voter will, in determining his or her own preference for public goods and services, weigh personal costs and benefits (at the margin). The model does not assume that voters will support policies which are efficient from a social point of view, only that they will support policies which will produce net benefits for them personally.
truthfully) express their public goods preferences in elections that and those preferences can be ordered on a continuum of low to high demands for public goods. The preferences of voters are said to be 'single peaked,' i.e. they are ordered in a transitory manner. Under these conditions, the preference of the voter "in the middle"--the median voter--will prevail. Even in the unlikely event that the vote is as evenly split as possible, with just under half of the electorate voting one way and just over half voting the other, the median voter is assured of being on the winning side. In such an electoral outcome, the votes of all other electors offset one another and the median voter's vote determines the outcome. Of course, the median voter will clearly be in the winning camp if the vote is less evenly divided.

Thus, the voter who occupies the political median, the middle ground of the political spectrum, determines the outcome of elections. Public choice theorists go a step further, however, in an attempt to identify this powerful elector. They assume that the person at the political median also occupies the economic median. This further

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Randall G. Holcombe, "Concepts of Public Sector Equilibrium," National Tax Journal 43 (March 1980): 79. While the outcomes of elections can not be claimed to be economically efficient, they do represent points of agreement among the electorate and can thus be called points of "equilibrium."

Ibid., p.p. 45-65. Inman's intent in this study was to test the validity of the median voter hypothesis. He tested the hypothesis by regressing the log of school expenditures per pupil on four alternative sets of independent variables using both ordinary least squares and two-stage least squares. In all formulations the coefficients on the median tax share and median income variables were statistically significant, relatively stable, and of the theoretically correct sign.
assumption allows the median voter to be identified as the owner of the median-valued residential property in the jurisdiction and also the earner of the median income. In this way the public choice theorist greatly simplifies, and probably over-simplifies, the "distribution" of political preferences. According to this model, political preferences precisely parallel economic interests. Such a model of voter behavior seems justified when the issues to be decided are purely or mostly financial; when voters have a choice of more or less spending on some governmentally provided good or service they can be expected to decide largely on the basis of self interest and their own financial capabilities. Many social scientists have modeled school levy elections in this way and they seem to have met with considerable success. It is apparently not unreasonable to assume that the voter has a reasonably good idea of what passage of the levy will cost him or her personally and an estimate of his or her personal benefit from the good or service.

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Inman concluded that "using the median income voter appears to be a reasonable first-order approximation to the process of local government politics in this sample of single service governments." (emphasis added) However, he also urged the inclusion of political variables in expenditure equations, noting that the cost of such inclusion was low and the information gains significant.

Edgar K. Browning and Jacqueline M. Browning, Public Finance and the Price System 2nd edition (New York: MacMillan Publishing Co., Inc. 1983) p. 56. While all voters make these calculations, or at least act as if they made them, only the preferences of the median voter are realized through the electoral process. Thus, neither society as a whole nor the majority of voters get what they want. Under the best of circumstances, only the median voter achieves an outcome that equates the marginal costs with the marginal benefits of the provision and consumption of public goods.
THE DEMAND FOR PUBLIC GOODS

One of the potentially more important applications of the theory of the median voter has been in the estimation of local public expenditures. Some economists feel that, with several assumptions, they can measure public goods and services in terms of expenditures and can statistically estimate a demand function for them. The assumption that the unit cost of public goods is constant with changing output makes expenditures proportional to the quantity of goods and services provided regardless of the quantity supplied, and thus suitable as a proxy for quantity in statistical (regression) models. A further assumption that unit costs are constant across political jurisdictions allows for cross-sectional analysis of expenditures.

In such models, the voters' expenditure preferences are posited as a function of prices, incomes, and tastes and preferences, just as is commonly done for the demand for private goods. The demand function is written

\[ G = f(t, y, x) \]

where \( G \) is the individual's expenditure preference, \( t \) is his or her "tax price," \( y \) is the individual's income, and \( x \) is a vector of the

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voter's tastes and preferences. Two of these variables, tax price and the vector of tastes and preferences, may be a bit unfamiliar and require explanation.

The tax price, $t$, is the "price" faced by the individual for his or her consumption of public goods and services. Since unit costs are assumed to be constant, tax price is proportional to the amount the tax bill changes with a marginal change in expenditures. In a political system in which all goods and services are paid for with property tax revenues, tax price can be modeled as proportional to the ratio of the value of the voter's property to that of the jurisdiction's entire property tax base.

Of course, local governments almost always finance goods and services with additional sources of funds, and if any of these other sources of funds are taxes other than property taxes they should be represented in the demand function through additional tax price variables. For instance, where the local government is partially financed through a sales tax, an additional tax variable should reflect this. This additional variable is required to account for the full effect of the expenditure-related costs on the voter. For instance, John Beck, in his study of the public expenditures of California municipalities, felt the need to incorporate a sales tax variable in his demand function since these municipalities derived a substantial proportion of their tax revenue from a state-wide sales tax.⁸ His

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formulation thus included both property tax and sales tax variables. Beck felt the property tax variable represented the voter's marginal price while the sales tax variable, which represented a tax whose rate was constant for all voters, could not be thought of as a price per se. It should be noted that Beck's tax variables were specified as mean, rather than median values; the marginal tax price was specified as tax base per capita and the sales tax variable was revenue per capita. The income variable, however, was specified as median family income in the jurisdiction.

The variable for income, $y$, serves precisely the same purpose the income variable serves in demand functions for private goods and services; it indicates the consumer's ability to pay for the item in question. Again, this demand function models the behavior of the median voter and the median voter is assumed to have the median income in the jurisdiction. Consequently, economists in recent years have used either median family or median household income in such models. Family income appears to be used most often, but a case can be made for use of household income when the tax-supported expenditures of the governments under study are paid for exclusively or primarily with property taxes.

The vector of tastes and preferences, $x$, represents a number of characteristics that describe the voter and thus indicate what sort of goods and services he or she is likely to desire, and in what quantity. A number of variables have been used in such demand analysis studies. They are chosen to fit the level of government and type of expenditures studied.
CRITICISMS OF THE MEDIAN VOTER MODEL

It should be noted that not all economists feel the median voter "theorem" has been adequately tested. Thomas Romer and Howard Rosenthal, in a 1979 article, pointed out methodological errors in the application of the theorem. They complained that this formulation was far too infrequently compared to alternative formulations which account for political institutions, such as control of agendas, or simple statistical alternatives, such as mean income and tax prices rather than median.9

These authors also point to two logical fallacies that challenge the primacy of the median voter's preferences in determining the outcome of elections. The first is the "multiple fallacy," by which Romer and Rosenthal argue that the ordinary least squares models that are often used to test the median voter formulation are not sensitive to the absolute amount of spending preferred by the median voter; they may provide a perfectly acceptable statistical "fit" to the data even though the median voter actually prefers some multiple of the observed spending level. The second logical fallacy, "the fractile fallacy," arises because any fractile of income and tax price would do as well as median values in certain formulations of the model.

Finally, there are several studies in which median tax price appears to be statistically significant but median income does not, or vice versa. Such results simply defy usual economic expectations and

suggest that the logical and statistical explanation of public
expenditures requires a model much more complex than a simple demand
function.

Also, while some researchers have affirmed the validity of the median voter model, they have qualified their findings. Economists such as Robert Inman have endorsed the median voter formulation for the study of single service governments such as school districts, but have stopped short of recommending the model for the study of multiple service providers, such as municipal and county governments. Werner Pommerehne has found that this model works best for 'explaining' the level of public expenditures in direct democracies with referenda.\textsuperscript{10} Confirmation of the usefulness of the model under such carefully delineated circumstances says little or nothing of its usefulness in the study of expenditures determined by representative bodies.

However, other researchers have gone further (perhaps too far) and assumed that the voter has sufficient information about candidates to know whether they favor more or less spending on a particular good or service and how much. The voter, in effect, makes a decision not only on the candidate but also on the budget. The assumption that a voter can assess his or her marginal costs and benefits of a public good or service when the price is virtually spelled out for him or her is one thing. An assumption that the voter can somehow glean comparable

information from a candidate's campaign and his party's platform is quite another.

This latter assumption is far less compelling than the first. Campaign promises and platforms are, by nature, vague sorts of things and often are not adhered to anyway. Also, the voter can never really know beforehand what issues will be coming before the elected official. Under such circumstances, the voting decision can never be made on completely rational grounds. The voter must often choose the candidate whose preferences he believes to conform most closely to his own.

Furthermore, a politician represents not a single public good or service but a large and varied package of goods and services. The difficulty faced by the voter of assessing the costs and benefits of a single public good is multiplied by the number of goods and services which the elected official is expected to decide upon once in office.

Finally, not all decisions faced by public officials are of the "more or less" variety. The task of choosing whether more or less tax money is to be spent on public roads or education, complicated as it may be, pales in comparison with the task of choosing a member of a legislative body who will decide that one type of behavior is criminal and another type is not. The first type of decision can be decided on the basis of anticipated costs and benefits. In the second type of decision, personal costs and benefits become nearly impossible to calculate and are often secondary to a voter's ideological preferences.

Thus the median voter model seems appropriate in cases in which the voter will decide on levels of public taxing and spending directly. The model seems entirely inappropriate for the modeling of elections for
officials who will spend public monies on a broad variety of public services and also decide issues of a more ideological nature, such as criminal law. It also seems inappropriate for the modeling of elections of candidates who will decide on a large number of unknown issues.

Dennis Mueller has noted that many, if not most, empirical tests of the median voter model use expenditure data on local government expenditures determined typically by representative governments voting on several issues simultaneously. Mueller points out that the median voter formulation has yielded quite satisfactory results in the context of a single issue vote in a direct democracy. However, the researchers conducting such studies have, either explicitly or implicitly, assumed away the theoretical points discussed above and have treated local public expenditures as if they contained only one characteristic and were decided separately. A further common assumption is that the campaign positions of candidates can be taken as honest representations of what they will do once in office.\textsuperscript{11} Mueller offers no rationale that would justify such a set of assumptions; he only makes them explicit.

A further complication results from the fact that most local governments engage, to some degree, in general fund budgeting. Because tax monies are pooled in a common fund used to finance several public goods and services, the taxpayer's perception of the potential costs and benefits of public goods is blurred. Voters, in Mueller's words, can

\textsuperscript{11}Mueller, p. 106. Mueller's book is intended as a survey of the more significant work in the field of public choice up to the time of its writing. He attempts to explain, but not justify, the work with which he is familiar.
suffer from what may be called "fiscal illusion." Again, Mueller offers little hope of escape from these dilemmas.

The complications resulting from general fund budgeting carried out by elected representatives rather than voters themselves comprise significant differences between the median voter model as originally conceived by Bowen and the models used in much empirical testing of the median voter theorem. Such complications may very well result in a "representative" committee elected on the basis of "fiscal illusion"--one that may be tempted and able to engage in log rolling and other strategic behavior. However, they also may not. It may well be that, in some times and places, policy outcomes are sufficiently clear cut for the model to be of some use to social scientists, even though some of the assumptions are dubious or even clearly wrong. The theoretical arguments that describe the possibility of blurring of the voter's perception of costs and benefits do not preclude the validity of testing the model.

\[12\] Ibid., p. 90.
CHAPTER THREE
THE EVOLUTION OF PUBLIC EXPENDITURE ANALYSIS

Economists have, for a little over half a century, attempted to explain local government spending through statistical analysis. The first efforts were unguided by any identifiable behavioral theory. However, as work in the field proceeded, progress was made both towards better empirical estimation and the formulation of a guiding theory that would allow economists to explain government spending in terms of economic behavior, as well as "explain" the variation of that spending in a statistical sense.

As the following paragraphs will show, an income variable was included in public expenditure models from the very beginning, but it was more than twenty years before economists began to think of income's position in the model as being similar to that of income in a consumer's demand function. Income was first specified as mean rather than median income, and there was, at first, no attempt to identify this income variable with the motivations of any single voter or even a set of voters.

Recognition of the importance of taxes was equally slow to come. It was more than ten years after work on such models began to appear that taxes, in any form, were even mentioned. Even then, a tax variable was passed over for consideration as an independent variable, and did not reappear in public expenditure formulations until twenty years after the first work on public expenditure analysis was done. When a tax
variable finally did come into use, it was as "tax price," an element of a somewhat dubious demand function for the decisive voter.

Besides the demand function variables of own-price and income, political variables such as party competition and the size (and supposedly strength) of interest groups were gradually introduced into public expenditure models. Such "political," as opposed to "economic," variables were intended to make the models sophisticated enough to capture the expenditure variation which results from a complex budgeting process.

**UNGUIDED EMPIRICISM**

One of the earliest notable attempts at statistical analysis of public expenditures was published in 1952. Solomon Fabricant explored interstate differences in public expenditures using Census data from 1942. Because of the varying responsibilities of different levels of government, state and local expenditures were aggregated within each state.

Fabricant posited expenditures per capita as a function of average per capita income, the state's degree of urbanization, and its population density. Using ordinary least squares (OLS), he "explained" 72 percent of the interstate variation in total expenditures per capita. He also determined that mean income was statistically the most important of his explanatory variables, with density being somewhat less

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significant (both statistically and, in his judgement, theoretically), and urbanization having only a small positive but statistically insignificant effect on the dependent variable.

In fact, Fabricant remarked that "there is a question whether anything is gained by including urbanization." Although the author emphasized the need for further research to analyze that portion of expenditures per capita as yet "unexplained," he seemed quite pleased with his model, choice of variables, and results. He wrote, "in the variables selected we have the major factors, or representatives of them, involved in interstate differences in government activity." (emphasis added)

The simplicity of Fabricant's formulation shows how far removed his model was from a true demand function. Income was included as an explanatory variable, but his article showed no theoretical basis for using this variable in the way it might be used in a demand function, i.e. as a measure of the voter's ability to pay for goods and services received. Another difference between Fabricant's formulation and the median voter approach is that he chose to use mean income in each state rather than median income, which is identified in the modern theory as the income of the decisive voter. Of course, mean income could be identified with a single voter just as easily as the median value, but Fabricant made no such argument. His model was also devoid of the price variables one would expect to see in a demand function. The prices of

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14 Ibid., p. 122.

15 Ibid., p. 123.
complements and substitutes are normally thought to be an important part of demand as well. In the case of public expenditure analysis, these prices would be the prices of private goods and services. While never intending to formulate a demand function, Fabricant mentioned, but virtually explained away, the effect of the prices of private goods and services: Interstate variations in price were too small to warrant their specific inclusion in the model. Furthermore, Fabricant stated, "...our measure of income indicates differences in real per capita income plus price differences."\(^{16}\)

The author's purpose was statistical estimation, not theoretical explanation of expenditures per capita, and apparently the collinearity of prices and incomes was judged sufficient to make his model work. The independent variable's own-price, its tax price, was nowhere to be found. In fact, Fabricant made only one fleeting reference to taxes; he noted that increases in real income would increase both the quantity of public goods and services demanded and the tax capacity basic to their supply.

Finally, economists conceptualize demand for a good or service as being dependent on the individual's tastes and preferences. Fabricant's urbanization and population density variables can indeed be thought of as indicators of the preference for public goods and services. However, they are not particularly good indicators (at least, they were not in his specification). The coefficient for population density was statistically significant for only five of ten functional

\(^{16}\)Ibid., p. 128.
categories of government spending. The urbanization coefficient was statistically significant for only four of these functional categories and insignificant in "explaining" total expenditures per capita. Fabricant himself pointed out that other measures, such as industrialization, might have been used, but made no attempt to make use of such variables.

Despite these differences between Fabricant's formulation and a median voter demand function, it should not be inferred that Fabricant was a poor social scientist. Far from it. Fabricant not only identified income (even if it was in somewhat different form) as the major explanatory variable, he also was a pioneer in applying OLS to the analysis of public expenditures.

These days it may seem quite natural that an economist could conceive of expenditures for goods or services, public or private, in terms of demand for that good or service, (at least, many economists do so, even though their conceptual models are often criticized for oversimplification and excessive assumptions.) However, in the case of public goods and services, Fabricant can not be blamed for not seeing this. In 1952, pubic choice theory was still in its infancy. It is true that the first theoretical steps towards a theory of voter-guided resource allocation had been made eight years previously, but there is no reason to believe that Fabricant knew of even these beginnings. For economists, the theory of demand is founded on individual behavior. In a sense, it would have been premature of Fabricant to posit a proper demand function with incomes, prices, and tastes and preferences without reference to a theory which described the behavior of the individual
doing the demanding. In any case, he certainly can not be faulted for failing to develop the theory of the median voter on his own.

In 1961, Glenn Fisher applied Fabricant’s model to data extracted from the 1957 Census of Governments. He noted the "widely recognized" influence of differences in per capita income on variations in public spending and added that differences in population density and urbanization were somewhat less important but were still "often recognized as being factors which should be considered."\(^{17}\) Fisher’s model "explained" only 53 percent of the variation in total per capita expenditures, considerably less than Fabricant’s seventy two percent. Consequently, he suggested that historians, political scientists, or legal scholars familiar with the geographic region for which his model’s predictions were amiss would be able to help explain some of the variation that statistical analysis was unable to "explain" statistically. For the most part, the estimated coefficients conformed in sign and size to Fisher’s expectations. For the 11 functional expenditure categories explored, he found 8 negative coefficients for the population density variable. Of the equations for spending in function... areas, 7 yielded positive coefficients for the urbanization variable, and 9 yielded positive coefficients for per capita income. Again, the income variable was much more statistically significant than the other two independent variables.

Because his model "explained" less variation than Fabricant’s, Fisher was apparently somewhat discouraged. He wrote

These coefficients are high enough to indicate that multiple regression analysis has made a substantial contribution to explaining expenditure variation. They are also low enough to leave room for much further work.\textsuperscript{18}

Fisher closed by suggesting two possible additional independent variables: percentage of students attending private colleges (for estimating higher education expenditures) and percentage of students attending parochial schools (for estimating expenditures on local schools). He noted that the income, population density, and urbanization variables used yielded mixed results in the statistical estimation of expenditures, depending on the functional category estimated. Variations "unexplained" by his model offered, he felt, "a fertile field for further study, using either quantitative or non-quantitative methods."\textsuperscript{19}

In 1963, Ernest Kurnow published the results of a revised model tested on the same Census data used by Fisher. Kurnow first changed the Fabricant-Fisher additive model to a "joint regression model", i.e. a model in which all variables, independent and dependent, are transformed by taking their natural logarithms. Such a transformation is intended to account for any interactions, or joint effects, of the independent variables on the dependent variable. Using the same 3 independent variables as Fabricant and Fisher had used, Kurnow "explained" 88 percent of the variation in the 1942 expenditure data and 78 percent of the variation in the 1957 figures.

\textsuperscript{18}Ibid., p. 352.

\textsuperscript{19}Ibid., p. 355.
Confident that his joint regression model represented a significant improvement over the mathematical form of the Fabricant-Fisher linear model, Kurnow then began making adjustments to the list of independent variables. He noted the increased reliance of state and local governments in the post-war period on federal grants-in-aid and thus decided to add federal aid per capita as an explanatory variable. Kurnow also added the student-teacher ratio in elementary schools as a proxy for the quality of public services. Finally, the population density variable was deleted from the model because it was found to be highly correlated with urbanization but not as good a predictor variable. Kurnow's joint regression model, with four independent variables, "explained" 81 percent of the variation in the 1957 expenditure figures. He thus felt he had demonstrated the importance of the proper choice of mathematical form and independent variables in estimating government expenditures.

It should be pointed out, though, that this model has been criticized. Elliot Morss has objected to the inclusion of federal aid as an explanatory variable. Because virtually all federal aid must be spent by recipient governments, the statistical significance of the coefficient for aid was unsurprising and almost vacuous. According to Morss,

...little is to be gained from simply regressing the dependent variable on itself or parts of itself....using aid to explain expenditures is analogous to using taxes to explain expenditures in the sense that both aid and taxes are sources of funds. The fact that these variables turn out to have substantial explanatory power serves as little more than verification of the
quite obvious fact that government receipts and expenditures are closely related.\textsuperscript{20}

In light of the importance of tax price in the median voter's demand function, it is quite ironic that Morss would refer to the possibility of using taxes as an independent variable in such a disparaging way--statistically significant but uninteresting. Of course, the point he was making was correct. Public expenditure analysis was taking a turn toward mindless number crunching, in which the only goal seemed to be to increase the predictive value of the models.\textsuperscript{21}

Morss can hardly be credited with hitting on the appropriate price variable (or any price variable, for that matter), but he correctly criticized the field's current lack of direction. His major concern was that recent studies in public expenditure analysis were geared too much toward increasing a model's "goodness of fit" and paid too little attention to finding a behaviorally based explanation of public expenditures. A model geared toward this latter purpose would be of much more practical use to economists trying to understand government finances and government officials trying to estimate revenue needs.

In 1964, Seymore Sacks and Robert Harris used Fabricant's "three basic factors," per capita income, population density, and urbanization, to "explain" 53 percent of the variation in state and


\textsuperscript{21}Ibid.
local expenditure figures from 1960.\textsuperscript{22} The amount of variation "explained" was almost precisely the amount "explained" by Fisher, but far below the amount "explained" by Fabricant. Again, Sacks and Harris focused on state and local governments' increased reliance on intergovernmental transfers to explain the increasingly poor performance of the "three basic factors" model. For this reason, they felt justified in adding federal and state transfer payments to the list of explanatory variables. According to the authors, "federal aid can be regarded as 'outside money' from the point of view of the state and local government, and its availability should be expected to have a direct impact on raising state and local expenditure levels."\textsuperscript{23}

State aid to local governments was a slightly different matter. Because state aid is financed partially by internally raised taxes, its effect on expenditures would be ambiguous. Thus, the authors expected a positive coefficient for the federal aid variable but had no theoretically based expectations for the coefficient of the state aid variable.

Sacks and Harris' 5-variable model "explained" 87 percent of the variation in per capita spending. The inclusion of federal aid in the model was found to be particularly helpful for the estimation of two functional expenditure categories, highways and public welfare, two

\textsuperscript{22}Seymore Sacks and Robert Harris, "The Determinants of State and Local Government Expenditures and Intergovernmental Flow of Funds," \textit{National Tax Journal} 27 (March 1964): 75.

\textsuperscript{23}Ibid.
programs in which the federal government had taken an increasingly large role.

The authors ended by endorsing three of the independent variables in their model.

The emerging picture shows the dominant role of the two aid variables and personal income in both total expenditures and in the dollarwise most important categories. Only in the case of the smaller and definitely locally financed functions are population density and percent urban statistically significant. Given federal and state aid, the income variable is statistically significant and positive in every case.\textsuperscript{24}

They also emphasized the importance of government’s means of financing to its level of spending. "In effect, it is impossible to explain the fiscal activities of a state-local government without reference to the other elements of the overall governmental system of which they are component parts."\textsuperscript{25}

FOCUS ON PERSONAL INCOME AND TAXES

Fisher published another study in 1964 which, in its final form, included seven of twelve variables considered. Two variables considered are of particular note. Fisher considered, but ultimately did not include in his model, median family income. Without reference to any theory of the median voter, he reasoned

the existence of a few very high income persons in a state would substantially raise the per capita income figure but would have little effect upon the median income. These high incomes, of course, represent taxpaying ability and, to the extent that the

\textsuperscript{24}Ibid., p. 82.

\textsuperscript{25}Ibid., p. 85.
tax system of the state is able to tap that income, may affect the level of government expenditure.\textsuperscript{26}

Thus, Fisher had considered precisely the measure of income used in median voter public expenditure demand functions, but had done so merely to attain a model that might "fit" the data better. It is also encouraging that he mentioned the ability of voters to pay taxes. However, as mentioned above, he ultimately eliminated this variable from the model. He did, however, include a measure of income distribution as an explanatory variable. His theoretically based expectations for the coefficient of the percent of families earning under $2,000 were ambiguous. Fisher reasoned "...the existence of a large number of low income persons would generally exert downward pressure on government expenditure, but, at the same time would result in greater 'need' for certain specific expenditures such as public welfare."\textsuperscript{27} Low income people were thought to feel the bite of the relatively regressive state and local tax structures more than the affluent. Thus, there would be greater political resistance to higher taxes among this group of voters.

In light of the previous absence of a price or price-like variable, it is even more encouraging that Fisher did include a tax-related variable, the per capita yield of a representative property tax, which is "... an estimate of the amount of revenue which would be produced if each state levied a representative tax upon property assessed at a


\textsuperscript{27}Ibid.
uniform percentage of true value. Fisher evidently was thinking of the voter's ability to pay and the government's ability to raise money, but he still had not come to the point of conceiving government spending as a response to the voters' wishes. Indeed, the tax measure used by Fisher measured the voters' ability to pay, but not the price they actually were required to pay, a very important feature of an economic demand function.

In addition to these 2 "economic" variables, 3 "demographic" variables, and 2 "socio-political" variables were included as explanatory variables. The "demographic" variables--population density, percent urban, and percent increase in population over the previous decade--as well as the "socio-political" variables--a measure of two party competition, and percent of the population over 25 with fewer than 5 years of schooling--turned out to be statistically insignificant in estimating the total expenditures per capita. These latter five variables were also only fair to poor predictors in the estimations for the functional categories. Thus, the "economic" variables dominated the model statistically.

Finally, Fisher had "serious doubts about the validity of using federal aid as an independent variable" in a multiple regression model of public expenditures. Although a federal aid variable considerably increased the amount of variation "explained" in earlier models, he considered the "feedback effect" of federal aid on expenditures per capita.

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29 Ibid., p. 72.
capita too large for a valid specification. Thus, Fisher discarded the aid variable.

A 1965 study by Roy Bahl and Robert Saunders added what they saw as a further methodological refinement to public expenditure analysis. Rather than estimate absolute levels of spending per capita, the authors proposed estimating the changes in spending per capita as a function of the changes in the independent variables. Theoretically, this represented substantial progress, according to Bahl and Saunders. In a sense, it definitely did represent theoretical progress. It indicated that Bahl and Saunders were thinking in terms of voters' and governments' response to past conditions.

The results of the empirical test of the authors' model, however, were not so impressive. Using Census data for the years 1957 and 1960, the authors found that change in per capita federal grants to states was the only statistically significant variable in a model containing other independent variables.

Bahl and Saunders then tested their model on a subsample of states. They reasoned that "a breakdown into a smaller group of states having certain homogeneous traits may increase the proportion of variation of expenditures which can be explained." The traits chosen for study were population density and per capita income. A group of 15 states with densities over 65 persons per square mile and per capita incomes

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31 Ibid., p. 55.
over $2,000 was selected. Because only high income-high density states were included in the subsample, the model partially controlled for these variables. (It should be noted, however, that specific inclusion of income and density as independent variables would have controlled for these variables far more precisely.)

The 5-variable model "explained" less of the variation in change in total spending for the 15 selected states than for the 48 states, but the subsample estimation was more successful in "explaining" the variations in spending change broken down by function. The influence of federal grants was substantially reduced in the high income-high density group, indicating that federal aid is a less powerful predictor for spending changes in jurisdictions characterized by such traits. In other words, more affluent jurisdictions seemed to establish their own preference for public goods with less regard to federal largesse than did poorer jurisdictions.

Despite the fact that Bahl and Saunders "explained" only 31 percent of the variation of the expenditure change--and this only for a 15-state subsample--they felt their model was successful. Previous models had "explained" levels of spending, not changes in spending, and thus were not strictly comparable. Non-longitudinal cross-sectional studies simply did not address the practical problems of state and local government planning. Thus, the authors felt they had suggested a fruitful area for further research for economists and other social scientists.

A 1966 study by James Barr and Otto Davis added little to the body of empirical work in government expenditure analysis, but laid much of

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the theoretical groundwork to be used later. Barr and Davis presented logical and mathematical arguments that voters could and indeed did attempt to maximize their personal utilities—subject to their incomes, the prices of private goods and services, and the prices of public goods and services—through the votes they cast. Thus the authors explicitly recognized that public goods and services, as well as the "prices" paid for them, entered into the calculation of one's utility. In this formulation, public goods and services were figured in to the utility function in much the same way as private goods and services. There was also an argument that politicians sought to remain in office and a mathematical proof which, the authors asserted, demonstrated that the surest way to do so was to appeal to the preferences of the median voter.

Income and price appeared in the model and they considered it a true demand function, although it was based on admittedly simplistic assumptions concerning the political process of budgeting. However, the model was not yet ready for testing, according to the authors; they felt it untestable because the median voter's preferences were unobservable and the median voter in different jurisdictions would have different incomes as well as differing tastes and preferences. (Barr and Davis did not go so far as to identify the voter at the political median with the voter at the economic median.)

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A simplified version of the model was tested for Pennsylvania counties, but with only countywide taxable value and the ratio of owner-occupied homes to registered voters as independent variables, the results were of little practical use. The estimated coefficients were of the correct sign and usually statistically significant, but only a small portion of the variation of the expenditure variable was statistically "explained." Curiously, the addition of income as an explanatory variable did not improve the explanatory power of the model.

In 1967 Ira Sharkansky, a political scientist, estimated government expenditure with a model that accounted for the spending of previous years. He thus acknowledged that government budgets are often established through what is known as an "incremental" process. Sharkansky's dependent variable was state expenditures per capita (for 1963), not aggregated state and local spending. His independent variables were per capita personal income, federal aid as a proportion of state government revenue, state and local taxes as a proportion of personal income (Sharkansky's measure of "tax effort"), the proportion of state and local spending done by states, and previous state expenditures.

Personal income had a role in public expenditure models since the time of Fabricant's formulation, but its place in the model had never been given a theoretical justification. Sharkansky specifically included his income variable because he felt it to be a measure of "economic development." Thus, Sharkansky's behavioral justification for including an income measure was not the same as the justification given it by proponents of the median voter model. Despite this difference in
behavioral approaches, the use of a measure of tax effort represented a significant theoretical step. Tax effort was included because "...it measures the level of economic support given to state and local governments by citizens, and thereby stands as an indicator of popular support for government services." Surprisingly, though, the coefficient for tax effort was not statistically significant in the estimation of total spending or spending in any functional category.

The use of previous expenditures as a predictive variable says more than simply that the future will be similar to the past. Political scientists have long thought of government budgeting as incremental. Apart from the influence of "force of habit," the level of previous spending

...may work its influence through the formal process of budgeting and appropriations....the techniques of incremental budgeting place great weight on previous expenditures in the determination of current expenditures....The (expenditure) base serves as the starting point for calculations among those who ask for funds, and the base serves as the portion of a request that is most likely to be considered legitimate by those who review appropriations.34

Furthermore, as Robert Harlow has pointed out, last year's expenditures can be thought of as a proxy for the combined effect of all the political forces, formal and informal, which enter into the budgetary process, as well as economic and demographic conditions.35


34Ibid.

The coefficient of the previous expenditure variable in Sharkansky's study was positive and quite significant for all spending categories estimated. However, this variable is of limited practical use since it represents the compounded effect of several separate forces. In fact, previous expenditures seems to be too powerful a predictor; when it is included in a multiple regression model, variables that were previously statistically significant and theoretically important, such as income, become statistically insignificant.

In 1968, David Smith published the results of a 50-state cross-sectional expenditure analysis based on a "political approach to tax and expenditure decision making." Smith's model was based on many of the elements of public choice theory. For instance, he worked from the assumption that elected officials seek to maximize the probability of their re-election, i.e. they attempt to maximize their votes. Furthermore, he assumed that individuals had different "demands" for public goods and services and were able to make these demands known through the election of public officials.

Smith's unit of analysis, however, was the governmental unit, specifically the governmental unit receiving a federal grant-in-aid, and not the individual taxpayer-voter. Consequently, he recognized the disutility associated with the taxes needed to support public expenditures. However, this disutility was that faced by the legislator voting to levy the tax.

Smith's analysis did contain a price variable, of sorts, but not the tax price of recent public expenditure analysis. His major concern was the expenditure response of recipient governments; he maintained that "the basic feature of a conditional matching grant is that it has the effect of reducing the price of a specific governmental service to a lower-level government".37 Because public goods and services were generally not produced in physical units that were "sold" to the public, it was impossible to quantify either a unit or a price for them. However, Smith assumed the recipient government's expenditure response to a federal grant was analogous to a price elasticity of demand for the aided function and the "grant elasticity of expenditure" yielded a proxy price faced by the recipient. Using a log-linear multiple regression model, Smith estimated per capita state and local government expenditures as a function of five independent variables, all of which, except percent of population 65 or over, have been discussed in reference to earlier studies. He "explained" 79 percent of the variation in the general expenditures.

Because the focus of Smith's study was the behavioral effect of grants on governments, not voters, his conclusions are of limited value in constructing a demand function that describes the median voter's preference for public goods. The reasoning used to build the model, however, bears a striking resemblance to that used in modern public choice-median voter models.

37Ibid., p. 351.
A PROPOSAL FOR A TRUE DEMAND FUNCTION

In 1973, Theodore Bergstrom and Robert Goodman published an attempt to "develop a method for estimating demand functions of individuals for municipal public services." The model was based on the theory that "demand will depend on the traditional variables, price and income, as well as on certain demographic characteristics of the individual and the city in which he lives". (emphasis added)

The authors listed a set of assumptions on which their model was based. They can be summarized as the following:

1) The production of public goods and services is a constant cost industry.

2) Every consumer of public goods pays a tax share, a fraction of the total cost of public expenditures in the community. This tax share may be based on the consumer's wealth, his or her income, or other individual characteristics, but it does not vary with public expenditures or the way in which the desire for public goods and services is expressed.

3) Every consumer of public goods and services has a tax price, the product of his tax share and the total cost of the public goods and services in question, and is able to determine the quantity of the public commodity which he would choose for the community given that he must pay his share of the cost. To do this he needs to maximize his own utility subject to a budget constraint containing this tax price.

4) In each jurisdiction, the quantity supplied of the public good or service in question is equal to the median of the quantities demanded by its citizens. In other words, the government responds to the median set of quantity preferences in its supply of public goods and services.

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39 Ibid.

40 Ibid., p.p. 280-1.
5) In each jurisdiction, the median of the quantities demanded is the quantity demanded by the citizen with the median income in that jurisdiction.

Assumptions four and five allow one to view the quantity of public goods chosen by the jurisdiction through the political process as the amount that is desired by the consumer with the median income. Assumptions one and two allow public expenditures to be treated as observations (of the quantity demanded) on the demand curve of a consumer of public goods who has the median income in his community. The own-price of those public goods is proportional to the tax share (assumption three).

All together, the assumptions posit public expenditures as a function of the "traditional economic variables, price and income." Bergstrom and Goodman noted that the first four of these assumptions had been proposed and studied by Howard Bowen in 1943.\(^1\) and again by James Barr and Otto Davis in 1966. Additional assumptions, which seem even more questionable, are that the prices of private goods and the unit costs of public goods are the same in each jurisdiction observed.

The only one of their variables which Bergstrom and Goodman felt needed explanation was tax share (which, again, is proportional to tax price). In order to have a true demand function, the voter-consumer must be thought to respond to a perceived price for public goods.

\(^1\)Howard H. Bowen, "The Interpretation of Voting in the Allocation of Economic Resources," Quarterly Journal of Economics 53 (November 1943): 27-48. Bowen attempted to delineate the conditions under which democratic voting might produce "the ideal output of a social good." Modern public choice-median voter theory does not require this social optimum. Indeed, it generally will not be attained, according to the modern theory. However, Bowen's work did outline underlying assumptions still used today.
While most people do not know their tax share, most have a pretty good idea of the total tax bill they receive every year.

If one were to ask several individuals what their tax shares are, we suspect that few would be able to answer the question sensibly without more reflection than usually takes place before voting. Nevertheless, they may have knowledge which is for our purposes equivalent. For example, if a citizen knows his municipal tax bill and believes that his taxes will change in proportion to municipal expenditures, he will know the cost to him of a given percentage change in municipal expenditures.42

Bergstrom and Goodman tested their theoretical model by estimating, with a log-linear regression model, three functional expenditures for 826 medium-sized American cities. They were pleased to discover that their estimates of income elasticities were usually positive and statistically significant and estimates of price elasticity usually negative and significant. In no case were any estimated elasticities of the theoretically incorrect sign and statistically significant. Thus, the "traditional" variables of income and price appeared to be acting in the model as economic theory would predict. The estimated elasticity for population was everywhere positive and almost always statistically significant. The coefficient for percent population change was virtually everywhere negative and statistically significant about half of the time. The authors explained this response to population change as a failure to achieve "political equilibrium".43 Time is required for a rapidly growing or declining city to adjust its level of expenditures, and such cities apparently were not adjusting their expenditures as rapidly as their populations might warrant.

42Bergstrom and Goodman, p. 284.

43Ibid., p. 290.
Six other independent variables were used in the Bergstrom-Goodman model. One of those is of particular relevance to the present study, which attempts to examine the effect of economic growth on public expenditures. The ratio of employment to residential property owners was used as an indicator of a community's commercial or industrial activity. Bergstrom and Goodman hypothesized that larger amounts of public goods and services must be provided by a local government in order to attract and retain such activity. This hypothesized relationship was apparently borne out by the estimates; the estimated elasticity for this variable was usually positive, and always positive wherever statistically significant.

Douglas Booth's 1978 article about the simultaneous effects of economic growth on public expenditures and the tax base is particularly germane to any investigation of the fiscal impacts of economic growth. Booth's study was designed to explore the relationship between a city's employment base and its fiscal health. His model was based on the insight that two kinds of economic change, growth or decline in either manufacturing or mercantile activity, affect both the desire and need for public services and the local government's means for paying for such services. (Booth used per capita employment to represent commercial and industrial activity; manufacturing activity was represented by manufacturing employment and mercantile activity by employment in services and wholesale and retail trade.) Thus, he estimated two functions—one to "explain" public expenditures and one to "explain" the tax price faced by voters.
Although he recognized the roles of politicians and voters, as outlined previously, in the process of determining public spending, Booth felt the median voter model somewhat unrealistic because it failed to include the influence of interest groups. Because each citizen's vote is only one among several, he has little reason to spend a great deal of time and energy becoming informed about political and governmental matters; he remains "rationally ignorant" on many issues and is easily influenced by political information received, at no cost, from politicians or special interest groups. Booth also recognized the importance of the economic role of local government and felt that this role should be accounted for in the expenditure model.

The ability of the municipal politician to retain political office hinges in large measure on the smooth functioning of local economic institutions. This requires that municipal services be kept within certain bounds. On the one hand, the consequence of inadequate levels of municipal expenditures and services would be significant damage to the local economic base from such problems as high crime rates, traffic congestion, high incidence of property damage from fires, and a poorly educated population. On the other hand, if municipal expenditures are excessive, municipal taxes would become so burdensome on household budgets as to impinge on consumption of private commodities necessary to an orderly functioning of economic life. Excessive taxes could also impinge on business profits in a municipality, disrupting the accumulation of business wealth and curtailing local employment." (emphasis added)

Individual voters will generally be much more aware of their tax bills and public expenditures than they will be about the full array of public goods and services. On the other hand, organized interests will have their own particular objectives and will take pains to become

informed of the benefits (to themselves) of public goods and services. According to such reasoning, any model that fails to include interest groups will be greatly misspecified; voters, who will tend to want to hold the line on taxes and expenditures, should be balanced in the model by interest groups, such as downtown merchants associations, public employee unions, and neighborhood organizations, whose members will lobby for specific public goods and services. 

Booth's empirical model of public spending included only six independent variables. He used population and population density as "environmental variables" which acted as "constraints on the municipal service production process in service supply decisions." Booth felt it likely that the per capita cost schedule for a particular service with respect to population was U-shaped, implying that the costs of providing services, and the expenditures necessitated by those costs, varied with population and eventually reached a turning point at which diseconomies of size began to predominate. Because congestion problems appear and begin to increase at some point, population density was felt to have a conceptually similar impact on costs. Thus, the sign on these coefficients could not be predicted a priori.

Booth's insights into the politics of government spending, as well as the production realities of the public sector, led him to include both manufacturing and mercantile employment per capita as independent variables in his expenditure regression. They served as measures of the level of business activity and consequent demand for business-related

\[4^{5}\text{Ibid.}\]
services. They also served as a proxy for the political clout of the business community.

The "economic" variables of income and tax share were also included, although it should be noted that their specifications were not the same as those found in models like the Bergstrom and Goodman model. Although Booth was quite aware of the theory that politicians respond to the demands of the median voter, he used mean rather than median family income in his model. He also used the ratio of residential assessed value to total assessed value as his measure of tax share, thus specifying a variable proportional to the mean rather than median tax price.

Booth's linear regression model tested a cross section of 47 medium to large Wisconsin cities using 1970 data. The results gave only limited confirmation of the theoretical assumptions used. The coefficients for the mercantile employment variable were positive, as expected, and statistically significant for all three functional areas examined--police, fire, and school expenditures. The coefficients for the manufacturing variable, surprisingly, were in all cases positive, but statistically significant only in the regression for police expenditures.

Coefficients for the income variable were all positive, but significant only for estimating police and school spending. The coefficients for tax share were negative--seeming to affirm the negative relationship of price and quantity which economists usually expect--and statistically significant for spending on fire protection and school spending. They were positive and insignificant for spending on police...
protection. The model "explained" only 47, 57, and 67 percent of the variation in fire, police, and school spending respectively.

The second regression in the model had the tax price (technically, the tax share) as a function of two previously used variables, manufacturing and mercantile employment per capita. Both employment elasticities were negative and statistically significant, and 57 percent of the variation in tax price was "explained" by the model.

Feeling that his two regressions adequately reflected the determination of public spending and tax price, Booth used the estimated elasticities to compute the changes in residential tax bills and public spending that would accompany employment growth. He reasoned that the impact of an added employee on the residential tax bill could be expressed as

$$e_i \Delta t/\Delta n_i + t(\partial e_i/\partial n_i + \partial e_i/\partial t \cdot \partial t/\partial n_i)$$

where $E_i$ is the expenditure for function $i$, and $n_j$ is the ratio of manufacturing employment to population for $j = \text{manufacturing}$ and the ratio of mercantile employment to population for $j = \text{mercantile}$. The residential share of taxes required for financing municipal services is represented as $t$. The first component of the expression is the change in the residential tax bill that results from the change in the residential tax share. The second component is the change in the residential tax bill that results from a change in the expenditure per capita. Changes in public expenditures as employment grows or declines can be represented with the following expression:

$$\partial e_i/\partial t \cdot \partial t/\partial n_i,$$
Booth calculated the tax price and expenditure effects of employment change based on the above expressions and the average values of expenditures and tax share for the sample. He concluded that, if political and tax base mobility effects were small enough to be ignored, manufacturing activity had a beneficial impact on local government, reducing taxes while increasing expenditures on local residents. Mercantile activity, though, had a harmful fiscal impact, causing taxes to increase by a greater proportion than the increase in expenditures on services.

Of course, Booth realized that the effects of politics and tax base mobility could not be ignored in the real world, and thus considered his conclusions quite tentative. Yet he felt that if his results were replicated in other studies his model could very well be used to describe the fiscal plight of many older cities.
CHAPTER FOUR
THE STATISTICAL MODEL
LESSONS FROM PAST STUDIES

The successes and failures of past empirical work on the estimation of public expenditures, outlined in the previous chapter, provide many lessons useful in the construction of a model intended to explore the effects of economic growth on local government spending. This chapter will describe such a model developed with these lessons in mind. As in all of the previous work mentioned, ordinary least squares will be used to statistically estimate the effects of a set of independent variables on a set of measures of government spending. Cross-sectional analysis of expenditures will be performed on expenditure figures for 54 of the 56 county governments in Montana.

Previous studies often analyzed state and local expenditures aggregated together. This was necessary for nation-wide studies, because of the difficulty of distinguishing between State and local responsibilities in the various states. This aggregation problem can be overcome by focusing the analysis on the expenditures of Montana county governments alone, since counties in Montana have similar responsibilities for providing public goods and services and are bound by similar State laws.

Such a focus has an important additional advantage. To the degree that the voter/consumer determines public expenditures, aggregation of

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state and local expenditures only compounds the problems of estimation. The voter/consumers of the various States are far more likely to have dissimilar tastes and preferences than those of the a single State. Statistical analysis of government expenditures in the single state is less likely to be complicated by unknown and unmeasured differences in taxpayer preferences; Montanans are simply more likely to be homogeneous in their preferences than are Americans as a whole.

Also, as in previous studies of this nature, equations accounting for general expenditures, as well as expenditures in several functional areas, will be estimated. For reasons to be explained below, some of the variables will not be used to measure expenditures in the functional areas.

Because there is no theoretical guide as to the correct mathematical form of the equation, two common forms, the linear and log-linear, will be estimated and reported. The linear function will be more appropriate if the independent variables are thought to affect the dependent in an additive way. The log-linear form will be useful in the interpretation of any joint effects of the independent variables on the dependent variable.

THE DEPENDENT VARIABLES

The dependent variables used will be various measures of aggregate county expenditures for fiscal year 1981-82. This means there will be a lag of approximately nine months between the observation times of my dependent and major independent variables. Some lag time, however,
seems appropriate to allow time for voters to react to changing economic conditions, and the timing of the Census Bureau's collection of data makes these dates most convenient. Because the goods in question are public goods and are characterized, to some degree, by jointness in both consumption and production, it is quite possible that aggregate expenditures rather than expenditures per capita is the more appropriate form of the dependent variable. The appropriate proxy for the quantity of public goods demanded will be expenditures per capita if the median voter perceives the utility of each unit of the public good provided as being diminished by the use of other citizens. If the median voter perceives no such crowding effect, the more appropriate proxy for quantity is aggregate expenditures. Of course, there are very few pure public goods, and the public goods provided by county governments, such as roads and police and fire protection, are especially prone to the effects of crowding at some point. Economic theory is not decisive here. Whether the expenditures of county governments are more appropriately modeled as aggregate expenditures or expenditures per capital is an empirical question. The answer to this question is probably not the same for all county expenditures in all places and times.

In order to help resolve this matter, a data set for fiscal 1971-72 was constructed, using the same variables as in the data set for the 1980's. This data set was used to estimate, for purposes of comparison, both aggregate general expenditures and expenditures per capita. The model for aggregate expenditures provided a better statistical "fit" to the data than did the expenditures per capita model. The model using
expenditures per capita yielded an $R^2$ of 0.70, indicating that 70 percent of the variation in expenditures per capita were "explained" by the model. An indicator of the model's overall explanatory ability, the F statistic, was 8.03; However, the model for aggregate expenditures "explained" about 85 percent of the variation of the dependent variable; the value of $R^2$ for this equation was 0.85 and that of the F statistic was 19.06. Because of the statistical superiority of the aggregate expenditures formulation, it was decided to use aggregate expenditure measures in the 1980's models of both general and functional expenditures.

The authors of past studies of a similar nature have used expenditures per capita as the dependent variable, so it was somewhat surprising to find that such a large improvement in the model's statistical "fit" could be made by departing from the usual form. Furthermore, this departure means the results from this study will not be entirely comparable to past work in the area. Yet such a departure seems justified; the improvement in statistical estimates is very likely an indicator that public goods and services provided by Montana counties, and perhaps by other local governments, are more public, i.e. less subject to crowding effects, than was previously implied by the expenditures per capita formulation. This could be because previous researchers simply used the worse of the two forms. It could also very well be a function of Montana's relatively sparse population; perhaps crowding effects simply are not yet felt by the median voters in Montana's counties.
Estimates will be made for general expenditures (GENX) as well as expenditures in the functional areas of education (EDUC), highways (HIWA), welfare (WELF), hospitals (HOSP), health (HEAL), police (POLI), natural resources and parks and recreation (NRPR), and all other (OTHR), a catch-all category that includes correction, financial administration, general control, public buildings, interest on debt, unallocable spending, and sewerage and sanitation.

THE INDEPENDENT VARIABLES

Population or population density has traditionally been included in such models. They have usually been found to be statistically significant and can be interpreted as taste and preference variables. This model will use 1980 population (PP) and the percentage of the population living in urban areas in that year (RB) as independent variables. The estimated coefficients for these variables are expected to be positive. It is reasonable to assume that those living in more populous areas will prefer more of certain public goods and services, like paved streets and police protection, than those living in less densely populated areas. It is also equally likely that city dwellers prefer and have the leisure to enjoy a wider variety of public goods and services, such as parks, museums, libraries, etc. Finally, those who require public assistance of some sort will likely migrate to densely populated areas, since public assistance is generally more readily available and available in more generous quantities in urban areas. Also, urbanites may well have fewer, or at least different, subsistence
living alternatives available to them and may thus be reliant on a different mix of public goods with a different price tag. According to the median voter model outlined in Chapter Two, a proper specification must include the traditional demand function variables of "tax price" (TS) and median income in the county (MY). Median income, as was explained before, is used because it is supposed to be the income of the decisive voter in the community. The income variable chosen for this model is median family income in each county in 1979. The coefficient for this variable is expected to be positive. The magnitude of the coefficient will certainly vary from one geographic area to another and the wide variation of estimated income elasticities in past studies makes prediction of the coefficient's magnitude precarious.

The tax price is in truth a tax share; it is computed as the 1980 taxable value of the home with the median value (assumed to belong to the decisive voter) divided by the taxable value of the entire tax base in that year. The estimated coefficient for this "price" is expected to be negative. However, the completeness of this formulation of "price" is somewhat questionable. On the one hand, the variable seems appropriate because the property tax is the major own-source tax revenue available to Montana counties and the only tax for which the county commissioners (presumably) can be held responsible by the voters. Counties in Montana receive shares of some of the State's excise taxes, such as those on alcohol and gasoline, but those shares are relatively small when compared to the revenues produced by the property tax. Also, even though these taxes are paid by the residents of the counties, county voters probably do not perceive the connection between these
excise taxes and the goods and services provided by county governments. Thus, any tax price variable constructed for county voters should indeed be based on property values.

A problem arises, however, in that a substantial amount of the taxed property is owned by nonresidents of the counties containing property. The owners of such property must pay taxes but do not get to vote for (or against) the county commissioners who levy the mills against taxable value. Because the tax levy is a function of all taxable property in the jurisdiction, not just that owned by residents, the resident’s perception of property taxes as a "price" paid for public goods and services received is blurred. The county’s voters do not have to bear the entirety of even the tax-financed portion of the cost of publicly provided goods and services, let alone the portion financed through non-tax revenues.

Since this "tax price" variable is a very imperfect measure of what taxpayers actually pay for their public goods, additional explanatory variables will be included to help account for the voters’ ability to make nonresidents pay for the public goods and services enjoyed by residents. A proxy for the ability of taxpayers to export taxes to nonresidents (XP) will be included as an explanatory variable. This proxy will consist of the proportion of the county's property tax base composed of net and gross proceeds, mining royalties, and utility property. This portion of the property tax base is the portion most likely owned by nonresidents. The higher the proportion of this kind of property in the jurisdiction, the more likely residents will be to
approve of higher county government expenditures. The coefficient for this variable is expected to be positive.

The absolute size of the county's tax base per capita will also be included in the model (TB). It is expected that voters will wish to make not only nonresidents but also other residents pay for their public goods and services. The fact that a uniform county mill levy is applied to all taxable property in the jurisdiction allows the voter to spread the cost of public goods among all taxpayers, regardless of residence. Assuming the non-tax portion of the financing for public goods remains unchanged, the larger the tax base the lower the cost to the individual for a particular level of public expenditure. Thus, the tax base, as well as the ability to export taxes, can be thought of as supplements of sorts to the "tax price;" they acts a other indicators of the marginal cost accruing to the taxpayer/voter for his or her public goods and services. These two variables can also be thought of as indicators of wealth. They represent the wealth available for use by the taxpayer, regardless of the portion of that wealth he or she owns. Regardless of whether these variables are thought of as (inversely proportional) indicators of marginal cost, indicators of wealth, or both, their estimated coefficients should be expected to be positive.

The distribution of income in the jurisdiction is expected to affect the level of public expenditures, although economic theory is of little help in determining the direction or magnitude of this relationship. The proportion of the county's families living below the federally defined poverty level (PV) will be used to measure such distribution. On the one hand, the greater this proportion, the greater
the need for public goods such as welfare and possibly certain types of public health expenditures. In fact, state and federal laws may, in effect, mandate some proportionality between this measure of income and welfare spending. Furthermore, the median voter may very well have feelings of "public regardingness" towards those living in poverty and may choose to subsidize them. However, in the unlikely case that the median voter has an income which places him below the poverty level, he will be less willing and/or able to support such expenditures. No expectations for the size or sign of this coefficient are hypothesized.

The diversity of funding for county government necessitates that non-tax sources of revenue be accounted for in the model. Thus intergovernmental transfer payments from the State and federal governments (TF) and charges and miscellaneous fees (CG) for fiscal 1982 are included as independent variables. Inclusion of these variables in all of the equations would be preferred, but it is not possible (at least, no way was found) to disaggregate these amounts according to the functional spending categories used. Thus, it will only be appropriate to use these two variables for the general expenditures equation. It is likely that both of these types of funds are thought of as "free" money by the voter. This, of course, is not strictly true. Taxpayers in the county pay a small portion of the taxes which finance grants from higher levels of government, but they probably do not perceive the connection between these taxes paid to the State and federal governments and the financing of county-provided goods and services. Even if they do see the connection, they are likely to perceive such financing as another way of having nonresidents pay for a larger share of local goods
and services. Such transfers can also be thought of as price indicators. They allow voter/consumers to acquire more public goods without incurring greater costs.\(^{46}\)

The estimated coefficient for intergovernmental transfer payments is expected to be positive in both the linear and log-linear regression models. Because much of such transfer payments come with matching funds requirements, the coefficient is expected to be greater than unity in the linear model. Charges and fees are also very likely seen as quite different from taxes, as they are not mandatory. The estimated coefficient for this variable is also expected to be positive in both the linear and log-linear equations, but nothing can be said of its expected magnitude.

Finally, two independent variables will be included in the model to test the maintained hypothesis of this study—that employment growth affects local government expenditures in a positive way. Employment growth will be measured as percentage changes in employment over a ten-year period, 1970 to 1980. Two broad employment categories will be used. Employment in basic industries (BA) will measure the percentage change in the number of employed persons in the areas of agriculture, forestry, fisheries, mining, construction, manufacturing,

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\(^{46}\)Following Smith's reasoning, such transfers are also seen as prices by government. However, their effect from local governments' perspective is to reduce the cost of supplying additional public goods and services. For Smith, transfer payments were a supply variable. Yet they are here included in the median voter's demand schedule. That a "price" (marginal cost) variable appears in both supply and demand functions should not be surprising, as price does double duty in the supply/demand system for private goods and services. This same reasoning can be applied to the variables representing the size of the tax base, the ability to export taxes, and charges and fees.
transportation, communication, and utilities. Employment change in all other industries constitutes nonbasic employment (NB). The changes in employment will be calculated as the 1980 employment figure less the 1970 employment figure, all divided by the 1970 figure. The estimated coefficients are expected to be positive for both of these variables. Growth in employment should create a need for public services and make the electorate more optimistic about its ability to maintain a higher level of public expenditures. These variables could conceivably be thought of also as indicators of the political strength of business. Previous researchers have reasoned that great size amounts to great political strength and have thus hypothesized positive coefficients for employment variables. However, employment growth may be a somewhat dubious indicator of political clout. The magnitudes of these coefficients are not expected to be the same, and they are expected to be positive. This expectation is based on increased need and the electorate's ability to pay rationale, not increased political power for business.

The single equation to be statistically estimated several times will be:

\[ G = f(RB, XP, NB, TX, BA, PV, TB, MY, PP, TF, CG) \]

where \( G \) represents government expenditures. The dependent variables, general expenditures and each of the variables representing spending in the functional categories, will be substituted for \( G \) in turn. Variables used in the model are as follows:
DEFINITIONS OF VARIABLES IN THE MODEL

DEPENDENT VARIABLES

GENX = general expenditures
EDUC = education expenditures
HIWA = highway expenditures
WELF = welfare expenditures
HOSP = hospital expenditures
HEAL = health expenditures
POLI = police expenditures
NRPR = natural resource and park expenditures
OTHR = other expenditures

INDEPENDENT VARIABLES

PP = population
RB = urbanization
MY = median family income
PV = percent of families below poverty level
TS = "tax price" (tax share)
XP = the ability to export property taxes
TB = taxable property value
TF = intergovernmental transfer payments
CG = charges and fees
BA = employment change in "basic" industries
NB = employment change in "nonbasic" industries
CHAPTER FIVE
RESULTS OF THE REGRESSIONS

This chapter reports the results of the regressions. Three tables are presented. The first summarizes the results of the linear regressions. The second table gives the results of the log-linear regressions. The final table shows the simple Pearson correlation coefficients between each pair of the independent variables. Each cell of the results tables contains a variable's estimated coefficient, the coefficient's t-statistic, and its p-value. The p-value gives the actual level of statistical significance of the coefficient. It provides an alternative to use of the classical 0.05 cut-off point for statistical significance. The t-statistics are made somewhat superfluous by the inclusion of the p-values, but they are reported because economists are more familiar with them than with p-values. Also, inclusion of the t-statistics allows comparison of this model's statistical "fit" of the data with that of other studies.

In general, the statistical goodness of fit of both the linear and log-linear regression models, as measured by \( R^2 \) and the F statistic, is acceptable and, in fact, remarkably high in the cases of general expenditures and spending on education. The F statistics are almost always quite high, the one exception being the regressions for hospital spending (HOSP), indicating that most equations explain far more of the variation in the dependent variables than is left unexplained. The
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## Regression Results

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values for $R^2$ show the linear equations for general expenditures and spending in all functional areas except welfare, hospitals, and other spending compare favorably to single equation models in previous studies. The linear equation for welfare spending yielded an acceptable, though hardly outstanding, $R^2$. The equations for hospital and other spending, though, are quite disappointing. Much the same can be said for the statistical "fit" of the log-linear equations to the data; the equations are generally acceptable or better, with the exception of those for welfare and other spending.

Also, it is the coefficients of the same independent variables which often are statistically significant in both the linear and log-linear forms. Because the estimates for the coefficients in the log-linear equations show much the same pattern of statistical significance as those in the linear equations, little is to be gained by discussing both sets of regressions. The log-linear formulation has one advantage over the linear form, however; it has the virtue of producing coefficients that economists can interpret as elasticities. For these reasons, the discussion will be confined for the most part to the performance of the variables in the log-linear models.

The results of the regressions for general expenditures and spending in all functional areas show that the population variable's coefficient is the coefficient which is most frequently statistically significant. It is also positive, as was expected. Except for the regressions for hospital expenditures, these coefficients are always significant at the 0.09 level or below. They are statistically
significant at or below the 0.05 level for general expenditures and for five of the eight functional spending categories.

The urbanization variable, however, does not perform nearly as well in these models. That its coefficients are statistically significant at the 0.06 level or below in the log-linear regressions for three functional areas, education, highways, and hospitals, is somewhat encouraging. However, the regression for hospitals explains so little of the variation in spending that the statistical significance of the coefficient means little, if anything. The equations for education and highway spending do, however, explain substantial portions of the spending in these areas, and the statistical significance of the urbanization coefficients probably has theoretical importance here as well. The negative sign on these coefficients indicates that some consumption or production economies are enjoyed as urbanization increases. This should not be too surprising in light of the fact that Montana is quite sparsely populated and even urban areas, as defined by the Census Bureau, are small and sparsely populated by national standards.

The general statistical insignificance of the "traditional demand variables," tax price and median income, in these models was quite disappointing—especially since the models were cast in the mold of the previously quite successful median voter model. The coefficient for tax price did not even once in the log-linear models have the theoretically correct (negative) sign that one would expect of a price variable. (It did display a negative sign for three functional areas in the linear models; however, even these coefficients were not statistically
significant at any acceptable level.) One must conclude that whatever role this measure of taxes plays in the determination of public spending, it is not as a simple price.  

The estimated coefficient for median income was not statistically significant for any of the regression equations. Along with the poor showing of the "tax price" coefficients, this is strong evidence that county government expenditures, at least in Montana, are not properly modeled as the quantity variable in a taxpayer's demand function. That these demand function variables do so poorly in these models is quite surprising in light of their statistical importance in previous studies of public expenditure analysis. The cause of their statistical insignificance may be that the incomes of taxpayers play a relatively minor role in the financing of county expenditures. This possibility seems to be supported by the fact that the coefficients for the

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47 It should be noted here that the tax price here is not a simple variable at all. In fact, a number of other variables have been included in the model to capture the marginal cost of public goods. A technical problem in the estimation of coefficients for all of these "price" variables arises from the fact that a number of such variables exist and several of these variables are highly collinear with one another.

48 Again, multicollinearity may be the cause of the statistical insignificance of this variable's coefficient. Romer and Rosenthal have pointed out that collinearity between income variables and wealth-based variables such as those involving the tax base may be the reason for the lack of explanatory effect for income in some models. Collinearity between median income and "tax share" does not appear to be a problem here (r = -.185). However, multicollinearity may yet be a problem. In this Montana data set, median income is most highly correlated with the poverty variable (r = -.785) and moderately correlated with transfer payments (r = .513), charges and fees (r = .596), and population (r = .550). Median income's statistical insignificance could well be because of that variable's correlation with any of these others mentioned or the compounded effect of all correlations with other explanatory variables.
proportion of families below the poverty level were positive in all of the equations in which they were statistically significant. The coefficients for this income distribution variable were positive and statistically significant for general expenditures at the 0.08 level and the 0.09 level for education expenditures. The coefficient for this variable was positive and statistically significant at an even lower level for natural resources spending. If taxpayer incomes were important for the financing of public goods and services, one would expect the coefficient for the median voter's income to be positive and statistically significant in most, if not all, of the equations, especially the general expenditures equation. One would also expect the coefficients for the income distribution variable to be negative and significant in many of the equations. The fact that these expectations were not borne out indicates that the resident taxpayer may have a much less powerful role in the determination of public spending than the median voter model implies.

Other factors important in the finance of local goods and services do better in this model. For instance, the size of the tax base and the proxy for the ability to export taxes both yield positive and statistically significant coefficients in the general expenditures model. Also, the coefficients for the tax base are positive, as predicted, and statistically significant in three of the functional areas. The coefficient for the ability to export taxes is also positive and significant for one of the functional areas. These two variables represent wealth that the taxpayer may tap to finance public goods. By voting for a candidate who will levy more taxes against all property in
the county, the decisive voter or block of voters, whether at the economic median or not, can spread the pain of having to pay for public goods to others, both inside and outside the jurisdiction. He or she can enjoy a high level of consumption of public goods without having to pay the full cost. The idea that voters choose to force others to pay for their own consumption whenever possible should not be surprising to economists at all. Such "free rider" behavior has long been observed in the behavior of consumers of private as well as public goods and services.

The strong positive effect which intergovernmental transfer payments and charges and fees have on general expenditures in these models supports such a theory of voter behavior. Intergovernmental transfers allow the cost of public goods to be spread among taxpayers other than those in the jurisdiction receiving the payment. The intent of those initiating the transfers is to induce greater public spending by the receiving government, and this device apparently works. Whether transfers induce greater local spending because the voters choose to take advantage of the opportunity to spread the costs or because politicians see the opportunity to spend without inflicting too much financial pain among their constituents is not addressed by statistical models. However, the results of this public expenditure study seem to be consistent with either interpretation.

The two measures of employment growth used in these models seemed to have little effect on the amount of public expenditures (and presumably on the quantity of public goods demanded). In the few cases in which statistically significant relationships were detected, they
appeared to be contradictory. The estimated coefficient for basic employment, for instance, was statistically significant at the 0.05 level or below only twice in the log-linear equations. In the hospital expenditures equation, the coefficient is positive; the basic employment coefficient is negative in the natural resources equation. The estimated coefficient for nonbasic employment was positive and significant in only one of the functional area equations.

These two variables were included in the model as tests of the maintained hypothesis that employment growth positively affects county government expenditures. Virtually no support was found for this hypothesis. If any relationship exists, it is not one which could be detected by a linear regression model or a log-linear model.
CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

THE MEDIAN VOTER MODEL

The builder of any econometric model faces a dilemma in the choice of his or her independent variables. Because virtually any economic process is quite complex, several variables may be needed to describe that process. Thus the econometrician always runs the risk of misspecifying his model by omitting important variables from the model. The other side of the dilemma results from the likelihood that economic variables, particularly those relating to the same process, are likely to be collinear and thus cause technical problems in a multiple regression model. A set of single equation models such as this, with 11 independent variables, is quite likely to suffer the ill effects of multicollinearity. Also the correlation matrix previously presented indicates that there is substantial collinearity between several pairs of the variables. The predictor variables identified in the previous chapter as statistically significant do, in fact, "explain," by themselves, a great deal of the variation in the general spending of county governments in Montana. A log-linear regression of general expenditures on the five most statistically significant independent variables reported in the previous chapter--charges and fees, intergovernmental transfers, population, the size of the tax base, and the proxy for the
ability to export taxes—statistically "explains" ninety seven percent of the variation in the log of general expenditures. However, the coefficients of two of these variables, population and the size of the tax base, seem to be quite unstable. Even though the eleven-variable model "explains" virtually no more of the variation in expenditures, the coefficients of these two variables have a value approximately double that in the five-variable model. Such instability indicates substantial multicollinearity among the explanatory variables and is a sign that there may well be more of them than are needed in the model. The point of this comparison is that general expenditures can be statistically "explained" quite thoroughly with fewer variables than used in the larger model tested in this study. Furthermore, none of the statistically important variables happens to be one of the "traditional demand function variables," tax price or median income.

THE PROXIES FOR PRICE AND QUANTITY

The fact that the "traditional demand function variables" of tax price and median income were very rarely statistically significant in this model may be accounted for in one of at least three ways. Two explanations are theoretical and remaining is technical.

A possible explanation of the poor showing of tax price in this model is that one or more of the many assumptions used to construct the demand relationship in the median voter model was unrealistic. These assumptions are of three main types. First, the assumption that expenditures are a valid proxy for the quantity of public goods and
services demanded is doubtful. For this to be maintained, one must also assume that government is a constant cost industry and that costs do not vary across political jurisdictions. The constant cost assumption may be somewhat reasonable within a very narrow range of output, but it would be surprising indeed if unit costs remained unchanged as government output changed greatly. Structural differences in government, party and ideological differences in politicians, and variations in the prices of private goods from place to place make the second of these underlying assumptions untenable.

The second type of assumption allows tax share, or "tax price," to be interpreted in the same way as the price of a private good or service in traditional demand analysis. The flaw in this assumption is the formulation of this "price." The "tax price" variable in this model was the ratio of the taxable value of the median-valued home in the county to the taxable value of all taxed property in the county. For such a formulation to be interpreted as a price faced by voters (who "choose" an expenditure level), non-residents must own no residential property in the county and residents must own no nonresidential property. Only in such circumstances can this measure of tax price be the median voter's true share of the tax burden.

Recognizing that such a distribution of the tax base is improbable, previous researchers have still been willing to use this measure as a proxy for the marginal cost faced by taxpayers. They have constructed models which appear quite sound, at least when judged by statistical criteria. That the estimated coefficient of "tax price" did not show up in this study as statistically significant at an acceptable level, and
often had the theoretically incorrect sign, may be the result of poor craftsmanship on the part of this researcher in the construction of the model. It could also be that previous researchers were simply lucky in their choice of data sets and/or explanatory variables.

The third type of assumption is that which has the voter perceiving the tax share as his or her marginal cost for the public goods received. This assumption is vulnerable whenever expenditures are determined in a legislative body and not a market. Public expenditures are most often determined in some sort of legislature, such as a council, commission, House of Representatives, or Senate. They are never determined in a market; even when levies are voted on directly, the voter has only two options and cannot bargain for a third. Prices in the private market can be relied upon to give the consumer very definite information about the marginal cost of a good or service. Proponents of the median voter theory maintain that analogous information is offered to the voter in political campaigns. It is almost a commonplace, though, that voters get very indefinite information from the political candidates with whom they supposedly place their purchase orders. Furthermore, the legislator's opportunities for strategizing, the fact that not all citizens use and enjoy all public goods equally (even if they have equal access), and the prevalence of general fund financing make the voter's job of identifying the tax dollars he pays as financing any particular public goods he receives nearly impossible.
A PUBLIC FINANCE ALTERNATIVE

The second theoretical explanation for the failure of the median voter model in this study encompasses the roles of both the "tax price" and median income variables. It also suggests that the median voter model should be augmented with a number of variables of the type used in this study. The performance of a number of variables that describe the method of financing government expenditures in the linear models tested, the tax export variable (XP), size of the property tax base per capita (TB), transfer payments (TF), and charges and fees (CG), suggests that voters, politicians, or both pay as much or more attention to who pays as to how much is paid for public goods and services. The ability to spread the cost of public goods by taxing the property of nonresidents of the jurisdiction and other residents, accepting revenues (someone else's tax dollars) from higher levels of government, or collecting fees from the users of particular public goods was embodied in several of the statistically significant variables in this model. Together with the influence of population they "explained" almost all the variation in general expenditures and a substantial portion of the spending in the functional areas. The strength of these variables may point to the reason for the weakness of "tax price" and median income.

The variables mentioned above have been justified in the median voter's demand schedule as supplements to "tax price." Their presence in the model helps to capture that voter's true marginal cost of public goods. However, they may also be interpreted as variables in the supply schedule of local government. That there is some overlap of variables
in the supply and demand functions of an economic system does not in itself invalidate the model, but it does point to a possible cause for concern. The demand function of the median voter presented here may not be adequately identified—i.e. distinguished from local government's supply function.

Identification may be viewed as a technical problem in econometrics which is caused by an improper choice of variables included and excluded in each equation in the economic system. Improper identification makes it impossible for the investigator to tell which function in the system is being statistically estimated. In the case of a system "explaining" the supply and demand of public goods, a potential misidentification of the demand function will make it impossible to determine whether the supply function, the demand function, or some combination of the two is being estimated.

An equation in an economic system is identified by the variables it does not contain. This fact suggests a solution to the identification dilemma: review the equation in question to insure that it does not contain too many important explanatory variables appearing in the other equations of the system. The solution is formalized as the "order condition" for identification and can be stated as the requirement that the number of excluded exogenous variables must be greater than or equal to the number of included endogenous variables less one.49 Such a solution may appear a bit too ad hoc, since the supply equation in the system in question has not been formally specified. However, one can

probably safely say that the supply equation in a public goods system would contain such common supply variables as lagged prices of public goods, leftover stocks, costs of physical factors of production, and technology indicators. This list of probable indicators would appear to adequately identify the median voter's demand schedule as it is expressed here, since these variables do not appear in the demand equation.

Montana county taxpayers, in fiscal 1981-82, actually financed surprisingly little of their respective county's general expenditures. On average, among the 54 counties in this study, the difference between general expenditures and the sum of intergovernmental transfers and charges and fees accounted for only sixty-four percent of county general expenditures. Citizens of three counties—Treasure, Granite, and Lincoln—actually financed less than half of county general expenditures with their own tax dollars. The highest paying citizens, those of Blaine county, paid for only eighty-six percent of general expenditures with their tax dollars. With less than two thirds of county general expenditures being financed with locally raised tax dollars, and much of that burden being exported to nonresidents and the rest being spread among many residents, the share of the median voter might well be expected to have little statistical influence in a regression model.

LIMITATIONS OF THE REGRESSION MODEL

The final possible explanation of the failure of the estimated coefficients of "tax price" and median income to show up as
statistically significant is that a regression model, such as the one used here, can only measure linear relationships between variables (or transformed variables). If either or both "tax price" and median income were closely related to expenditures in some nonlinear manner, the relationship would not be detected by a regression model. This appears to be the case for the data used in this study.

Simple plots of median income with general expenditures and spending in all functional areas show a pattern of expenditures increasing with increasing income, although this pattern is not nearly so pronounced for some spending categories as others. If one can interpret expenditures as a proxy for quantity (which is admittedly doubtful), this appears to be the relationship one would observe in a demand function.

The case for the redemption of the "tax price" variable is not quite so strong, but it is also encouraging for those who would like to think the taxpayer has something to say in the spending of his or her money. When "tax price" is plotted against the expenditure figures, most cases are clustered near the origins (see appendix B). However, a few are scattered along the axes. Only a little imagination is required to see a line concave to the origin in what could be a diagram of a demand function. Furthermore, the clustering of cases near the origin is greatly, although not entirely, relieved by the exclusion of a single outlier. The plots on the following page show this clustering effect and its partial remedy. The first plot shows the relationship of general expenditures and "tax price" (TX) for all 54 cases in the sample.
The second plot shows that of general expenditures and "taxprice" for 53 cases (54 cases less the outlier).
PLOTS OF TAXPRICE WITH GENERAL EXPENDITURE

Plot of 54 Cases

Plot of 53 Cases

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RECOMMENDATIONS FOR FURTHER STUDY

One must conclude that county government spending in Montana, for the period tested, was not significantly affected by changes in employment. If the employment variables had been important, they probably would have been statistically "significant" in the regression models tested. It is true that there may be some non-linear relationship between county expenditures and employment changes, but no such relationship could be detected through examination of plots of these variables. This study turned up no evidence to support a statistical relationship. Employment variables are probably not appropriate for use in future public expenditure research, at least for the foreseeable future.

The statistical insignificance of median income in the models tested indicates that the level of county expenditures in Montana in fiscal 1982 was being determined by forces other than the ability of the local voter to pay for those expenditures. One is tempted to conclude that the "tax price" variable was statistically insignificant for much the same reason. However, the use of a tax-related variable still seems sound conceptually. It could well be that a better formulated tax variable would appear statistically significant in a regression model.

Both taxes and incomes have theoretical importance in public expenditure analysis; any model of public expenditure determination which omits them will be seriously misspecified. Any future public expenditure model should contain these variables; the magnitude of the...
roles of these variables in the determination of public expenditures should be decided through empirical analysis, and these roles will most likely be different for data from different times and places.

The formulation of both variables in the median voter model, especially that of "tax price," is questionable. The problem in distinguishing the portion of taxes paid by county residents (who are potential voters) from those paid by nonresidents (who are not) has been particularly problematic in the model tested here. A measure of the "price" paid by local voters should include only taxes paid by county residents, and the "tax price" variable used here clearly does not make this distinction. Further research into the distribution of ownership of taxed property among residents and nonresidents is necessary for the formulation of a more accurate "price" variable. If this distribution between residents and non-residents can be accurately determined, the "price" variable can be greatly improved and the ability to export taxes to nonresidents could also be calculated much more precisely.

Economists who use the median voter model most often assume the voter at the political median is the voter at the economic median as well. The model thus requires the use of median income as an independent variable. As discussed earlier, this assumption is dubious. Models which operate on median income values should be compared in the future to those using mean income and income at other fractiles. The question of which to use becomes an empirical, not a theoretical, question.

While the median voter model has performed well in analyses of public spending in other times and places, the model fit the Montana
data presented here only because it had been greatly modified. It would appear that the weaknesses of the median voter model were made apparent by the inclusion in the model of the other public finance variables discussed above. When these variables were included in the analysis, they made the median income and tax share variables statistically superfluous. The median voter model has served as a guide to the formulation of this model, though. In particular, the "demand function" tenor of the model has led this researcher to focus on the marginal cost faced by the decisive voter in his or her acquisition of public goods, as well as the portion of the total cost of public goods and services which the voter can put off onto nonvoters (nonresidents). Ultimately, someone must pay for such goods and the inclusion of a variable or set of variables which reflect this required payment seems a significant advance in the structure of the model. The marginal cost variables identified can also be thought of as public sector finance variables. Thus, a fruitful course for future research in the area of public expenditure analysis will likely be concentration on these methods of finance and measurement of these methods.

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50This is demonstrated by a "stepwise" regression process, beginning with the most elementary specification of the demand function. When general expenditures is regressed on "tax price" and median income alone, the coefficients of the two independent variables both have the theoretically correct sign (positive for income, negative for price). While the coefficient for "tax price" is statistically insignificant at an acceptable level of confidence, that for median income is quite significant \( t = 5.254, p = .0000 \). Introduction of the alternative cost (and wealth) variables—tax base per capita (TB), the ability to export taxes (XP), intergovernmental transfers (TF), and charges and fees (CG)—"washes out" the statistical significance of income. The latter two variables in particular, seem to do the most to overshadow median income in the model.
Intergovernmental transfer payments are among these cost variables. Such transfers increased dramatically in almost all parts of the U.S. in the first thirty-five years of the post-war era. They have been decreasing radically for the last eight years, at least in most places. The results of this analysis of Montana county expenditures indicate that local voters and/or politicians are quite willing to increase public expenditures if those expenditures will be matched by "outside" money from the Federal or State governments. Unfortunately, transfer payment figures were available only in highly aggregated form and, for this study, could only be used for the general expenditures equations.

Research should be done with an eye towards eventually disaggregating such intergovernmental transfer figures according to functional spending categories. County spending responses should also vary with differing origins of the transfers (State vs. federal) and differing requirements of such transfers for matching monies. Research in these areas is needed as well. Likewise, a disaggregation of the figures for charges and user fees by the spending categories for which they are used would be quite fruitful.

The use of debt finance is also theoretically important to public expenditure determination. Thus, further research is needed into the use and legal limits on the use of this finance tool by local governments.

Modification of the median voter model by including the marginal cost/public finance variables identified (or improvements on them) would seem to be advised. Ordinary least squares seems to be an adequate tool for the testing of such models, and the variables suggested above, if
they can be developed, will probably provide a superior statistical "explanation" as well as a more insightful theoretical explanation of the complex process which determines public spending.
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