

## AN ABSTRACT OF THE THESIS OF

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Title: THE EFFECTS OF FEDERAL AGENCY PAYMENTS IN LIEU OF TAXES  
ON OREGON COUNTY EXPENDITURE PATTERNS

Abstract approved:

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Federally managed lands in Oregon are exempt from county property taxes. Instead of tax payments, the U.S. Forest Service makes direct payments to the county governments, which have National Forests in their boundaries. The payment amount is based on the revenue generated from commercial timber sales and leases of rangeland on the federal lands. Payments in lieu of taxes are restricted in use: 75 percent of the payment must be used for roads and highways, 25 percent for education. While the payments carry legal use restrictions, they may theoretically effect other local government service expenditures, and/or property taxes.

To examine the effects of payments in lieu of taxes on county expenditure patterns requires a model of the overall local fiscal decision making process. Prior modeling efforts can be broken into two broad groups: those which principally rely on a demand framework, and those which explicitly identify demand and supply forces in the community. This research holds that observed expenditures are a function of the interaction of the demand and supply forces in the community.

In this model, the median voter's demand functions are derived for five separate public goods, and estimated using generalized three stage

least squares. For these same goods, five supply of expenditure relationships are developed. The distribution, or supply, of revenues is viewed in terms of non-local revenues, the tax rate, costs of production, and the demands of the median voter, and are estimated using ordinary least squares. In both the demand and supply equations, quantities are measured in dollars and the tax rate is viewed as the rationing variable.

The results are generally in accord with the theoretical alternate hypotheses, based on established economic theory. Findings indicate that at higher tax rates smaller quantities of expenditures are desired, and that these demands are price inelastic. On the other hand, the supply of expenditures are positively related to the tax rate; more money is supplied as the tax rate increases, though these supplies are also price inelastic.

A one dollar increase in payments in lieu of taxes is found to increase the supply of road and education expenditures. Social services, general government, and public safety spending is not affected by changes in payments in lieu of taxes.

Dollar increases in payments in lieu of taxes, general federal aid, and cash balances are found to increase total local government expenditures by about one dollar. Both specific federal aid and non-tax related local revenues stimulate total expenditures by more than the amount of aid. State revenues are not found to have a statistically significant expenditure effect on any individual service, or on expenditures in total.

The Effects of Federal Agency Payments  
In Lieu of Taxes on Oregon County Expenditure Patterns

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THE EFFECTS OF FEDERAL AGENCY PAYMENTS  
IN LIEU OF TAXES ON OREGON COUNTY EXPENDITURE PATTERNS

CHAPTER I

INTRODUCTION

Dependent Community Stability

The United States Forest Service does not pay county property taxes on the land parcels they manage. By Federal law, agencies such as the Forest Service and Bureau of Land Management are exempt from local taxes on the land they hold in public trust. In counties where federal land stewardship is particularly large, a potential burden exists for private land owners who are subject to such taxes. Aware of the distributional tax burden "exemption" could create, the U.S. Congress, over a period of years, devised a program where by the Forest Service makes direct payments to county governments based on revenues from commercial timber sales and grazing leases from the lands they control.<sup>1/</sup> These direct payments, which have become known as payments in lieu of taxes (PILTS), amount in total to 25 percent of the gross revenues from the land, and are distributed to individual counties, which include National Forests in their boundaries, on a fixed percentage basis.<sup>2/</sup>

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<sup>1/</sup> The first of such payments was made in 1953. Various changes have been implemented since that time, the most recent alteration in the payments occurring when the U.S. Congress passed the National Forest Management Act of 1976. This legislation changed the aggregate amount of payments from 25 percent of net revenues to 25 percent of gross revenues. First payments under this new schedule were distributed in 1978.

<sup>2/</sup> PILTS, as defined here, are known as National Forest Receipts in some circles.

Oregon houses 18 national forests, in part or total, which accounts for 39.6 percent of the total state acreage and contain 61 percent of the total timber stock in the state (Oregon Blue Book, 1978). One result of such large land holdings is that 32 of the 36 Oregon counties receive Forest Service payments in lieu of taxes. The range of payments in large; from less than one percent of total revenues in Polk County to in excess of 40 percent of total revenues in Grant County.<sup>3/</sup> However, 20 counties receive more than 15 percent of their revenues from this single "non-local" source.

Counties which rely heavily on payments in lieu of taxes, as evidenced by the percentage of total county revenues this single source represents, are naturally more responsive to changes in the payment levels. A decrease, for instance, of 25 percent of the annual aggregate amount available for distribution to the counties would have a much more adverse effect on a county such as Grant, than on Polk County. Payment levels may vary due to changes in stumpage prices, alterations in the allowable cut, and other general federal land-resource management options. While the payment levels have been relatively constant over the recent past, county budget officers have been faced, at the same time, with high rates of inflation and generally larger budget requirements.<sup>4/</sup> The geographical distribution of National Forests in Oregon is such that the predominant share lies east of the Cascade Mountains; relative to western Oregon counties these eastern counties tend to have natural resourced based

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<sup>3/</sup> These figures are derived from county budget documents for the fiscal years 1976-77, 1977-78, and 1978-79.

<sup>4/</sup> Much of the budget growth was made possible by rapid growth of other federal to local transfers or grants. Between 1965 and 1975 federal aid increased in excess of 400 percent.

economies. While a strict east-west dichotomy is inappropriate, the eastern counties are more dependent on payments in lieu of taxes, and thus on federal land management practices.

The Forest Service, realizing the relationship between their land management actions and the dependent community economy and government, has identified the stability of dependent communities as a management objective. An understanding and analysis of the processes by which their actions are transmitted through the economy and community are paramount to achieving that objective. The Forest Service's concern is not limited to PILTS, but includes impacts upon local jobs, incomes, government, and the general quality of life in the community due to various land management practices.

It is beyond the scope of a single research effort to analyze all the economic and community externalities associated with land and resource management actions of the Forest Service. A comprehensive and complete analysis of the effects of PILTS on the community is also beyond the scope of a single effort. Such a project would require (1) expectations of market determined stumpage prices; (2) expectations of the allowed timber cut and rangeland available for lease; (3) the effects of payments on county expenditure patterns; (4) employment, income, and service quality changes attributable to changes in local government spending; and (5) the overall effects of the above variables on the private sector, economy, local population growth, and migration. The research presented here is part of a larger project dealing with the above five-pointed task. Market analysis tools exist to accomplish (1), and the Forest Service can provide information on (2). The purpose of this re-

search is to gain insight with respect to component (3), while a separate, but integrated, portion of the larger project deals with the elements of (4) and (5).<sup>5/</sup>

### Specific Problem

The purpose of this research is to identify the effects of Forest Service payments in lieu of taxes on Oregon county expenditure patterns. Oregon counties are restricted in the use of these resources by state statute. Of the payment received, 25 percent must be spent on education and the remaining 75 percent on county, state, and interstate roads and highways.<sup>6/7/</sup> In light of these legal limitations it is interesting to note Inman's (1977, p. 1) comment that "local government's were perceived as public spending bodies who played according to legal rules; give them money and they will spend it by the guidelines. But as experience has taught us, the rules were their own".

The Forest Service is presently in the process of evaluating alternative land management practices which may imply changes in timber cut and rangeland available for lease. As these are the basis upon which PILTS are determined, use decisions result in different levels of payment to

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<sup>5/</sup> This research and that identified as dealing with components (4) and (5) are portions of an Oregon State University research effort "Alternatives for Growth in a Resource Based Economy: A Pilot Study for Grant County, Oregon".

<sup>6/</sup> Because Grant and Curry Counties receive particularly large PILTS, Oregon law allows these counties to spend 25 percent of their total PILT payment for services other than roads and education. The remainder is portioned 25 percent to education, 75 percent to highways.

<sup>7/</sup> Payments in lieu of taxes are, in grant terminology, specific grants. Various stipulations as to the use of federal monies may be made in an effort to tailor the grant to its intended purpose. A more complete discussion of these stipulations appears on page 14.

local governments, suggesting changes in local government expenditure patterns. In light of the "dependent community stability" objective, an understanding of the local government externalities, in terms of expenditure changes, associated with public land resource management and use decisions is appropriate and timely.

### Theoretical Outcomes

While payments in lieu of taxes are tied by Oregon law to spending for education and roads, the predicted theoretical outcomes of a specific grant, such as PILTS, vary (Wilde, 1968, 1971). The range of effects include:

- (1) Stimulation of expenditures on the ~~aided~~ function resulting in a spending increase greater than the amount of aid. Local revenues, in excess of the local contribution in the pre-grant situation, are diverted to the aided public good. In this case PILTS and local revenues are complementary revenues. An increase in PILTS results in an increase in locally operated revenues.
- (2) Federal aid acts as a substitute for local tax money allowing increased tax supported expenditures on other services. For this case, PILTS and local tax revenues act as substitute revenues for specific services.
- (3) Federal aid acts as a substitute for local tax money allowing a decrease in taxes. PILTS and taxes are substitute revenues. An increase in PILTS results in a decrease in locally collected tax revenues.



- (4) Federal aid results in a combination of (2) and (3).

### Objectives

In light of these potential expenditure and tax outcomes from the receipt of PILTS, and the overall purpose of this research, the principal objectives here are:

- (1) to confirm or deny the hypothesis that PILTS are significant determinants of road and education expenditures;
- (2) to confirm or deny the hypothesis that PILTS stimulate expenditures on roads and education; and
- (3) to confirm or deny the hypothesis that PILTS are significant determinants of other county service expenditures.

### Theoretical and Methodological Overview

The expenditure effects of PILTS are part of the broader economic literature dealing with the federal to local transfer of grant monies and local government fiscal decision making. This area encompasses the determinants of public expenditures, taxes, and the production of public goods. Prior models can be divided into two general classifications: those which rely on a demand-oriented framework, and those which explicitly identify demand and supply forces within the community.

Two principal models have evolved in the demand framework. The constrained maximization model identifies the utility function of the elected decision maker as relevant in the community, with public good expenditures included in the utility function, and maximizes the functions

value, subject to the community budget constraint. The median, or majority, voter model holds that the median voter in the community has the relevant function. Again public good expenditures appear as major arguments in the utility function. This individual's utility is maximized subject to his budget constraint with tax prices included in the constraining equation. In both models, demand functions for public good expenditure can be derived and empirically estimated.

Other models have held that both demand and supply of expenditure forces originate in the community, and that the interaction of these two forces result in observed expenditures. Four models which view the local government expenditure process in this manner are fully developed in Chapter II, as are the demand-oriented models identified above. In the remainder of this research the demand models are referred to as political-fiscal models and the demand-supply models as non-political models. Both, of course, are economic in nature.

The model developed in this research views the community as being both the demander and supplier of expenditures for the provision of public goods and services. Citizens of a community are held to derive utility from the goods local governments produce. Viewing expenditures as a proxy for output, the individual is thus seen to demand expenditures for public goods.

Public goods are not costless, but are financed with non-local monies and local property tax revenues. If only non-local funds are used to support public goods, the individual's cost is essentially zero. However, with the implementation of property taxes the individual is paying a price for public goods, determined by the tax rate, and the concept of demand (equilibrium quantities desired at alternative prices, other things constant) becomes applicable.

In a similar vein, the community becomes a partial supplier of expenditures when non-local revenues are exhausted and property taxes implemented by exchanging private funds for public funds at a rate determined by the tax rate. The distribution, or supply, of expenditures among services is more complex as it must consider the actual costs of providing services, the allocation of various revenues, and the tax rate which allows an overall equilibrium level of expenditures.

For both sets of equations, quantity and price terms are notably different from those found in more traditional economic analysis. Quantities demanded and supplied are measured in dollars rather than units of output, while the tax rate is assumed to be the relevant price rationing variable.<sup>8/</sup> All variables are measured in per capita terms and all equations are specified as linear.

In response to the specific objectives of this research, public expenditures have been disaggregated to five functional categories: highways and roads, public education, public safety, social services, and general government and administration. A demand and supply equation are estimated for all functions.

Elected officials, responsible for the budgeting and actual expenditure of public monies, are hypothesized to respond to the preferences of the average or majority voter in an effort to gain their vote, and insure the officials re-election. As such, the average citizen's demand for expenditures is modeled. This individual's demand for each service identified is assumed to be a function of four common variables: (1) the county tax rate, (2) per capita income, (3) value of residential property

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<sup>8/</sup> The unorthodox measurement and the use of "demand" and "supply" terms, may concern some readers. The terms "desired" and "distributed" may be substituted for demand and supply, respectively.

in the county, and (4) value of non-residential property in the county. In addition, five taste and preference variables are identified as demand shifters which appear in various combinations in specific equations. They are: (1) percent of county population living in incorporated areas, (2) registered automobiles per capita, (3) percent of adult population completing high school, (4) percent of population under 17 years of age, and (5) the seasonally adjusted county unemployment rate. The theoretical rational for inclusion of these variables is fully developed in Chapter III.

The tax rate appears as an explanatory variable in all five demand for expenditure equations, yet expenditures are one of the determinants of the tax rate.<sup>9/</sup> As such, the tax rate is endogenous to the system of demand equations, and is modeled as an endogenous identity. When an endogenous variable appears as an explanatory variable, ordinary least squares is an inappropriate estimation technique. Three-stage least squares is one of the many appropriate estimation procedures for such a system and is used to estimate the parameters of the five demand equations.<sup>10/</sup>

Economic theory suggests that the supply of a commodity is a function of its price, the price of inputs, prices of alternative products, and technology. The supply of expenditures here is conceptually somewhat different from the traditional approach in economics to estimation of supply response schedules. While the supply relationship here contains

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<sup>9/</sup> The tax rate is held to be an identity of the form:

$$\text{TAX RATE} = \frac{\text{Expenditures} - \text{Non-Tax Revenues}}{\text{Total Assessed Value}} .$$

<sup>10/</sup> A full discussion of the properties and assumptions of three-stage least squares appears in Chapter III, p. .

cost of production elements, the elected officials responsible for the supply, or distribution, of expenditures for public goods are also seen as partially determining the aggregate amount of expenditures available for distribution through use of the property tax system. The tax rate acts as a complex rationing variable by determining, in conjunction with PILTS and other non-tax related revenues, funds available for public expenditure.

The supply of expenditures for all five services is assumed to be a function of eleven common variables: (1) county tax rate, (2) wage rates, (3) other local revenues, (4) PILTS, (5) specific federal aid, (6) general federal aid, (7) state revenues, (8) net cash balances, (9) and (10) dummy variables for the fiscal years 1976-1977 and 1977-1978, and (11) a dummy variable to identify Grant County. All supply equations are estimated using ordinary least squares. As for the demand equations, the theoretical rationale for inclusion of these supply variables is developed in Chapter III.

While the principal interest here is the supply response of local governments to receipt of PILTS, the model can be used to predict expenditure levels. Given an estimated supply and demand equation, in terms of tax prices, the system of two equations can be solved for the equilibrium tax rate, given values for exogenous variables. With the equilibrium tax rate, equilibrium expenditure levels can be estimated.

All coefficients in all equations will be subjected to two statistical tests (1) to determine if they are individually significantly different from zero, and (2) to determine if the equation taken as a whole provides results significantly different from zero.<sup>11/</sup> As price and income vari-

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<sup>11/</sup> Additional specific hypotheses tests will be outlined in Chapter III.

ables are included in the demand and supply equations, it is possible to gain estimates of demand and supply elasticities. These will be calculated at the mean value of the variables and compared with previous estimates.

### Research Limitations

This research effort, as described earlier, is one portion of the larger task of identifying community externalities associated with federal resource use decisions. The scope is intentionally limited. The large number of resource use impact questions presently being asked by resource managers, communities, and in the literature, could lead the over-zealous researcher down a path of frustration. Effects of changes in expenditure levels on many variables of current interest -- quality changes, potential growth or decline, employment and income changes are not pursued here. While important issues, these and similar impact issues are beyond the scope of the present study.

The public expenditure researcher is confronted with the task of either identifying objectives which existing models are capable of "handling", or synthesizing a model, from prior efforts, appropriate to the task at hand. Quite simply, this study area is relatively young; an established, generally accepted theory of local government expenditure does not presently exist. Viewed as either a challenge or a limitation, additional assumptions are required, the appropriateness of which, as in any economic model, should be evaluated in terms of the model's ability to "explain" real world events.

Aside from these conceptual limitations, data for this effort partially temper the interpretation of the results. Data observations are drawn from actual county budget documents. The budgetary practice of

transferring monies from one fund to another, on paper, may allow the county to meet the letter of the law, while to paraphrase Inman (1977, p. 1), 'they actually spend the money as they see fit.' Moreover, the task of reducing the often large number of county budget funds to five functional categories is difficult and in fact subjective. The degree to which mis-specification occurs may limit interpretability of results, and hence the use of the model for forecasting purposes.

### Organization of Thesis

Chapter II consists of a discussion of the two principal theoretical political-fiscal models and four non-political expenditure models. The research methodology and design are presented in Chapter III. Specific hypothesis tests and a discussion of prior empirical efforts appear. Chapter IV presents the results of the research, with interpretations regarding changes in payments in lieu of taxes on county expenditures. In Chapter V the overall summary of the research is provided and avenues for future research in this problem area are suggested. In Appendix I sources of information are documented. Appendix II provides the results of selected regressions.

## CHAPTER II

## REVIEW OF THE LITERATURE

Model Developments

In 1959 Brazer found that the federal grants "worked" in explaining local government expenditures in his single-equation expenditure function. His results stimulated research in the subject area in the following ten years, but efforts amounted to the inclusion of various "ad hoc" explanatory variables in other single-equation determinant studies resulting in, as Hirsch (1977, p. 314) states, "no major improvement". In 1969, Gramlich published a review stating "These (previous) studies have either confirmed or denied the importance of Federal grants, from either a theoretical or a statistical standpoint, using cross-section or time series data, and each study has invariably been followed by a comment attributing everything to simultaneous equation bias" (p. 569-570). He chided economists for not developing a theoretical base for their empirical work. The review represents a turning point in the literature.

In the ten years following Gramlich's comments, the political process in which fiscal decisions are made has come to center stage in the theoretical modeling of local government expenditures. The models which have been developed have not excluded neoclassical demand and supply forces, drawing heavily on the theories of the firm and consumer demand, but have tended to focus on the decision-maker's objectives and the process by which citizen preferences are transmitted to the decision-maker. As Musgrave (1969) stated, "while they (public goods) cannot be summarized as readily into market supply and demand functions as for the private good, the two blades of the scissors continue to exist".



The difficulties in deriving supply and demand relationships for public goods are principally due to the nature of the goods produced (failure of the exclusion principle to apply), and to the undefined objectives of the producing governments.<sup>1/</sup> The publicness of these goods makes quantity and price measurements tenuous. Moreover, consumption decisions are not reached individually, but are made collectively and are the result of preferences "articulated only indirectly by political representatives" (Deacon, 1977, p. 208). For commodities which are characterized by non-rivalness, "failure of the exclusion principle to apply raises potential problems for the revelation of individual preferences" (Deacon, 1977, p. 208).

The view of the marginal cost curve as the supply curve for the competitive firm implies a cost minimization (profit maximization) objective. As Hirsch (1970, p. 185) states, "we have no assurance that the least-cost combination of resource inputs, i.e. the lowest cost function of an infinite number of such functions, will be selected by the government unit to produce an additional increment of output". In addition, the services produced by local governments appear in a market with monopolistic characteristics; "the marginal cost curve is not the monopolist's supply curve ... 'supply' ... has a much less precise meaning in monopoly than in perfect competition" (Ferguson and Gould, 1975, p. 270). This research does not assume cost minimization, but rather that the observed marginal cost is a partial determinant of the supply of expenditures.

Political-fiscal models tend to identify an objective function which is maximized subject to a budget constraint, much as in consumer demand theory. Demand functions are then derived for the major arguments of the utility function. The two leading models are the constrained maximization

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<sup>1/</sup> If citizens do not face the possibility of being excluded from consumption, a system that relies upon voluntary contributions is likely to fail since consumption is not tied to a contribution.

model and the median voter or majority rule model. In both models, grants enter into the system by altering the budget constraint.

Though most recent research has relied on one of the two above models, non-political modeling of local government expenditures has been pursued. Modeling of the supply and demand for expenditures, where expenditures are viewed as a proxy for output, has been developed. Variables suggested in the theory of the firm and consumer demand theory are hypothesized to shift their respective curves, yielding different equilibrium positions. Other non-political modeling options also exist.

The most recent and unique theoretical treatments of expenditure patterns and grant effects contained in the literature are reviewed below. Single-equation expenditure determinant functions, precursor to current modeling, are not reviewed. The literature examining grant effects in the constrained maximization model and the median voter models are examined first. Then, four non-political models are evaluated with specific attention paid to the roles grants play in the analysis.

### Typology of Grants

Before reviewing the expenditure models, it may be instructive to identify the classification of grants in general. Depending on the type of grant, and the expenditure model chosen, the theoretical impact of grants vary.

Grants may be either specific, where the donor government specifies the functions to be aided, or general, allowing the recipient government to determine which function(s) to aid. They may also have matching requirements, where the recipient government must spend local monies on the aided function equal to a set percentage of the grant; or they may be

non-matching, where no local spending requirements are stipulated.<sup>2/</sup>

With these distinctions a 2x2 matrix may be constructed.

Typology of Grants<sup>3/</sup>

	Matching	Non-Matching
Specific	II	I
General		III

where

I = specific non-matching (i.e., payments in lieu of taxes)

II = specific-matching (i.e., transportation planning grants)

III = general non-matching (i.e., revenue sharing).

Additional grant distinctions include open versus closed-ended, and requirements as to the type or location of resource inputs purchased with the grant monies.<sup>4/5/</sup>

### Political-Fiscal Models

#### Constrained Maximization

The constrained maximization model was one of the first political-fiscal decision models developed to deal with the difficulties of pre-

<sup>2/</sup> A general-matching grant will not be made; matching grants are specific.

<sup>3/</sup> Adopted from Rittenoure and Pluta. Theory of Intergovernmental Grants and Local Government, Growth and Change, 1977.

<sup>4/</sup> The analysis here requires a level of disaggregation which yields grant type I, specific non-matching, which is the grant of interest throughout this effort.

<sup>5/</sup> Closed-ended grants are for a limited period of time. An open-ended grant does not have a time limitation as to receipt of the grant. It may be extended indefinitely.

ference aggregation in public goods (Scott, 1952). It has since been used by Bahl (1969), Osmon (1966), Sacks and Harris (1964), Fitch and Godwin (1976), Rittenoure and Pluta (1975) and others. Its basic constructs are drawn from consumer demand theory. The utility function is that of the fiscal decision-maker(s), with the objective of utility maximization subject to the budget constraint relating to local incomes and grants-in-aid.

The cogent feature of the model is that the decision-maker's preferences determine the utility function which he seeks to maximize. To assume the community preferences are perfectly represented by the decision-maker's utility function is a "leap of faith (requiring) communication of true citizen preferences to legislators ... and an 'efficient' legislative voting mechanism which can turn those preferences into appropriate community (expenditure) decisions" (Wilde, 1971, p. 143). While the model may not be politically realistic, its purpose has been to establish a theoretical base to view and forecast the effects of federal grants. "It is virtually certain that local governments do not perfectly reflect the preferences of their citizens ... (but) it seems likely that this condition has existed for some time, and that its effects are included in past expenditure patterns .... Use of the latter in forecasting effects of grants should be valid..." (Wilde, 1968, p. 345). Few, if any, researchers have literally taken the total leap of faith, though recently several have more fully developed the theoretical basis for such a step, the most notable and convincing being Inman (1977).

Inman holds that information costs and the costs of voting, viewed as the method of preference revelation, are so great that individuals do not become involved in the political decision-making process. Bureau-

cractic decision-makers are thus able to make expenditure decisions subject to their own preferences and the community budget constraint. While Inman's manuscript becomes more sophisticated, its basic tenet remains with the constrained maximization model.

### Grant Effects

The traditional reference for the effect of a federal grant on local government expenditures, as viewed from the constrained maximization model, is Wilde (1968). The tool of analysis is the indifference curve. In order to allow the indifference maps to yield "consistent results", Wilde makes the following four assumptions.

- (1) receipt of the grant does not shift the indifference map because of possible redistributational effects on the community;<sup>6/</sup>
- (2) the receipt of the grant does not cause a shift in the map because of a type of demonstration effect;<sup>7/</sup>
- (3) grant money receives no special treatment beyond the stipulation made by the higher unit of government;<sup>8/</sup> and

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<sup>6/</sup> Redistribution refers to the substitution of grant monies for local tax dollars allowing decreased taxes and a redistribution of income within the community. The redistribution might alter community demands resulting in a shift of the indifference curve.

<sup>7/</sup> If grants play an educational role, by forcing or inducing a community to provide certain services which leads to increased appreciation of the good, a demonstration effect has occurred. Such an effect may also shift the indifference curve.

<sup>8/</sup> If grant money is treated as "special" or "free" money, unlike other revenue sources, the effects predicted in Hirsch's analysis may differ from the true effect. Such special treatment of grant money may shift the budget constraint, indifference curve, or both, in an unpredictable manner.

- (4) the taxes levied by the donating government to finance the grants have the same impact on the community as all other influences on its disposable income.<sup>9/10/</sup>

The frame of reference for the decision-maker is the local government. In Wilde's terms this may be a school board, board of county commissioners, or state legislature. The analysis assumes the decision-maker(s) has a consistent set of preferences for public and private goods, such that normal indifference curves may be used in the analysis, and that he seeks to maximize utility subject to given prices and resource availabilities.<sup>11/</sup>

In Figure 1, units of the aided good are measured on the horizontal axis and all other public goods and private goods on the vertical axis. The measurement is in terms of dollars spent on these goods. As stated, other public and all private goods are aggregated such that separate public and private effects which might exist cannot be distinguished.

In the pre-grant situation the community faces the budget constraint PP' and is in equilibrium at point A, spending B on the aided function. OO' represents the income consumption curve given initial relative prices. Now assume a specific non-matching grant (of the federal agency payment in lieu of taxes type) is made in the amount of P'T'. The budget con-

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<sup>9/</sup> Assumption four relates to matching grants. If the community feels that tax monies which are used to gain additional federal money are substantially different from other taxes, their willingness to provide such monies may alter the budget constraint, indifference curve, or both.

<sup>10/</sup> A number of researchers have refined the basic constrained maximization model by testing a variety of these assumptions. See Ladd (1975), Rassmussen (1976), McGuire (1973), Rittenoure and Pluta (1977).

<sup>11/</sup> Wilde does not make the assumption that local government's perfectly reflect local citizen's preferences, and such an assumption is not necessary to the analysis.

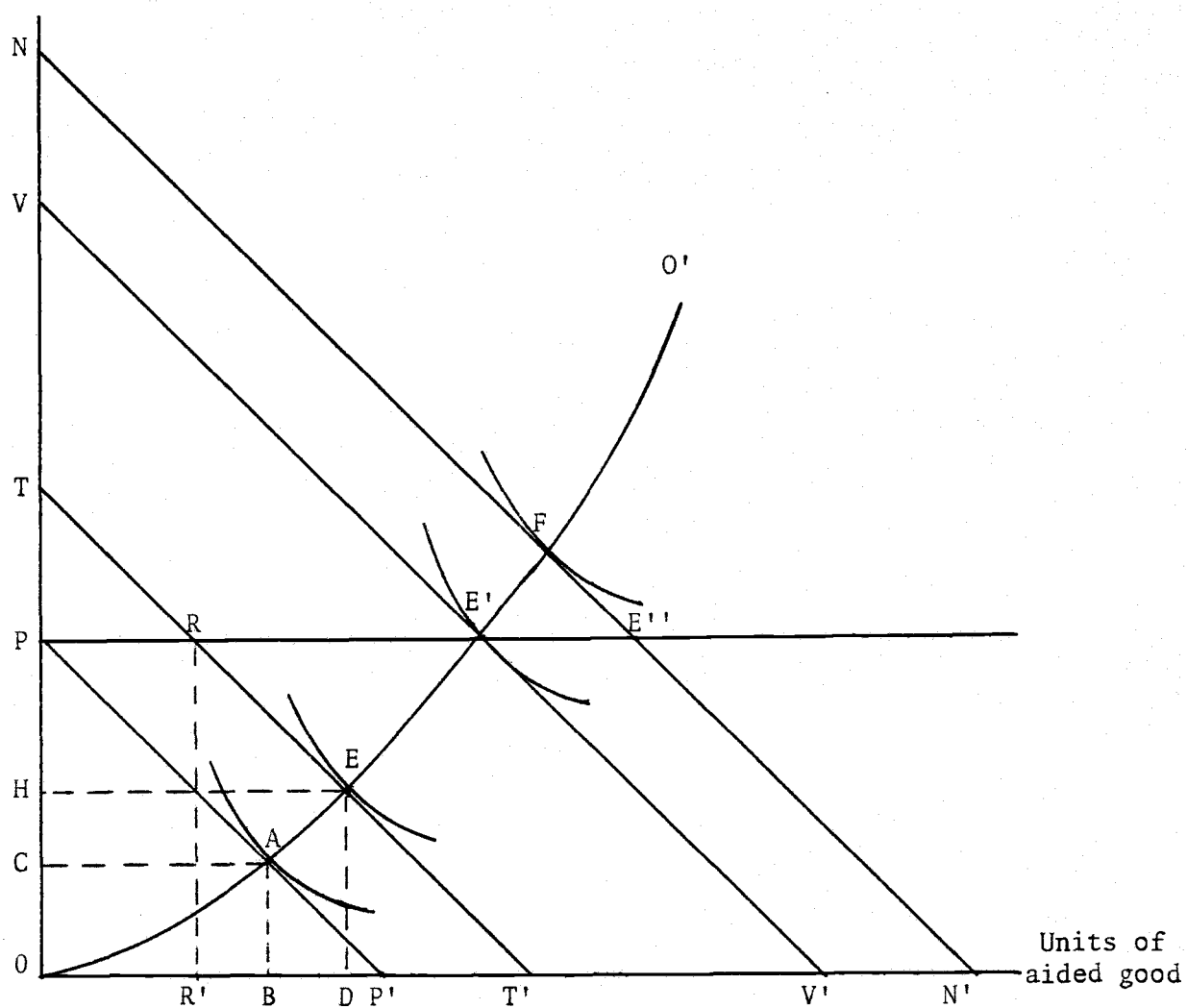
Units of all other  
public and private goods

Figure 1. Constrained Maximization Model-Specific and General Grant Effects.

straint shifts out in parallel fashion to  $TT'$ . Because of the specificity of the grant, the relevant constraint becomes  $PRT'$ .<sup>12/</sup> The new equilibrium is at E and the grant stimulates expenditures on the aided function in the amount BD, and by CH on all other goods. This is the same equilibrium position that would have been achieved if the grant had been general ( $TT'$  was the relevant constraint).

General and specific non-matching grants will continue to have the same result up to the point where the grant amount exceeds  $P'V'$ . With a grant of  $P'N'$  ( $P'N' > P'V'$ ) the relevant constraint in the specific case is  $PE''N'$ . Because of the specificity constraint, the community leaves the income consumption curve and locates at the kink, pt  $E''$ . Wilde refers to this effect of the grant as the deflection effect. In the general grant case, the community again locates on  $OO'$  at point F. General and specific grants thus may, or may not, have different results depending on the size of the grant relative to the pre-grant expenditures and the slope of the income consumption curve,  $OO'$ .<sup>13/</sup> For grant amounts which yield equilibriums beyond the deflection point, the general grant will allow the community to attain a higher indifference curve (pt. F) than will the specific grant (pt.  $E''$ ).

Wilde recognizes leakages of grant monies occur allowing increased expenditures on other goods, or tax relief. In the pre-grant situation OB was spent on the aided good, X. With aid of  $P'T'$ ,  $DR'$  dollars of local

<sup>12/</sup> Note the grant amount,  $P'T'$ , is equal to PR the amount of the good  $P'T'$  will buy.

<sup>13/</sup> The slope of the income-consumption curve is the marginal propensity to consume X or  $\frac{\partial E_X}{\partial G}$ , where  $\frac{\partial E_X}{\partial G}$  is the change in expenditures on good X,  $E_X$ , given a change in grants, G.



revenue are spent on X. The amount  $DR'$  is less than  $OB$  and the difference represents a "leakage". This leakage increases with the amount of aid and, in the limit, equals what was spent in the aided good in the pre-grant situation, at and beyond the deflection point. At the deflection point,  $E'$ , further leakage is prevented as further aid is wholly devoted to the aided function at the margin. Only in the case when the local government receives a specific grant and was not initially spending anything on the aided good will 100 percent be spent on the good.

In Figure 2,  $ZZ'$  represents expenditures on the aided good as a function of aid in the general grant case.  $ZZ''$  is the expenditure function in the specific case. Leakages are represented by the vertical distance between  $ZZ''$  and the  $45^\circ$  line, up to point  $P$ , the deflection point. At  $P$ , leakage is complete, equal to pre-grant expenditures, and beyond  $P$  expenditures increase dollar for dollar with aid.

In the Wilde analysis, the expenditure response of the local government is dependent upon the slope of the income-consumption curve, local expenditures prior to the grant, and the size of the grant relative to prior expenditures. Subject to the combination of these factors, a grant may be stimulative, substitutive allowing increased spending on other services, and/or substitutive allowing a decrease in needed tax monies.

Wilde's analysis can be extended to a two public good world if the income elasticity of demand for the aided good and the cross elasticity of demand between goods are known. If the goods are complements (substitutes), an increase in the expenditure for the aided function results in an increase (decrease) in the complementary (substitute) good, subject to the supply of revenues. The initial increase or decrease in the aided function is a result of the type of grant and income elasticity of

Expenditures on  
X (\$)

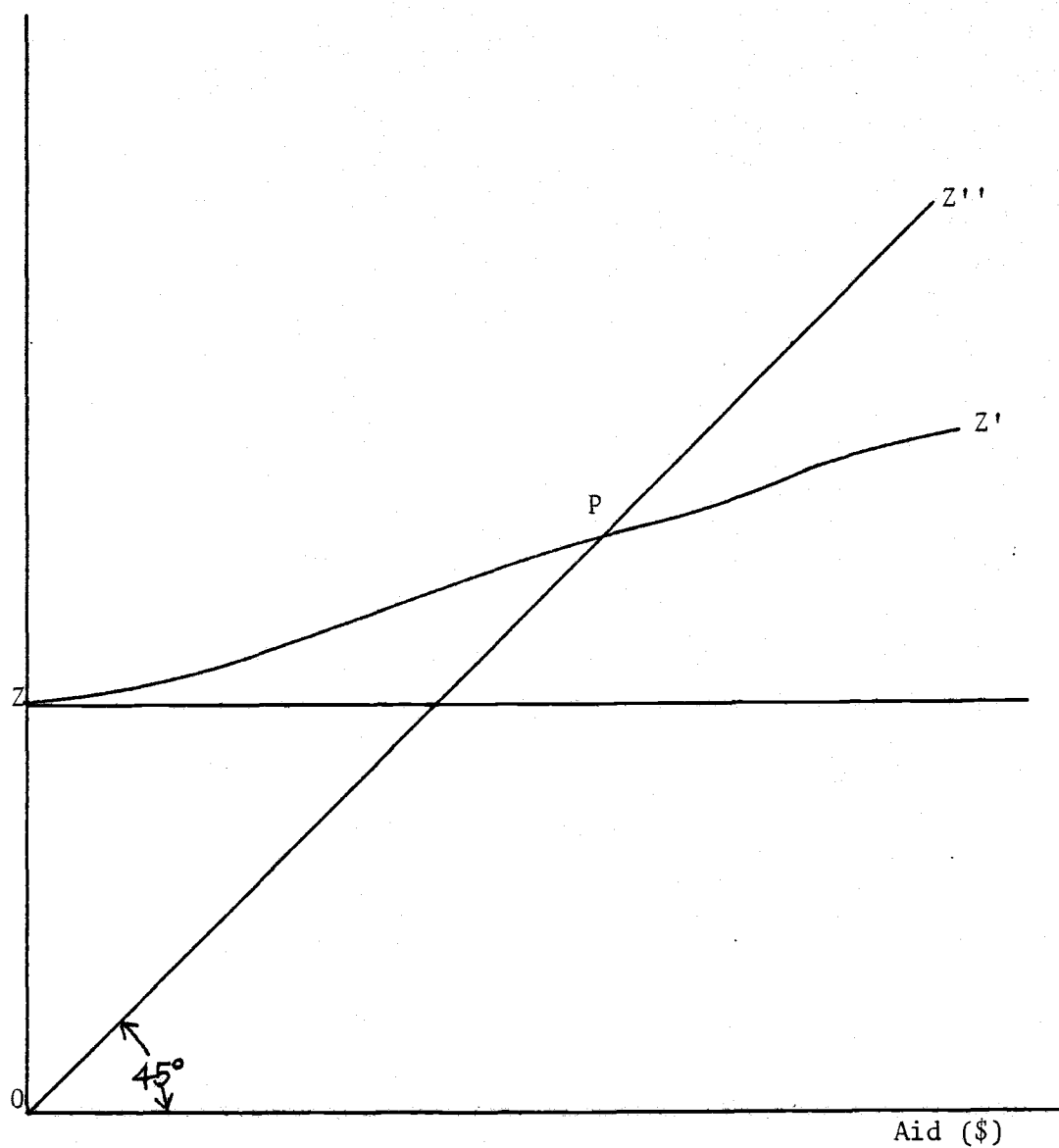


Figure 2. Expenditures as a Function of Specific and General Aid-Constrained Maximization Model.

demand. The expenditure change for the related good is a "second round effect" due to the cross elasticity relationship between the non-aided good and the aided good. Unfortunately the model is unable to deal with more than two goods.<sup>14/</sup>

Rittenoure and Pulta (1977) extended Wilde's analysis slightly by considering various slopes of the income-consumption curve. In Figure 3, if the line segment connecting the original equilibrium position and the equilibrium on the new (aided) budget constraint has a negative slope greater than negative one, the aided good has a negative income elasticity (inferior good) and all other goods are normal (IC' and Region I). If the segment has a positive slope, both goods are normal (IC'' and Region II). If the line segment has a negative slope less than unity the aided good is normal and all other goods are inferior (IC''' and Region III).

This analysis defines the marginal propensity to consume,  $\frac{\partial E_A}{\partial G}$ , where  $E_A$  is the expenditure on good A and G is the grant amount, in terms of the initial equilibrium point and the aided budget constraint. These relations are shown in Table 1.

#### Median Voter Model

The median voter, or majority voter model, also relies on the utility maximization framework. The utility function which is maximized is viewed as belonging to the median voter rather than elected officials as in the constrained maximization model. Utility maximizing behavior is

<sup>14/</sup> Consider a three good world where A is the aided function, B a complement to A, and C a substitute for A. Expenditure changes in A thus have opposite effects on expenditures for B and C. B and C are also related. The final equilibrium spending for A, B, and C is a function of the relative changes in B and C as a function of A, and the cross elasticity effects between B and C. Expenditures for the three goods are simultaneously determined.

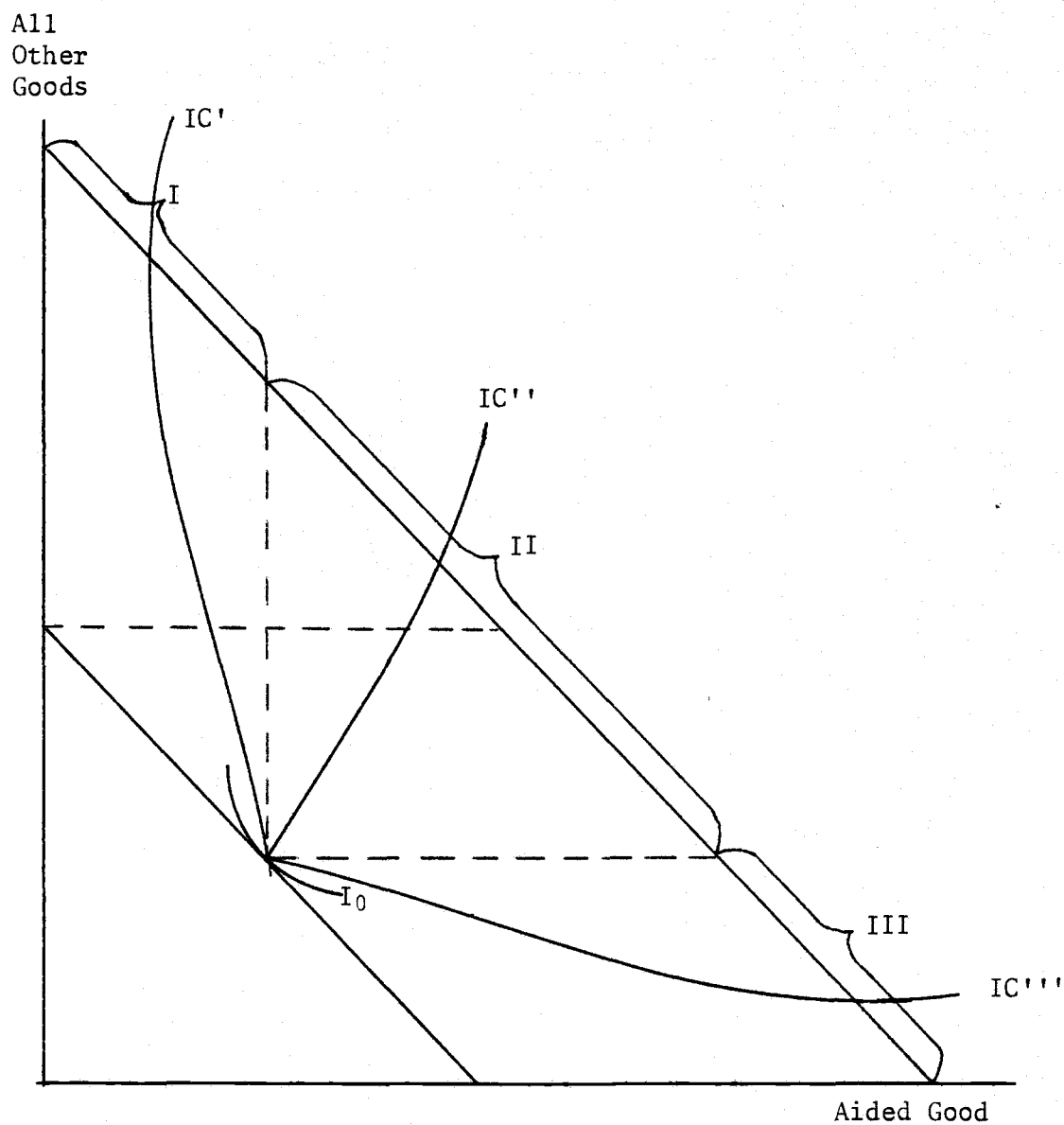


Figure 3. Expenditure Equilibriums Under the Range of Possible Income Consumption Curves.

Table 1. Elasticities, Marginal Propensity to Spend, and Income Consumption Curve Relationships

Income Elasticity	Marginal Propensity to Spend	Diagrammatic Equivalent*
$N_Y A < 0$ $N_Y O > 0$	$\frac{\partial E_A}{\partial G} < 0$	Region I
$0 < N_Y A < 1$ $0 < N_Y O < 1$	$0 < \frac{\partial E_A}{\partial G} < 1$	Region II
$N_Y A > 1$ $N_Y O < 0$	$\frac{\partial E_A}{\partial G} > 1$	Region III

where  $N_Y A$  is the income elasticity for the aided good

$N_Y O$  is the income elasticity for all other goods

$E_A$  is the expenditure on the aided good

$G$  is the grant amount.

\* refers to Figure 3, p. 25.

assumed and the relevant budget constraint is that of the median individual. Elected officials are viewed as seeking to maximize the likelihood of their being (re)elected. This is accomplished by providing the bundle of public goods and services which is desired by the majority, or median voter. By satisfying their objectives he gains their vote, and thus his own (re)election.

The political process is seen to be highly competitive, much as in the model of pure competition. Politicians and voters have relatively full information and there are few barriers to entering the political arena. Many politicians enter the race and seek (re)election by developing platforms they feel align with the preferences of the community's majority. Politicians thus practice vote maximization, not unlike profit maximization. Voters are confronted with alternative platforms and candidates and select, or vote for, the platform or bundle of goods and priorities they most desire; that is, they vote in their own self-interest. Voting is the method of demand revelation and the candidate who is elected most closely represents the demands of the majority.

The elected official is viewed as being responsive to the median voter demands, and this voter's utility function becomes the relevant one in the community. The modeling of the relationship can become more sophisticated, though this remains as the basic premise of the median voter model.<sup>15/</sup>

The median voter model treats federal aid in the same way the constrained maximization model does. This becomes most clear by identifying

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<sup>15/</sup> For a more elaborate theoretical treatment of the relationships between elected officials and their constituency, see Breton, The Economic Theory of Representative Government, 1974.

the decision-maker as the median voter, and the two models are essentially indistinguishable.

The median voter model is, perhaps, the most popular for use in dealing with local government expenditures. It was first used formally by Davis (1965) and later by Barr and Davis (1966), Ladd (1975), and a host of others.

Davis (1965) placed emphasis on the price effect in determining demands, the hypothesis being that individuals will want more of a public service the lower their share of the total tax bill. Expenditures were held to increase with the size of the industrial tax base and be negatively related to the percentage of the electorate owning property. His results were generally in accord with the hypothesis.

In 1966 Barr and Davis developed hypotheses concerning the equilibrium level of demand for public services. They held individuals will demand public services until their marginal valuation of the service is equal to the price (tax) paid for the service. By including taxes in the consumer's budget constraint, and public goods in the utility function, Barr and Davis were better able to estimate individual demands supporting the hypothesis.

Once prices (taxes) had been introduced into the budget constraint, and thus into derived demand, it was not long before demand parameters were estimated specifically. Income and price elasticity estimates were provided by Barlow (1970) and Deacon (1976).<sup>16/</sup>

Ladd (1975) further extended the earlier work of Davis. The percentage of community assessed value which was non-residential was

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<sup>16/</sup> For a review of these results see Chapter III.

identified as a demand variable with the hypothesis that the larger non-residential valuation, the greater portion of the tax burden could be shifted to non-residential property. Incorporating the marginal equilibrium hypothesis of Barr and Davis, she held that demand for services was positively related to non-residential assessed value. Her results generally supported this hypothesis.

More recently, efforts have considered various methods by which the median voter's preferences are made known. The notion that individuals act in self-interest when choosing among ballot alternatives suggests the use of voting data as information on revealed preferences for public goods. This topic is rapidly growing as a new study area. For the most part, however, these efforts are beyond the scope of this research. For a brief review and reference see Niemi and Weisberz (1976).

#### Non-Political Models

Not all researchers have viewed local government fiscal decisions from the utility maximization framework. A number, including Hirsch (1977), Hambor, Phillips and Votey (1973), Ohls and Wales (1972), and Booms and Hu (1971) instead have focused on the simultaneous working of supply and demand for expenditures with the community. These efforts have tended to make simplifying assumptions concerning the articulation of demands to decision makers, concentrating efforts on applying the market concepts of demand, supply, and equilibrium to the provision of public goods. The principal difference between these models and those reviewed under political-fiscal models is an explicit consideration of the supply response of local governments.

These researchers have criticized single-equation determinant functions for "estimating expenditures jointly within a system of demand



for and supply of ... services by reducing this system of equations to just one equation. In effect, they thus estimate a single reduced form equation derived from a structural equation which is part of a larger structural framework" (Hirsch, 1977, p. 315). As Deacon (1977, p. 211) stated, "though expenditure determinant equations may be relatively successful in explaining cross-sectional differences in per capita spending, that is literally all they are capable of doing. Without explicit theoretical underpinnings, they present no opportunity to test or refute behavioral hypotheses." As with the demand-oriented models reviewed earlier in this chapter, the purpose of the demand-supply models is to apply typical economic constructs to local government expenditures is an attempt to develop and test behavioral hypotheses.

#### Booms and Hu - 1971

Booms and Hu (1971) estimated the demand for and supply of financial resources devoted to education, hypothesizing that simultaneous interaction of these two forces resulted in observed expenditures. The provision of financial resources to the public sector is viewed as an exchange of private funds for public funds; considering the use of funds, it is an exchange of private goods for public goods, not unlike the consumer credit market where present funds are exchanged for future funds, at some price.

Exchange implies specialization of product which provides the incentive to exchange. As Booms and Hu state:

"... differences exist between private and public goods because of the nature of public goods. These goods are by character such that they will not ordinarily be produced without some joint effort (i.e., governmental effort) aimed

at internalizing the benefits and costs of the good. In other words, some form of the exclusion principle must be brought to bear on the members of the society. In the presence of some internalizing force it is to each individual's benefit to reveal, at least in part, his preference for these public goods, and thus they are provided. Government succeeds in internalizing the benefits and costs by forcing all of its citizens to conform to the desires of the majority. The community becomes both the demander and supplier of public funds" (Booms & Hu, 1971, p. 423-24).

To avoid political modeling confusion, the community is assumed to behave as the average citizen, or the majority of citizens behave. This assumption is similar to the median voter model tenet.

The emphasis in their study is on the demand for and supply of expenditures for education rather than for the service itself. The quantity and price terms are somewhat different than in conventional demand and supply analysis. The quantity variable is measured as per capita education expenditures. The price variable is the price at which private funds are exchanged for public funds, or the tax price. The price-quantity demand and supply relationships suggested by economic theory are posited to hold in the model. On the demand side, the tax rate is expected to be negatively related to the demand for per capita education expenditures. Citizens will demand public education expenditures until the marginal utility of the last private dollar converted to a "public dollar" is equal to the marginal utility of the last dollar retained for private expenditures; that is, the community maximizes utility in the process of exchange. On the supply side, the supply of public education funds should increase with increases in the tax rate, other things held constant.

Other variables, suggested by economic theory, which influence demand and supply are included in the specifications. This is partially in an effort to solve the classical identification problem of modeling

two price-quantity relationships simultaneously. Income is hypothesized to measure the ability with which a community can convert desires (demand) into expenditures and is also a measure of the community's ability to supply expenditures. Taste and preference variables appear in the demand function including non-public school enrollment, median years of education for adult population, and other public expenditures. Other variables affecting the ability of the community to supply expenditures, and thus the price of the service, appear in the supply equation. These include per capita federal education grants and per capita interest expenditures for schools.

The interaction of the demand and supply forces is the principal interest. A market clearing equation is specified such that the quantity of expenditures demanded is equal to the quantity of expenditures supplied. The equilibrium represents observed expenditures.

Tax rates and federal grant payments to the local government are viewed as being endogenous to the system. Equations for both are included in the structural system. The average tax rate is hypothesized to be a linear function of per capita income, demand for expenditures, assessed value of real property, and per capita interest expenditures for education. Per capita federal grants for education are hypothesized to be a linear function of per capita income, demand for expenditures, and percent of population of school age.

The role grants play in this model appears in the supply function. Grants are viewed as increasing the ability of the community to supply expenditures at any given tax price. Essentially the supply curve is shifted out and to the right yielding the potential for greater levels of expenditures at any given tax price. This suggests the relationship

between PILTS and tax rates are complementary revenues. The range of potential spending options parallels the previously described analysis of Wilde (1968).

#### Ohl and Wales - 1972

The Ohls and Wales model (1972) is an attempt to identify the roles that demographic variables play in the demand for and supply of local government services. They simplify the political problems by assuming services are provided in accordance with the voting patterns of the median voter; that is, voting is the method by which citizens reveal their demand preferences and elected officials respond to the demand of the majority.

Most studies which take a simultaneous equations approach to the demand and supply for services include the demographic variables in the demand equation, arguing these characteristics further define the demands of the community. Ohls and Wales argue that demographic factors more accurately indicate the costs of providing services.

For instance, population densities and degree of urbanization are expected to affect the costs of providing given levels of police protection rather than the level of protection which is demanded. Essentially they use some traditional demographic variables as proxies for difference in production functions -- variations in the costs of a unit of service rather than as demand shifters.

The demand equation is specified as a function of income, price of the output, and federal grants. The supply equation is formally specified, and then simplified and terms rearranged such that price is a function of supply related variables. Stating that public good unit prices and unit quantity cannot be accurately measured, they combine the demand

and price equations (rearranged supply equation) in a single equation (multiplying quantity demanded by price), to be estimated. While the structural effects of various elements are hypothesized, their equation is essentially a single-reduced form equation of a larger structural system. While the higher ordered system has been identified, strict demand and supply behavioral hypotheses cannot be tested.

Hambor, Phillips, and Votey - 1973

Hambor, Phillips, and Votey (1973) developed a simultaneous equation approach for estimating the demand and supply of educational attainment. The model assumes welfare maximization. The community is the producer of education facilities and also the demander of educational attainment.<sup>17/</sup> The level of educational attainment which the community chooses is assumed to be that level which maximizes the value of attainment, net of production costs, or the sum of producers and consumers surplus. Differing from other efforts reviewed here, quantity and quality measurements are required for use of this model.

A log-linear demand function is derived from the objective function in terms of teacher input, student input, nature of the community, and the load of the school system. A log-linear supply function containing variables for educational attainment, income, load on the system, and wages of educators is then formulated. The two equations are estimated simultaneously using two-stage least squares with special attention to price and income elasticities.

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<sup>17/</sup> Demand of educational attainment is tied to the spillover effects of education.

The welfare maximizing objective function is unique. It provides a theoretically appealing basis from which to draw inferences concerning local government expenditure patterns.

#### Hirsch - 1977

In a more general treatment of local government expenditures and their determinants, Hirsch (1977) provides a thoughtful framework. The argument begins by criticizing single-equation expenditure determinant functions for including demand variables in what he holds should be a cost relationship. By failing to identify the higher order structural relationships, theoretical hypotheses cannot be tested, and cost and demand relationships are not elucidated.

To show that expenditure determinant studies do embody implicit demand and cost functions, Hirsch begins with a Fabricant-type model

$$E = m(P, Y, U)$$

where E is total expenditures, P is population, Y is per capita income, and U is degree of urbanization. Hirsch relates his analysis to police expenditures, although the demand, production, and cost considerations will hold for any publicly-produced service.

Assuming total crime varies directly with population, and using total crime as a proxy for the demand for police services, a relation between population size and the demand for police output is obtained. As drawn in quadrant I of Figure 4, the demand relation, D, is linear, holding Y and U constant. Now, however, rising income shifts the demand to D' due to the income effect (police output is assumed to be a normal good) and due to the fact people are wealthier now, have more to lose, and desire

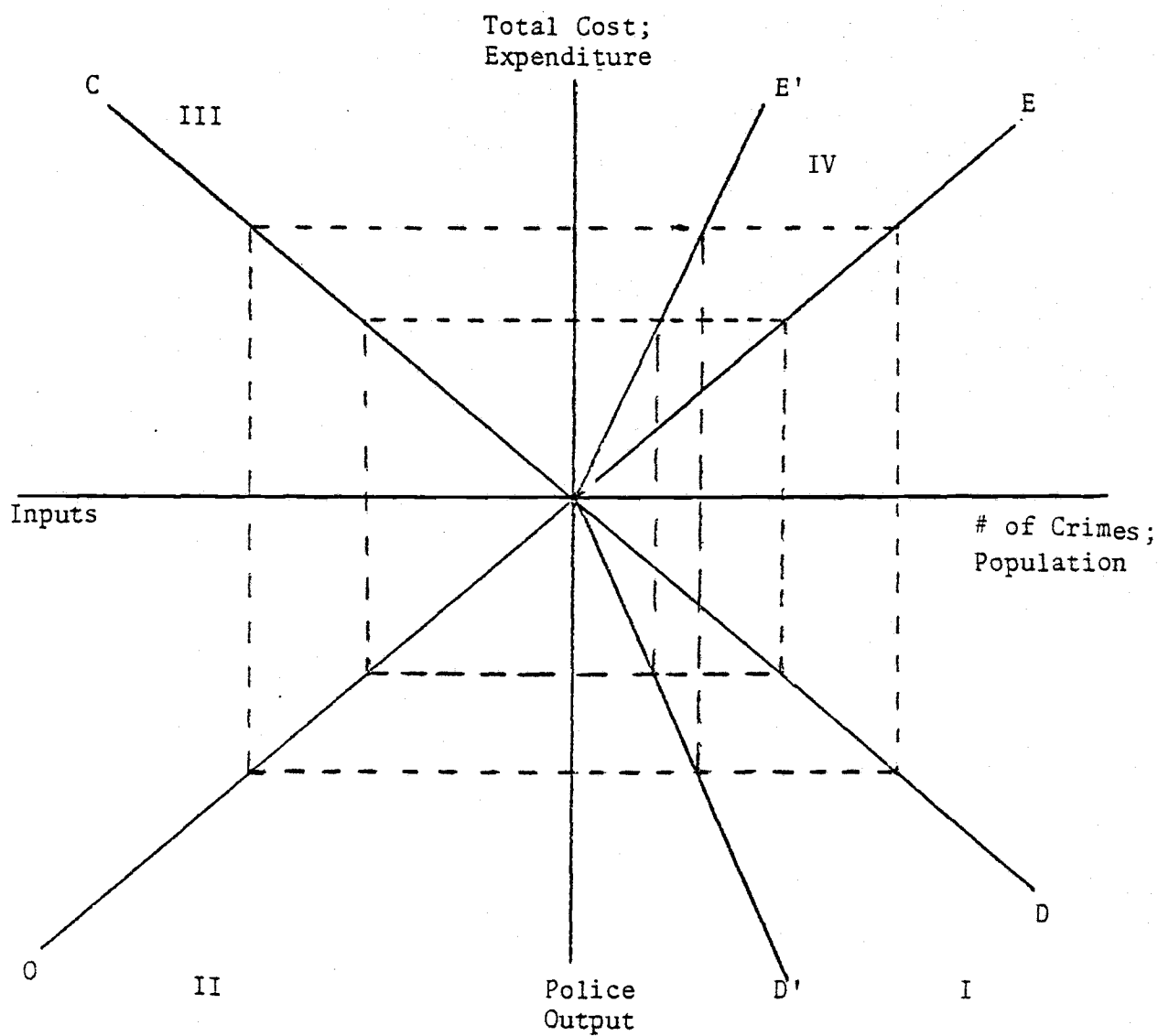


Figure 4. Demand, Output, Cost, and Expenditure Relations for Provision of Police Services<sup>a/</sup>

<sup>a/</sup> Derived from Hirsch, 1977, p. 317.

greater protective services. On the supply side, Quadrant II indicates a linear production function for police output,  $O$ . For any level of police output the required inputs are known. Quadrant III identifies the total cost associated with possible input bundles identified in II. Input prices are known with certainty and by taking the vector of input prices and multiplying by the vector of inputs levels, the cost relationship,  $C$ , results. The total cost function is linear, as drawn here, suggesting that purchases of inputs by the local government are not sufficiently large to affect market prices. Expenditures in IV are a function of demand transmitted through the production and cost functions. The rise in income which shifted  $D$  to  $D'$  has shifted expenditure patterns from  $E$  to  $E'$ .

Hirsch fails to state several important conclusions. Given that input prices and the production function are constant, as indicated here, it can be said that expenditures are strictly a function of demand. Expenditures are a linear function of a linear function of a demand function. Each demand schedule, transmitted through the production function and inputs costs, results in a unique expenditure schedule. This entire analysis requires the very strict assumption that citizen demands are perfectly transmitted through bureaus and fiscal decision-makers resulting in optimum expenditure and production decisions.

While Hirsch's model provides an interesting view of the local government production process, it is not sufficiently well developed to be valuable in estimating the effects of federal grants. The result of a grant in the model appears as a southwesterly shift in the cost curve, allowing the purchase of inputs at no local cost. Consideration of sources of expenditures exceeds the current abilities of the model.



### Technical and Conceptual Problems

All of the models described above have been subject to some critical review, ranging from misspecification of variables to inappropriate estimation techniques. While the techniques of economic modeling and statistical estimation that have been employed have become more sophisticated over time, a common set of problems continue to appear.

As presented earlier, the theoretical effect of different grant types is unique. The expenditure response of a specific grant and a general grant are not necessarily identical. It is not uncommon, however, to find researchers who have aggregated federal and/or state aid into a single aid variable. The results of such efforts limit the conclusions, for academic and policy analysis, which may be drawn concerning structural relationships. For the analysis to be particularly useful the assumption must be made that the weighted average of various aid types remains constant over time. It seems likely these weights do indeed change with time.

One problem is inherent to all demand modeling when cross-section data is employed. These models assume a single objective function across units of observation. "(T)he structure may not be constant across units. In each case the problems faced ... are entirely different, the political environment and representation are entirely different, and it is likely that the governmental response to various outside stimuli will also be entirely different" (Gramlich, 1969, p. 579). Half the sample may be budget maximizers, one-third tax rate minimizers, and the other one-sixth with mixed objectives. To assume they react to aid in a single way is an over simplification. Moreover, if the government's objectives change over time, the use of time series data introduces additional problems. Pro-

ponents of the demand models do not explicitly identify this potential shortcoming. "Pooled cross-section regressions offer a promising means of escape for many of the problems of one period cross-sections, at least as long as the time interval over which observations are pooled is short enough to minimize the risk of time passage structural change" (Gramlich, 1969, p. 579).

The nature of public goods, and the inherent difficulties of unit cost and quantity measurement, generally forces measurement of expenditures and tax rates rather than quantities and typical prices. While these quasi-measures can be, and are, used the assumptions necessary to allow the application of traditional economic theory may or may not be wholly appropriate. The addition of a third index, the quality of service, further complicates variable measurement and comparisons.

The technical estimation techniques which have been employed range from ordinary least squares to generalized three-stage least squares. Recently greater care has been taken to estimate structural systems, viewing expenditures as a function of the simultaneous working of a variety of forces, but the structural relationships posited to hold and the methods used to avoid biased estimates have not resulted in a "best" technique. If demand and supply forces are held to exist, any single reduced form equation will be subject to simultaneous equation bias. Structural systems which are estimated have the drawback that if any single structural equation is misspecified, the estimates will be biased.

In general, the number and sophistication of local government expenditure models has increased over time, but the nature of the problem area, and the continued absence of a clearly accepted theoretical model, have left much room from continued efforts.

### Summary

The theoretical models of local government expenditures which have been reviewed do not provide a definitive conclusion as to the local government response to a specific federal grant. The constrained maximization and median voter models indicate that the response is a function of (1) pre-grant expenditures, (2) the size of the grant relative to pre-grant expenditures, and (3) the slope of the revenue-consumption curve (that is, the value of  $\frac{\partial E}{\partial G}$ ). The range of responses include (1) stimulation of local expenditures (PILTS and taxes are complements), (2) substitution of federal revenues for local revenues for the aided service resulting in increased spending on other public services (tax revenues and PILTS are substitutes), and (3) substitution of federal revenues for local revenues resulting in a decrease in locally collected tax revenues (PILTS are substitutes for property taxes).

Other models reviewed provide even less clear cut predictions of the local government response. The emphasis in these efforts is the development of a framework to apply traditional market demand and supply constructs to local government expenditures within a positive economic framework. The political-fiscal models, in contrast, focus on the demand for expenditures and the articulation of individual demands. While the application of public choice models to local government expenditure study has, and will continue to be enlightening, in consideration of Inman's (1977, p. 1) comment that the rules by which local governments spend federal money "were their own", it may be most productive to pursue a positive theory of local government finance.

## CHAPTER III

### RESEARCH DESIGN

#### Introduction

The purpose of this chapter is to develop the theoretical and methodological bases of the model which is used in this research. The design of the model is an attempt to combine the economic forces of demand and supply in such a way as to explain the expenditure patterns of local governments. Within that framework, the purpose is to identify the roles PILTS play in the process so as to meet the objectives of this research identified in Chapter I.

The chapter begins with a descriptive analysis of the relationship of PILTS and county expenditures. The legal use limitations of PILTS are discussed, as are recent changes in these laws and the relative importance of the payments, as evidenced by the percentage of total county revenues the monies account for.

The community is identified as the supplier and demander of public expenditures, with the interaction of these two forces resulting in observed expenditures. The measurement of quantities and prices used in the supply and demand equations are somewhat unique and are developed in the section following PILTS in Oregon. All quantities are measured in dollars of expenditures rather than units of output. These expenditures are disaggregated into five functional categories such that the separate effects of PILTS on various services can be determined. The tax rate is held to be the price vehicle by which the expenditure "market" is brought into an equilibrium condition. PILTS also affect the tax rate, with

implications for both demand and supply, as the tax rate is viewed as a determinant for both market forces.

A theoretical overview of the model, which is further developed in the remainder of this chapter and used throughout this research, appears in the third section. The model is then compared to two other models used in prior studies. As is usually the case, portions of existing efforts have been fused together as is appropriate to the task at hand. The model which is used in the research has its basic tenets in the non-political models reviewed in Chapter II.

The fourth section of this chapter identifies all variables included in the set of five demand equations, the tax rate identity, and the five supply equations, and provides the theoretical rationale for their inclusion. The demands which are modeled are those of the median voter in the community and, thus, are derived from the utility function of that individual. The interrelationships of these demands indicate the demands are simultaneously determined. An estimation procedure appropriate for simultaneous equation systems is selected and discussed in the fifth section. The tax rate is held to be an identity relationship of total expenditures, non-local revenues, and assessed valuations. This identity is endogenous to the demand for expenditures and is modeled as part of the simultaneous demand system. The supply, or distribution, of expenditures is viewed as the responsibility of the elected official who is responsive to the demands of the median voter and bureau managers. The five supply equations are not part of the simultaneous system, and are estimated using ordinary least squares.

The statistical estimating equations and accompanying hypothesis tests are then developed. The chapter concludes with a discussion of the

data set used to determine the effects of payments in lieu of taxes on Oregon county expenditure patterns for the fiscal years 1976-77, 1977-78, and 1978-79.

### PILTS in Oregon

Forest Service payments in lieu of taxes represent one of the federal to local transfers which, in total, have grown tremendously in magnitude over the last 15 years. PILTS differ, however, from most other federal monies in that (1) they have been relatively constant over this period, (2) no formal grant applications are required for receipt, (3) payments are made because the recipient county has National Forest lands within its boundaries, (4) payment levels are based on federal revenues generated from timber sales and rangeland leases on the lands the Forest Service manages, and (5) the funds transferred to recipient counties must be spent for roads and education in fixed percentages.

These payments are an important source of revenues for many Oregon counties. Table 2 displays the dollar value of payments and the percentage of total county expenditures PILTS represent for all Oregon counties for the fiscal year 1976-77. Recipient counties "know" they will receive payments, though there is some uncertainty as to the level. In an effort to reduce this budgetary risk, the Forest Service provides the Association of Oregon Counties with expected payment levels in advance, and they in turn provide the information to the appropriate counties.

The receipt of these monies is tied by Oregon law to expenditures for roads and schools. Because, however, "one dollar, no matter how received or spent, offers the same benefits as any other" (Inman, 1977, p. 716), it is naive to assume that (1) expenditures for roads and schools

Table 2. The Relationship Between Total Per Capita Expenditures and Per Capita PILTS. Oregon County Expenditures FY 1976-77.

County	Total Per Capita Expenditures	Per Capita Payments In Lieu Of Taxes	PILTS as Percent of Total Expenditures
Baker	\$ 177.31	\$ 40.97	23.1%
Benton	114.48	3.31	2.9
Clackamas	111.94	17.68	15.8
Clatsop	194.65	0.00	0.0
Columbia	107.57	0.00	0.0
Coos	158.49	11.53	7.3
Crook	192.35	118.58	61.6
Curry	392.27	211.90	54.0
Deschutes	168.11	66.36	39.5
Douglas	406.71	93.33	22.9
Gilliam	381.21	0.00	0.0
Grant	773.34	375.78	48.6
Harney	272.34	167.98	61.7
Hood River	219.15	126.36	57.7
Jackson	179.47	13.07	7.3
Jefferson	230.26	50.10	21.7
Josephine	263.47	8.53	3.2
Klamath	164.19	74.54	45.4
Lake	440.41	287.35	66.5
Lane	215.71	55.65	25.8
Lincoln	134.46	80.75	60.1
Linn	131.79	55.55	42.2
Malheur	108.60	0.12	----
Marion	67.94	10.73	15.8
Morrow	371.25	30.96	8.3
Multnomah	159.16	0.93	0.6
Polk	119.88	0.07	----
Sherman	298.57	0.00	0.0
Tillamook	297.34	66.02	22.2
Umatilla	102.32	9.56	9.3
Union	206.55	18.55	8.9
Wallowa	163.83	36.19	22.1
Wasco	182.54	73.24	40.1
Washington	80.03	0.00	0.0
Wheeler	324.38	228.09	70.3
Yamhill	110.60	7.41	6.7
STATE AVERAGE	\$ 287.38	\$ 69.74	24.3%

increase dollar-for-dollar with aid, (2) tax rates are constant, or (3) that expenditures for services other than roads or education remain constant. It is conceivable that counties spend PILTS for roads, when in the absence of these payments they would have spent local tax money for this good, perhaps causing tax money to be diverted from other needed services or increasing needed tax collections. For the converse situation where PILTS increase, it is equally possible that previously committed road tax dollars are returned to taxpayers in the form of reduced taxes, or that these tax monies are diverted to a previously under-financed public service. A third potential outcome is that receipt of, or increases in, PILTS may stimulate expenditures such that increased local revenues are spent on the aided function.

The above arguments for changes in road related expenditures, due to changes in PILTS, are not directly applicable to education related expenditures. Oregon law requires that each county government make a property tax supported contribution to the county school fund, roughly on a "per student-year" basis. As such, PILTS may not completely substitute for local tax monies for this service. PILTS may, however, affect expenditures which would have been made in excess of the state required minimum levels in a way similar to that described for roads.

It is important to note the distinction between the expenditures referred to as "education" in this research, and total education expenditures within a county. The county level of government's contribution to the county school fund represents a small portion of the total revenues of that service. The county revenues are then passed along to the school districts within the county. The largest share of revenues for education are generated with property taxes, but they are levied by the individual



school districts rather than the county. Throughout this research, expenditures for education refer to the monies the county passes along to the school districts, rather than total education expenditures in the county.

The National Forest Management Act of 1976, an act of the U.S. Congress, changed the basis of PILTS. Prior to the Act the total amount available for distribution to the counties was 25 percent of total forest revenues, net of costs. With passage of the Act, however, the figure was changed to 25 percent of gross revenues. The first payments received on the new schedule were distributed in 1978 and, unfortunately, adequate data are not yet available to test the hypothesis that a structural change has occurred.

#### Quantity and Price Variables

The measurements of quantities and prices for public goods differ from those for private goods. Units of output and cost per unit are the traditional measures employed for private good analyses. The nature of public goods, however, make unit measurement difficult and subjective. To avoid these problems in this analysis, quantities demanded and supplied are measured in dollars of expenditures and the tax rate is argued to be the relevant price rationing variable. These terms are particularly appropriate for this research as county expenditure patterns are of interest, rather than the services themselves.

## Quantity Variables

The use of expenditures as a proxy for output has a history of use in the modeling of government expenditures.<sup>1/</sup> This, at least in part, is an outgrowth of the difficulty in identifying units of public services.<sup>2/</sup> Some services are more amenable than others to unit measurement. For instance, a unit of police services might be measured as decreases in crimes per 100,000 population, or highways in miles of roads. It is less clear however, what an appropriate measure of a unit of social services or general government would be. This research focuses on expenditure patterns such that, in this context, these measurement questions may be dismissed.

With expenditures as the method of quantity measurement, alternative methods for measuring expenditures still exist; total expenditures per service category or expenditures per capita per service may be used. The use of total expenditures introduces the problem of scale factors. A county of 50,000 population and one of 100,000 persons are likely to have different levels of total expenditures, though per capita expenditures for the two counties may be the same. If total expenditures were used as the quantity measure, and population used as an explanatory variable to account for scale factors, statistical estimation problems could result. If population and other included explanatory variables were correlated, these variables would tend to "move together" such that the separate effects of individual variables on the dependent variable could not be determined. In a statistical sense this causes the variance of the estimates to be large such that the statistical confidence of the results is decreased.

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<sup>1/</sup> See Booms and Hu (1971), Hambor, Phillips and Votey (1973), Ohls and Wales (1972), Rittenoure and Pluta (1977).

<sup>2/</sup> For a complete discussion see Hirsch, 1970.

Measuring quantities of expenditures on a per capita basis avoids the problems potentially created by scale factors, and yields a more constant variance for the quantity variable. This is a desirable property as it more reasonably allows the assumption that the variance of the error term is constant, an assumption which is necessary for the estimation procedures which are employed.

Expenditures, measured on a per capita basis, are disaggregated to five functional categories: highways and roads, public education, public safety, social services, and general government and administration. Roads and education are specifically identified as these are the two services to which PILTS are legally committed. The three other service categories include all other local government expenditures, with classification based on the type of service. Social services are generally human oriented services, public safety is a property related service, while general government primarily is composed of administrative expenditures. A listing of the specific county services included in each of the five functions is provided in Appendix I.

The disaggregation scheme implemented in this research differs substantially from that in prior efforts. Several previous demand oriented models have identified two or three services of interest and aggregated remaining service expenditures in an "other" category. Demand-supply oriented models have dealt with two separate services, at most. These aggregation techniques have led to many critical comments as such practices may tend to bias estimated coefficients. The common use of "expenditures" as a single dependent variable implicitly assumes explanatory variables impact various public services in identical ways, "which there is little reason to believe" (Booms and Hu, 1971, p. 421). The procedures employed

here are expected to yield more accurate and less biased estimates of the demand and supply parameters.

### Price Variable

The traditional definition of a public good, "each individuals consumption of such a good leads to no subtraction from any other individuals consumption" (Samuelson, 1954, p. 387) suggests much of the difficulty in measuring quantities and prices of such goods. If individuals do not face the possibility of being excluded from consumption of these goods "potential problems for the revelation of individual preferences (exist) ... any system of provision that relies on voluntary contributions ... is likely to fail since the amount of the goods available for an individual to consume is not significantly influenced by the magnitude of his contribution towards its provision" (Deacon, 1977, p. 208). By requiring citizens to pay a portion of the costs of providing these goods, through use of property taxes "it is to each individuals benefit to reveal, at least in part, his preference for these public goods, and thus they are provided" (Booms and Hu, 1971, p. 423-424).

The price rationing mechanism here is argued to be the tax rate.<sup>3/</sup> It is held that community members' demand for public good expenditures is in response to the published tax rate, and to changes in that rate. If an individual's cost of these goods was zero, he would be expected to demand expenditures until the utility derived from the last dollar spent to produce them was zero. If only non-local funds are used to

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<sup>3/</sup> The use of the tax rate as the relevant price variable is common in the literature. Breton (1974) uses "given tax prices" as the price of public goods. Samuelson (1954) uses the term "pseudo prices" in place of tax-price.

support public goods, the individuals' cost is essentially zero. However, with the implementation of property taxes the individual is paying a price for public goods, determined by the tax rate, and the concept of demand (equilibrium quantities resired at alternative prices, other things constant) becomes applicable. The tax rate used in this study is that published in the county budget document.

On the supply side, the tax rate is the "final" determinant of the available supply of revenues (after non-local revenues are exhausted) for elected officials' distribution to the various services based on cost of production and perceived majority voter utilities of services. Altering the tax rate allows officials to accrue the optimal aggregate supply of revenues; the equilibrium level of expenditures, other variables constant, is a function of the tax rate. While the optimal aggregate supply of revenues is seen as a function of the tax rate, the prices of inputs are seen to affect the distribution of expenditures. The costs of producing various services act as shadow prices for the distribution of the aggregate supply of revenues. Input costs are assumed to be a function of the wage rates associated with various services.

### Theoretical Overview

This section details the theoretical basis of the model used in this research. The relevant demand in the community is viewed as belonging to the median voter. All citizens of the community are, however, viewed as the demanders of expenditures for public goods. The supply of expenditures is held to be the responsibility of the elected official who is responsive to the demands of the median voter. These elected officials are identified as the county commissioners responsible for budget decisions

in the county. While they are responsive to the demands of the median voter, these officials also are responsive to the expenditure demands of bureau chiefs and managers.

The theoretical supply and demand relationships are developed and then compared to the single equation reduced form expenditure model, commonly used in prior research, and the median voter expenditure model described in Chapter II.

### Demand for Expenditures

The process by which individuals reveal their preferences for the provision of public goods is argued to be the voting system with "rules regarding the way in which specific public proposals are chosen, and rules concerning the fashion in which costs of public goods are shared" (Deacon, 1977, p. 208). Elected officials, responsible for public expenditure decisions, are viewed as attempting to maximize the likelihood of being (re)elected. In the simplest case, the official must garner  $(N/2+1)$  votes, where  $N$  represents the number of voters, or a simple majority (Breton, 1974). This is accomplished by providing the bundle of goods which aligns with the preferences of the majority. "Governments and their electorates are engaged in a sort of exchange in which policies are traded for votes; to maximize the probability of their re-election, governments endeavor to 'produce' those policies which can be exchanged for the largest possible ... number of votes" (Hirsch, 1970, p. 23). The political arena is considered to be much like the model of pure competition; relatively full information exists, and barriers to political

entry and exit are limited. Officials are thus vote maximizing not unlike profit maximization.<sup>4/</sup>

The relevant demand in the community has been identified as that of the average or majority of voters. Consider the community which produces one public good, protection, and taxes individuals to financially support this service. Further assume that the majority voter, in this community, has a utility function of the form:

$$(1) \quad U = U(\text{EXPRO}, \text{EXPRI}, \bar{Y}, T)$$

where  $U$  is utility,  $\text{EXPRO}$  is expenditures on protection,  $\text{EXPRI}$  is expenditures on private goods,  $\bar{Y}$  is after-tax income, and  $T$  defines taste and preferences. This consumer attempts to maximize the value of  $U$  subject to the following budget constraint (BC).

$$(2) \quad \text{BC} = (Y, \text{TR}, \text{PRI})$$

where  $Y$  is before-tax income,  $\text{TR}$  is the protection tax rate, and  $\text{PRI}$  is the price of private goods. Forming the Lagrangian function, assuming:

$$(3) \quad \frac{\partial U}{\partial \text{EXPRO}} > 0 \quad \text{increased expenditures on protection yield positive utility}$$

$$(4) \quad \frac{\partial^2 U}{\partial \text{EXPRO}^2} < 0 \quad \text{increased protection expenditures yield diminishing marginal utility}$$

$$(5) \quad \frac{\partial U}{\partial \text{EXPRI}} > 0 \quad \text{increased private expenditures yield positive utility}$$

$$(6) \quad \frac{\partial^2 U}{\partial \text{EXPRI}^2} < 0 \quad \text{increased private expenditures exhibit diminishing marginal utility}$$

<sup>4/</sup> Breton (1974) refers to the objective function of the government official as a profit function.

$$(7) \quad \frac{\partial U}{\partial Y} > 0 \quad \text{increased after-tax income yields positive utility}$$

$$(8) \quad \frac{\partial^2 U}{\partial Y^2} < 0 \quad \text{increased after-tax income yields diminishing marginal utility}$$

yields the following demand function for expenditures on protection.

$$(9) \quad \text{DEXPRO} = f(Y, \text{TR}, \text{PRI}, T),$$

where DEXPRO is the demand for protection expenditures and all other variables are defined as before. The majority voter is in equilibrium where:

$$(10) \quad \frac{\text{MU}_{\text{EXPRO}}}{\text{TR}} = \frac{\text{MU}_{\text{EXPRI}}}{\text{PRI}},$$

where  $\text{MU}_{\text{EXPRO}}$  is the marginal utility of protection expenditures and  $\text{MU}_{\text{EXPRI}}$  is the marginal utility of private expenditures. Given the previous assumptions, and assuming income and private good prices are constant, the individual will demand more at low tax rates to remain in equilibrium than at high tax rates. The demand curve in Figure 5 may then be constructed with dollars spent on protection on the vertical axis and tax prices on the horizontal axis.

### Supply of Expenditures

The supply of expenditures is made up of two components, non-local revenues consisting of state and federal transfers to county governments, and local property tax revenues. Property taxes, in theory and practice, act as a supplement to non-local revenues in the provision of local public goods. If the elected official, responsible for the supply of expenditures, perceives his constituents marginal utility of the last unit of protection provided with non-local revenues to be less than the cost of



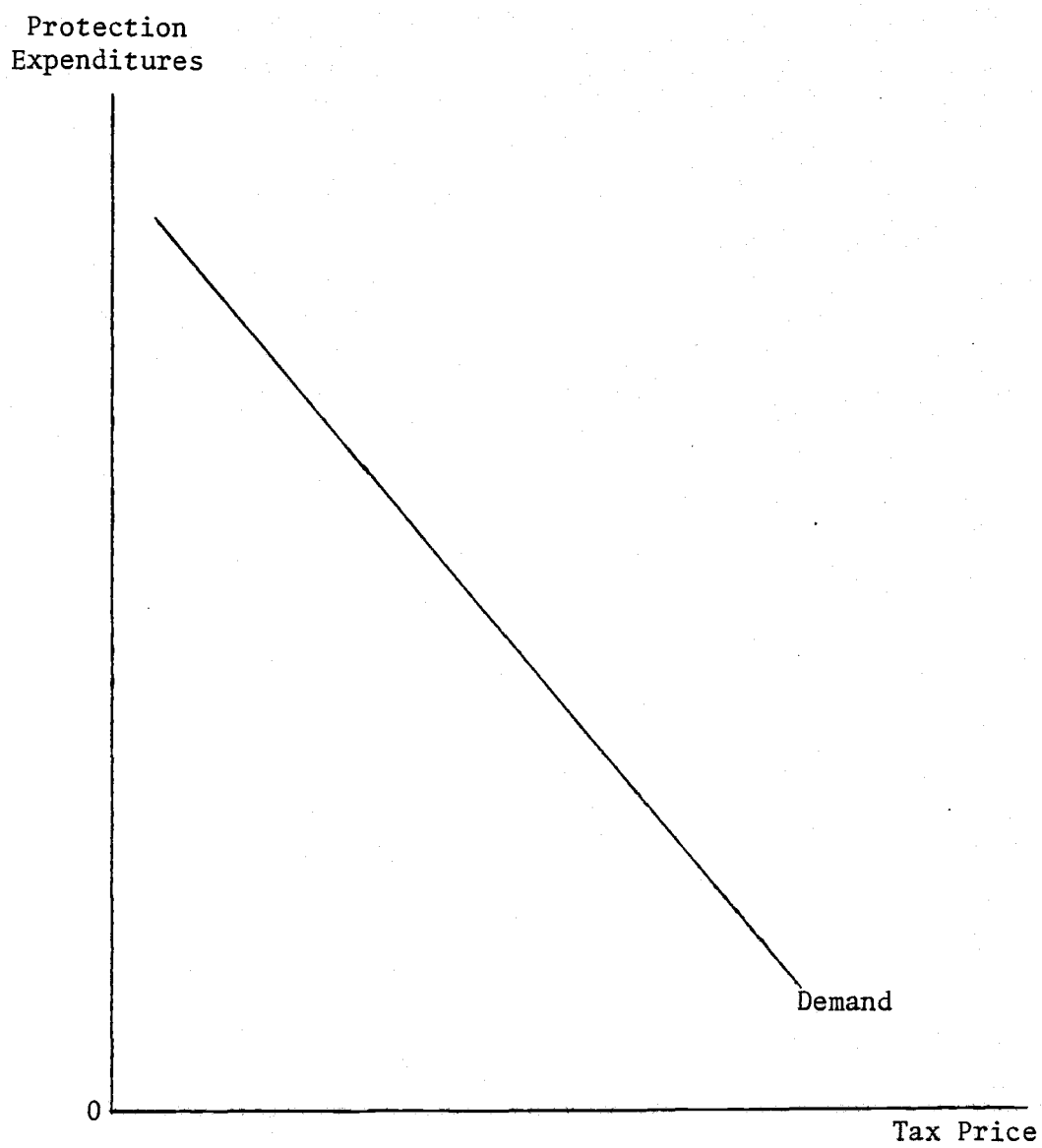


Figure 5. The Demand for Protection Expenditures.

imposing a tax rate, a zero tax rate is desirable.<sup>5/</sup> In the case of a specific grant, if the marginal utility of protection becomes negative before these revenues are spent, the community is forced to a non-optimal position, as the full amount of the grant must be spent. If the marginal utility of protection is positive when non-local revenues have been exhausted, and that value exceeds the cost of the proposed tax rate, the tax will be implemented.

To this point, the elected official has been viewed as being responsive to the demands of the majority voter only. It is clear, however, that county commissioners are subject to the demands of the bureau managers who desire appropriations for their specific functions. These managers are viewed as having a different objective function that does the median voter. Bureau chiefs are held to be budget maximizers who desire greater revenues assigned to their particular services. While the distribution of revenues among services is made in terms of the elected officials perception of the median voter's marginal utility, it implicitly considers the other, more political pressures of bureau managers demands for expenditures, under which the elected official operates.

The elected officials consideration of his constituents marginal utility of protection implies unit measurement. The official seeks an equilibrium between the majority voter's marginal utility and tax price, though this implicitly considers unit measurement which further implies the elected official considers unit prices.<sup>6/</sup>

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<sup>5/</sup> This is the case in Oregon's Josephine County which does not collect property taxes.

<sup>6/</sup> A tax rate of \$X yields revenues of \$Y. With a unit price for protection of \$Z, a tax rate of \$X yields Y/Z tax supported units. The objective is to set X such that the marginal utility of the Y/Zth unit equals X.

Assuming a Cobb-Douglas production function, and further assuming capital costs are constant across counties, the marginal cost of another unit of output is a function of the wage rate, such that the wage rate determines unit costs of production. The supply of protection expenditures can be expressed:

$$(11) \text{ SEXPRO} = f(\text{NL}, \text{TR}, \text{WAGES})$$

where SEXPRO is the supply of protection expenditures, NL is non-local revenues, TR is the tax rate, and WAGES are a proxy for unit price.

High property tax rates imply larger tax collections and a greater ability to supply expenditures than at low tax rates, other things constant. Figure 6 is the supply curve for protection expenditures. Non-local revenues of OA have been received, such that the Y intercept is positive. The slope of the supply curve is a function of assessed value.<sup>7/</sup>

Combining Figures 5 and 6 results in Figure 7. The community is in equilibrium at a tax rate of TR\* and expenditures of E\*. At a tax rate of TR2, E<sup>4</sup> is supplied and E<sup>3</sup> demanded with excess supply of E<sup>4</sup> - E<sup>3</sup>. At a rate of TR1, E<sup>2</sup> is demanded and E<sup>1</sup> supplied resulting in excess demand of E<sup>2</sup> - E<sup>1</sup>. By locating at TR\* and E\* the community maximizes utility in the process of exchange of private funds for public funds while also maximizing the sum of producers and consumers surplus for the community.<sup>8/</sup>

<sup>7/</sup> The supply curve represents an expenditure frontier. Oregon law requires counties to have a balanced budget. Expenditure levels which exceed total revenues (deficit spending) are not possible. Expenditures below the supply frontier are possible, causing surpluses or cash balances to occur.

<sup>8/</sup> The area bordered by E-TR\*-R represents consumer surplus - the cumulative amount the community would have been willing to pay for protection expenditures at prices higher than the equilibrium price. The area A-E-E\* represents producer surplus - the cumulative amount that the community would have been willing to forego at prices less than the equilibrium price.

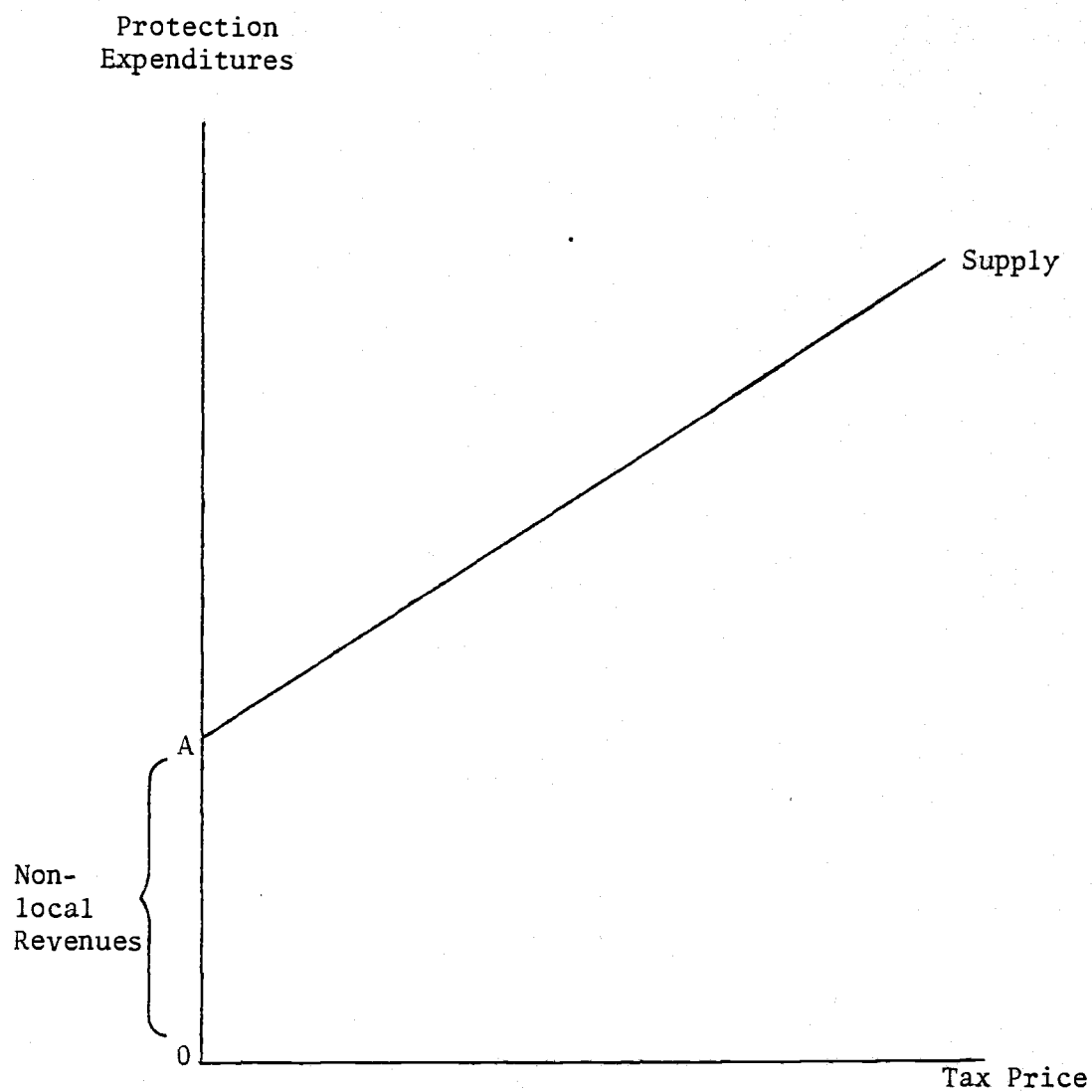


Figure 6. The Supply of Protection Expenditures.

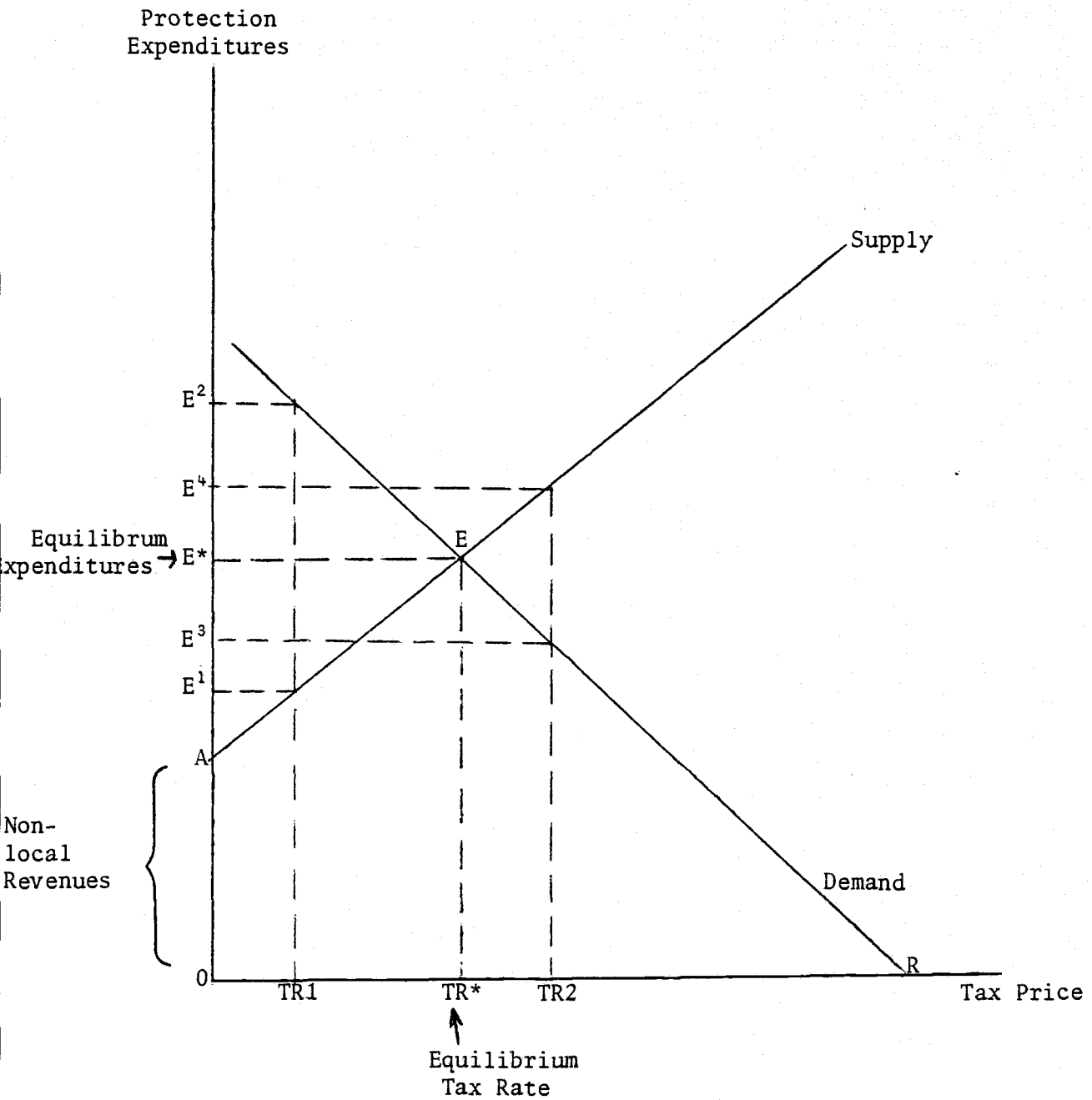


Figure 7. Interaction of the Demand and Supply for Protection Expenditures.

In the model, demand is viewed as a function of the expected tax rate. Simultaneously, the expected tax rate is a function of demand or planned expenditures. Larger demands imply higher tax rates such that an adequate supply of revenues is available to meet demands while higher tax rates suggest smaller demands for expenditures. The supply of revenues is a function, separate from the demand equations, with the supply of revenues consisting of non-local monies and property taxes.

For the model developed, PILTS play a dual role. The payments represent one of the non-local revenues which are identified in the supply of expenditures, allowing the Y intercept to be positive valued. In a less explicit manner, PILTS affect the tax rate by altering the amount of additional revenues which need to be generated to allow the community to reach an equilibrium. Because the tax rate and demand for services simultaneously interact, PILTS indirectly affect the demand for expenditure. These PILT relationships are the focus of interest throughout much of the remainder of this chapter, as well as in Chapters IV and V.

### Alternative Models

The model specified above explicitly identifies demand and supply relationships in terms of tax rates. The functional relationships identified in equations (9) and (11) are estimated in this research. Many past studies have identified these relationships, but have argued that the demand and supply functions cannot be observed or estimated. Generally, these research efforts have argued that expenditures are a function of the two market forces, but have estimated a single reduced form equation.

Returning to the model of equations (9) and (11), and solving for such a reduced form equation, EXPRO, results in the following equation:

$$(12) \text{ EXPRO} = f(\text{NL}, \text{TR}, \text{WAGES}, \text{Y}, \text{T}, \text{PRI}),$$

when all terms are defined as before. While estimation of equation (12) will provide information on expenditure patterns, it does not allow the estimation of various elasticities or tests of demand and supply behavioral hypothesis. In contrast, the specification of equations (9) and (11) allow the estimation of price and income elasticities of demand and price and revenue elasticities of supply, all valuable information which, in prior studies, has been largely ignored.

Other models which have been used in the past provide information on expenditure patterns, but again do not allow the estimation of the various elasticities desired in this research. One such model considers the median voter's demand as relevant, with elected officials maximizing the value of this function subject to the community budget constraint.

With the utility function as in equation (1) and the community budget constraint:

$$(13) \text{ BC} = (\text{NL}, \text{TC}, \text{WAGES}),$$

where NL is non-local revenues, TC is tax collections, and WAGES represents the cost of a unit of protection, expenditures for protection can be expressed:

$$(14) \text{ EXPRO}' = f(\text{NL}, \text{TC}, \text{WAGES}, \text{T}).$$

Allowing T (tastes and preferences) to be defined in part by income, and realizing that TC is a function of the tax rate:

$$(15) \text{ EXPRO}'' = f(\text{NL}, \text{TR}', \text{WAGES}, \text{Y}, \text{T}').$$

The relationships described in equations (15) and (12) are essentially the same, but come from different theoretical bases. Both assume maximization of the median voter's utility, but revenues are treated theoretically differently. Information and hypotheses tests desired in this research are not available from the models of either equation (12) or equation (15). The two principal factors which cause the model specified in equations (9) and (11) to be preferable to equations (12) and (15) are: (1) Additional information can be generated on price and income elasticities in this formulation. (2) Equation (15) implies that at the equilibrium level of expenditures the marginal utility of protection and the cost of production are equal. However, individuals rarely pay the true cost of the provision of public goods (Hirsch, 1970). The cost they bear is more accurately the tax price, as portrayed in equation (9).

#### Demand Equations

Five demand equations are specified, one for each of the public services of general government, highways, education, social services, and public safety. Again, these demands are derived from the utility function of the average or median voter. Because of the interrelationships of the demands, the equations are treated as a simultaneous equation system and are estimated simultaneously. In each case the dependent variable is measured as per capita expenditures per service category.

Economic theory suggests that the demand for a good is a function of price, income, and tastes and preferences. As argued earlier, the tax rate is held to the relevant price variable. An increase in the tax rate for a given quantity of public expenditures will reduce the funds available for private consumption such that, given some income level,



the community will evidence a negative response between quantity demanded and price.

The inclusion of the price variable in the demand equations allows calculation of price elasticities of demand. Few estimates of these elasticities are available in the literature upon which to base expectations of the elasticities calculated in this research. Barlow (1970) calculated the price elasticity of demand for education with a log-linear demand function of the type:

$$(16) \quad q = ap^{\delta}y^{\epsilon},$$

where  $q$  is unit output,  $p$  is price, and  $y$  is income. His estimate of  $\delta$ , price elasticity, was  $-.34$ . As Hambor (1973, p. 102) points out by "multiply(ing) by  $p$ , we obtain an expression proportional to expenditures ...  $pq = ap^{1+\delta}y^{\epsilon}$  ... then the coefficient on price is the elasticity plus one." Their reported elasticity would be comparable to  $-1.34$  for the estimation technique used here. Using expenditures as a measure of output, Hambor (1973) estimated a price elasticity of  $-1.10$  for education.

Per capita income measures the ability of a community to demand expenditures. Income levels determine the degree to which desires for various expenditures can be translated into actual demands. The higher the income level the greater the potential demand.

Estimates of income elasticities are also rare in the literature, though Barlow's (1970) estimate was  $0.64$ , Hambor's (1973)  $0.88$ , Hirsch (1960)  $0.56$ , Brazer (1959)  $0.73$ , and Pryor (1968)  $1.07$ , all for education, using various samples and estimation techniques.

Two additional variables, assessed value of residential property, and assessed value of non-residential property are included in all five demand

functions. The hypothesis is that as residential assessed value increases, the demand for expenditures will decrease, as higher assessed values imply larger tax payments. As non-residential assessed values increase the hypothesis is that demands for expenditures will increase as a larger portion of the tax burden may be shifted to this property class. Ladd (1975) developed and tested a similar hypothesis, with the percent of non-residential assessed value as an explanatory variable in the demand for education. The results showed a positive and significant relationship between demand and the presence of non-residential property. Ladd's conclusion was that residential property owners feel they may shift a portion of the tax burden to non-residential property.

Taste and preference variables are held to further define the utility function of the median voter. As such, taste variables are included in the specification of each demand equation. The variables, and the theoretical rationale for their inclusion are discussed below.

### Roads and Highways

Roads and highways, and vehicles which use these roads are complementary goods. The utility which can be derived from more miles of road, or better quality highways, both requiring larger expenditures, is in part determined by the availability of a vehicle to use on these roads. The number of vehicles registered per capita is a measure of the availability of vehicles within a county, and is expected to increase the demand for road expenditures as per capita vehicle ownership increases.

The demand for road expenditures is also hypothesized to be positively related to the distance to a market center. In rural areas, consumers may have to travel relatively large distances to purchase necessary

goods and services, requiring more miles of road, while in urban communities, individuals can purchase necessities by "walking to the store" or driving shorter distances. In addition, rural areas tend to be less densely populated such that per capita expenditures for roads in these areas will be larger than in more urban communities. The percent of county population living in incorporated areas is intended to capture both these utility and economies of scale arguments. As this measure of the degree of urbanization increases, the per capita demand for road expenditures is expected to decrease.

### Education

The demand for education expenditures is expected to display a positive relationship between the educational level of the adult population and the percentage of population under 17 years of age. Higher average levels of education in the community, measured as the percentage of the adult population completing high school, tend to create a desire for education services. The greater the percentage of school age children in the county, the larger should be the levels of per capita education expenditures. This last cause for education expenditures is related to the fact that the community reaps some of the benefits of educating its citizens through higher incomes, a tendency for higher employment levels, and fewer social problems, all utility generating outcomes.

### Public Safety

Public safety expenditures are directed towards police and fire protection. It is hypothesized that the greater the potential loss from

criminal acts or fire, the greater the demand will be for public safety expenditures. Individuals do not derive utility from public safety expenditures per se, but experience disutility when the public is not safe. The degree of urbanization in a county and the unemployment rate, statistically correlated with crime rates, are hypothesized to measure the potential loss from criminal acts. As these two variables increase in value, the demand for per capita public safety expenditures is expected to increase.

### Social Services

Social services include two principal categories: human services and parks and recreation. Human services tend to be directed to the financially and emotionally less fortunate members of a community. As the number of such individuals in a community increases, their presence becomes more obvious and the need to deal with their problems, more clear. The unemployment rate in a county is used in the social services demand equation to measure the presence of the less fortunate and is expected to be positively related to social service expenditures.

Urban communities have fewer open spaces than do rural communities, such that the utility of publicly provided parks and recreation is predicted to be greater in urban areas. Increases in the measure of the degree of urbanization, the percentage of the county population living in incorporated areas, is expected to yield larger per capita social service expenditures.

### General Government

The demand for general government and administration is a function of the demand for the four previously identified services, particularly

in terms of administration. As the demand for other services increases, the need for general government management is expected to also grow, requiring larger per capita expenditures. The six previously identified variables which influence the other demands are all held to affect the demand for government administration.

A single variable, composed of the other six taste variables, is derived and used as the taste variable for government. It is expected to have a positive relationship with expenditures, as its components are positively related to their respective demands.

#### Demand Specification

Symbolically, the linear demand functions are:

$$(17) \quad DROAD = f(NTAXR, CITY, CARS, NHOME, PPINC, VHOME)$$

$$(18) \quad DED = f(NTAXR, PPINC, NHS, KID, NHOME, VHOME)$$

$$(19) \quad DSAFE = f(NTAXR, PPINC, CITY, UR, NHOME, VHOME)$$

$$(20) \quad DSOCIAL = f(NTAXR, PPINC, CITY, UR, VHOME, PPINC)$$

$$(21) \quad DGOV = f(NTAXR, AVG, NHOME, VHOME, PPINC)$$

Table 3 identifies the variable, code name, and unit of measurement.

#### Tax Rate Equation

The single county tax rate appears as an explanatory variable in each of the five demand equations. Because of the nature by which tax rates are calculated, the tax rate is endogenous to the local government expenditures process, that is, expenditures partially determine the tax

Table 3. Variable Definition, Variable Class, Symbol, and Measurement of Variables Included in the Demand for Expenditures Equations.

Variable	Class	Symbol	Measurement <sup>a/</sup>
Demand for Roads	Dependent	DROAD	Dollars per capita
Demand for Education	Dependent	DED	Dollars per capita
Demand for Public Safety	Dependent	DSAFE	Dollars per capita
Demand for Social Services	Dependent	DSOCIAL	Dollars per capita
Demand for Government	Dependent	DGOV	Dollars per capita
County Tax Rate	Price	NTAXR	Dollars per thousand assessed value
Degree of Urbanization	Taste	CITY	Percent population living in incorporated communities
Vehicle Registrations	Taste	CARS	Vehicles registered per capita
Non-Residential Assessed Value	Taste	NHOME	Dollars
Residential Assessed Value	Taste-Price	VHOME	Dollars
Income	Income	PPINC	Dollars per capita
Education of Adult Population	Taste	NHS	Percent of adult population completing high school
Population Under Age of 17	Taste	KID	Percent of total county population
Unemployment Rate	Taste	UR	Percentage of work force <sup>b/</sup>
Combination of Taste Variables	Taste	AVG	Principal components analysis

<sup>a/</sup> All dollar figures are computed in constant dollars using the Portland Consumer Price Index with 1976 as a base year.

<sup>b/</sup> Seasonally adjusted.

rate. As such, the demand equations and the tax rate are part of a simultaneous system. While the demand equations are stochastic in nature, the tax rate equation is not. The tax equation is an identity of the form:

$$(22) \quad \text{TAX RATE} = \frac{\text{EXPENDITURES} - \text{NON-LOCAL REVENUES}}{\text{ASSESSED VALUE}}$$

or more formally, (22) is specified as:

$$(23) \quad \frac{\text{NTAXR} = \text{DEMAND} - \text{PILT} - \text{SFED} - \text{GFED} - \text{STATE} - \text{LOCAL} - \text{CASH}}{(\text{VHOME} + \text{NHOME})/\text{POP}}$$

where all terms are as defined in Table 4.

#### Supply Equations

The set of five supply equations represent the elected officials distribution of the aggregate supply of revenues to individual services in response to the perceived utilities of the median voter and the budget demands of bureau managers. The set of supply equations are treated as a system separate from the simultaneous demand and tax equations and are estimated using ordinary least squares. A common set of eleven variables appear in each equation.

The tax rate is included in all five supply equations. For any community, given pre-specified values for non-local revenues and total assessed valuation which are held constant, changes in the tax rate imply changes in total revenues which the elected official may distribute among services. The lower bound on the tax rate is zero; in such a case property taxes are not levied (as in Josephine County). As the tax rate increases, additional revenues are generated which imply larger per capita expenditures, such that a positive relationship between the tax rate and expenditures is hypothesized to exist.

Table 4. Variable Definition, Variable Class, Symbol, and Measurement of Variables Included in Supply of Expenditures and Tax Rate Equations.

Variable	Class	Symbol	Measurement <sup>a/</sup>
Supply of Roads	Dependent	SROAD	Dollars per capita
Supply of Education	Dependent	SED	Dollars per capita
Supply of Public Safety	Dependent	SSAFE	Dollars per capita
Supply of Social Services	Dependent	SSOCIAL	Dollars per capita
Supply of Government	Dependent	SGOV	Dollars per capita
County Tax Rate	Price	NTAXR	Dollars per thousand assessed valuation
Total Expected Demand	Identity	DEMAND	Dollars per capita
Payment in Lieu of Taxes	Revenue	PILT	Dollars per capita
Specific Federal Aid	Revenue	SFED	Dollars per capita
General Federal Aid	Revenue	GFED	Dollars per capita
State Aid	Revenue	STATE	Dollars per capita
Local Non-Tax Revenues	Revenue	LOCAL	Dollars per capita
Net Cash Balances	Revenue	CASH	Dollars per capita
Non-Residential Assessed Value	Identity	NHOME	Dollars
Residential Assessed Value	Identity	VHOME	Dollars
Average County Public Wage Rate	Price	WAGE	Dollars per year
Dummy Variable for 1976-77	Dummy	YR1	1 if 1976-77, otherwise 0
Dummy Variable for 1977-78	Dummy	YR2	1 if 1977-78, otherwise 0
Dummy Variable for Grant County	Dummy	GRANT	1 if Grant County, otherwise 0

<sup>a/</sup> All dollar figures are in constant dollars, using 1976 as the base year.



A theoretically appropriate specification of the supply response function would include wage rates associated with each service type, for which public expenditures are made, as a measure of input costs. However, such information is unavailable. An alternative, and that which is used here, is to assume that within a county, public labor costs per unit of output are constant across services, but that such costs do differ among counties. Consequently, the use of the average county public wage provides a measure of the differential for input costs for public goods among counties, and is included in the specification of all supply relationships. The expected sign of the wage variable is negative. Wage increases imply unit cost increases. In such a case, the elected official is hypothesized to decrease expenditures (and thus output) in an effort to increase the marginal utility of the service so as to keep the median voter in an equilibrium position, where the voter is maximizing utility.

Six of the variables which appear in the supply equations are actual sources of revenues. Two sources are local in nature: net cash balances and revenues from local licenses, fees, and land sales. Aggregated state revenues include liquor taxes, cigarette taxes, gasoline taxes, state revenue sharing, and other state sources. Three types of federal aid are specified (1) specific federal aid, (2) general federal aid, and (3) payments in lieu of taxes.<sup>9/</sup> The expected relationship between these six variables and the per capita supply of expenditures is positive, as greater revenues provide a potential for larger expenditures. One of the purposes of this research is, however, to investigate this hypothesis.

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<sup>9/</sup> c. f. ante, p.15.

Past research does not provide a clear answer on whether aid is stimulative or substitutive. Much of the controversy on the effects of aid has been due to the aggregation of the aid variables. Osman (1966) found that the single variable "federal aid" was purely stimulative, while Pogue and Sgontz (1968) argue there is no support for Osman's hypothesis. The review of Wilde's work (1968) in Chapter II indicates a theoretically different expenditure effect varying with aid types, suggesting that aid should be typologically disaggregated. "There is little reason to believe that the determinants of expenditures levels for each public sector function are the same, ... it is potentially more meaningful to carry on disaggregative studies" (Booms and Hu, 1971, p. 421). It is argued that the disaggregation of revenue sources in this research is theoretically appropriate and will provide valuable information on the relationships between specific service expenditures and specific aid types.

The final three variables included in the supply equations specification are dummy variables. Two variables are used to distinguish between the three fiscal years which make up the data set used for estimating the model. A single intercept dummy variable is included to identify Grant County in the supply of expenditure equations. This dummy variable is included in part because the larger Grant County Project, of which this research is one portion, focuses on Grant County, and also because Grant County receives the largest per capita PILT in the state of Oregon. This larger PILT could imply an expenditure pattern different from other counties.

Symbolically, the supply equations are:

$$(24) - (29) \quad S_i = f(\text{NTAXR}, \text{WAGE}, \text{PILT}, \text{SFED}, \text{GFED}, \text{CASH}, \text{STATE}, \\ \text{LOCAL}, \text{YR1}, \text{YR2}, \text{GRANT}),$$

where  $i$  represents the categories of public services (roads, education, public safety, social services, or general government). The variables, symbols, and units of measurement for the supply equations are summarized in Table 4.

### Estimation Procedures and Hypotheses Tests

The relationships described above can be depicted as a system of ten linear stochastic equations, and one identity, consisting of a set of variables, unknown regression coefficients, and error terms. The system is constructed here as two submodels, a set of simultaneous demand equations, and the set of supply equations estimated using ordinary least squares.

The assumptions which are necessary for the use of ordinary least squares (OLS) to be a valid estimation technique are: (1) explanatory variables exhibit some independent variation, (2) expected value of the error term is constant and equal to zero, (3) the error terms are uncorrelated and have constant variance, and (4) the error terms are normally distributed.<sup>10/</sup> These assumptions can be made for the supply equations, but cannot be made for the demand-tax submodel. In the demand model the tax rate is endogenous to the system but is included as an explanatory variable in all five demand equations. As such, the tax rate variable is correlated with the error terms, a violation of assumption (3) above. Use of OLS for the demand system would result in parameter estimates which would be biased and inconsistent.

<sup>10/</sup> For a complete discussion of ordinary least squares see Hanushek and Jackson, 1977, pp. 46-108.

There are a number of estimation procedures which are appropriate for use with simultaneous equation systems, including generalized three-stage least squares (3SLS).<sup>11/</sup> In comparison to other techniques, 3SLS is generally less expensive to operate and more readily available. For these reasons 3SLS was selected here.

As the name implies, 3SLS consists of three separate estimation stages. In the first stage all endogenous variables are regressed against the complete set of exogenous variables. The expected values of the endogenous variables from this first stage are then used in estimating the structural equations of the simultaneous system. The resulting coefficients are the two stage estimates. By using the expected values of the endogenous variables, the correlated error terms are "removed", resulting in estimates which are asymptotically consistent. Moreover, the two stage estimates make a distinction between the endogenous explanatory variables and exogenous variables which OLS does not make. The result of using this additional information is that the 2SLS estimates are asymptotically more efficient.

The three stage estimates utilize information on the correlation of error terms between equations in the system, which is developed in the second stage. Using the variance-covariance matrix for the error terms between equations, developed in the second stage, the third stage produces parameter estimates which are asymptotically more efficient than in 2SLS. Essentially 3SLS is to 2SLS as generalized least squares is to OLS. By considering information as to which variables are, and are not, included in other equations in the system, as well as making the

<sup>11/</sup> Other procedures appropriate for simultaneous system estimation include two stage least squares, instrumental variables, limited information maximum likelihood estimation, and full information maximum likelihood estimation. For a discussion of these techniques see Intriligator, 1978, pp. 384-412.

distinction between included endogenous and exogenous variables, 3SLS estimates the entire simultaneous system, rather than one equation at a time as in 2SLS, producing more consistent and less biased coefficients than 2SLS or OLS.<sup>12/</sup> Three stage least squares is a particularly appropriate technique when the covariance between estimating equations is expected to be non-zero, as when the demand for one public expenditure may be related to another public service expenditure.

After the regression coefficients are estimated, hypothesis tests based on the study objectives are carried out. Additional analysis is conducted in terms of goodness of fit, as evidenced by the amount of variation in the dependent variable which the individual equations explain. A test of whether coefficients in a single equation, taken together, are significantly different from zero is also conducted.<sup>13/</sup>

The statistical form of the demand equations to be estimated are:

$$(30) \quad \text{DROAD} = A_1 + \beta_{11}\text{NTAXR} + \beta_{21}\text{PPINC} + \beta_{31}\text{NHOME} + \beta_{41}\text{VHOME} \\ + \beta_{51}\text{CITY} + \beta_{61}\text{PCAR} + U_1$$

$$(31) \quad \text{DED} = A_2 + \beta_{12}\text{NTAXR} + \beta_{22}\text{PPINC} + \beta_{32}\text{NHOME} + \beta_{42}\text{VHOME} \\ + \beta_{52}\text{NHS} + \beta_{62}\text{PPKID} + U_2$$

$$(32) \quad \text{DSAFE} = A_3 + \beta_{13}\text{NTAXR} + \beta_{23}\text{PPINC} + \beta_{33}\text{NHOME} + \beta_{43}\text{VHOME} \\ + \beta_{53}\text{UR} + \beta_{63}\text{MIN} + \beta_{73}\text{CITY} + U_3$$

<sup>12/</sup> For a more complete discussion of three-stage least squares, see Intrilligator, 1978, pp. 402-412.

<sup>13/</sup> The three-stage least squares computer estimation package does not provide summary statistics such as the coefficients of determination ( $R^2$ ) or an overall F statistic. The output is in terms of coefficients and standard errors. Because of the nature of 3SLS,  $R^2$  and F statistics would have entirely different meanings than for OLS such that direct comparison would be inappropriate if the statistics were generated.

$$(33) \quad \text{DSOCIAL} = A_4 + \beta_{14}\text{NTAXR} + \beta_{24}\text{PPINC} + \beta_{34}\text{NHOME} + \beta_{44}\text{VHOME} \\ + \beta_{54}\text{CITY} + \beta_{64}\text{UR} + U_4$$

$$(34) \quad \text{DGOV} = A_5 + \beta_{15}\text{NTAXR} + \beta_{25}\text{PPINC} + \beta_{35}\text{NHOME} + \beta_{45}\text{VHOME} \\ + \beta_{55}\text{AVG} + U_5$$

where the  $A_j$  represent the constant values, the  $\beta_{ij}$  the unknown regression coefficients, the  $U_j$  the unobserved error terms, and all variables are identified as in Table 3.

The first statistical hypothesis test of the estimated demand parameters will be to determine if the value of the coefficients are significantly different from zero in a statistical sense. The test is:

$$(35) \quad H_0: \beta_{ij} = 0 \\ \text{for } i = 1, 2, \dots, 7 \\ j = 1, 2, \dots, 5 \text{ for all demand equations}$$

$$(36) \quad H_a: \beta_{ij} \neq 0$$

The expected relationship between the tax rate and the demand for expenditures for all services is negative.<sup>14/</sup> The hypothesis test of this theoretically expected relationship is:

$$(37) \quad H_0: \beta_{1j} = 0 \\ \text{for } j = 1, 2, \dots, 5$$

$$(38) \quad H_a: \beta_{1j} < 0$$

Non-residential assessed value is expected to be positively related to the median voter's demand for expenditures, as a portion of the tax burden can be shifted to this non-residential property.<sup>15/</sup> This theoretical outcome is used to develop the following test:

<sup>14/</sup> c. f. ante, p. 61.

<sup>15/</sup> c. f. ante, p. 63.

$$(39) \quad H_0: \beta_{3j} = 0$$

for  $j = 1, 2, \dots, 5$

$$(40) \quad H_a: \beta_{3j} > 0$$

The assessed valuation of residential property is expected to be negatively related to the demand for expenditures such that the parameter estimate on this variable should be negative.<sup>16/</sup> The test of this hypothesis is:

$$(41) \quad H_0: \beta_{4j} = 0$$

for  $j = 1, 2, \dots, 5$

$$(42) \quad H_a: \beta_{4j} < 0$$

While formal statistical tests are not employed, price and income elasticities of demand are calculated at the mean values of the variables and compared to previous research estimates.

The statistical form of the supply equations to be estimated are:

$$(43) \quad \begin{aligned} \text{SROAD} = & N_1 + R_{11}\text{NTAXR} + R_{21}\text{PILT} + R_{31}\text{SFED} + R_{41}\text{GFED} \\ & + R_{51}\text{LOCAL} + R_{61}\text{STATE} + R_{71}\text{CASH} + R_{81}\text{WAGE} \\ & + R_{91}\text{YR1} + R_{101}\text{YR2} + R_{111}\text{GRANT} + E_1 \end{aligned}$$

$$(44) \quad \begin{aligned} \text{SED} = & N_2 + R_{12}\text{NTAXR} + R_{22}\text{PILT} + R_{32}\text{SFED} + R_{42}\text{GFED} \\ & + R_{52}\text{LOCAL} + R_{62}\text{STATE} + R_{72}\text{CASH} + R_{82}\text{WAGE} \\ & + R_{92}\text{YR1} + R_{102}\text{YR2} + R_{112}\text{GRANT} + E_2 \end{aligned}$$

$$(45) \quad \begin{aligned} \text{SSAFE} = & N_3 + R_{13}\text{NTAXR} + R_{23}\text{PILT} + R_{33}\text{SFED} + R_{43}\text{GFED} \\ & + R_{53}\text{LOCAL} + R_{63}\text{STATE} + R_{73}\text{CASH} + R_{83}\text{WAGE} \\ & + R_{93}\text{YR1} + R_{103}\text{YR2} + R_{113}\text{GRANT} + E_3 \end{aligned}$$

<sup>16/</sup> c. f. ante, p. 63.

$$\begin{aligned}
 (46) \quad SSOCIAL = & N_4 + R_{14}NTAXR + R_{24}PILT + R_{34}SFED + R_{44}GFED \\
 & + R_{54}LOCAL + R_{64}STATE + R_{74}CASH + R_{84}WAGE \\
 & + R_{94}YR1 + R_{104}YR2 + R_{114}GRANT + E_4
 \end{aligned}$$

$$\begin{aligned}
 (47) \quad SGOV = & N_5 + R_{15}NTAXR + R_{25}PILT + R_{35}SFED + R_{45}GFED \\
 & + R_{55}LOCAL + R_{65}STATE + R_{75}CASH + R_{85}WAGE \\
 & + R_{95}YR1 + R_{105}YR1 + R_{115}GRANT + E_5
 \end{aligned}$$

where the  $N_j$  are the constant values, the  $R_{ij}$  are the unknown regression coefficients, the  $E_j$  are the unobserved error terms, and all variables are identified as in Table 4.

To determine if the parameter estimates are statistically different from zero, and thus whether the variables affect the supply of expenditures for the service in question, all supply coefficients will be subjected to the following test:

$$(48) \quad H_0: R_{ij} = 0$$

$$\begin{aligned}
 i &= 1, 2, \dots, 11 \\
 j &= 1, 2, \dots, 5
 \end{aligned}$$

$$(49) \quad H_a: R_{ij} \neq 0$$

It has been argued in this research that as the tax rate increases, the supply of expenditures should also increase.<sup>17/</sup> Given this expectation, the sign on the tax rate coefficient should be positive. The following formal hypothesis is developed to test this relationship statistically.

$$(50) \quad H_0: R_{1j} = 0$$

$$\text{for } j = 1, 2, \dots, 5$$

$$(51) \quad H_a: R_{1j} > 0$$

<sup>17/</sup> c. f. ante, p. 68.



Payments in lieu of taxes are the principal focus of this research. To test whether Oregon counties meet the letter of the law and spend 75 percent of their PILTS for roads and 25 percent for education, the following hypotheses are specified.<sup>18/</sup> Accepting the null hypothesis implies that PILTS receive no special treatment, and are neither stimulative nor substitutive for roads and education.

$$(52) \quad H_0: R_{21} = .75$$

Where  $R_{21}$  is the coefficient on PILTS in the supply of road expenditures equation

$$(53) \quad H_a: R_{21} \neq .75$$

$$(54) \quad H_0: R_{22} = .25$$

Where  $R_{22}$  is the coefficient on PILTS in the supply of education expenditures equation

$$(55) \quad H_a: R_{22} \neq .25$$

The effects of revenue sources on total expenditures may be fully stimulative, partially stimulative, or substitutive.<sup>19/</sup> These effects may be tested by summing the coefficient on a single revenue source over all expenditures and statistically comparing that value to one. The test of the effects of revenues on total expenditures is:

$$H_0: \sum_{j=1}^5 R_{ij} = 1$$

for  $i = 2, 3, \dots, 7$

$$H_a: \sum_{j=1}^5 R_{ij} \neq 1$$

<sup>18/</sup> c. f. ante, p. 43.

<sup>19/</sup> c. f. ante, p. 70.

Revenues which do not carry use restrictions may be used by the county in any way they desire. To test whether individual services receive a larger percentage of these "free money" revenues, the following hypotheses are developed;

$$R_{ij} = \text{budget share } j$$

$$\text{for } i = 4, 5, 6, 7,$$

$$j = 1, 2, \dots 5$$

$$R_{ij} \neq \text{budget share } j$$

where the budget share is the percentage of the total supply of expenditures each service represents.

While formal statistical tests are not carried out, revenue variable coefficients are compared across equations to see if they are different between services. As with the demand equations, supply price elasticities will be calculated and compared with prior estimates. In addition, revenue supply elasticities will be calculated at the mean values of the variables and compared to previous research estimates, and among services.

### Summary

The theoretical model and statistical estimating equations developed in this chapter are based on the concept that the demand for and supply of expenditures for public goods originate in the community. The relevant demand in the community is that of the median voter. The county commissioners are held to be the elected officials who make supply decisions in response to the utility the median voter derives from public expenditures, and to the demands of bureau managers. The specification of the model allows statistical tests of demand and supply behavioral relation-

ships, the effects of payments in lieu of taxes on county expenditure patterns, and the calculation of various elasticities.

The statistical equations are estimated using actual county budget data, for the fiscal years 1976-77, 1977-78, and 1978-79, provided by the Oregon Department of Revenue.<sup>20/</sup> The results of these regressions are presented in the following chapter. Interpretation of these results in terms of the theoretical relationships suggested in this chapter and Chapter II, and implications for policy decisions, are presented in both Chapters IV and V.

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<sup>20/</sup> The Oregon Department of Revenue has developed a computerized data system consisting of revenue and expenditure data for all taxing authorities in the state of Oregon, which is available to the public at a minimal cost. Initially, actual budget documents are analyzed and coded for specific revenue sources and types of expenditures. This data is then entered into the state computer system, such that specific information on various taxing jurisdictions can be made available with relative ease. The specificity of the computer system data is greater than that utilized in this research. A listing of the funds and expenditures which were aggregated from the state data for current use is presented in Appendix I.

## CHAPTER IV

### RESULTS

The purpose of this chapter is to present the results obtained using regression techniques to estimate the parameters of the ten equations presented in the preceeding chapter. Specific attention is paid to the relationship between these results and the objectives identified in Chapter I and the hypotheses tests outlined in Chapter III. The primary emphasis is placed on the statistical significance of the point estimates of the explanatory variable coefficients, with the implications of these results presented in the following, and concluding, chapter.

Generally, the results are in accord with the alternative hypotheses of Chapter III and the majority of the explanatory variables are statistically significant. Over-zealous interpretation of the results should, however, be avoided. First, the data upon which the estimates are based came from actual county budget documents. Since cross-county variance in reporting practices is high, variable measurements may be subject to reporting error. Second, the budget data were aggregated into five functional categories. Fund names and functions are not necessarily consistent across counties; and while consistency in aggregation procedures was attempted, a certain amount of aggregation error may remain. Third, wage rates were not available for various services by county. The WAGE variable is a measure of average public wage differentials across counties. These limitations should be kept in mind in interpreting results.

### Demand for Expenditures

The results of the five demand equations, estimated using three stage least squares, are presented in Table 5. These estimation procedures do not produce summary statistics such as the coefficient of determination ( $R^2$ ) or F statistics to test the significance of a regression taken as a whole. Without such statistics, interpretation is limited to whether estimated coefficients are statistically different from pre-specified values, and whether the difference between coefficients in the same equation are statistically different from pre-determined values.<sup>1/</sup>

The use of pooled cross-sectional-time series data, as in this research, often results in estimation problems of serial correlation and heteroskedasticity.<sup>2/</sup> The usual test for the presence of serial

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<sup>1/</sup> Coefficients and their standard errors are developed in the computer package allowing the test  $\frac{b-b^*}{s_b}$  which is approximately distributed as t with  $N-k$  degrees of freedom where  $b$  is the estimated coefficient,  $b^*$  is a pre-specified value,  $s_b$  is the standard error of the coefficient,  $N$  is the number of observations, and  $k$  the number of explanatory variables. This statistic is used in the test  $H_0: b=b^*$ . By generating the variance-covariance matrix of the estimated coefficients, the test of the equality of parameters is possible. This test is:

$$\frac{b_1 - b_2}{\sqrt{s_{b_1}^2 + s_{b_2}^2 - 2COV_{b_1b_2}}}$$

which is distributed as t with  $N-k$  degrees of freedom where  $b_1$  and  $b_2$  are parameter estimates,  $s_{b_1}$  and  $s_{b_2}$  are the standard errors of the estimate, and  $COV_{b_1b_2}$  is the covariance of  $b_1$  and  $b_2$ .

<sup>2/</sup> Time series correlation occurs when the error terms are correlated over time for the unit of observation. Cross-sectional serial correlation occurs when the error terms are systematically correlated between units of observation. The effect of serial correlation is inefficient estimates of the parameters; that is they do not have minimum variance, although they are still unbiased (see Intrilligator, p. 159). (continued)

Table 5. Three Stage Least Squares Regression Results of the Demand for Public Expenditures: All Oregon Counties

Dependent Variable	Tax Rate <sup>a/</sup>	Income <sup>a/</sup>	Residential Assessed Value <sup>a/</sup>	Non-Residential Assessed Value <sup>a/</sup>	AVG <sup>b/</sup>	CITY <sup>b/</sup>	CARS <sup>b/</sup>	NHS <sup>b/</sup>	KID <sup>b/</sup>	UR <sup>b/</sup>	Constant <sup>b/</sup>
DROAD	-29.32** (17.37)	-.014 (.013)	-25.26*** (8.21)	2.84 (2.91)		-.089 (.660)	75.34* (40.67)				263.30*** (83.95)
DED	-13.05** (7.63)	-.005 (.005)	- 5.44* (3.83)	.665 (1.19)				1.18** (.440)	1.32 (2.04)		6.28 (98.5)
USAFE	.709 (2.49)	.001 (.001)	.238 (1.05)	.421 (.363)		-.313*** (.096)				-.121 (.440)	32.85*** (11.13)
DSOCIAL	-22.30*** (7.00)	.015*** (.005)	- 6.32** (3.32)	-.031 (1.13)		.050 (.303)				-1.43 (1.64)	35.89 (35.89)
DGOV	-26.95*** (11.32)	-.012* (.009)	-10.0** (5.58)	5.48*** (1.94)	373.2*** (36.6)						83.79* (48.59)

\* Significant at the 90 percent confidence level.

\*\* Significant at the 95 percent confidence level.

\*\*\* Significant at the 99 percent confidence level.

<sup>a/</sup> Significance level determined using a one tailed t test.

<sup>b/</sup> Significance level determined using a two tailed t test.

correlation is the Durbin-Watson statistic which is not produced by the utilized computer package. The Goldfeld-Quandt test is the standard test for heteroskedasticity, but it too is not generated in the estimation technique employed here. While these tests could be manually developed, the use of generalized three stage least squares provides estimates of the regression coefficients which are asymptotically devoid of heteroskedasticity and serial correlation. As such, the three stage least squares (3SLS) parameter estimates of the demand equations are held to be reliable.<sup>3/</sup>

#### Tax Rate Variable

The null hypothesis relating the tax rate and the demand for expenditures, developed in Chapter III, is stated such that the tax rate parameter is equal to zero. The alternate hypothesis is in accord with the theoretically expected negative relationship between the tax price term and demand for expenditures; that the coefficient is negative. The null hypothesis is rejected, and the alternate hypothesis concluded for the tax rate point estimates for general government (-26.96), roads (-29.32), education (-13.05), and social services (-22.29), all at the 95 percent confidence level. These estimates imply that a one dollar increase in the tax rate per thousand dollars assessed valuation results in a de-

<sup>2/</sup> continued. Heteroskedasticity occurs when the error terms do not have constant variance, with two implications. First, the estimated coefficients do not have minimum variance, although they too remain unbiased. Second, the variances of the estimated explanatory variable parameters are biased such that t and F tests are no longer valid. Both t and F values are underestimated such that the significance of estimated explanatory variable coefficients will be understated.

<sup>3/</sup> c. f. ante, p.73.

crease in the demand for the service expenditures, with the proportional decrease defined by the value of the tax rate regression coefficient. Using a one or two tailed t test, the null hypothesis cannot be rejected for the public safety point estimate (.709).

These results indicate that the demand for road, education, social services and general government expenditures are all price responsive. As tax rates increase, less of these services will be desired. Public safety is not, however, price responsive. The coefficient is not statistically different from zero, and in magnitude is less than one. Given the fact that few substitutes exist for publicly provided police and fire protection, and that safety is generally considered a necessity, this result is reasonable, and in fact, promotes greater confidence in the general results.

### Income

The hypothesized theoretical relationship between income and the demand for expenditures is that as income increases, individuals are better able to convert desires to actual demands. Given the null hypothesis that the income coefficients are equal to zero, and the alternate hypothesis that these parameters are positive, the null hypothesis may be rejected for social services at the 99 percent confidence level using a one tailed t test. The value of this coefficient is .016, which suggests that a one dollar increase in per capita income results in a 16 cent increase in the demand for per capita social service expenditures. Though not discussed previously, this finding may support the sociological hypothesis that as wealth increases, so does the social concern for the less fortunate.



The null hypothesis may not be rejected for the remaining services. Interestingly, while these parameters are not statistically different from zero, the income point estimates are negative for general government (-.012), roads (-.014), and education (-.005) which indicates that as income increases (decreases), the demand for these services decreases (increases).

If these estimates were statistically significant, the conclusion could be drawn that roads, education, and general government are inferior goods.<sup>4/</sup> Rather than conclude these goods are inferior, it seems more likely than the income variable reflects some influence other than ability to convert desires to actual demands. Increasing incomes may reflect increased property ownership, which is found in this research to be negatively related to the demand for expenditures. Such a conclusion is consistent with the observation that the income coefficient is positive (.001), but not statistically significant, in the demand for public safety equation. As property holdings increase, due to increased income, the potential of loss from fire or theft increases resulting in increased demand for safety expenditures.

#### Residential Assessed Value

With the value of other explanatory variables held constant, increases in the assessed value of residential property are hypothesized to be negatively related to the demand for expenditures, as increased assessments imply larger tax payments, payments for services. With the alternate hypothesis that this coefficient is negative, the null hypo-

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<sup>4/</sup> An inferior good is defined as a good for which the quantity demanded varies inversely with real income. The traditional example of an inferior good is margarine, where as income increases, butter is substituted for margarine.

thesis is that the residential assessed value coefficient is equal to zero. Based on the point estimates for government (-10.02), roads (-25.27), and social services (-6.30) the null hypothesis is rejected and the alternate hypothesis is concluded at the 95 percent confidence level. The null hypothesis is also rejected for education (-5.44) at the 90 percent confidence level using a one tailed t test. These results indicate that a one thousand dollar increase in the assessed value of residential property in the county results in decreased demands for the above from services, in amounts proportional to the estimated regression coefficients.

The expectation of a negative sign on this coefficient in the public safety equation is not reasonable. As home values increase, the potential for greater loss to these homes increases, and thus the utility from public safety expenditures increases, implying increased demand. As such, the expected sign of this coefficient is positive. While the residential assessed value coefficient is not statistically significant, it is positive for public safety (.238), the only equation for which this variable has a positive sign. The fact that this coefficient is not statistically significant, however, further supports the conclusion that the demand for public safety is not price responsive.

The similarity of the tax rate and residential assessed value results are striking. These two variables not only have the same signs on their respective coefficients in each equation, but the order of magnitude of the parameter estimates are identical among services. Because individuals "out of pocket costs" are actually determined by their tax bill -- a function of assessed property value and the tax rate -- the result is reasonable. As hypothesized, the residential assessed value is capturing a portion of the price effect.

### Non-Residential Assessed Value

Non-residential assessed values are included in the demand equations as a measure of the degree to which residents can shift the tax burden to non-residential property. The null hypothesis is that the coefficient on non-residential property is zero, the alternate hypothesis that the coefficient is positive. Given the point estimates and standard errors of these estimates, the null hypothesis cannot be rejected for roads (2.84), education (.665), public safety (.421), or social services (-.0314), though three of these four parameters are positive as expected. The coefficient is both positive (5.49) and significant (at the 99 percent confidence level) in the demand for government expenditures equation.

These results imply a \$1,000 increase in non-residential assessed value will result in an increase in the demand for general government expenditures by \$5.49, but will not affect the other four demands. As such, the theoretical hypothesis of tax burden shifting to non-residential property is not supported. Previous efforts which have empirically supported the hypothesis have measured non-residential assessed value as a percentage of total assessed value. The measurement technique employed in this research, total dollars, may have muddled the underlying relationships.

### Taste and Preference Variables

For the following variables the null hypothesis is that the coefficients are equal to zero, with the alternate statistical hypothesis that the coefficient is not equal to zero. As such, two tailed t tests are used. The discussion is organized in such a way that the taste and preference variables for each service are discussed together, rather than each variable individually.

Roads and Highways. Vehicles and road expenditures are held to be complementary goods such that the expected value of the coefficient on the variable measured as registered vehicles per capita is positive. The null hypothesis is rejected for this variable at the 90 percent confidence level for the point estimate, 75.34. A one vehicle per person increase in the ownership of automobiles results in a \$75.34 increase in the demand for road expenditures. At the mean value of the explanatory variable, such an increase in ownership (approximately twice current ownership rates) would result in expenditures on roads which are slightly less than double.

The percentage of the county population who reside in incorporated communities is expected to be negatively related to the demand for road expenditures.<sup>5/</sup> While the estimated parameter is negative (-.089), it is not statistically different from zero. The calculated t value is less than 0.2 given credence to the conclusion this variable is not a significant determinant of road expenditures.

Scale factors of densely populated areas were the basis of the hypothesized relationship between road expenditures and urbanization. It may be, however, that city road expenditures in urban areas, not included in these county figures, tend to hide the relationship between road expenditures and urbanization.

Education. Increases in the education expenditures as defined here, represent the county's contribution to the county school fund as required by state law, rather than total education expenditures in the county. The average educational attainment of the community, as measured by the

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<sup>5/</sup> c. f. ante, p. 63.

percentage of the adult population who have completed high school, is hypothesized to result in increased demand for education expenditures. The parameter estimate of this variable is consistent with these expectations and is positive valued (1.18), and statistically significant at the 95 percent confidence level. A one percent increase in the percentage of adult population completing high school results in a one dollar eighteen cent increase in expenditures demanded.

The percentage of county population who are of school age, defined as under seventeen years of age, was also expected to increase the per capita demand for education. The null hypothesis cannot be rejected for this variable (t value less than 0.65) though the regression coefficient is positive (1.32). This result may indicate that individuals do not perceive positive externalities which tend to be associated with education.

Public Safety. Increases in the percentage of county population residing in incorporated areas is expected to increase the demand for public safety expenditures, such that a positive sign on this variable is predicted. Urbanization is statistically correlated with crime rates, and thus the potential of loss due to criminal acts is higher in these urban areas. The null hypothesis for this variable is rejected at the 99 percent confidence level, but the coefficient has an unexpected negative sign (-.313). A one percent change in the percent of urban population results in a decrease in the demand for safety expenditures of 31 cents.

This result may indicate economies of size for public safety in densely populated urban areas. For instance, the expenditure for one police officer and one vehicle may "service" a greater number of in-

dividuals in a densely populated area than would be the case in a very sparsely populated rural area, allowing per capita demands for safety expenditures to decline as population becomes more dense. Another explanation of this result is that the incidence of some violent crimes is greater in rural counties, and the demand for safety expenditures may be particularly sensitive to these crimes.

The unemployment rate was held to also measure the need for public safety expenditures, but the coefficient of this variable is not significant, and is in fact negative (-.121). It may well be that individuals do not perceive unemployment to add to the need for public safety expenditures.

Social Services. The demand for social service expenditures is expected to be positively related to the percentage of county population residing in incorporated areas.<sup>6/</sup> While the estimated parameter is positive (.050), it is not statistically different from zero, with a t value less than 0.2. The expected positive value was based on the hypothesis that urban dwellers value parks and recreation expenditures, which are included in social services, more greatly than do residents of rural areas. The results do not support this hypothesis. It may be that adequate substitutes exist for public parks and recreation.

The seasonally adjusted county unemployment rate is included as a measure of the incidence of individuals in need of human services, one of the services included in the social service category. Increases in this rate are expected to increase the demands for social services. This coefficient (-1.43) is not significant, and in fact has a t values less

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<sup>6/</sup> c. f. ante, p. 65.

than 0.9. Other expenditures are included in this service category which may tend to overshadow the relationship between unemployment and expenditures on the aggregate social services function.

General Government. The single taste variable which appears in the demand for government equation is AVG, which is a function of the other five taste and preference variables, created through the use of principal components analysis. For this variable the null hypothesis is rejected at the 99 percent confidence level for the point estimate of 373.20. Because AVG cannot, in itself, be observed or measured the only inference which may be drawn is that when the taste determinants of other demands increase, the demand for government increases. This result is also generally consistent with the observation that government overhead costs have been proportionately increasing over time.

### Constants

The null hypothesis that the value of the constant is equal to zero (the alternate hypothesis that the constant is not zero) cannot be rejected for the education (6.28) or social service (35.89) equations. This result implies that if all other explanatory variables had a zero value, education and social service expenditures would not be demanded. For the constants in the general government (83.79), roads (263.30), and public safety (32.85) equations, the null hypothesis is rejected at the 90 percent confidence level suggesting the positive valued per capita expenditures which would be demanded if all other variables were equal to zero.

### Price and Income Elasticities

Given the functional demand specifications, price and income elasticities of demand for expenditures can be calculated at their mean values. These elasticities are presented in Table 6. The set of estimates indicate that public goods are rather price inelastic, with the exception of social services which is mildly price elastic (-1.08). The estimates compare favorably with the few existing price elasticity estimates for selected services. The education elasticity of -.906 compares to Hambor, Votey, and Phillips 1973 estimate of -1.10, and Barlow's 1970 estimate of -1.34. The road elasticity of -.564 compares to Ohls and Wales 1972 estimate of -.50. Estimates of general government and public safety price elasticities with which to compare these estimates (-.553, 0.048) are unavailable.

Economic theory suggests that a good will tend to be price elastic if a large share of total income is spent on the good and/or if a large number of substitutes for the good exist. Moreover, necessities tend to be price inelastic while luxuries are price elastic. The two services for which private market substitutes are most readily available are education (private schools), and social services (alternative recreation sites and private agencies dealing with social problems). Of the five services, education and social services are most elastic. The more inelastic services -- government, roads, and public safety, do not have direct substitutes. While substitutes do not exist for public roads and general government, these services receive a large budget share (in excess of 30 percent of total expenditures), and the calculated elasticities both approximately -0.55, may reflect the two opposite elasticity influences of large budget share and few substitutes. Public



Table 6. Price and Income Elasticities of Demand for Expenditures  
Calculated at the Mean Value Using Three Stage Least Squares.

Service Category	Price Elasticity	Income Elasticity
Roads	-0.564*	-0.755
Education	-0.906*	-0.972
Public Safety	0.048	.256
Social Services	-1.08*	2.21*
General Government	-0.553*	-0.667*

\* The elasticity estimate is based on a coefficient which is significant at the 90 percent confidence level.

safety is nearly perfectly inelastic which reflects the fact that this service receives a relatively small share of local government expenditures, that few, if any adequate substitutes for publicly provided safety exist, and that safety is a necessity. The results here are in accordance with what economic theory suggests.

The income elasticity estimates for general government, roads, education, and public safety are based on coefficients which are not statistically different from zero. Calculated elasticities based on these coefficients indicate, however, that the demands for these services are income elastic. The one elasticity which is based on significant parameter is social services, with a value of 2.11. A one percent increase in income results in a 2.11 percent increase in the demand for social services.

### Supply of Expenditures

The estimated regression coefficients for the set of five supply equations are presented in Table 7. The ordinary least squares computer package used in estimating the supply equations provides a much "richer" set of associated statistics than does the three stage demand estimation procedure. Hence, a wider range of statistical hypothesis tests are possible. The presence of serial correlation and heteroskedasticity, which could tend to cause inefficient estimates, was checked for. The Durbin-Watson statistic was used to test for serial correlation. The statistics produced were in the range such that it was determined both positive and negative serial correlation were not present. To test for heteroskedasticity, counties were partitioned into two groups, the 18 eastern and the 18 western Oregon counties. The sum of the squared

Table 7. Ordinary Least Squares Regression Results of the Supply of Public Expenditures: All Oregon Counties.

Dependent Variable	Tax Rate	PILT	LOCAL	STATE	SPED	GFED	CASH	WAGE	YR1	YR2	GRANT	CONSTANT	R <sup>2</sup>	D-W	F
SROAD	16.80*** (5.82)	.814*** (.083)	.219 (.153)	.029 (.637)	.053 (.621)	.125 (.100)	.324*** (.123)	-.014*** (.005)	-62.83*** (17.23)	6.12 (14.61)	-57.71 (48.56)	145.25** (72.97)	.744	1.82	25.47***
SED	.247 (2.06)	.261*** (.029)	.012 (.054)	-.082 (.225)	.123 (.219)	.148*** (.035)	.174*** (.043)	.0006 (.0019)	2.60 (6.09)	3.54 (5.17)	27.05 (17.18)	-15.55 (25.81)	.771	2.06	29.42***
SSAFE	2.81*** (.957)	.013 (.013)	.116*** (.025)	-.044 (.105)	.562*** (.102)	.078*** (.016)	.042** (.020)	.0002 (.0008)	-3.70 (2.83)	.478 (2.40)	-1.40 (7.97)	8.11 (11.98)	.500	1.82	8.75***
SSOCIAL	2.79 (2.99)	.023 (.042)	.301*** (.079)	-.096 (.327)	2.07*** (.319)	.184*** (.051)	.067 (.063)	-.007** (.003)	-18.47** (8.85)	1.86 (7.51)	-18.22 (24.95)	81.26** (37.47)	.567	1.96	8.32***
SGOV	4.82 (5.28)	-.084 (.075)	1.04*** (.139)	-.112 (.577)	.867 (.563)	.389*** (.090)	.547*** (.112)	.0016 (.0049)	-32.35** (15.62)	1.35 (13.25)	104.48** (44.03)	- 8.77 (66.16)	.595	2.02	12.85***

\* Significant at the 90 percent confidence level.

\*\* Significant at the 95 percent confidence level.

\*\*\* Significant at the 99 percent confidence level.

residuals for the two groups were used to create a ratio. As in the Goldfeld-Quandt test, this ratio is approximately distributed as F with  $N_1 - N_2$  degrees of freedom. The sum of the squared residuals ratio was then used to test the null hypothesis that the variances for each group were equal. The hypothesis could not be rejected for any of the five supply equations.

#### Tax Rate Variable

The tax rate is expected to be positively related to the supply of expenditures for all services. The null hypothesis is stated such that the tax rate coefficient is equal to zero and the alternate hypothesis is that this parameter estimate is greater than zero.

In all five supply equations, the tax rate is found to be positively related to the supply of expenditures, supporting the alternate tax rate variables hypothesis. The coefficient is, however, statistically different from zero (at the 99 percent confidence level) in only two equations -- roads (16.80) and public safety (2.81). A one dollar increase in the county tax rate per \$1,000 assessed valuation results in a \$16.25 increase in the supply of per capita road expenditures and a \$2.60 increase in per capita public safety spending. These two services tend to be more "good" oriented than social services (point estimate of 2.79), general government (4.82), or even education (0.25). This result may indicate a tendency on the part of elected officials to make larger expenditures on visible types of services when high tax rates are in effect.

#### Payments In Lieu Of Taxes

The null hypothesis that the payments in lieu of taxes coefficient is equal to zero is rejected and the alternate hypothesis that the co-

efficient is not equal to zero is concluded for two services at the 99 percent confidence level -- roads (.814) and education (.261). The coefficients for public safety (.013), social services (.023), and government (-.084) are not statistically different from zero.

Roads and education are the two services to which PILTS are legally committed. By state statute, 75 cents of each PILT dollar goes to roads, the other 25 cents to education. Tests of the null hypothesis that the respective coefficients are equal to .75 and .25, as a test of meeting the letter of the law, cannot be rejected.

These results indicate that the counties do "play by the rules", but that PILTs do not stimulate the expenditure of other revenues on roads and education, or the other three services. A change in the level of PILTs would be totally absorbed by roads and education. The sum of these two expenditures would change dollar for dollar with the payments. It seems clear that in the event PILTs were discontinued, revenues would be diverted from other services to roads and education, needed tax monies would increase, or both. The implications of these results are more fully discussed in Chapter V.

### Local Revenues

Local revenues (LOCAL) consist of monies collected in the county by non-property tax means, including land sales, licenses and fees, and other community specific revenue sources. The null hypothesis that the coefficient on this variable equals zero is rejected in favor of the alternate hypothesis that the parameter does not equal zero, at the 99 percent confidence level, for the public safety (.116), social services (.301), and general government (1.04) supply equations. The parameter estimates

for the road (.219) and education (.012) equations are not statistically different from zero. Interestingly, the coefficient on LOCAL is significant in only those equations where PILTs are not significant, and significant in all such equations. It may be local revenues are specifically directed to non-PILT supported services as part of the equilibrium budgeting process.

### State Revenues

The null hypothesis that the state revenues coefficient was equal to zero could not be rejected for any of the five services. The t values associated with this variable do not exceed 0.5 in any equation. The theoretical expectation was that state revenues were positively related to the supply of expenditures; the results instead indicate the lack of a dominant pattern in use of state monies. Savage (1979) reached a similar conclusion for mental health spending.

### Specific Federal Aid

Specific federal aid is a significant determinant, at the 99 percent confidence level, of social service (2.07) and public safety (.562) expenditures. The null hypothesis that the coefficient is equal to zero cannot be rejected for roads (.053), education (.123), or government (.867). These results are most likely due to the nature of the distribution of specific aid to certain services rather than the county budgeting and expenditure process. During initial data collection the bulk of federal money available for social services and public safety was coded as specific aid. The stimulative nature of specific aid (one dollar of federal aid results in over two dollars in social services

expenditures) may be due to the federal use of matching grants where a local contribution is prerequisite to receipt of the federal money. For instance, a 50/50 matching grant would require one dollar of local money be spent for every dollar of federal money, resulting in a two dollar expenditure. Unfortunately, data were not disaggregated to account for matching grants; and thus a definitive conclusion is not possible.

### General Federal Aid

General federal aid consists of monies appropriated to the counties without specific restrictions as to their use.<sup>7/</sup> With the exception of roads, the coefficient on this variable was found to be statistically different from zero at the 99 percent confidence level in all supply equations, and all coefficients are positive. The receipt of a dollar of general federal aid thus stimulates all expenditures except roads, and it further appears that this dollar is distributed across service categories rather than predominantly devoted to a specific type of local government service.

### Net Cash Balances

The null hypothesis that the coefficient on this variable is equal to zero is rejected at the 95 percent confidence level for roads (.324), education (.175), public safety (.042), and government (.547). The social services parameter estimate (.067) is not statistically different from zero.

Neither the previous category, general federal aid, nor net cash balances are legally committed to specific service categories. The uses

<sup>7/</sup> Oregon and California Railroad revested land payments are included in this category.

of these monies, then, provides an indication of how local governments value the services. For both revenue sources, general government receives the largesse of the money and public safety the smallest portion.

The dominant view of the local government budgeting and expenditure process holds that counties use their committed monies, such as PILTS, to finance road and education expenditures, and uncommitted funds to finance public safety, social services, and general government. The results here contradict this widely held view, as uncommitted revenues are found to be statistically significant determinants of road and education expenditures.

The significance of these uncommitted revenues in the supply of education expenditures equation is particularly puzzling. The county school fund has a statutory minimum expenditure which must be met with property tax revenues. While PILTS are also legally directed to this fund, there is no clear rationale for the expenditure of uncommitted monies on this service, above the legal minimum. In terms of the theoretical model, the only clear explanation of this result is that the counties have "excess funds" and are directing additional monies to education to maximize utility. In such a case, however, the model suggests that there would be a zero tax rate.

#### Total Expenditure Effects

In every case, the significant coefficients on non-property tax revenues (PILT, LOCAL, STATE, SFED, GFED, CASH) are positively related to the supply of expenditures as predicted in the theoretical model. Hypothesis tests were conducted on the sum of these coefficients to determine if the non-local revenues fully stimulated total expenditures



( $\sum \beta_i$  greater than or equal to one) or partially stimulated expenditures ( $\sum \beta_i$  greater than zero but less than one). The results of these tests are presented in Table 8.

The null hypothesis that the sum of the coefficients is less than or equal to one can be rejected for local revenues (t values of 2.96) and specific federal aid (t value of 2.88). The matching grant requirements of many specific federal aid programs may explain the stimulative nature of this revenue. While conclusive evidence is not available, the results suggest that local revenues may be the source of funds used to match specific federal aid, resulting in the stimulative effect of local funds. The sum of the coefficients for PILTS, general federal aid, and net cash balances are not statistically different from one. A one dollar increase in these revenue sources will increase total expenditures by approximately one dollar.

The sum of the state revenue coefficients is not statistically different from zero (t value of -.32). This result implies that a one dollar change in state revenues will not have a perceptible effect on total expenditures.

#### Budget Share Criterion

For revenue sources which are not committed to specific services, an additional hypothesis test is conducted. If uncommitted sources of revenue increase by one dollar they may be distributed in equal portions, or in any way the county desires. Tests of the null hypothesis,  $H_0$ :  $\beta_i$  = budget share i, where the budget share represents the percentage of total expenditures each service accounts for, were conducted to determine if the service in question received its "fair share" of non-committed

Table 8. The Effect of Non-Property Tax Revenues on Total Expenditures:  
All Oregon Counties.

	PILT	LOCAL	STATE	SFED	GFED	CASH
Total Expenditure Coefficient*	1.03	1.69	-.312	3.68	.924	1.15
Hypothesis Test Result	One	Full	Zero	Full	One	One

One = the coefficient is not statistically different from one.

Full = the coefficient is statistically greater than one.

Zero = the coefficient is not statistically different from zero.

\* These coefficients are derived from a single total expenditure equation.

on-specific revenues. The results of these tests are presented in Table 9. The results are somewhat mixed.

Both social services and general government receive a larger "share" of local revenues than their budget share would indicate, though other services do not receive less than their fair share of this revenue. All services receive state revenues in proportions which are not statistically different from their budget share. Roads receive a smaller share of general federal aid than would be expected under the fair share criterion, though expenditure proportions are in accordance with the null hypothesis for other services.

The null hypothesis is rejected for the distribution of cash balances to three services; general government and education receive larger budget share than expected and public safety receives a smaller payment than the percentage of total expenditures this service represents. The implications of these results are limited to the conclusion that 70 percent of revenues are dispersed among expenditure categories in a manner which is not statistically different from a budget share criterion.

#### Wage Variable

The wage variable was intended to measure differences in production costs among services, by county. Unfortunately, wages by service category were unavailable. The wage variable is significant in two equations: roads (-.014), and social services (-.007) at the 95 percent confidence level, but it is not statistically different from zero for the education (.0006), public safety (.0002), or government (.0016) equations.

The negative coefficients for roads and social services imply that as wage rates increase, total expenditures decline. An explanation of

Table 9. t Values of the Test That Public Services Receive Their Budget Share of Uncommitted Revenues.

Dependent Variable	LOCAL	STATE	GFED	CASH
Roads <sup>a/</sup>	- .79	- .48	-2.15*	- .13
Education <sup>b/</sup>	-1.53	- .78	1.51	1.83*
Public Safety <sup>c/</sup>	.76	-1.34	-1.18	-2.75*
Social Services <sup>d/</sup>	2.03*	- .13	.86	-1.16
Government <sup>e/</sup>	5.07*	- .78	.54	1.84*

a/ Ho:  $\beta = .34$   
Ha:  $\beta \neq .34$

b/ Ho:  $\beta = .095$   
Ha:  $\beta \neq .095$

c/ Ho:  $\beta = .097$   
Ha:  $\beta \neq .097$

d/ Ho:  $\beta = .14$   
Ha:  $\beta \neq .14$

e/ Ho:  $\beta = .34$   
Ha:  $\beta \neq .34$

\* Statistically different from zero at the 90 percent confidence level.

this result, consistent with the theoretical model developed in Chapter III is that as wage rates increase, the unit costs of the services increase. The elected official, who is attempting to maximize the utility of the median voter with his expenditure decisions, will supply less to these services (expenditures decrease) to increase the marginal utility of the last dollar spent on these services so as to keep the ratio of marginal utilities to prices consistent across services, the equilibrium condition.

The positive coefficients on the wage variable in the other equations, while not statistically significant, may imply the factor demand for labor is inelastic for these services. When wage rates increase, the use of labor declines by a smaller percentage than wages increase, such that the total labor bill increases as do total expenditures. The wage elasticities presented on page 109 do indicate that these services are wage rate inelastic. This result may be explained by the fact that labor is the primary input for education, public safety, and general government, and few substitutes exist.

#### Dummy Variables

Two dummy intercept variables, YR1 for FY 76-77 and YR2 for FY77-78 were included in the supply equations to account for expenditure differences among years. While all variables measured in dollars were price deflated, YR1 is statistically significant in three of five regressions. Relative to 1978-79, 1976-77 per capita road expenditures were \$62.90 less, \$32.25 less for general government, and \$18.50 less for social services; measured in constant dollars, expenditures of local governments have dramatically increased between these years for these services.

Changes do not appear to have occurred for public safety or education expenditures. Statistical tests indicate that there is no significant difference in the spending levels of 1977-78 and 1978-79 for any services.

As discussed earlier in the thesis, a dummy variable was included to identify Grant County. This was done partially because of the larger projects' (of which this research is one part) emphasis on Grant County, and also because of the magnitude of the PILT the county receives which may affect its expenditure patterns. The parameter estimates for this variable allow the null hypothesis that it is equal to zero to be rejected at the 95 percent confidence level for one service, government (104.48). This result is consistent with the observation that Grant County is partially exempted from the state law dealing with PILTS and allowed to spend 25 percent of the total payment as desired. For the three data years, \$104.00 is approximately one quarter of the PILT of Grant County received, suggesting the uncommitted PILT funds are budgeted for general government.

#### Price, Input, and Revenue Elasticities

The specification of the supply equations allow calculations of various revenue and price elasticities. Most prior research in this problem area has used a demand oriented model rather than a demand supply model. The result is that far fewer prior supply elasticities are available for comparison to the results here than for the demand elasticities.

As discussed earlier, aggregation of aid variables into single categories has been common in the past such that the "effect of aid" is not comparable for the disaggregation scheme employed here for revenue

sources. Moreover, past researchers who have estimated supply relationships have often been content with estimated coefficients rather than calculating the related elasticities. The calculated elasticities from this research are presented in Table 10.

Interpretation of the price elasticities should be guarded. A traditional supply elasticity relates changes in the price of the good to changes in the quantity which is supplied. In this context, however, there is a single price variable relating to five different services. A change in the tax rate should not be expected to be fully reflected in the supply response of any single service. As such, the results are expected to indicate an inelastic supply response, and in fact do so. Roads are the most price elastic (.323), followed by public safety (.191). The other three elasticities are not statistically different from zero, suggesting they are nearly perfectly price inelastic. The calculated education price elasticity, .017, compares to Booms and Hu's 1971 estimate of .57, though the elasticity here is not statistically significant. A one percent increase in the tax rate will result in increased expenditures for roads by .32 percent and for public safety by .19 percent, without a perceptible effect on education, social services, or general government. This may reflect elected officials political wisdom in supplying expenditures to "visible" services when high tax rates are in effect.

The calculated wage elasticities tend to support the conclusion made earlier concerning a decrease in spending, brought on by wage increases, to increase the marginal value of the last dollar spent on the service. The wage coefficient is elastic for both roads (-1.48) and social services (-1.90). The implication for government, public safety and education is that these services are nearly perfectly wage rate inelastic.

Table 10. Price and Revenue Elasticities of the Supply of Expenditures Calculated at the Mean Value Using Ordinary Least Squares.

Dependent Variable	TAX RATE	PILT	LOCAL	STATE	SFED	GFED	CASH	WAGE
Roads	.323**	.571*	.085	.009	.002	.064	.167*	-1.48*
Education	.017	.660*	.016	-.100	.023	.275*	.323*	.247
Public Safety	.191*	.033	.160*	-.052	.103	.143*	.076*	.092
Social Services	.135	.041	.297*	-.082	.272*	.239*	.088	-1.90*
Government	.099	-.062	.432*	-.042	.048	.214*	.301*	.184

\* The elasticity estimate is based on a coefficient which is significant at the 90 percent confidence level.



More than anything else, these elasticities provide a measure of comparison for the relative dependence of each service on the various revenue sources. All revenue variables which are significant are inelastic for all service categories, most with calculated elasticities less than 0.3. For coefficients which are not significant, the conclusion drawn is that the revenue elasticity is nearly perfectly inelastic. The supply elasticity for PILTs is the most elastic, with a value of 0.571 for roads and 0.660 for education. This is a function of the magnitude of the PILTs and the legal restrictions attached to their use for these services which result in PILTs being the principal sources of revenue for roads and education. While these values are in the inelastic range, expenditures on roads and education are more responsive to PILT changes than any other service to any aid type. This supports the conclusion that communities which receive PILTs are relatively dependent on these federal payments; and radical changes in PILTs could introduce major distortions in the budgeting and expenditure process, resulting in substantial local government instability.

### Summary of Results

In consumer demand theory, and in prior empirical estimation of individual demands for public services, the quantity demanded is held to be negatively related to the price of the good. Past efforts have invariably considered public goods as a single good, at most three goods, and the results have generally supported the hypothesis of a negative price-quantity relationship. The present research disaggregates services into five functional categories and further supports the negative price-quantity hypothesis. However, the range of services over which the relationships holds is extended.

For all thirty-six Oregon counties, the point estimates for the tax rate indicate that a one dollar increase in that rate results in a \$29.32 decrease in the per capita demand for roads, a \$13.05 decrease in the demand for education, a \$22.30 decrease for social services, a \$26.95 decrease for general government, and a 70 cent change in the demand for public safety. The public safety coefficient, however, is not statistically different from zero.

Increases in the assessed valuation of residential property are negatively related to the demand for all expenditures. Individual "out of pocket costs" for the provision of public services are partially determined by the assessed valuation -- actual payments are a function of their assessed property values and the tax rate. It is concluded the residential assessed value does capture a portion of the price effect.

Non-residential assessed value was included as a measure of residents ability to shift the tax burden to non-residential property as found in prior research. This hypothesis is not supported as the variable is not significant in four of the five demand equations. Measurement of this variable here differs from prior research efforts, and it is possible that the techniques employed have muddled these relationships.

The number of registered vehicles per capita within a county is positively related to the county demands for road expenditures, though the degree of urbanization has no effect on this demand.

The demand for educational expenditures is positively related to the educational level of the adult population. Presence of school-age children is not, however, related to education demands.

Demand for public safety expenditures is negatively related to the degree of urbanization within a county. The level of unemployment does not affect this demand in a statistically significant way.

Urbanization and unemployment do not impact the demand for social services.

In the aggregate, variables hypothesized to increase the demand for other services, are expected to yield an increased demand for general government expenditures. The results support this hypothesis.

Estimates of the price elasticity of demand for expenditures on public services are rare in the literature. Those which do exist indicate that public good demands are relatively price inelastic. Elasticities based on the estimated coefficients in this research substantiate the price inelastic claims. In only one case is the demand found to be price elastic (social services), and then only mildly elastic.

Previous estimates of income elasticities are also extremely rare for all public services, except education, which is generally found to be income inelastic. Results here indicate education, general government, education, and public safety are nearly perfectly income inelastic, while the demand for social services is income elastic.

As in the theory of the firm, the quantity supplied is held to be positively related to the price of the good. In prior research, this premise has been empirically demonstrated for individual services. This research disaggregates services into five functional categories and concludes that there is a positive relationship between the tax rate and the supply of expenditures for all services considered.

State statute in Oregon requires counties to spend PILTs for roads and education. This research finds that counties are budgeting their expenditures in accordance with the law and that PILTs are significant determinants of road and education expenditures.

The hypothesis that PILTs purely stimulate expenditures on roads and education is not supported here. While expenditures increase dollar for

dollar with increased PILTs, there is no evidence that additional local tax monies or other non-local revenues are attracted to these services, nor is the hypothesis that PILTs act as a substitute for locally collected revenues supported. Rather than substitution or pure stimulation, expenditures are found to increase with aid in equal amounts.

It has been previously suggested that specific revenues may influence the level of expenditures for non-aided services. This research concludes that PILTs do not affect county expenditures for general government, public safety, or social services in a stimulative or substitutive way.

Local revenues, collected by the local government through non-property tax means, are found to be positively related, statistically significant, determinants of expenditures for public safety, social services, and general government. Moreover, the total expenditure effect of a dollar increase in this revenue source is stimulative. This may be due to the use of these revenues as the source of the local match necessary for federal matching grants.

The counties' use of state revenues does not indicate a statistically significant pattern. The coefficient on this variable is not statistically different from zero for any expenditure equation.

Most prior research efforts indicate federal aid is positively related to public good expenditures. The conclusion here is in accordance with those efforts; significant coefficients are positively related to the supply of expenditures for all services as expected. A dollar increase in general federal aid results in approximately a one dollar increase in total expenditures while specific federal aid has a purely stimulative effect on total expenditures. The specific aid result is probably due to the use of matching grants.

Net cash balances are statistically significant determinants of four of the five services -- roads, education, public safety, and general government. As expected, increases in the cash balances variable result in increased per capita expenditures for these services.

Disaggregated supply of expenditure revenue elasticities are rare in the literature. Such elasticities, calculated here, indicate the revenue-expenditure relationship is inelastic for all services.

The PILT elasticity of supply for roads and education are the least inelastic of all service-revenue combinations. Of these two, education is the least inelastic (.712), the road elasticity is .540. Percentage changes in PILT levels will effect expenditures on roads and education in a more dramatic way than any other revenue change will effect any other service. Communities could be adversely effected by changes in PILTs.

Supply price elasticities are not common in previous research efforts. Those calculated here indicate inelastic price response, and are such that the supply responses are less elastic than their demand counterparts.

The empirical results presented in this chapter allow many implications to be drawn concerning the nature of the local government expenditure process, in terms of the theoretical models evaluated in Chapter II, and with reference to the model developed in Chapter III. These results also allow conclusions to be drawn concerning the objectives identified in Chapter I. The most important conclusions which have been summarized in this chapter are more fully discussed and evaluated in the following, and concluding, chapter.

## CHAPTER V

## SUMMARY AND CONCLUSIONS

The principal objective identified for this research was to determine the effects of payments in lieu of taxes on Oregon county expenditure patterns. The theoretical framework which was developed to analyze these effects also allows a variety of inferences to be drawn concerning the local government expenditure process, the actors involved, and the determinants of quasi-market forces of demand and supply.

The appropriateness of any economic model is measured by its ability to explain real world events, which this model does reasonably well. While some simplifying and extending assumptions were made, the model is based on established economic theory and provides results consistent with that body of theory.

The local government expenditure process is not "neat and clean". Problems basic to the provision of public goods -- quantity, quality, and price measurement, the articulation of demands, the nature of production decisions -- these all tend to muddle an already complex process. In light of, and in spite of, these inherent problems, the following conclusions, derived from the results documented in the preceding chapter, are presented.

Results in Terms of Objectives

The objectives of this research, formally identified in Chapter I, relate to the following three questions:

- (1) Are PILTS significant determinants of road and education expenditures?

(2) Do PILTS stimulate expenditures on these two services?

(3) Are PILTS significant determinants of expenditures for general government, public safety, or social services?

The results presented in the preceeding chapter provide an indication of how the counties are currently using PILTS, and provide answers to these questions. PILTS are significant determinants of road and education expenditures, and in fact that these are the only two services which are affected by this revenue source. Each PILT dollar is apportioned among roads and education, approximately in accordance with the legal mandate of 75 percent going towards roads and 25 percent to education. The regression results indicate that PILTS do not stimulate or substitute for locally collected revenues, but that the total affect of PILTS is absorbed by roads and education. Payments in lieu of taxes are essentially "gravy" for these two services without expenditure effects on other services.

The above questions grew out of the more policy-oriented concerns dealing with the consequences of federal resource management alternatives. Changes in resource use imply changes in the level of PILTS, and the results of this research can be most valuable in suggesting the expenditure implications of changes in payment levels.

The results indicate that marginal changes in PILTS will be solely reflected in expenditure changes for roads and education. The PILT revenue elasticities provide an indication of the relative impact of marginal changes in payment levels on these service expenditures. A one percent decrease in PILTS will result in a .66 percent decrease in education expenditures and a .57 percent decrease in road expenditures.

While these estimates are in the inelastic range, they are the most elastic revenue elasticities which were calculated, and indicate that local government expenditures are more responsive to changes in PILTS than to any other source of revenue. Moreover, the impacts of these changes are focused on the two services of roads and education. While small fluctuations in payment levels can be absorbed by the counties, the relative impacts on these two services are indeed significant.

While marginal changes in PILTS will tend to be reflected in marginal expenditure changes in roads and education, it seems clear that a major, long-term, decrease in payment levels would have an adverse effect on the county budgetary and expenditure process. In the theoretical model, expenditure decisions are made in such a way as to maximize the utility of the median voter. If a significant decrease occurred in PILT levels, the regression results indicate the affect would be transmitted as a decrease in expenditures for roads and schools. As expenditures decrease, the marginal utility of the last dollar spent for these services is assumed to increase, and the median voter would no longer be at an equilibrium, or utility maximizing position. To return to an equilibrium position revenues would be diverted from other services until the ratio of marginal utilities and prices across services were again equal. If at this point the marginal utilities of the services were greater than the "cost" of increasing the tax rate, additional revenues would be generated through use of the property tax system. At least in the short-run, such changes would introduce major distortions in the budgeting and expenditure process, resulting in substantial local government instability.

A similar argument can be made for very large increases in PILTS. Such changes would cause increases in road and education expenditures,



causing the marginal utility of the last dollar spent for these services to decline. To return to an equilibrium, other revenues currently directed to roads and education would be redirected to the other services. The results indicate tax revenues and net cash balances, currently spent for roads, and general federal aid and net cash balances, currently spent for education, would, most likely, be directed toward government, public safety, and social services expenditures. If at the new "equilibrium", the tax cost exceeded the utilities derived from the public services, the tax rate would be reduced. Again, local government instability would result in the process of reaching the new equilibrium, though increased revenues do not suggest the fiscal dilemma that decreases in public funds would.

For either of the above scenarios an exogenous change in PILTS, which is sufficient to shift the supply curve, has some interesting implications as to the new equilibrium which the community will achieve. For all services, the supply of expenditures is less price elastic than the demand for expenditures. As such, when the supply curve shifts out, due to an increase in PILTS, the quantity supplied will increase by a greater amount than the price will decrease. When the supply curve shifts in, due to decreases in PILTS, the quantity of expenditures will decrease by a greater amount than the price will increase. The implications of this result are that changes in federal payments in lieu of taxes will have a greater effect on the level of expenditures (and thus on the quantity or quality of services) than on the property tax rate within the community.

This conclusion may be expanded for the general case. For any change in an exogenous variable, sufficient to shift the supply curve,

movement to a new equilibrium will entail a greater quantity change than change in price. A change in an exogenous variable which shifts the demand curve will result in a new equilibrium requiring a greater price change than the accompanying change in price. Aid variables, which tend to affect the supply of expenditures, will be associated with greater changes in expenditures while taste and preference variables, associated with changes in demand, will cause greater changes in the prices paid for goods.

### Price Responsiveness of Demand

The results presented in the preceeding chapter indicate that the demand for all services considered, except public safety, are price responsive; increases in the tax rate result in decreased demands. The demand for roads and social services are the most price responsive; a one percent increase in the tax rate suggests the demand for these services will decrease by approximately one percent. For roads and general government, the demands are found to be mildly inelastic, and the demand for public safety to be almost perfectly price inelastic. Increases in the tax rate have an almost imperceptable affect on the demand for police and fire protection expenditures. The values of the constants in the demand equations provide additional information on individual preferences for public goods. Not only are education and social services the most price responsive, but the estimated constant values for these services indicate that if the values of the other variables in the equation went to zero, these services would not be demanded. In contrast, roads, general government, and public safety would still be demanded. These results combine to imply that individuals value public

safety expenditures most highly, followed by roads and general government, with the least utility derived from education and social services expenditures.

### The Price Variable

The total price effect of the demand for public expenditures is not entirely captured by the tax rate. The residential assessed value also measures a portion of the cost of these expenditures as the tax bill -- a function of assessed value and the tax rate -- is the actual price paid. While the effects of the two variables are similar, they are not identical. The inclusion of both terms provides information which a single tax bill variable would not provide. For instance, the results indicate that as assessed value increases, the demand for public safety increases. A single measure of "taxes paid" would not provide this information.

Non-residential assessed value was also included in the demand equations, as a quasi-price variable, to measure the degree to which residents may shift the tax burden to non-residential property. Evidence of tax shifting was not found. This may be due to the fact that tax shifting is not occurring in Oregon. However, past researchers have found evidence of tax burden shifting, with the non-residential assessed value variable entered in the equations as a percentage of total assessed value. Because this variable was measured differently in this research, in total dollars, the measurement technique may have muddled the underlying relationships. Future research should be conducted to determine if tax burden shifting is occurring in Oregon.

### Income Variable

Increases in per capita income were found to result in decreased demands for roads, education, and general government. While only one parameter estimate is statistically significant, the implications are that these services are inferior, which seems nonsensical. These results become more reasonable by realizing increased incomes generally result in increased land holdings. As such, the income variable may be capturing a portion of the price effect attributed, earlier, to residential assessed value. An appropriate wealth variable, which incorporates income and land holdings, may be more fruitful in future research.

Social services appear to be superior goods. As incomes increase, individuals are better able to care for the less fortunate members of the community and demand greater expenditures for this service.

### Price Responsiveness of Supply

As the tax rate in the community increases, the results indicate that the services which receive the bulk of these funds are roads and public safety. It is important to note, however, that as the tax rate increases, the supply of expenditures to all services also increases. The largesse of tax revenues goes towards roads and safety which may indicate the political wisdom of providing tangible evidence -- police officers in conspicuous view and road crews patching "chuckholes" -- of tax dollars at work during times of high tax rates.

### Stimulative Versus Substitutive Aid

Perhaps the greatest controversy in this problem area of local government expenditures is whether aid, and which type of aid, has a

stimulative or substitutive effect on total expenditures. This research concludes that state revenues do not have a perceptible effect on total expenditures. This is likely due to the fact that, while individual counties may use these revenues in a definitive way, for all counties taken together, a dominant pattern does not exist. Payments in lieu of taxes, general federal aid, and net cash balances are found to increase total expenditures dollar for dollar with increases in these revenue sources. The effects of locally generated non-property tax revenues, and specific federal aid are found to stimulate expenditures. Specific federal aid often implies matching grants. These grants require local revenues be spent in addition to the federal aid, as a prerequisite to receipt of the grants. As such, the finding that matching grants are stimulative may be due to a federal accounting requirement. The result indicating local revenues are stimulative may reflect the use of this source of revenue as the local match for federal matching grants. Some past researchers have specifically identified matching grants, which would have been desirable here. This grant type should be specified as a separate variable in future research efforts. Given the current aggregation of specific federal aid, a definitive conclusion as to the cause of the stimulative effect of these aid types cannot be drawn.

#### Uncommitted Revenues

The generally accepted view of the local government budgeting process holds that funds earmarked for roads and education, primarily PILTS, support these services and that uncommitted revenues are used to support public safety, social services, and general government. This research

does not support this position. Uncommitted revenues, primarily general federal aid and net cash balances, are being directed towards roads and education.

It may be possible that during the interim time, from the beginning of the fiscal year (July) until receipt of the first PILT payment (October), portions of these uncommitted revenues are used to meet on-going obligations related to roads and education, such as payroll expenditures. For roads, particularly, this summer period is one of high activity and expense. This explanation is tenuous at best, and it seems more likely that, for some previously unexplained reasons, counties do use uncommitted funds for road and education expenditures.

#### Suggestions for Future Research

The old adage that "hindsight is clearer than foresight" is never more apparent than at the conclusion of a research project. Fortunately, time and money limitations bring an end to the "if I just" and "then I can" research syndrome. It is potentially more productive to identify current research options such that future research efforts have the benefit of prior thought, and no doubt, frustration.

Perhaps the weakest assumption of this effort was the tax rate as a proxy for the price of public goods individual consumers face. While it has been argued that the nominal published tax rate is the one to which individuals respond, the study period for the present research is one in which the real estate market has experienced phenomenal price increases. Property prices have become "big news". The consuming public is vitally aware that increased assessed values generally imply increased tax bills, or increased out of pocket costs for public goods. The research

results bear this fact out, and suggest alternative measures for the price term. Per capita residential property tax payments may provide a better measure of the price paid by individuals as such a variable would capture both tax rate and assessed value changes, though it would not distinguish between the two, as discussed earlier in this chapter.

Assumptions concerning the costs of production also are tenuous. The most easily achieved improvement would be to gather wage rate data for each service, by county. More desirable, although certainly more arduous, would be estimation of actual cost functions for the various services. With such a function, a quasi-supply curve could be assumed or developed. This process implicitly assumes unit measurement, which if available, would no doubt alter the procedures employed in this research. A systematized method of unit measurement would, however, greatly simplify both demand and supply considerations.

The supply and demand relationships developed here have been partially confounded by the dual role of the elected official as a supplier of expenditures subject to the demands of his constituency, and the role of determining aggregate expenditure levels. At least two options exist to model this system in terms of a single equation model. First, the decision maker can be viewed as maximizing the utility function of the median voter subject to the budget constraint the community faces. Another option is to specify a demand and supply function, and then estimate a reduced form expenditure equation for the system where observed expenditures are a function of the demand and supply forces.<sup>1/</sup>

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<sup>1/</sup> These two options were estimated, and results are presented in Appendix II.

While these models are more simple to estimate, and perhaps theoretically appealing, they do not provide elasticity information, nor do they allow specific behavioral hypotheses related to demand and supply considerations to be developed and tested.

Another option which holds a good deal of promise is to develop the supply and demand framework for a single unit of government with time-series data. In this way, structural changes within the county may be accounted for, more consistent data gathered, and public capital formation and investment explicitly considered. With adequate time-series data, an understanding of the temporal nature of investment response could be acquired. This type of effort would allow an investigation of the hypothesis of "domino budgeting"; where expenditures in prior years plus a fixed percentage growth rate yields the current years expenditures.

By focusing on one county, other taxing authorities in the county who provide public services could be considered, in addition to the county government, to broaden the analysis. School districts, port authorities, cities, fire districts, and other governmental units all are in the business of taxing and providing public goods and services, and should be considered in future efforts. By developing tax rates for each service it may also become appropriate to estimate the demand, supply, and tax sub-systems as a part of a larger simultaneous equation system. Such an approach would consider the demand and supply of expenditures, as well as tax rates, to be endogenous to the system.

Various non-local revenue sources might also be considered endogenous to the system. Communities may be viewed as "investing" funds by employing individuals, as many counties and cities now do, to write pro-



posals to generate outside funding of local projects. A potential avenue exists to extend this research to consider the optimal investment level and pattern, discounting for risk and the rate of return on investment, which "should" be made to maximize the value of grants which the local government would receive.

### Summary

This research began by asking the question "how do payments in lieu of taxes affect Oregon county expenditure patterns?". Answers to this question have been developed, and implications drawn as to the effects on expenditure patterns, given changes in these payment levels.

The theoretical and empirical models which have been developed to answer this question provide an avenue for future research. Information on demand and supply elasticities, some which were previously unavailable, have been developed. Importantly, the overall results of the research are consistent with the economic theory upon which it is based, which further supports the model's legitimacy.

Much research in this problem area remains. Some of the advantages of the model developed here can, however, be useful in future efforts.

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APPENDIX I  
SOURCES OF INFORMATION



## APPENDIX I

## SOURCES OF INFORMATION

The following revenue and expenditure data was derived from an Oregon Department of Revenue computer synopsis of all Oregon county budgets for the fiscal years 1976-77, 1977-78, and 1978-79.

- Demand for road expenditures (DROAD)
- Supply of road expenditures (SROAD)
- Demand for education expenditures (DED)
- Supply of education expenditures (SED)
- Demand for public safety expenditures (DSAFE)
- Supply of public safety expenditures (SSAFE)
- Demand for social service expenditures (DSOCIAL)
- Supply of social service expenditures (SSOCIAL)
- Demand for general government expenditures (DGOV)
- Supply of general government expenditures (SGOV)
- Local revenues (LOCAL)
- State revenues (STATE)
- Specific federal grants (SFED)
- General federal grants (GFED)
- Net cash balances (CASH)
- Payments in lieu of taxes (PILT)

Oregon Property Tax Statistics for the years 1976, 1977, and 1978, published by the Oregon Department of Revenue, were used to gather the following:

- County tax rates (NTAXR)
- Total assessed valuation (TOTAL)
- Residential assessed valuation (VHOME)
- Non-residential assessed value (NHOME) was calculated as TOTAL-VHOME.

Indicators of Depressed Socio-Economic Conditions for 1976, 1977, and 1978, published by the Oregon Department of Human Resources, were the source of:

- Per capita income (PPINC)
- Percent of county population living in incorporated areas (CITY)
- Seasonally adjusted unemployment rate (UR).

The 1970 Federal Census was used to determine the educational attainment level of the adult population (NHS). Vehicles registered per capita (PCAR) were developed from information provided by the Oregon Department of Motor Vehicles yearly total of licenses issued, by county. The Oregon Center for Population Research and Statistics provided the estimates of county population (POP) for each of the years 1976, 1977, and 1978.

The Oregon Department of Revenue's computer analysis of county budgets required aggregation of various funds to arrive at the desired expenditure and revenue categories for this research. Table 11 identifies the state funds which were aggregated into the appropriate variable.

Table 11. Services and Revenues Aggregated in Regression Variables.

<u>General Government</u>	<u>Roads</u>	<u>Public Safety</u>	<u>Social Services</u>	<u>Education</u>
General Government	Public Works - Streets and Roads Mass Transit	Law Enforcement Fire Protection	Human Services Library Vector Control Hursing Home Parks & Recreation	Education
<u>Local Revenues</u>	<u>State Revenues</u>	<u>General Federal Grants</u>		
Earnings on Investment	State Revenue Sharing	Federal Revenue Sharing		
Sale of Bonds	Cigarette Tax	O & C Payments		
Other taxes	Liquor Tax	Miscellaneous Federal Grants		
Miscellaneous Local Sources	Amusement Tax			
Service Charges & Fees	Motor Vehicle Tax			
Property Assessments	Beer & Wine Tax			
Contractual Agreements	State Forests			
	State Grants			
<u>Specific Federal Grants</u>	<u>Payments In Lieu of Taxes</u>	<u>Cash Balances</u>		
Anti-Recession	In Lieu of Taxes	Beginning Cash Balance		
Specific Federal Grants	National Forest Receipts	Ending Fund Balance		

## APPENDIX II

## SELECTED REGRESSIONS

## APPENDIX II

## SELECTED REGRESSIONS

The following tables present three selected regressions. The first is the supply of total expenditures, similar to the equations in the main body of this research. The second is a single equation reduced form estimation of the demand and supply system for each service category as identified in the research. The third set of regression estimates are based on a model where maximization of the median voter's utility function, subject to the community budget constraint, is the objective.

Table 12. Supply of Total Expenditures: All Oregon Counties.

Dependent Variable	TAX RATE	PILT	LOCAL	STATE	SFED	GFED	CASH	WAGE	YR1	YR2	CONSTANT	R <sup>2</sup>	D.W.	F
Total Expenditures	27.99***	1.06***	1.67***	-.389	3.68***	.912***	1.20***	-.018**	-114.6***	14.62	211.8**	.835	1.45	49.14***
	(8.65)	(.110)	(.228)	(.944)	(.926)	(.148)	(.172)	(.007)	(25.7)	(21.7)	(108.7)			

\*\* Significant at the 99 percent confidence level.

\*\*\* Significant at the 95 percent confidence level.

Standard error in parentheses.

D.W. = Durbin-Watson statistic.

Table 13. Reduced Form Expenditure Equations: All Oregon Counties.

Dependent Variable	TAX RATE	LOCAL	PPILT	PFED	PFED	STATE	INCOME	WHOME	HOME	CASH	WAGE	YR1	YR2	CITY	PCUR	DOLLAR	PRID	NIS	UM	AVG	CONSTANT	MIN	R <sup>2</sup>	D.N.	F
ROAD	0.32 (6.93)	.063 (.213)	.768*** (.077)	.329 (.660)	.194 (.105)	-.133 (.443)	-.005 (.0048)	-.4.49 (.458)	3.79 (2.28)	2.87*** (.115)	.018 (.008)	27.88*** (27.58)	8.30 (4.75)	-.244 (.530)	-76.32*** (64.1)						234.55*** (112.79)		.76	1.85	19.42***
EDUCATION	2.21 (2.55)		.245*** (.0276)				-.0015 (.0029)	2.60 (1.74)	-.720 (.789)	.284*** (.047)	.00007 (.002)	2.4 (6.5)	4.8 (5.3)			.112*** (.034)	1.20 (3.34)	.105 (.402)			-74.37 (62.48)		.76	2.07	25.28***
SANITY	2.50** (1.12)	.131*** (.032)	.014 (.042)	.567*** (.102)	.070*** (.017)	-.132 (.407)	-.003** (.009)	-.726 (.777)	-.361 (.367)	-.034*** (.018)	-.0005 (.0009)	-8.23*** (.393)	-1.29 (2.63)	-.154 (.093)						.659 (.743)	14.12 (15.35)	.639 (.434)	.53	2.05	7.58***
SOCIAL	-1.08 (4.19)	.330*** (.0668)	.02 (.03)	1.98*** (.302)	.218*** (.0596)	-.282 (.314)	-.017*** (.003)	-5.27*** (2.06)	-2.45** (1.06)	.052 (.051)	.007*** (.002)	-21.58 (11.4)	.633 (7.69)	.037 (.243)						-.46 (2.0)	61.7 (32.4)		.60	1.83	9.35***
GOVERNMENT	5.40 (4.32)	.645*** (.135)	.298*** (.065)	1.53*** (.409)	.297*** (.064)	.315 (.408)	-.003 (.005)	-2.0 (2.8)	1.46 (1.43)	.365*** (.09)	.003 (.003)	29.97*** (11.19)	4.25 (9.16)							425.7*** (43.8)	-167.4*** (54.7)		.81	1.84	27.10***

\*\* Significant at the 95 percent confidence level.

\*\*\* Significant at the 99 percent confidence level.

Standard errors in parentheses.

D.W. = Durbin-Watson statistic.

Table 14. Utility Maximization Subject to Community Budget Constraint.

Dependent Variable	PILT	CITY	YR2	SFED	LOCAL	STATE	GFED	INCOME	WAGE	CASH	PAVED	YR1	PCAR	PKID	NHS	MIN	UR	AVG	R <sup>2</sup>	F	CONSTANT
ROAD	.801*** (.076)	-.141 (.52)	12.42 (14.61)	.342 (.657)	-.058 (.184)	.127 (.634)	.109 (.102)	.004 (.05)	.013*** (.05)	.225*** (.115)	.673*** (.203)	-60.46*** (25.5)	-14.32 (59.97)						.75	21.97***	178.21*** (107.0)
EDUCATION	.284*** (.027)		4.47 (5.20)	.108 (.235)	.020 (.068)	-.136 (.231)	.160*** (.037)	.00035 (.0024)	.0001 (.0019)	.197*** (.041)	.033 (.069)	2.98 (6.19)		-.722 (1.26)	-2.88 (.44)				.76	23.8***	28.27 (62.2)
SAFETY	.018 (.012)	-.091 (.087)	-.781 (2.59)	.587*** (.1)	.0811*** (.028)	-.133 (.106)	-.063*** (.016)	.002*** (.0009)	-.0003 (.0008)	.028 (.018)	.070*** (.031)	-7.84*** (3.90)				.989*** (.389)	1.04 (.72)		.56	8.48***	5.72 (14.33)
SOCIAL	.025 (.036)	.057 (.246)	.930 (8.75)	1.89*** (.30)	.212*** (.08)	-.214 (.315)	.199*** (.050)	.011*** (.002)	.006 (.002)	.063 (.055)	-.027*** (.095)	-19.4 (11.5)					-.217 (2.12)		.56	9.46***	23.55 (42.85)
GOVERNMENT	.345*** (.058)		8.77 (8.99)	1.47*** (.40)	.581*** (.117)	.410 (.400)	.288*** (.059)	.00009 (.0037)	.0005 (.003)	.393*** (.075)	.337*** (.119)	-29.1*** (10.5)						424.15*** (41.96)	.81	33.64***	-166.12*** (53.35)

\*\*\* Significant at the 99 percent confidence level.

Standard errors in parentheses.

D.W. = Durbin-Watson statistic.