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An Empirical Examination of the Grant Induced Price and Income Effects of Lump-Sum Intergovernmental Aid.

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AN EMPIRICAL EXAMINATION OF THE GRANT INDUCED PRICE AND INCOME EFFECTS OF LUMP-SUM INTERGOVERNMENTAL AID

A Dissertation

Submitted to the Graduate Faculty of the
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in

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by
Peter M. Mitias
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M.S., Louisiana State University, 1993
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Dedication

To my parents Michael and Samira, my brothers Johnny and Michael, and my wife Catherine.

Acknowledgments

I would like to thank Dr. Geoffrey K. Turnbull for his guidance, patience, insight, and wisdom. He gave me the encouragement, discipline and skills necessary to complete this dissertation and begin a fruitful career as an economist. I would also like to thank Dr. William J. Moore, Dr. R. Carter Hill, and Dr. Loren C. Scott for their patience and help throughout this process. Most of all, I would like to thank my loving wife Catherine for everything. She gave me the motivation to complete this work.

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Abstract

This work is concerned with the nature of fiscal illusion and its effect on local government spending. Fiscal illusion is hypothesized to be a source of the "flypaper effect." The flypaper effect is an empirical phenomenon of the asymmetric effects of income and intergovernmental aid on the level of local public spending in the context of demand models of the local fisc. Lump sum aid is observed to be more stimulative on the level of public expenditures than income (Gramlich and Galper 1973). As a method of explaining this phenomenon, tax-price and income illusion are incorporated into demand models of the local fisc [Oates (1979); Courant Gramlich and Rubinfeld (1979); Filimon, Romer, and Rosenthal (1980); Turnbull (1995); Holsey (1993)].

This work provides both theoretical and empirical contributions to the growing body of literature on fiscal illusion. The theoretical contribution is a clarification of the parametric interdependence between income and price illusion. The relationship between income and price illusion has ramifications for estimation. This paper contributes to the empirical literature by estimating local public expenditure functions using two panel data sets, one for county government spending and the other for state government spending. The results demonstrate that fiscal illusion is felt primarily through the traditional grant channels rather than Holsey's depiction of the income illusion channel.

Chapter One

Introduction

Over the past few presidential administrations there have been several eras of proposed "new federalism" with respect to how the federal government redistributes resources back to state and local governments. The Nixon and Reagan administrations both proposed significant shifts in the federalist structure, each emphasizing different roles for matching and block grants from federal to state and local governments. The current legislation spearheaded by Newt Gingrich is promotes yet another revision, with renewed focus on the use of unconditional block grants as a method of revenue sharing in hopes of giving the state and local governments more control over the distribution of resources.

This process of continually revising intergovernmental relationships within the federalist structure may reflect overall dissatisfaction with how the federalist structure is operating or may represent ideological shifts in the definition of the appropriate roles for federal and state governments in the U.S. Either way, any misspecification of or misunderstanding about how local governments respond to changes in policy hampers policy debate. Significant revisions in the structure of fiscal federalism that are based on faulty models of local fiscal behavior may generate outcomes that are neither intended nor desired. Not surprisingly, the steady stream of literature concerned with modeling local fiscal behavior is, in part, motivated by the need to better understand the consequences of redefining the federalist structure.

This work is concerned with the nature of fiscal illusion and its effect on local government spending. Fiscal illusion, the notion that taxpayer-voters misperceive the connection between governmentally provided goods and their associated tax burdens, can substantially modify how intergovernmental aid affects the delivery of local government services. Taxpayer ignorance about the government budget process, and in particular about intergovernmental aid awards and receipts, plays a key role in the modern fiscal illusion models, typically leading to income effects as well as perceived tax price distortion effects not present in the perfect information framework. Further, a variety of types of fiscal illusion have been proposed in the literature, with a corresponding variety of implications for local spending behavior. Identifying the nature and effect of fiscal illusion, which remains an unsettled issue in the Public Finance literature, is therefore an integral part of the search for models that best explain the behavior of the local fisc.

Mueller (1979) attributes the fiscal illusion concept to Amilcone Puviani (1897), who views the state as a tool of the ruling class, seeking to extract as much revenue from the ruled as possible. The state deliberately creates fiscal illusion by exercising its monopoly power over tax and spending information in order to increase its control over economic resources and thus expanding the size of the public sector.

The modern approach to fiscal illusion at the state and local level follows Puviani's to the extent that it typically views the illusion as taxpayer misperceptions of the incremental taxes associated with increases in public spending. The presence of intergovernmental aid plays a key role in most modern fiscal illusion models. Generally, the separation of taxing from spending decisions, necessitated by the introduction of intergovernmental aid from

higher to lower levels of governments in the fiscal tier, provides the complex multi-level fiscal relationships between governments that are used to justify voter ignorance in the form of fiscal illusion [Winer (1983); Wagner (1976)]. A more direct role for intergovernmental grants is evident in the partial equilibrium public spending models in which voter ignorance about the presence of intergovernmental aid drives a wedge between the true marginal tax price and the perceived tax price of spending at the state and local levels [Oates (1979); Logan (1986)]. Also voter ignorance about the amount of their own tax payments for intergovernmental aid going to other jurisdictions generates income effects (Holsey 1993).

Fiscal illusion is hypothesized to be a source of the "flypaper effect." The flypaper effect is an empirical phenomenon of the asymmetric effects of income and intergovernmental aid on the level of local public spending in the context of demand models of the local fisc. Lump sum aid is observed to be more stimulative on the level of public expenditures than income (Gramlich and Galper 1973). As a method of explaining this phenomenon, tax-price and income illusion are incorporated into demand models of the local fisc [Oates (1979); Courant Gramlich and Rubinfeld (1979); Filimon, Romer, and Rosenthal (1980); Turnbull (1995); Holsey (1993)].

This work provides both theoretical and empirical contributions to the growing body of literature on fiscal illusion. The theoretical contribution is a clarification of the parametric interdependence between income and price illusion. The relationship between income and price illusion has ramifications for estimation. This paper contributes to the empirical literature by estimating local public expenditure functions using two panel data sets, one for county government spending and the other for state government spending. The

disaggregate county data set used in this analysis allows us to address previously ignored issues like how fiscal illusion varies with fiscal complexity, temporal trends of fiscal illusion, and how fiscal illusion varies over different levels of governments. The panel data for county governments provides several advantages. First, the disaggregate county data lies closer to the underlying crucial voter, thus making it more appropriate than aggregated data for estimating local government spending functions. Second, county governments are multi-purpose and reflect differing degrees of fiscal complexity, which Wagner (1976) argues underlies taxpayer-voter fiscal illusion. We can use this data set to directly estimate how fiscal illusion parameter estimates vary with the degree of fiscal illusion, as reflected by our measures of budgetary complexity. Third, this data allows us to examine the intertemporal stability of the estimates using data from 1970 and 1980 and come to some conclusions about the long term trend of fiscal illusion effects on local spending.

Chapter two reviews various models of local and state government spending behavior, beginning with an explanation of the Leviathan model of government. The chapter also summarizes the median voter models that comprise much of the empirical public demand literature and concludes with how fiscal illusion has been integrated into modeling local government spending behavior.

Chapter three begins with a methodology laid out in a recent paper by Holsey (1993). In that paper she uses the Stone-Geary framework to directly estimate fiscal illusion parameters and identifies two potential channels of illusion that she labels as "grant" and "income" illusion. Grant illusion stems from voter misperceptions about aid receipts and income illusion stems from the misperception of the taxes associated with aid. She uses

local spending data aggregated to the state level to estimate the fiscal illusion parameters. Taking this study as a point of departure, I show that the two separate types of fiscal illusion identified by Holsey are not independent, as she assumed, which leads to inconsistent econometric estimates of her illusion parameters. This chapter extends and corrects Holsey's analysis, using disaggregate local government data (county) from 1970 and 1980 to find consistent estimates taking into account the interdependent nature of grant and income illusion.

Chapter three also uses the county data set to examine how intergovernmental aid affects the provision of specific services as well as general services. The empirical results show that the structural demand equations derived from the Stone-Geary utility function with Holsey's corrected procedure leads to fragile and unstable fiscal illusion parameter estimates. The remainder of the chapter estimates the local public expenditure functions using an alternative reduced form approach. This reduced form approach exploits the derived relationship between "grant" and "income" illusion to test for the presence of the different types of fiscal illusion. The results from the reduced form approach demonstrate that fiscal illusion is felt primarily through the traditional grant channels rather than Holsey's depiction of the income illusion channel.

Chapter four examines how fiscal illusion effects vary between higher and lower levels of government. It employs state data from 1970 and 1980 to estimate the demand equations and compare the size and significance of the key parameter estimates to test how fiscal illusion varies across levels of government for the provision of general services and

specific services. These results yield an interesting pattern of changes from the county to the state level and does not find uniformity between the county and state estimates.

Chapter five focuses on the issue of fiscal complexity as a possible source of fiscal illusion. The sample is partitioned by degree of fiscal complexity using a switching regression technique and then the fiscal illusion parameter estimates are compared for both the county and state governments. These results show that the degree of tax and revenue complexity play an important role in determining the size and significance of the fiscal illusion parameter estimates.

Chapter six uses the results derived from the previous chapters to examine the temporal stability of the estimates by analyzing the trend in size and significance of the key parameter estimates. These results show no evidence of systematic growth or decline in fiscal illusion at the county or the state level for either the provision of general or specific services. Chapter Seven provides a brief summary and conclusion.

Chapter Two

Modeling Fiscal Behavior

Broadly speaking, there are two popular ways of modeling the public sector. The first follows what is known as the Pigouvian or Musgravian tradition which assumes the government behaves as a benevolent agent. Models in this orthodox tradition assume that politician-bureaucrats find the advice professed to them to be compelling. This approach also assumes that the politician-bureaucrats have the power to determine governmental and political outcomes.

The major alternative to these models are those in the Wicksillian tradition. Wicksillian public choice models assume the median voter in majoritarian democracy drives the political machine so as to generate the results that reflect the wishes of the electorate, or at least a subset of it. It is argued that these models are limited in that they have been almost entirely demand driven.[1]

Geoffrey Brennan and James Buchanan (1980) revive a hypothesis about the behavior of government known as the Leviathan hypothesis. This topic has sparked much debate and research as to whether the government sector really behaves "as if" it were a monolithic entity whose sole purpose is to expand its size. First there is a rejection of the benevolent agent that is implicit in the conventional "normative policy framework" such as a Bergstrom-Samulson type welfare function in either the Pigouvian or Musgravian

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[1] In these types of models government is considered to be neither despotic nor benevolent.

tradition. Brennan and Buchanan argue that it seems illogical to assume or to use the benevolent despot model. If government could be predicted to act perfectly, then there would be no constitutional limits for that will only hinder the ability for the representative to do what may be desirable. Perfect prediction of government actions implies that the constitutional perspective is at odds with the model of the benevolent despot. They feel those who argue for agent benevolence are "denying the legitimacy of any constraints on government, including electoral ones" (Brennan and Buchanan, 1980). If this is the case then there is no logical or plausible reason for a constitution.

2.1 Leviathan Model

The leviathan model views government as monolithic. The only difference from the aforementioned orthodox models is that the assumption of benevolence is dropped. If such is the case then the question becomes who would give advice to a non-benevolent entity. The emphasis now turns on constraining government in light of this new image of indifference or malevolence.

Brennan and Buchanan assume that the political process in a post-constitutional setting is not constrained by the electoral competition in a Wicksillian manner and that the electoral process can adequately constrain the natural tendencies of government only when coupled with additional constraints and rules imposed at the constitutional level. Brennan and Buchanan seek non-electoral constraints on government because they believe the assumption in current public choice theory that the electoral process is sufficient to constrain government is vulnerable.

First, the electoral process, even when harmonious with the demand of the electorate, is inappropriate for certain types of decisions relating to resource use. For example, some resources like police and fire protection, and the judiciary cannot be made subject to the will of the majority, thus these decisions must be made independent of in-period political processes. Also, preferences may change at the post-constitutional phase from behind the Rawlsian veil of ignorance. Additionally, voters in a Downsian sense are rationally ignorant due to the asymmetric information; thus yielding monopoly power to those in possession of such information. It is empirical evidence of this type of asymmetric information that this paper attempts to find.

Second, the inadequacy of the majority rule to constrain and can lead to cycling, and depending on the sequence of voting, the outcome can be steered away from the most preferred outcome of the median voter. Thus with sequential announcement of platforms, monopoly power can be derived from the simple majority rule in that the winning party has resources available for his or her discretionary use (Brennan and Buchanan, 1980).

Third, bureaucrats who have the right of tenure have the power to select and implement certain policy proposals and are inherently in a monopolistic position in the provision of public goods and services and are not constrained by the voting populous. They are the agenda setters. Romer and Rosenthal expand upon this inherent monopoly power in their setter/reversion models.

According to the above arguments government is effectively unconstrained by the electoral process, which leaves open the question of how to model government behavior. The Leviathan model assumes that the decision makers maximize their own utilities subject

to the constitutional constraints and the constraints they face enter as parameters in the agent's utility function.

The simple version of the Leviathan model assumes that governments maximize revenues from whatever sources of taxation that are made available to them constitutionally. Without constraints on uses revenues then become equivalent to personal income to the decision makers.

Government maximizes revenue because it becomes a proxy for surplus, which is defined as the total revenue generated less government spending on goods and services.[2] Even if specific restrictions did not exist on the tax side, revenue maximization is still a good measure of Leviathan's maximand, if taxes were to be spent only on the specified goods and services and could be identified in some agreed upon way, then government agents could maximize their own utilities such that they manipulate the tax system so as not to pay any taxes themselves.

With government spending not restricted to financing pure public goods and services, but quasi-public goods and services (which yield benefits to those in the political community), we again see an incentive for budgetary expansion by the government. Thus, revenue maximization is the main characteristic of government behavior.

This model does not imply that government is something that exists independently of those people on whose behalf it supposedly acts. The individual decisionmakers may not

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[2] The surplus is defined as $S = (1-a)R$. where the citizen taxpayer would like "a" to be 1. This implies that all revenue taken is spent on goods and services that are of benefit like in the polar Samulson case. S is the excess of revenues collected over spending of specified uses of G and "a" is the share of revenues spent on G.

have revenues enter directly as an argument in their utility functions, and do not try to further Leviathans interest any more than the public interest. The idea is that revenue maximization emerges from the whole set of government decisionmakers even though no one person explicitly sets revenue maximization as a goal, much the same way that the "public interest" is promoted by the operation of a competitive marketplace. If the Leviation model accurately depicts the "as if" behavior of government, then one should observe, at the local level, monopolistic characteristics exhibited by these governments.

It does not seem plausible that the citizen taxpayer would allow unconstrained growth of Leviathan. With electoral constraints being inadequate to constrain growth, then the question of what type of non-electoral constraints exist arises. Brennan and Buchanan suggest that decentralization of the public sector is one mechanism by which the size of Leviathan can be constrained.

In sum the underlying assumption of the Leviathan model is that the outcome is driven by the agent and the alternative modeling, those in the Wicksillian tradition, posit that the outcome is driven by the median voter. If one is to a accept the Leviathan model as the model that appropriately describes local expenditure decisions then it becomes necessary to examine those median voter models to see if some of the implications of monopoly power are evident. As mentioned above, this paper searches for evidence that the median voter is confronted with asymmetric information about the level of intergovernmental aid that is received in his or her jurisdiction. If the agent can control the amount of information flowing to the median voter, then the agent has obtained some monopoly power. This monopoly power allows the agent to manipulate the budget and the size of the local fisc. It now

becomes necessary to examine the models of local fiscal behavior that follow the Wicksillian tradition.

2.2. Models of Local Fiscal Behavior

The early demand models begin with Gramlich (1968) who hypothesizes local expenditures to be a linear function of per-capita income, per-capita grants in aid and other socio-economic characteristics. An important outcome from this ad hoc model is that it yields empirical evidence of a systematic relationship between local spending and economic and demographic characteristics.

Later work by Gramlich (1969), Henderson (1968), and Barr and Davis (1966) view the process of local fiscal choice as an *as if* preference maximization subject to a budget constraint. This demand framework assumes a continuous, quasi-concave preference function representing ***individual*** preferences. This then raise the questions concerning ***whose*** preferences are being maximized. Two alternative models are presented; the median voter model and the dominant party model. In the median voter model, the voters determine the outcome. Two restrictions in this demand model are that each government supplies only one service financed by a fixed tax structure and the median voter is the one with the median income. Thus, the *as if* maximization of the preference function corresponds to the family with the median income subject to their income constraint. The dominant party model allows for the examination of multi-service governments in medium to large cities. In this model, local politics is seen as "an occasional two-party fight" in which a clear and controlling winner emerges. The winner is given full control over the local fisc and is hypothesized that the local political bosses maximize their own long run welfare, thus the budgetary process

will be defined by the bosses' preference for income. Romer and Rosenthal (1978) expand on this assumption and introduce a model that allows a limited referendum check on the chosen budget. In this agenda control model, the referendum approved budgets will be greater than or equal to the median preferred budgets.

Borcherding and Deacon (1972) and Bergstrom and Goodman (1973) attempt to include technology in the budget model. Borcherding and Deacon introduce a model of public spending derived from a collective decision making theory and test the significance of certain variables that are deemed important in determining the level of expenditure. The motivation for this type of model is that the previous models used in the analysis of the public sector were *ad hoc* constructions with little theoretical standing. This type of model requires the aggregation of voter preferences, tastes of the chooser, and the opportunity costs to the chooser of the activities. The median voter model is applied as method of aggregating voter tastes and preferences, which permits the estimation of key parameters like price elasticity and the degree of publicness of the goods.

The assumptions of the model are: 1) No logrolling, 2) bureaucracy is not present, 3) only non-discriminatory taxes are used, 4) labor and capital are the only inputs used where capital is perfectly mobile and labor is not which implies that the price of capital is the same across all communities and wage differentials can exist across communities, 5) fixed prices of labor and capital, 6) governments are price takers, and 7) using a Cobb-Douglas variety production function, the local government is assumed to provide services using efficient production.

The median voter model is employed in order to be able to aggregate voter tastes and preferences. After solving the input choice problem and rearranging terms, the marginal cost of provision is defined as

(2.1) $C_G = k'w^B$

which describes a "unique and horizontal supply function for each unit dependent only on the wage rate, w, in that unit" (Borcherding and Deacon, 1972). The parameter B represents the cost of mobile capital and k is constant term.

The amount of consumption for the median voter is defined as $q = G/N^a$, where a is the congestion parameter and G is the level of public output and N is the population. With non-discriminatory taxes, each voter pays an equal amount to finance each unit of a public good. The tax share for the median voter is defined as

(2.2) $sq = C_G G/N$

which becomes

(2.2') $s = C_G N^{a-1}$

The median voter demand schedule for expenditures is assumed to be log linear in tax share, s, and income, y.

(2.3) $q = As^{\eta}y^{\delta}$

Reduction of equation (2.3) into per-capita expenditure yields

(2.4) $e = A'w^{B(\eta+1)}y^{\delta}N^{(a-1)(\eta+1)}$

and taking the log of (2.4) yields

$$(2.5)\quad \ln e = \ln A' + (\eta+1)\ln w^{B} + (a-1)(\eta+1)\ln N + \delta \ln y$$

which provides an estimable expenditure equation for estimating relevant parameters such as the price elasticity (η) and the degree of publicness of the goods (a).

Bergstrom and Goodman (1973) develop a method for estimating demand functions of individuals for municipal public services which allows for predictions about tax structure, scale economies, and changes in economic and demographic variables on quantities of public goods to be supplied. By observing the choices of municipalities, inferences about responsiveness of individual demands for municipal services can be inferred employing some assumptions about the political process.

The assumptions of the model are: 1) municipalities provide services at constant cost q_j, 2) the ith consumer's tax share, t_i, is a function of wealth and income and does not vary with the size of the expenditure nor personal tastes, 3) all consumers are aware of the tax price which is equal to $t_i q_j$, 4) the quantity of a good supplied in municipality j is equal to the median quantities demanded by all i consumers in municipality j, and 5) the median of quantities is equal to the quantity demanded by the citizen with the median income. Conditions 1, 2, 3, & 4 constitute a Bowen equilibrium. The consumer's price of the goods provided is proportional to the tax share under the assumption of a constant tax share and service cost.

They use the log-linear equation

$$(2.6)\quad \log E = c + \log N + \delta \log t + \epsilon \log Y + \sum_{i}^{k} B_i X_i$$

where expenditure E is a function of population, N, tax share, t, median family income, Y and a set of socio-economic variables. Also employed in this model is the possibility for congestability in the consumption of certain goods. $Z^*=Z/N^a$ where a is the congestion parameter. Thus demand for public services, Z, can be defined as

$$(2.7)\quad Z=cq^{\delta}t_i^{\delta}Y^{\epsilon}N^{a(1+\delta)}$$

where price and income elasticities (δ and ϵ respectively) are constant. Given this then the congestion parameter, a, is equivalent to the elasticity of demand with respect to population. The vector of socio-economic variables are difficult to interpret and are included in order to eliminate distortions of price, income, and population elasticity measures.

The tax share of the citizen with the median income, t_i is an iid random variable with the $E(t_i) = t_i$. The tax bill on the house of median value (which is assumed to be the house of the citizen with the median income and constitutes his or her entire holding of property) is determined by tax rates and ratios of assessed to market values. This is then divided by total property tax revenue for the municipality to produce an estimate of the tax share.

$$(2.8)\quad t_i = \text{tax bill / total tax revenue}$$

The demand equations by Borcherding and Deacon and Bergstrom and Goodman of these median voter models is a log-linear relationship between output, income, and tax price, aid, and other socio-economic variables, where tax price is equal to the cost of service

[C(G)/GN], where G is total local spending on goods and services. By including technology into the budget model, there is a reduction in the possibility of omitted variable bias and estimation of the new parameter, N, can provide new information if interpreted correctly. The innovation of these works is the use of reduced form rather than structural estimates in the empirical evaluation of policies.

Turnbull (1985) points out how the use of reduced form rather than structural estimates has led to confusion surrounding empirical evaluation of policies. The main focus is on the interpretation of estimated coefficients of tax price elasticities. When a reduced form equation is specified as

$$(2.9)\quad \ln E = B_0 + B_1 \ln LS + B_1 \ln T + B_2 \ln(Y+T*BA) + \epsilon$$

then a direct estimate of the price elasticity is available from the tax share term coefficient, T. LS is the community's local share of expenditures and BA is the community's unconditional aid award. But when the specification follows the form

$$(2.10)\quad \ln E = B_0 + B_1 \ln LS + (B_2+B_3) \ln T + B_2 \ln Y + B_3 \ln BA + \epsilon,$$

the tax share term coefficient, if interpreted as the price elasticity, will provide an estimate that is algebraically biased upward. Also noted is that the local share and tax share elasticities should not be identical under the median voter hypothesis, as implied by equation (2.10). In sum, the estimated tax share elasticity is not always the sum of the tax price and

grant elasticities. The tax price elasticities in these two models do possess this bias for there is no intergovernmental aid term present. Also, the same type of bias in interpretation mentioned by Turnbull can occur with the congestion parameter. Both Borcherding and Deacon and Bergstrom and Goodman are cautious in interpreting the congestion parameters because ratios of unbiased estimators do not necessarily lead to unbiased estimators.

Inman (1979) states that this demand framework examines local resource allocation as the choice of a single agent where outputs provide benefits and money is fungible, and implicit in this framework are a priori restrictions on the process of fiscal choice. Inman provides a three equation supply side model in which public outputs and factor inputs are simultaneously determined as part of the budgetary process. This system allows for the introduction of bureaucracy into the budget production model where labor and capital intensity are functions of the relative bargaining position of the relevant bureau. Also, the percentage of those who are eligible to receive favors become endogenous to the budget production process. Several studies using this budget-cum production system are cited.[Hambor, Phillips, and Votey (1973); Getz (1978)].

By adding another equation to the system, the endogeneity of wages can be included into the model. This endogeneity of wages is important for if there are omitted variables, then this can lead to biased coefficient estimation and misunderstanding of fiscal policy. Inman stresses the importance of wage effects and considers it a "first priority" in future research-- an issue later addressed by Courant, Gramlich and Rubinfeld (1979).

Another potential problem that may contribute to model misspecification is the treatment of the grants-in-aid structure. Early econometric work did not distinguish the

separate fiscal effects of lump-sum and matching aid. This misspecification was later realized and corrected. Inman then introduces the notion of "grantsmanship" which is the process of winning federal and state assistance. This process introduces the possibility of endogenous matching rates into the analysis and introduces further econometric complications. Studies by McGuire (1977) and Inman (1971) both introduce the endogeneity of matching aids in their fiscal models.

Gramlich and Rubinfeld (1982) take the construction of demand equations for public goods one step further along its evolutionary process. They concentrate on estimating demand for public goods using micro surveys of individuals rather than community spending data. Doing this allows one to test certain assumptions previously used in estimating demand equations using macro data, namely the median voter hypothesis [Borcherding and Deacon (1972); Bergstrom and Goodman (1973); Inman (1979)]. Incorporating this type of micro data allows one to control for different distributions of public services across individuals. Also, the demand for public services can be a function of community and individual income; a feature not possible using macro data. A key result from allowing different distributions of services is that demand for public services does not depend on the variation in income across individuals within a community. This addresses Bergstrom and Goodman's (1973) problem with the Bowen majority rule outcome being Pareto efficient with no proportional income taxation.

2.3 Models of Fiscal Illusion

Theoretically, income and lump sum aid should have the same effect on the level of local public goods provided under the median voter hypothesis (Oates 1979). However, it

has been empirically observed that lump sum grants are more stimulative than income on the level of public expenditures. In a review of the empirical literature on the effects of intergovernmental grants Gramlich (1977) cites studies like that of Gramlich and Galper (1973) who find estimates of the marginal propensity to spend from lump sum grants to be much higher than the estimates of an increase in one dollars worth of private income. This asymmetry of income and aid that is observed has been dubbed the "flypaper effect"--or money sticks where it hits. Gramlich cites Feldstein (1975) and Weicher (1972) who also use a similar analysis for a pooled cross-sectional study and find empirical evidence of the asymmetry between income and aid elasticities. These studies all examine single purpose governments, school districts. It was these confusing results that caused Gramlich to call for further examination into the way in which governments, particularly overlapping governments, really work.

Fisher (1982) provides a review and a comprehensive analysis of the flypaper effect. He states that there are four basic explanations of the flypaper effect: 1) some form of fiscal illusion, 2) political institutions, 3) tax substitution, and 4) statistical errors. The examination here focuses on fiscal illusion as a source of the flypaper effect. In his analysis, Fisher addresses the models of Oates (1979) and Courant, Gramlich, and Rubinfeld (1979) and concludes that whether or not this type of fiscal illusion can explain the flypaper effect depends on whether individuals or officials base their spending decisions on some form of average price instead of marginal price. It is this formulation that can generate price effects from lump-sum grants.

Oates (1979) finds that changes in lump sum intergovernmental grants have price effects, that is, they move one along the demand curve as opposed to a shift brought about by changes in income. Oates provides a model of local budgetary choice in which local officials maximize output subject to the constraint that voter's demand be fulfilled. Oates also uses the median voter model in his analysis as a way of aggregating voter preferences. He proposes that the voter makes his or her decision based on two pieces of information: the level of output and the associated tax liability which is known only as the tax price, not necessarily the true cost of the good. In this model, intergovernmental grants allow the local authority to provide a given level of services at a lower tax-price to the voters; this is the source of the price effect. What happens is that the median voter *perceives* the average and not the marginal price of the local public good, thus causing the perceived price to be lower.

The effect of this price misperception on the level the level of public expenditure is demonstrated in Figure 2.1. Segment AB is the voter's original budget constraint when no intergovernmental aid is present. Maximizing the median voter's utility subject to this constraint yields a public expenditure level of g0. The introduction of unconditional grants from higher levels of government shifts the actual budget constraint to CD. The level of expenditure that will maximize the voter's utility increases to g1. However, if the voter is unaware of the aid, he will misperceive the average for the marginal price of the public good. The average price, defined as total expenditures less aid divided by output, is less than the actual marginal tax price of public goods. This misperception causes the perceived budget constraint to become segment AE, and the level of public expenditure that maximizes the median voter's utility is g2.

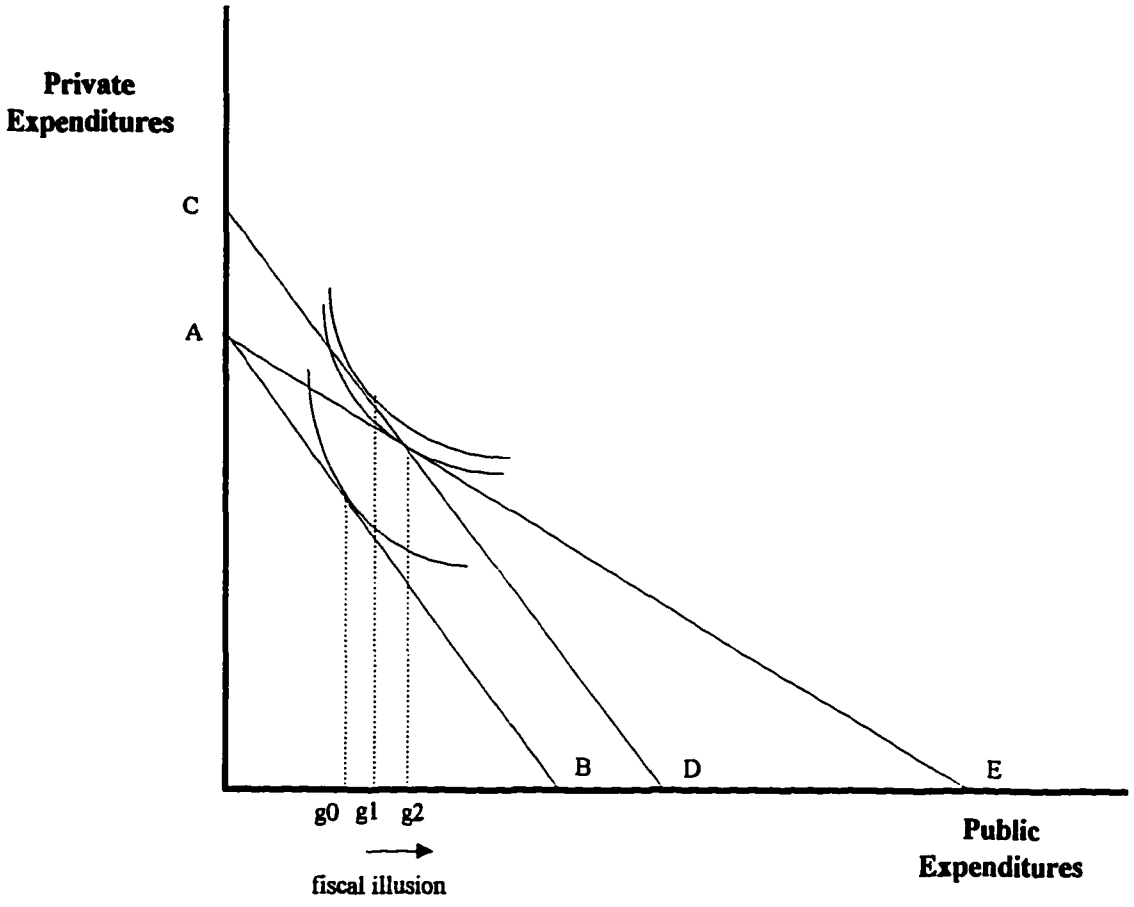

Figure 2.1
Oates Model of Fiscal Illusion

Perceived Budget Constraint

Actual Budget Constraint

Increases in the level of income shift the voter's budget constraint from AB to CD. But an increase in the level of intergovernmental aid causes the voter's perceived budget constraint to rotate from AB to AE. Because equilibrium must be on the actual budget constraint, the voter must chose output level g2. This difference of g1 and g2 is due to fiscal illusion and illustrates the asymmetric effects of income and lump sum aid. In sum, it is the perception of the average rather than the marginal prices that is the source of the flypaper effect in this model.

In a concurrent work, Courant, Gramlich and Rubinfeld (1979) [CGR] also attribute the flypaper effect to fiscal illusion. They provide two modifications to explain the asymmetric effects of income and aid on the level of public expenditure. First, there is a misperception of the marginal tax price by the voter and second, that there may be wage effects by public employees that could cause incorrectly perceived relative prices and cause larger real expenditures. The economic rationale for the flypaper effect is based on the inability of the median voter to perceive the true marginal tax price of the local public good in the presence of lump sum aid. In order for symmetry to hold in this model, the level of grants must be taken into account in the computation of the tax shares. If intergovernmental aid is not computed in the formulation of tax share by the agent, then there would be price effects. They show that a higher level of expenditure is chosen when the government does not incorporate the revenue sharing grant into locally taxable income. Price illusion in this model can also occur if the revenue is raised by a property tax rather than an income tax. This occurs when the non-matching grant is not fully capitalized in property values an not

all of the local resources are taxed. However, If the non-matching grant is fully capitalized into the property values, then no price illusion is present.

Filimon, Romer, and Rosenthal (1980) [FRR] present an modified analysis of the Oates fiscal illusion model, and according to Fisher (1982), report the first econometric evidence on fiscal illusion and the flypaper effect. In the FRR model, the median voter perceives the amount of aid to be less than it actually is and selects an optimal expenditure level based on that perception. The innovation here is that only a **portion** of the aid is unknown, thus causing grant illusion. This innovation is later applied by Holsey (1993).

The following analysis demonstrates that grant illusion is nothing more than tax price illusion. Let the average tax price, ATP, be

$$(2.11)\quad ATP = [P_G G - (1-\theta)A]/G$$

where θ is the perceived portion of aid receipts, A represents the level of aid, $(1-\theta)A$ is the unknown portion of aid, P_G be the price of public goods, and G be the total quantity of public goods, then budget constraint for the consumer becomes

$$(2.12)\quad I + (1-\theta)A = P_G G - P_y Y$$

where I is income, P_y is the price of private goods, and Y is the level of private goods. Rearranging yields

$$(2.13)\quad I = \{[P_G G - (1-\theta)A]/G\}G + P_y Y$$

which demonstrates that grant illusion reduces to the traditional tax price illusion.

Wagner (1976) provides a conceptual and empirical exploration of one aspect of the theory of fiscal illusion. He focuses on how the differing degrees of complexity in the revenue structure affects the stock of taxpayer knowledge concerning tax-prices of public goods. According to Wagner there are three reasons why fiscal illusion had not previously played a significant role in the agenda of fiscal analysis. First, fiscal analysis had been predominantly normative and only when the analysis becomes positive does fiscal illusion becomes pertinent. Second, fiscal illusion had been widely interpreted as implying irrational individual behavior. Finally, fiscal illusion had been largely devoid of empirical content.

Winer (1983) and Wagner (1976) suggest that fiscal illusion by the voter stems from the imperfect information that arises from public sector fiscal complexity created by the separation of taxing and spending functions. Logan (1986) suggests that the source of this illusion arises from the distribution of aid from the higher levels of government.

Turnbull (1992, 1993, 1996) states that the typical approach to modeling fiscal illusion is that the imperfect information is modeled as a non-stochastic wedge between average and marginal tax prices. Such a method of modeling imperfect information in a certainty framework implies a violation of the rationality implied by the utility maximization (Logan 1986). Turnbull (1992, 1993, 1996) uses the theory of demand under uncertainty to model imperfect information, thus no longer violating the rationality assumption. Within this framework, fiscal illusion now represents the level of uncertainty facing the voters,

thereby different degrees of fiscal illusion can be thought of as inducing differences in not only the mean but the variances of the perceived distribution of possible outcomes. Also, the ability of the bureaucrats and politicians to exploit the imperfect information is limited by the offsetting risk effects on voter demand.

Using the uncertainty framework, Turnbull (1992) finds that the offsetting risk effects on the median voter does not necessarily lead to an overexpansion of the budget implied by the certainty models. Empirically, the results are mixed and the illusion-expansion 'connection' is unstable across different spending categories at the municipal level. It is important to note that this work, unlike many of the previous empirical examinations of fiscal illusion, uses various expenditure categories of a multi-service government, as opposed to a single service government like school districts.

An important outcome of this line of literature is the creation of a measure of fiscal complexity, the tax concentration and the expenditure concentration term. The tax concentration measurement is used by Wagner (1976) as a measure of the complexity of the revenue side of the budget. The expenditure concentration measurement is used by Turnbull (1993) to capture the complexity on the spending side of the budget. The contribution of these works is the ability to examine two types of fiscal complexity which may influence voter perceptions. This implies that the taxpayer-voter not only is unsure about how much he is paying, but about what he is receiving as well (Turnbull 1995). These concentration terms also provide another way of directly testing the hypothesis that fiscal illusion is related to budget complexity.

Holsey (1993) also considers the possibility that fiscal illusion concerns not only the misperception of expenditures but also the misperception of taxation levels associated with spending. This work is an important contribution to the fiscal illusion literature because in this demand model, fiscal illusion is looked upon as a two-dimensional rather than in a single dimensional issue. Traditional illusion is tax-price illusion which is caused by the misperception about the amount of aid that the local government is receiving. Holsey adds to this by opening up another avenue of misperception--not about how much you receive, but what you pay. Even if the voters know what their tax bill really is, the question becomes how much of that tax money goes to other jurisdictions; in other words how much does the taxpayer-voter perceive of what he pays for aid comes back as aid.

Chapter Three

Price and Income Illusion

3.1 Income Illusion

Holsey (1993) attempts to provide a unified framework in which the relative importance of both price and income illusion can be assessed. She states that it is premature to incorporate price illusion into standard theory and claim it as the sole source of illusion resulting from the grant system. She argues that although Winer (1983) and Filimon, Romer and Rosenthal (1982) conclude that grant induced price illusion is a significant determinant of local government expenditure, the role of price illusion remains undefined because they cannot isolate voter knowledge parameters. Further, neither study adequately recognizes the existence of imperfect information about donor government tax payments for grants.

Holsey labels this source of fiscal illusion, the imperfect information about how much of the donor government tax payments for grants actually comes back to the jurisdiction, as 'income' illusion. This type of illusion stems from the voter's failure to recognize the simultaneity in grant allocations to other jurisdictions. Previous models, like those presented earlier, assume a grant tax burden of zero. This model allows such an assumption to be relaxed. The contribution here is the modeling of demand such that the effects of simultaneity in grants can be examined, an extension of Winer's work.

Holsey's explanation of income illusion can be summarized using Figure 3.1. Segment AB is the voter's original budget constraint when no intergovernmental aid is present. Maximization of the median voter's utility subject to this constraint yields a public

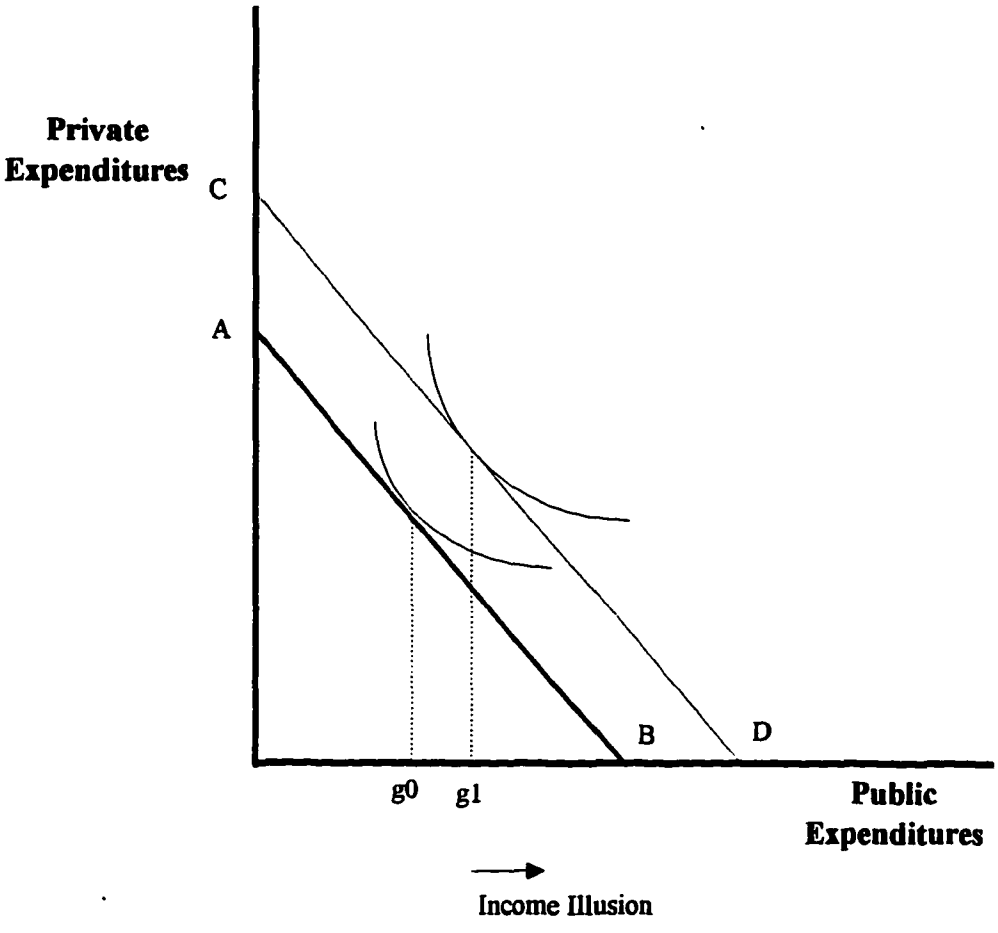

Figure 3.1
Holsey Model of Income Illusion

Perceived Budget Constraint

Actual Budget Constraint

expenditure level of g0. The voter's failure to recognize simultaneity in grant allocation creates a discrepancy between the actual and perceived budget constraints. Now, assume that all localities receive federal grants such that the voter's share of his locality's grant just equals the increase in federal taxes he must pay for the overall increase in federal grants. The voter's actual income is not changed and the actual post-grant budget constraint remains segment AB. The level of expenditure that maximizes the voter's utility remains g0. However, the voter's perceived budget constraint becomes segment CD assuming he has perfect information concerning his own local grant but no knowledge of the associated tax burden required to pay for the grant. Post grant perceived income is equal to pre-grant income plus the voter's share of his locality's grant. The level of public expenditures becomes g1. The amount of income illusion becomes the vertical distance between AC and the increase in public consumption due to the flypaper effect is g1-g0.

3.2 The Relationship between price and income illusion

The logical inconsistency in the Holsey description of income illusion is that the crucial voter's most preferred level of output, g1, is not on the **actual** budget constraint. Consistency requires that the voter be on both the perceived and actual budget constraint in equilibrium. The reason for this is that the median voter cannot consistently spend more on goods and services than his income will allow, which means that he cannot be outside of his actual budget constraint in equilibrium. The imposition of the consistency condition effects the relationship between income and price illusion that Holsey proposes. The analysis that follows clarifies the parametric interdependence between price and income illusion. It shows that Holsey's income illusion is really the traditional tax price illusion.

Maximizing the median voter's utility subject to his budget constraint, which incorporates the imperfect information about intergovernmental grants, yields the demand equation for local expenditures under imperfect price and income information. Assume that there exist only two jurisdictions, 1 and 2, and only one level of higher government called state government.

Under perfect information the voter's problem can be expressed as

(3.1) max U(Y,G) subject to $I = Y + T^1_L + T^1_S$

where Y is the amount of private goods purchased, G is the total expenditures by the locality for public goods, T^1_L is community 1's local tax burden for public goods and T^1_S is community 1's tax burden to the state for intergovernmental aid for local public goods. Local tax payments can be broken down into the individual components as

(3.2) $T^1_L = w^1_L (G - L^1_S)$

where w^1_L is the voter's marginal tax share of local expenditures, and L^1_S is the total amount of intergovernmental aid received from the state government by community 1. State level tax collections can also be broken down into the individual components as

(3.3) $T^1_S = w^1_S (L^1_S + L^2_S) = w^1_L (L^1_S + L^2_S)V^1$

where L^2_S is the total amount of state aid going to community 2, w^1_S is the voter's tax share of the state tax burden, and V^1 is the community's share of the state tax burden from community 1, where $V^1 + V^2 = 1$ and total aid, $L_S = L^1_S + L^2_S$. Substituting (3.2) and (3.3) into (3.1) yields the expanded budget constraint

$$(3.4)\quad I = Y + w^1_L (G + L^1_S) + w^2_L (L^1_S + L^2_S) V^1$$

and rearranging (3.4) yields

$$(3.5)\quad Y = I - w^1_L G + (w^1_L + w^2_L V^1) L^1_S - w^1_L L^2_S V^1$$

The last two components on the right hand side of the equation represent the perceived aid by the median voter net of state taxes. Equation (3.5) represents the budget constraint of the median voter who is not confronted with any misperceptions about the amount of aid received, amount of taxes being paid for the aid, or the amount of aid going to other jurisdictions.

The analysis of both price and income illusion is examined by introducing imperfect information about intergovernmental aid into the model. There are two possible sources of imperfect information. The first is the misperception about the amount of aid received by the voter, which is the source of traditional tax price illusion. The second is the misperception about how much of the tax payments for aid is going to other jurisdictions, which is the source of Holsey's income illusion. The following analysis will show that

incorporating both types of illusion into the above model reveals a functional dependency between the two types of illusion.

3.2.1 Income Illusion

The perceived amount of aid going to locale 2, per dollar of aid to locale 1 is L^{*2}_S which can be defined as

(3.6) $L^{*2}_S = \Gamma L^1_S$

where Γ measures locales 2's perceived aid as a proportion of 1's aid. The asterisks denote perceived amounts by the median voter in locale 1. The perceived net aid component of (3.5) now becomes

(3.7) $w^1_L (1 - V^1) L^1_S - w^1_L V^1 \Gamma L^1_S$

which reduces to

(3.7') $w^1_L \{ (1 - V^1) - V^1 \Gamma \} L^1_S$

In equilibrium it must be the case that the actual tax bill of 1 be equal to the perceived tax bill which implies that $T^1_S = T^{*1}_S$ and can be expressed as

(3.8) $(L^1_S + L^2_S) w^1_L V_1 = (L^1_S + L^{*2}_S) w^1_L V^1$

and substituting (3.6) into (3.8) yields the condition in equilibrium

$$(3.9)\quad (L^1_S + L^2_S)\, w^1_L\, V^1 = (L^1_S + \Gamma L^1_S)\, w^1_L\, V^1$$

Rearranging (3.9) and solving for Γ yields

$$(3.10)\quad \Gamma = L^2_S / L^1_S$$

which is the actual distribution of aid and is the perfect information outcome. Therefore, "income illusion", which Holsey (1993) contends stems from the misperceptions of the voter in jurisdiction 1 about the amount of aid going to locale 2, cannot exist without tax price illusion.

3.2.2 Tax Price Illusion

Tax price illusion in the traditional sense stems from the misperception by the median voter of the amount of aid that he receives from higher levels of government. Since the actual local tax bill is defined as $w^1_L (G - L^1_S)$, then a misperception about the amount of aid implies that there is a misperception about the marginal tax price of additional public spending. Incorporating the aid misperceptions into (3.2) and (3.3) gives us the perceived tax payments

$$(3.11)\quad T^{*1}_L = w^1_L\, V^1 (G - L^{*1}_S)$$

and

(3.12) $T^{*1}_S = w^1_L V^1 (L^{*1}_S (1+\Gamma))$

where $L^{*1}_S = \Theta L^1_S$ and is the perceived amount of aid received. Θ is the portion of aid receipts that is perceived by the median voter. The perceived taxes which include the misperception in the marginal tax price can be expressed as

(3.13) $T^{*1}_L = w^{*1}_L V^1 (G - \Theta L^1_S)$

and

(3.14) $T^{*1}_S = w^{*1}_L V^1 (L^{*1}_S (1+\Gamma))$

where w^{*1}_L and w^{*1}_S are the perceived marginal tax shares. In equilibrium, the actual local tax bill must be equal to the perceived local tax bill, $T^{*1}_L = T^1_L$, and thus ex post

(3.15) $w^{*1}_L = (1 - (1-\Theta) L^1_S/G)$.

Also, the actual state tax bill must equal the perceived state tax bill, $T^{*1}_S = T^1_S$, which implies ex post that

(3.16) $w^1_L V_1 (L^1_S + L^2_S) = w^{*1}_L V^1 \Theta L^1_S (1+\Gamma)$

and substituting (3.15) into (3.16) yields

(3.17) $w^1_L V_1 (L^1_S + L^2_S) = w^1_L (1 - (1-\Theta) L^1_S/G) V^1 \Theta L^1_S (1+\Gamma)$.

Rearranging terms

(3.18) $L^1_S + L^2_S = (1 - (1-\Theta) L^1_S/G) \Theta L^1_S (1+\Gamma)$.

Solving for Γ yields

$$(3.19)\quad \Gamma = \frac{1 + L^2_S/L^1_S}{\Theta(1-(1-\Theta)L^1_S/G)} - 1$$

Equation (3.19) demonstrates the result found earlier that under perfect information about intergovernmental aid receipts: if $\Theta = 1$, then $\Gamma = L^2_S / L^1_S$. Thus "income" illusion, which Holsey (1993) maintains stems from the misperception about the portion of aid going to other jurisdictions, cannot exist independent of tax price illusion which in turn stems from misperceptions about own aid receipts.

3.3.3 The relationship between price and income illusion

The relationship between income and price illusion can be analyzed by rewriting (3.19) as

$$(3.20)\quad \frac{1 + L^2_S/L^1_S}{1 + \Gamma} = \Theta(1-(1-\Theta)L^1_S/G).$$

This equilibrium relationship implies that if there is an underestimation by the median voter of the tax payments for aid, that is $\Gamma < L^2_S / L^1_S$, then there must be an overestimation of the amount of aid received, $\Theta > 1$, and the perceived marginal tax price must be higher than the actual marginal tax price. If there is an overestimation of the tax payments for aid, $\Gamma > L^2_S / L^1_S$, then this implies an underestimation of the amount of aid received, $\Theta < 1$, thus causing the perceived marginal tax price to be lower than the actual marginal tax price. What is most important is that *the existence of income illusion implies tax price illusion, thus the two types of illusion are not independent.*

To illustrate how this consistency condition affects Holsey's conclusions, consider Figure 3.2. Segment AB is the voter's original budget constraint when no intergovernmental aid is present. Maximization of the median voter's utility subject to this constraint yields a public expenditure level of g0. If all localities receive federal grants such that the voter's share of his locality's grant just equals the increase federal taxes he must pay for the overall increase in federal grants, then the voter's actual income remains unchanged and the actual post-grant budget constraint remains segment AB.

Now assume that the median voter has perfect information concerning his own local grant. If the voter is ignorant of concomitant grants to other localities, hence ignorant of donor government tax payments for grants, then the perceived price of public goods to the voter increases. The reason for this price misperception is that the median voter formulates the perceived price of the good by associating the level of output with the associated tax liability. In this case, the median voter is associating a higher tax liability with a given level of output due to ignorance that a portion of his tax payments does not come back in the

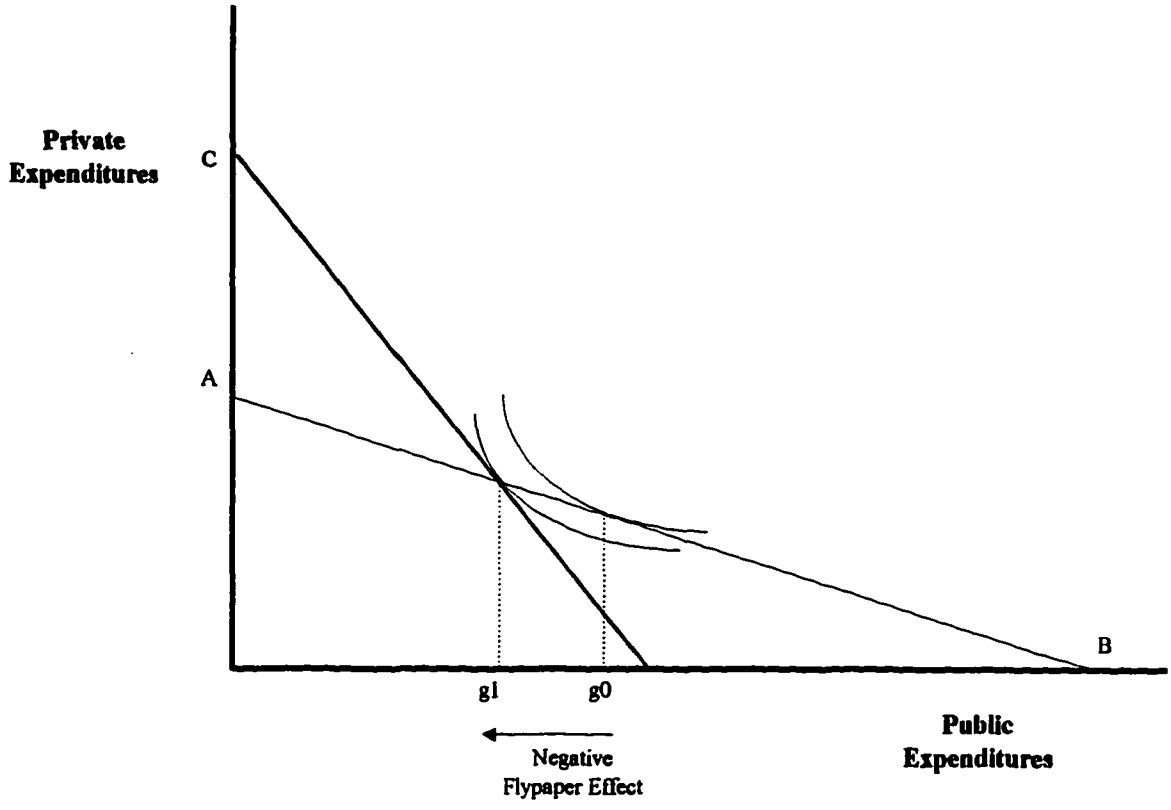

Figure 3.2
Corrected Model of Fiscal Illusion

Perceived Budget Constraint

Actual Budget Constraint

form of grants. This association causes an increase in the perceived price of public output by the median voter. As suggested by Courant, Gramlich and Rubinfeld (1979), the level of grants should be taken into consideration in the formulation of tax share. In the formal analysis by Holsey, the misperception of the tax liability for aid does not enter into the computation of the tax share.

The nature of the relationship between the effects of tax liability and grant perceptions becomes clear when the tax liability perceptions enter the tax share formulation, as demonstrated in the previous analysis. Given the changes in the perceived tax share by the median voter, the perceived budget constraint becomes segment CG because of the higher perceived price of public output. The utility maximizing voter then chooses expenditure level g1, and g1-g0 is the result of income illusion. In this scenario, the level of public output falls. Thus we conclude that income illusion produces a negative flypaper effect which is opposite of what the Holsey analysis predicts.

The implications of this analysis on the level of public goods chosen can be stated more formally:

1. If the voter overestimates the portion of his tax payments for aid going to other jurisdictions, then the perceived loss in net income due to grants generates an underestimation of the tax price by the median voter. This results in an expansion of the level of public expenditures.

2. If the voter underestimates the portion of his tax payments for aid going to other jurisdictions, then the perceived gain in net income generates an overestimation of the tax price by the median voter. This results in a contraction in the level of public output.

3. If the voter has perfect knowledge of the grant receipts, then this implies that there is no misperception about the level of tax payments for grants going to other jurisdictions. Conversely perfect information about tax payments implies then that there must be perfect information about grant receipts.

These theoretical conclusions have empirical implications in the Stone-Geary framework. One should observe an inverse relationship between the income illusion parameter and the tax price illusion parameter in the estimable demand equation derived using the Stone-Geary framework. These parameters should not be estimated as independent but rather as functionally interdependent.

This theoretical innovation allows testing for the presence of fiscal illusion without directly estimating parameters that measure voter's perceptions about aid amounts and tax payments going to other jurisdictions. Empirical evidence of grants being more stimulative than income on the level of public expenditures, a positive flypaper effect, suggests an underestimation of the level of aid received, $\Theta < 1$. This underestimation of grant amounts is coupled with an overestimation of tax payments for grants going to other jurisdictions, $\Gamma > 1$, which yields a perceived price lower than the actual price. Evidence of grants being less stimulative than income, a negative flypaper effect, suggests an overestimation of the

level of aid received, $\Theta > 1$. This overestimation of grant amounts is coupled with and underestimation of tax payments going to other jurisdictions, $\Gamma < 1$ which yields a higher than actual perceived price. In sum, the direction of the flypaper effect, or absence of it, indirectly reveals the source of tax price misperceptions. Therefore, the analysis of traditional tax-price and income illusion can be examined outside the context of a well defined structural model and extended into less restrictive reduce-form model specifications, a feature exploited in this study.

3.3 The Model

Holsey (1993) derives the median voter's demand function from a Stone-Geary utility function, incorporating the imperfect voter information about intergovernmental grants. Appendix One provides the derivation of the demand equation using this methodology. The demand equation for local public goods incorporates parameters that allow for the estimation of price illusion due to grant receipts and income illusion due to tax payments. Holsey's innovation is that the estimating equation is derived directly from the underlying preference function. The Stone-Geary utility function has well-known properties and is a homothetic function which facilitates the aggregation of preferences.

Holsey estimates the demand using time series data on primary and secondary education finances from 40 U.S. states over 1966-1980. She uses a two-stage non-linear least squares technique proposed by Amemiya (1974) to estimate the non-linear model. In order to conform to the local education data, Holsey aggregates all variables to the state level. The income illusion parameter for the state level cannot be estimated and the equality of state and local tax shares is implied as a result of this aggregation.

Holsey finds both illusion parameters significant and concludes that both types of fiscal illusion are determinants of voter behavior. Her estimates predict a $.51 increase in per student education expenditure for a $1.00 increase in per student grants, of which $.12 is due to the traditional picture of grant induced price illusion. These results differ from those of Filimon, Romer, and Rosenthal who predict a $.71 increase in expenditure per dollar of grants. In the Holsey study only the tax price and the coefficient representing the known portion of aid are significantly different from zero.

An extension of Holsey's fiscal illusion model is presented in Appendix One where local public demand is estimated using the demand equations derived using the Holsey methodology. These empirical results using disaggregate county data illustrate the theoretical relationship presented earlier that price and income illusion are not independent of each other. Both types of misperceptions by the voter concerning the level of aid received and taxes paid create a wedge between the actual and perceived price of the general services provided at the county level.

The parameters that measure income and price illusion are estimated independently, and therefore are biased in light of the previously established functional relationship between the parameters.[3] The full estimable model derived using the Holsey methodology does not converge to a global minimum when estimated using disaggregate county data from 1970 and 1980. The highly nonlinear specification of the model may be the reason for the inability of the model to converge to a global minimum. The use of more restrictive model

[3] The empirical specification of the model does not permit the parameters to be estimated as independent.

specifications yields estimates of coefficients that are very fragile, unstable, and vary significantly with model specification. The results show that the size and significance of the illusion parameter estimates depend on crucial assumptions about the knowledge of local, state, and federal tax shares as well as the empirical definition of the voter's income.

One important conclusion from this analysis is that the use of the Stone-Geary utility function is inappropriate for estimating demand equations using disaggregate county data. The fragility and variability of the estimates, including erroneous and economically inexplicable results, lead us to question the reliability of the estimates themselves for assessing the marginal impact of illusion on the perceived price of public goods.

3.4 The Log-Linear Model

One contribution of this paper is the use of a reduced form approach to indirectly analyze traditional tax price, or grant illusion, and income illusion. This paper exploits the log-linear model specification as an alternative to the more restrictive structural Stone-Geary model. The estimable demand equation derived form the log-linear model allows for the direct estimation of the voter's perception about the level of aid received. The theoretical innovations presented earlier allow us to indirectly attribute the cause of the price distortions by comparing the perception parameter estimates with the direction of the flypaper effect. The latter is calculated using the elasticity estimates from the empirical model.

Taking the variable definitions from the earlier analysis, the perceived marginal tax price of the median voter is

$$(3.21)\quad P_g^* = w_L \left(1 - \frac{(1-\theta)L_A}{P_g G}\right)$$

where P^*_g is the voter's perceived price of public goods, w_L is the voter's actual marginal tax share, P_gG is the actual total expenditures on public goods and $(1-\theta)L_A$ is the level of unperceived lump sum aid. Under perfect information $\theta = 1$ and the perceived price of public goods reduces to the voter's actual marginal tax share. When the voter underestimates the level of aid, $\theta < 1$ and the perceived price is lower than the actual price of the public goods; when the voter overestimates the level of aid, $\theta > 1$ and the perceived price is higher than the actual price of public goods. Substituting (3.21) into the net aid component of (3.5) yields the perceived net aid to the voter in jurisdiction 1 and equals

$$(3.22)\quad L^* = w_L \left(1 - \frac{(1-\theta)L_A}{P_g G}\right) \Theta L_A - w_L \left(1 - \frac{(1-\theta)L_A}{P_g G}\right) (1+\Gamma)\, V^l\, \Theta L_A$$

The individual demand function for local public goods is defined as

$$(3.23)\quad g = f(I, N, P_g^*, L^*)$$

where the median voter's demand for public goods, g, is a function of income, I, local population, N, the perceived price of the public good, and the perceived net aid received respectively. Equation (3.23) can be stated more formally in an exponential functional form,

and since individual output $g = \mu G$ where μ represents the congestion parameter, multiplying this form by $P_g \mu$ and rearranging terms yields an expression for the **total** demand for local public goods and can be stated as

$$(3.24)\quad P_g G = \alpha_0 I^{\alpha_1} N^{\alpha_2} P^{*\alpha_3} L^{*\alpha_4} P_g / \mu$$

Substituting (3.21) and (3.22) into (3.24) yields

$$(3.25)\quad P_g G = \alpha_0 I^{\alpha_1} N^{\alpha_2} w_L^{(\alpha_3+\alpha_4)} P_g^{(\alpha_3+1)} \left(1 - \frac{(1-\Theta)L_A}{P_g G}\right)^{(\alpha_3+\alpha_4)} \Theta L_A^{\alpha_4} (1-V^1(1+\Gamma))^{\alpha_4} / \mu$$

Taking the logarithms of both sides of (3.25) and collecting terms yields an estimable equation for local public demand and is expressed as

$$(3.26)\quad \begin{aligned} Ln\, P_g G = {} & A_0 + \alpha_1 Ln\, I + \alpha_2 Ln\, N + (\alpha_3+\alpha_4) Ln\, w_L + (1+\alpha_3) Ln\, P_g \\ & + (\alpha_3+\alpha_4) Ln\left(1 - \frac{(1-\Theta)L_A}{P_g G}\right) + \alpha_4 Ln\, L_A \end{aligned}$$

where the constant $A_0 = \alpha_0 + \alpha_4 Ln\Theta + \alpha_4 Ln(1-V^1(1+\Gamma)) - Ln\mu$.

3.5 Empirical Results

3.5.1 The Data

Holsey (1993) uses data drawn from single-purpose governments--education spending by school districts--aggregated by state to estimate the effect of fiscal illusion on the median voter's perceived budget constraint. This study extends Holsey's empirical analysis using two panel data sets, one for county government spending and the other for state government spending for the years 1970 and 1980. This data set allows us to address issues ignored in the earlier analysis. The panel data for county governments provides several important advantages. One advantage is that the disaggregate county data captures fiscal behavior at the jurisdictional level, which lies closer to the underlying median model appropriate for estimating local government spending functions. Another advantage is that county governments are multi-purpose and reflect differing degrees of fiscal complexity, which Wagner (1976) argues underlies taxpayer-voter fiscal illusion. This allows us a basis by which we can assess how *degrees* of fiscal illusion can affect the crucial parameter estimates of fiscal illusion. Another benefit of using county data is that examination of the provision of general services as well as specific services provided by the local governments can be undertaken.

This data set also provides the ability to test the test for inter-temporal stability of the estimates. Conclusions about long term trends of fiscal illusion effects on local spending behavior can be deduced by examining the trend in size and significance of the key parameter estimates. Finally, the panel data for state governments allows for all of the above analysis as well as the ability to examine how fiscal illusion effects vary between higher levels of government and lower levels of government.

The data used in this study are drawn from 437 county governments in the five midwestern states; Illinois, Indiana, Ohio, Michigan, and Wisconsin for the years 1970 and 1980. These states were chosen because they are all contiguous and large scale variations in climate, culture, and fiscal structure can be minimized. Expenditure, revenue, and grant receipts data are from the 1970 and 1980 *Census of Governments*. Population and income data come from the 1973 and 1983 *City-County Data Book*. A more complete explanation of the data used in this study is provided in Appendix Two.

3.5.2 Methodology and Assumptions

Estimation of the non-linear regressions is conducted using a maximum likelihood procedure.[4] It is assumed that the errors are additive and normally distributed. The algorithm employed in this procedure is a Quasi-Newton method and the convergence criterion for each coefficient is set equal to .00001. Non-linear regressions are conducted using the disaggregate county data from 1970 and 1980 described earlier.

The data used in the estimation of equation (3.26) are county general expenditures (P_gG), median family income (I), and county population (N). The price of the public goods, P_g, is measured by using the average wage of county employees. The median voter tax share, w, is assumed to be the median value house divided by the total property tax base in the county. These definitions are typically used in local public expenditure studies [Turnbull (1993); Turnbull and Djoundourian (1993,1994); Holsey (1993)].

[4] The regressions are programmed and executed using the SHAZAM econometrics computer program version 7.0.

This study estimates both county general expenditure functions and specific service functions at the county level. Five service categories are examined; education, public safety, transportation, environmental, and social services expenditures. The estimation of (3.26) for the service categories substitutes the total expenditures for each category as a measure of the dependant variable P_gG.

3.5.3 General Expenditure Results

Estimates of the log-linear demand equation for county general expenditures which incorporates imperfect voter information for 1970 and 1980 is reported in Tables 3.1 and 3.2, respectively. Examination of Table 3.1 indicates a significant and positive relationship between the median voter's income and general expenditures by the county government. The income elasticity (A1) estimate of .238 is slightly lower but consistent with income effects reported in the literature. Inman (1971) reports the income elasticity for education expenditures to be .56. Feldstein (1971) reports an income elasticity for education expenditures of .47. Ehrenberg (1973) using total local government data reports an income elasticity of .75.

The aid elasticity (A4) is also positive and significant with relation to general expenditures and the estimate of .536 is also consistent with the prevailing literature. Turnbull (1993) reports aid elasticities ranging from .48 to .78 for municipal governments. Ehrenberg (1973) reports the aid elasticity for total local government expenditures to be .22. Inman (1978) reports aid elasticities for education expenditures ranging from .23 to .40. The estimates for 1970 general expenditures show lump sum intergovernmental aid (A4) to

Table 3.1
Log-Linear Model Specification
County General Expenditures
1970

	Unrestricted Model	Restricted Model
Constant (A0)	-1.718* 0.357	-2.950* 0.396
Income (A1)	.238* 0.043	.231* 0.049
Population (A2)	.307* 0.031	.528* 0.03
Price Elasticity (A3)	-.728* 0.034	-.469* 0.033
Aid (A4)	.536* 0.024	.425* 0.025
Aid Perception Theta	.643* 0.012	
Log Likelihood Value	233.5894	177.4402
SSE	8.7846	11.3586
F-Statistic Ho: Theta = 1		112.30

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table 3.2
Log-Linear Model Specification
County General Expenditures
1980

	Unrestricted Model	Restricted Model
Constant (A0)	-1.444* 0.446	-1.705* 0.575
Income (A1)	.303* 0.053	.263* 0.068
Population (A2)	.187* 0.027	.362* 0.032
Price Elasticity (A3)	-.831* 0.027	-0.648* 0.032
Aid (A4)	.589* 0.02	0.454* 0.024
Aid Perception Theta	.646* 0.05	
Log Likelihood Value	289.3410	189.9201
SSE	6.8062	10.7280
F-Statistic Ho: Theta = 1		198.84

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

be more stimulative than income (A1) on the level of general expenditures at the county level.

Analysis of the θ parameter allows us to assess the degree of grant and income illusion of the level of county general expenditures. The estimate for the level of aid perceived (θ) by the median voter is .643 and is significantly different from zero. This result shows that the median voter underestimates the level of intergovernmental aid coming from the state and federal government. If the median voter underestimates the level of aid, as the results in Table 3.1 show, then according to the theory developed earlier, the median voter will underestimate the marginal tax price of the public goods. This price distortion causes an expansion of the level of output.

Table 3.1 also reports the estimates of the log linear model under the assumption that the median voter is confronted with perfect information about the level of aid received (θ=1). The hypothesis that the median voter has perfect information is tested using a likelihood ratio test. The hypothesis that θ = 1 is rejected at the 95% confidence level with an F-statistic of 112.30. These tests show the median voter does not have perfect information about the level of aid but is not totally unaware that it exists. This results supports the theory of partial grant illusion proposed by Filimon, Romer and Rosenthal (1980) and rejects the complete fiscal illusion proposed by Oates (1979).

Empirical evidence of grants being more stimulative than income on the level of public expenditures, a positive flypaper effect, suggests an underestimation of the tax price caused by an underestimation of the level of aid received or a corresponding overestimation of the tax payments for that aid. Comparing the differences in the marginal effects of

income and aid on the level of expenditures gives us the direction of the flypaper effect and yields the source of the tax price misperceptions. The coefficients estimated using the log linear approach yield elasticity estimates and should not be interpreted as marginal effects. However, by making the appropriate transformations, we can calculate the direction of the flypaper effect.

A positive flypaper effect is when intergovernmental aid is more stimulative than income on the level of expenditures. This relationship can be stated more formally as:

$$(3.26)\quad \frac{\partial(P_g G)}{\partial I} < \frac{\partial(P_g G)}{\partial(wL)}$$

Multiplying both sides by I/P_gG yields

$$(3.27)\quad \frac{\partial(P_g G)}{\partial I}\frac{I}{P_g G} < \frac{\partial(P_g G)}{\partial(wL)}\frac{I}{P_g G}$$

and multiplying the right hand side of (3.27) by 1 (wL/wL) and rearranging terms yields

$$(3.28)\quad \frac{\partial(P_g G)}{\partial I}\frac{I}{P_g G} < \frac{\partial(P_g G)}{\partial(wL)}\frac{wL}{P_g G}\frac{I}{wL}$$

which can be rewritten as

$$(3.29)\ E(I,G) < E(wL,G)\ \frac{I}{wL}$$

where E (I,G) is the income elasticity and E(wL,G) is the aid elasticity. Therefore by multiplying the elasticity of aid by the ratio of the median voter's income and the share of aid, we can determine if intergovernmental aid is marginally more stimulative than income.

Multiplying the elasticity of aid from Table 3.1 by the income-aid share ratio, which for 1970 is 4.53, gives us a value of 2.431.[5] This value is greater than the income elasticity of .238. Thus, for 1970 we find that intergovernmental aid is more stimulative than income. This result conforms with the theoretical results that an underestimation of the level of aid lowers the perceived price to public goods and leads to public output expansions. The positive flypaper effect confirms the result that the voter underestimates the level of aid and suffers from fiscal illusion.

The estimates for county general expenditures using the 1980 data are presented in Table 3.2. These results indicate a significant and positive relationship between income and intergovernmental aid and general expenditures by the local government for 1980. The income elasticity of .303 and the aid elasticity of .589 are both significantly different from zero. The estimate for the perception of aid by the median voter is .646 and is significantly different from zero. The hypothesis that $\theta = 1$ is tested using a likelihood ratio test and is rejected at the 95% confidence level with an F-statistic of 198.84. The results using the 1980 county data suggest that the median voter does not perceive the full level of aid

[5] Mean and median values of the variables are reported in Appendix Two.

received by the county government. The theory implies that this leads to an underestimation of the tax price, and causes an expansion in the level of output. We calculate the direction of the flypaper effect by multiplying the aid elasticity by the income-aid share ratio, which for 1980 is 2.43, and this gives us a value of 1.43 which is greater than the income elasticity of .303. This result indicates that intergovernmental aid is more stimulative than income for 1980 county general expenditures. This positive flypaper effect suggests an underestimation of the tax price by the median voter resulting from an underestimation of the level of aid received. This relationship is confirmed by the estimate of θ being less than one.

The empirical results presented above show that the median voter suffers from fiscal illusion. The source of this fiscal illusion stems from the voter's inability to perceive the full of amount of intergovernmental aid. This misperception drives a wedge between the actual and perceived marginal tax price of public goods. These results also show an underestimation of the level of aid received by the local government as the source of the flypaper effect.

3.5.4 Service Category Results

An important contribution of this work is the use of the disaggregate panel data to examine the provision of specific services at the county level. This section analyzes five service functions at the county level for 1970 and 1980: education, public safety, transportation, environmental, and social services. Estimation of the expenditure functions indicates that the median voter suffers from fiscal illusion stemming from the underestimation of the level of aid received by the local government. In all five service

categories for 1970 and 1980, intergovernmental aid is more stimulative than income on the level of expenditures.

Estimates of the log linear expenditure function using the 1970 data for the five service categories are presented in Tables 3.3 and 3.4. These tables indicate a significant and positive relationship between income and service functions with elasticity estimates ranging from .188 for public safety to .327 for education. The income effects appear to be stable across these categories. Further examination of these estimates indicates a positive and significant relationship between the level of intergovernmental aid and the specific expenditure categories. The intergovernmental aid elasticities for transportation, social services, and environmental expenditures at the county level are very strong and range from .833 to .950.

Analysis of the aid perception parameter (θ) allows us to assess the degree of grant and income illusion on the level of spending in these five categories. Tables 3.3 and 3.4 indicate that in all five expenditure categories the median voter underestimates the level of aid received for these specific functions. All the estimates of the theta parameters are significantly different from zero and are less than one. The hypothesis that the voter is confronted with perfect information about aid amounts (θ=1) is tested using the likelihood ratio test. The estimates of the restricted models are reported in Appendix Three. The F-statistics of this test are also reported in Tables 3.3 and 3.4. Examination of these results indicate that for all five expenditure categories in 1970, the hypothesis that the voter is confronted with perfect aid information is rejected at the 95% confidence level. The

Table 3.3
Log-Linear Model Specification
Specific County Services
1970

	Education	Transportation	Public Safety
Constant (A0)	-2.911* 0.488	1.759* 0.482	-2.698* 0.541
Income (A1)	.327* 0.054	.242* 0.061	.188* 0.062
Population (A2)	.354* 0.047	-.425* 0.032	.240* 0.045
Price Elasticity (A3)	-.633* 0.045	-1.452* 0.036	-1.000* 0.045
Aid (A4)	.430* 0.031	.950* 0.031	.544* 0.035
Aid Perception Theta	.602* 0.144	.774* 0.053	.788* 0.090
F-Statistic Ho: Theta = 1	108.05	447.26	372.88
SSE	13.90	17.41	17.61
Log Likelihood Value	133.34	84.08	81.60

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

Table 3.4
Log-Linear Model Specification
Specific County Services
1970

	Social Services	Environmental
Constant (A0)	3.912*	1.116*
	0.852	0.855
Income (A1)	.315*	.317*
	0.108	0.100
Population (A2)	-.698*	-.421*
	0.058	0.063
Price Elasticity (A3)	-1.923*	-1.696
	0.059	0.061
Aid (A4)	.996*	.833*
	0.056	0.053
Aid Perception	.777*	.492*
Theta	0.088	0.056
F-Statistic Ho: Theta = 1	855.26	673.22
SSE	54.29	47.19
Log Likelihood Value	-164.36	-133.73

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

underestimation of the level of aid leads to an underestimation of the tax price by the median voter and causes an increase in service expenditures.

The direction of the flypaper effect indirectly reveals the source of tax price misperception. Multiplying the median voter's income by the income-aid share ratio for each category and comparing this result to the income elasticity estimate gives us the direction of the flypaper effect. All five county expenditure categories exhibit a positive flypaper effect which indicates that intergovernmental aid is more stimulative than income on the level of county service expenditures for 1970. Therefore, we conclude that the median voter suffers from fiscal illusion caused by the misperception of aid levels for these five functions.

Estimates of the log linear expenditure function using the 1980 data for the five service categories are presented in Table 3.5 and 3.6. Examination of these tables indicates a significant and positive relationship between income and all five service functions with elasticity estimates ranging from .403 for transportation to .826 for environmental. The aid elasticity estimates are all positive and significant with respect to service expenditures. The aid elasticity estimate for social services of 1.056 implies that social service expenditures rise by more than the increase in the level of intergovernmental aid.

Analysis of the aid perception parameter indicates that the median voter underestimates the level of aid received with estimates ranging from .447 for social services to .872 for environmental. The hypothesis that the median voter has perfect information regarding the level of aid received is rejected at the 95% confidence level. The F-statistics are reported in Tables 3.5 and 3.6. The results indicate that the median voter is suffering from fiscal illusion.

Table 3.5
Log-Linear Model Specification
Specific County Services
1980

	Education	Transportation
Constant (A0)	-4.726* 0.644	0.173 0.694
Income (A1)	.592* 0.075	.403* 0.083
Population (A2)	.197* 0.040	-.226* 0.038
Price Elasticity (A3)	-.749* 0.041	-1.199* 0.038
Aid (A4)	.589* 0.020	.669* 0.032
Aid Perception (Theta)	.646* 0.050	.764* 0.060
F-Statistic Ho: Theta = 1	132.57	57.83
SSE	14.52	16.71
Log Likelihood Value	123.85	93.04

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

Table 3.6
Log-Linear Model Specification
Specific County Services
1980

	Social Services	Environmental
Constant (A0)	-.640 1.223	-3.201* 1.080
Income (A1)	.802* 0.146	.826* 0.127
Population (A2)	-.760* 0.061	-.487* 0.056
A3	-1.869* 0.056	-1.632* 0.051
Aid (A4)	1.056* 0.055	.982* 0.046
Aid Perception Theta	.447* 0.041	.872* 0.074
F-Statistic Ho: Theta = 1	855.26	562.41
SSE	53.98	39.54
Log Likelihood Value	-163.12	-95.11

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

Evidence of intergovernmental aid being more stimulative than income on the level of service expenditures indicates the nature of the price distortion stems from the voter's misperception about the level of aid. By multiplying the income-aid share ratio by the reported aid elasticities for each service category, we find that these values are all greater than the income elasticity estimates in that category. Thus we conclude that the positive flypaper effects exhibited in the service categories are a result of fiscal illusion by the median voter.

3.5.5 Summary of Results

The empirical results of the log linear model using the disaggregate county data from 1970 and 1980 are summarized in Table 3.7. The positive flypaper effects for county general expenditures and for specific categorical expenditures in 1970 and 1980 indicates that intergovernmental aid is more stimulative than income on the level of county expenditures. The consistent positive flypaper effect implies that the median voter underestimates the true marginal tax price of the public goods. The consistent underestimation of the level of aid for both general expenditures and specific service expenditures is summarized in Table 3.7 and is the cause of the price distortion. The empirical results show the median voter suffers from fiscal illusion. The source of this illusion stems from the inability of the median voter to perceive the full amount of intergovernmental aid. Thus we can conclude that the empirical phenomenon known as the flypaper effect is a result of fiscal illusion by the median voter. We find no evidence of Holsey's notion of income illusion which stems from the overestimation of the level of intergovernmental aid by the median voter.

Table 3.7
Fiscal Illusion Summary
County Level

1970	Direction of Flypaper Effect	Perception of Intergovernmental Aid
General Expenditures	Positive	Underestimation
Education	Positive	Underestimation
Public Safety	Positive	Underestimation
Transportation	Positive	Underestimation
Environmental	Positive	Underestimation
Social Services	Positive	Underestimation

1980	Direction of Flypaper Effect	Perception of Intergovernmental Aid
General Expenditures	Positive	Underestimation
Education	Positive	Underestimation
Public Safety	Positive	Underestimation
Transportation	Positive	Underestimation
Environmental	Positive	Underestimation
Social Services	Positive	Overestimation

The empirical tests in this study show that the median voter does not have perfect information concerning aid receipts at the county level. Therefore, modeling local fiscal behavior under this assumption is inappropriate and can lead to biased estimates. Table 3.8 compares the elasticity estimates of the some key variables used in fiscal policy analysis estimated under perfect information with those estimates from the demand equation which incorporates imperfect information. The variables examined are income, intergovernmental aid, and tax price elasticities. Casual observation of the estimates show that the key parameter estimates under perfect information tend to be lower than the estimates which incorporate imperfect information into the model for both 1970 and 1980 county expenditures. Another interesting result is the consistent manner in which the median voter model explains categorical spending at the local level. It is shown that the median model tends to explain general expenditure behavior well at the municipal level, however lacks in explaining the specific functions (Turnbull and Djoundourian, 1994). One reason is that voter's have some influence in regards to the overall level of spending, but little control as to the specifics of the expenditures. At the county level, we find the median model a strong tool in predicting the behavior of the local fisc.

Table 3.8
Comparison of Perfect versus
Imperfect Information Model
County Level

1970	Income	Aid	Tax Price
General Expenditures	Same	Lower	Lower
Education	Same	Lower	Lower
Public Safety	Lower	Lower	Lower
Transportation	Same	Lower	Lower
Environmental	Lower	Lower	Lower
Social Servies	Lower	Lower	Lower

1980	Income	Aid	Tax Price
General Expenditures	Lower	Lower	Lower
Education	Lower	Lower	Lower
Public Safety	Lower	Lower	Lower
Transportation	Lower	Lower	Lower
Environmental	Lower	Lower	Lower
Social Servies	Lower	Lower	Lower

Chapter Four

State Government

This chapter examines how fiscal illusion effects vary between higher and lower levels of government. We use state panel data from 1970 and 1980 to estimate a variant of the log linear demand equation developed in the previous chapter. The log-linear demand equation which incorporates imperfect voter information is estimated for state general expenditures and for five specific spending categories. The results provide strong evidence that the median voter suffers from fiscal illusion stemming from the underestimation of aid receipts at the state level. The estimates do show fiscal illusion as the source of the flypaper effect. The size and significance of the state estimates are compared with the county estimates to examine how fiscal illusion varies across levels of government. These results reveal an interesting difference between county and state governments.

4.1 Methodology and Assumptions

Estimation of the non-linear regressions is conducted using a maximum likelihood procedure. It is assumed that the errors are additive and normally distributed. The algorithm employed in this procedure is a Quasi-Newton method and the convergence criterion for each coefficient is set equal to .00001. Non-linear regressions are conducted using the state expenditure data from 1970 and 1980 described earlier. Expenditure, revenue, and grant receipts data are from the 1970 and 1980 *Census of Governments.*

Population and income data come from the 1973 and 1983 *City-County Data Book*. A more detailed explanation of all variables used in the estimation is provided in Appendix Two.

A variation of the non-linear demand equation (3.26) is estimated using a maximum likelihood procedure and is expressed as

$$Ln\ P_gG = A_0 + \alpha_1 Ln\ I + \alpha_2 Ln\ N + (\alpha_3+\alpha_4) Ln\ w_L + (1+\alpha_3) Ln\ P_g + (\alpha_3+\alpha_4) Ln\left(1-\frac{(1-\Theta)L_A}{P_gG}\right) + \alpha_4 Ln\ L_A + \alpha_5 South + \alpha_6 West + \alpha_7 North \quad (4.1)$$

This empirical specification includes regional dummy variables, south, west, and north to capture the effects of unmeasured determinants like weather, geography, and regional cultural effects.[6] There are no *a priori* expectations about the signs of the regional dummy variables. The data used in the estimation of equation (4.1) are state general expenditures (P_gG), median family income (I), and state population (N). The tax price of the public goods, P_g, is measured by using the average wage of state employees. The median voter tax share, w, is assumed to be the median value house divided by the total property tax base in he state.

4.2 General Expenditure Results

Estimates of the log-linear state general expenditures equation which incorporates imperfect information for 1970 and 1980 are reported in Tables 4.1 and 4.2, respectively.

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[6] A test of the null hypothesis that slope coefficients across states of different geographic regions are the same cannot be rejected for both 1970 and 1980 general expenditures and categorical expenditures.

The results in Table 4.1 show a positive relationship between median voter's income and state general expenditures in 1970. The income elasticity (A1) of .180 however is not significantly different from zero with a standard error of .155. The aid elasticity (A3) of .570 reflects a positive and significant relationship between intergovernmental aid and state general expenditures.

Analysis of the aid perception parameter (θ) allows us to assess the degree of grant and income illusion at the state level concerning general expenditures. The estimate of the level of aid perceived is .779 and is significantly different from zero. Table 4.1 also reports the estimates of the log-linear model under the assumption that the median voter has perfect information concerning aid levels (θ=1). This hypothesis is tested using a likelihood ratio test and is rejected at the 95% confidence level with an F-statistic of 5.28. Thus we conclude that the median voter underestimates the level of intergovernmental aid concerning state general expenditures in 1970. According to theory, this underestimation of the level of intergovernmental aid by the median voter leads to an underestimation of the marginal tax price of public goods.

Evidence of intergovernmental aid being more stimulative than income on the level of state general expenditures, a positive flypaper effect, also supports the conclusion that the median voter underestimates the tax price due to imperfect information concerning aid levels. Multiplying the elasticity of aid by the income-aid share ratio, which for 1970 is 3.49, gives us a value of 1.98. This value is greater than the income elasticity of .180 which indicates that intergovernmental aid is more stimulative than income on the level of state general expenditures for 1970.

Table 4.1
Log-Linear Model Specification
State General Expenditures
1970

	Unrestricted Model	Restricted Model
Constant (A0)	-.339 1.412	-.768 1.501
Income (A1)	0.18 0.155	0.204 0.164
Population (A2)	.247* 0.076	.302* 0.077
Price Elasticity (A3)	-.638* 0.086	-.568* 0.086
Aid (A4)	.570* 0.077	.527* 0.079
Aid Perception Theta	.779* 0.173	
South	.096* 0.042	.113* 0.044
West	-.045 0.051	-.053 0.052
North	0.07 0.046	0.078 0.047
Log Likelihood Value	46.6773	44.0389
SSE	0.4019	0.4486
F-Statistic Ho: Theta = 1		5.28

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table 4.2
Log-Linear Model Specification
State General Expenditures
1980

	Unrestricted Model	Restricted Model
Constant (A0)	-1.544 1.470	-1.799 1.470
Income (A1)	0.218 0.152	0.227 0.153
Population (A2)	405* 0.074	.427* 0.072
Price Elasticity (A3)	-.473* 0.082	-.451* 0.080
Aid (A4)	.466* 0.077	0.454* 0.076
Aid Perception Theta	.426* 0.215	
South	.130* 0.042	.133* 0.042
West	-.059 0.042	-.059 0.043
North	0.062 0.044	0.062 0.045
Log Likelihood Value	44.3996	44.3236
SSE	0.4419	0.4433
F-Statistic Ho: Theta = 1		0.15

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

The estimates for state general expenditures using the 1980 data are presented in Table 4.2. These results show a positive relationship between the median voter's income and the level of general expenditures. However, the income elasticity estimate of .218 is not significantly different than zero with a standard error of .152. The aid elasticity estimate of .466 reflects a positive and significant relationship between intergovernmental aid and state general expenditures.

The estimate of the level of aid perceived (θ) is .426 and is significantly different from zero. This result indicates that the median voter underestimates the level of aid received. Table 4.2 also reports the estimates of the log-linear model under the assumption that the median voter has perfect information concerning aid levels (θ=1). The hypothesis that the median voter has perfect information is tested using a likelihood ratio test and cannot be rejected at the 95% confidence level with an F-statistic of .15. The inability to reject the hypothesis of perfect aid information implies that the median voter does not underestimate the tax price of the public services at the state level for 1980.

Evidence of intergovernmental aid being more stimulative than income on the level of state general expenditures, a positive flypaper effect, therefore cannot be attributed to fiscal illusion by the median voter stemming from the underestimation of the level of aid receipts. Multiplying the elasticity of aid by the income-aid share ration, which for 1980 is 1.41, gives us a value of .659 and is greater than the income elasticity of .218. Evidence of a positive flypaper effect with no evidence of aid misperceptions implies that the source of the price distortions stem from something other than aid and tax payment misperceptions. This positive flypaper effect according to Fisher (1982) may result from various political

institutions at the state level or some tax substitution. The positive flypaper effect may also reflect the presence of tax price risk or consumption risk facing the median voter (Turnbull 1993,1995). The latter explanation seems more plausible because at the state level the median voter is further removed from the decisions concerning spending. This increased distance from the decision making process increases the cost of obtaining information and results in an increase in the risk or uncertainty the median voter must bear.

The empirical results show evidence that the median voter is confronted with imperfect information about aid receipts leading to price distortions concerning the marginal tax price of state level general expenditures. The evidence shows that the flypaper effect in the 1970 sample can be attributed to fiscal illusion caused by the underestimation of the level of intergovernmental aid receipts by the median voter. However, there is no strong evidence that the positive flypaper effect observed in the 1980 sample can be attributed to the underestimation of the tax price stemming from aid misperceptions.

4.3 Service Category results

Examination of specific service expenditures by states gives us another dimension in which to analyze the effects of fiscal illusion. This section analyzes five service functions at the state level for the years 1970 and 1980: education, public safety, transportation, environmental, and social services. Estimation of the expenditure functions provide strong evidence that the median voter suffers from fiscal illusion stemming from the underestimation of the level of aid received in 1970. No strong evidence of fiscal illusion is found using the sample from 1980. Estimation of all five service expenditure categories for 1970 and 1980 find intergovernmental aid to be more stimulative than income on the

level of expenditures. Overall, we find that the median voter model does not explain specific spending behavior well at the state level. The unstable/inconsistent estimates may reflect the increased distance between the median voter the specific spending decisions made at the state level.

Estimates of the log-linear expenditure function using the 1970 data for all five service categories are presented in Tables 4.3 and 4.4. Examination of theses results shows that the income elasticity is positive for education, transportation, public safety, and social services. The estimates, which range from .052 for education to .519 for public safety, are not significantly different from zero at the 95% confidence level. A negative and significant relationship between income and state environmental expenditures means the median voter perceives environmental services as an inferior good at the state level using the 1970 data. The unique nature of environmental services and uncertainty surrounding environmental expenditures may explain this negative relationship. Further examination of these tables indicate a positive and significant relationship between intergovernmental aid and expenditures in all the spending categories except public safety.

The estimates in Table 4.3 and 4.4 demonstrate that the median voter consistently underestimates the level of aid in regards to the specific service expenditures. The estimates of aid perception (θ) are all less than one and are also significantly different from zero for all five spending categories. The hypothesis that the median voter has perfect information ($\theta=1$) is tested using a likelihood ratio test and is rejected at the 95% confidence level for all the categories except education. The critical values from the hypothesis tests are reported in Tables 4.3 and 4.4. The estimates from the restricted estimation are reported

Table 4.3
Log-Linear Model Specification
Specific State Services
1970

	Education	Transportation	Public Safety
Constant (A0)	-.475 2.815	7.494* 2.947	-7.800* 2.813
Income (A1)	0.052 0.309	0.519 0.332	0.516 0.294
Population (A2)	.450* 0.169	-.054 0.162	.666* 0.16
Price Elasticity (A3)	-.388* 0.192	-.902* 0.185	-.214 0.181
Aid (A4)	.324* 0.168	.656* 0.168	0.047 0.157
Aid Perception (Theta)	.730* 0.246	.397* 0.133	.322* 0.040
South	-.076 0.086	0.032 0.092	.199* 0.099
West	-.105 0.102	-.036 0.096	.188* 0.087
North	-.240* 0.092	0.088 0.107	-.159 0.085
F-Statistic Ho: Theta = 1	0.24	20.04	12.16
SSE	1.65	1.90	1.44
Log Likelihood Value	13.14	9.39	16.05

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table 4.4
Log-Linear Model Specification
Specific State Services
1980

	Social Services	Environmental
Constant (A0)	0.987 3.550	10.471* 2.788
Income (A1)	0.442 0.396	-1.048* 0.311
Population (A2)	-.085 0.197	0.116 0.148
Price Elasticity (A3)	-1.132 0.221	-.791* 0.168
Aid (A4)	.860* 0.204	.584* 0.152
Aid Perception Theta	.594* 0.302	.444* 0.105
South	0.061 0.115	0.189 0.101
West	-.057 0.129	.391* 0.049
North	0.225 0.117	0.123 0.095
F-Statistic Ho: Theta = 1	19.70	16.47
SSE	2.75	1.55
Log Likelihood Value	0.49	14.21

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

in Appendix Three. The underestimation of the level of aid by the median voter leads to an underestimation of the price of these services. These results provide strong evidence the median voter is confronted with fiscal illusion in regards to state level specific service expenditures using the 1970 sample.

Evidence that intergovernmental aid is more stimulative than income implies that the output effect stems from the voter's misperception about aid receipts. Multiplying the income-aid share ratio by the aid elasticity and comparing it to the income elasticity reveals the direction of the flypaper effect. For all five categories, a positive flypaper effect is observed, which is consistent with the determination that the median voter underestimates the marginal tax price of state services.

Estimates of the log-linear specific service functions using the 1980 state data are presented in Table 4.5 and Table 4.6. These results show an unstable relationship between the median voter's income and categorical expenditures. The income elasticity estimate for public safety of .456 is the only spending category exhibiting a positive and significant relationship between income and expenditures. Estimation of the model using transportation and environmental expenditures yields a negative and significant relationship between the voter's income and expenditures. The income elasticities for education and social services are negative, but not significantly different from zero. The inability of the median voter to control specific spending decisions at the state level, due to the increased distance from the decision making process itself, may lead to these inconsistent income effects observed in the service category estimates. An alternative explanation could lie in the weakness of the median voter model in explaining the fiscal process at the state level. Either way, these

Table 4.5
Log-Linear Model Specification
Specific State Services
1980

	Education	Transportation	Public Safety
Constant (A0)	-1.296 2.962	4.1 3.663	-8.481* 3.010
Income (A1)	-.050 0.176	-.201* 0.384	.456* 211
Population (A2)	.601* 0.151	0.114 0.187	.887* 0.158
Price Elasticity (A3)	-.252 0.171	-.649* 0.205	0.04 0.173
Aid (A4)	.336* 0.169	.520* 0.199	-.070 0.043
Aid Perception (Theta)	.645* 0.009	.723* 0.329	.595* 0.160
South	0.073 0.075	.256* 0.109	.491* 0.086
West	0.017 0.08	0.021 0.105	.370* 0.083
North	-.253* 0.088	-.056 0.115	.257* 0.089
F-Statistic Ho: Theta = 1	8.10	10.88	0.89
SSE	1.04	2.87	1.74
Log Likelihood Value	17.19	-0.06	11.45

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table 4.6
Log-Linear Model Specification
Specific State Services
1980

	Social Services	Environmental
Constant (A0)	-1.199	11.417*
	2.753	3.578
Income (A1)	-.063	-.961*
	0.29	0.379
Population (A2)	.462*	-.135
	0.150	0.184
Price Elasticity (A3)	-.548*	-.918*
	0.164	0.218
Aid (A4)	.514*	.819*
	0.155	0.212
Aid Perception	.441*	.865*
Theta	0.067	0.202
South	-.0003	-.023
	0.079	0.109
West	-.248*	0.057
	0.078	0.113
North	0.161	-.142
	0.086	0.119
F-Statistic Ho: Theta = 1	1.68	6.78
SSE	1.45	2.44
Log Likelihood Value	15.83	1.75

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

inconsistent income effects do not affect the search for evidence of fiscal illusion as the source of the flypaper effect.

Tables 4.5 and 4.6 show a positive and significant relationship between intergovernmental aid and education, transportation, social service, and environmental expenditures. A negative but insignificant relationship is reported for public safety expenditures. Analysis of the aid perception parameter (θ) allows us to assess the degree of grant and income illusion at the state level concerning state specific services. The estimates of aid perception, which range from .441 for social services to .865 for environmental, are significantly different from zero at the 95% confidence level. The hypothesis that the median voter has perfect information (θ=1) is tested using a likelihood ratio test and is rejected at the 95% confidence level for environmental, education, and transportation. The hypothesis that the median voter has perfect information cannot be rejected at the 95% confidence level for public safety and social services. The critical values from the hypothesis tests are reported in Table 4.5 and Table 4.6. The estimates from the restricted estimations are reported in Appendix Three. The estimates show that the median voter consistently underestimates the level of aid received with respect to environmental, education, and transportation expenditures. This underestimation of aid causes the median voter to underestimate the true marginal tax price of the services and will lead to an expansion in output.

Further, a positive flypaper effect is observed in four of the five service categories: education, transportation, social services, and environmental which is consistent with the misperception of aid receipts. The direction of the flypaper effect for public safety is

negative, which would be consistent with an overestimation in the price of public safety by the median voter. However, we cannot attribute this overestimation of the tax price to an overestimation of taxes paid for these goods because the hypothesis that the median voter has perfect information concerning aid receipts cannot be rejected at the 95% confidence level with an F-statistic of .89. The negative flypaper effect, which represents an overestimation of the tax price, may stem from the increased tax price risk or consumption risk associated with public safety expenditures (Turnbull 1993,1995).

A summary of the empirical results concerning fiscal illusion using the 1970 and 1980 state data is presented in Table 4.7. A positive flypaper effect is observed for general and specific services in 1970 which shows that intergovernmental aid is more stimulative than income on the level of expenditures. This underestimation implies the median voter has underestimated the true marginal tax price. The source of this price distortion stems from the inability of the median voter to perceive the full level of intergovernmental aid received as demonstrated by the results in column three of Table 4.7. The results using the 1980 sample also provide evidence of fiscal illusion, however the results are not as robust when compared with the 1970 sample. The positive flypaper effect can be attributed to fiscal illusion for education, transportation, and environmental services. The positive flypaper effect for 1980 general expenditures and social service expenditures cannot conclusively be attributed to the consistent underestimation of the level of aid. Also, the negative flypaper effect for public safety cannot be attributed to fiscal illusion stemming from the overestimation of the level of intergovernmental aid.

Table 4.7
Fiscal Illusion Summary
State Level

1970	Direction of Flypaper Effect	Perception of Intergovernmental Aid
General Expenditures	Positive	Underestimation
Education	Positive	Perfect
Public Safety	Positive	Underestimation
Transportation	Positive	Underestimation
Environmental	Positive	Underestimation
Social Services	Positive	Underestimation

1980	Direction of Flypaper Effect	Perception of Intergovernmental Aid
General Expenditures	Positive	Perfect
Education	Positive	Underestimation
Public Safety	Negative	Perfect
Transportation	Positive	Underestimation
Environmental	Positive	Underestimation
Social Services	Positive	Perfect

These empirical results demonstrate that the median voter suffers from fiscal illusion at the state level and are consistent with the results found using county data. The notion of complete income illusion is rejected in favor of the notion of partial grant illusion. We find that the median model explains general expenditure patterns better than specific spending patterns at the state level. This result is consistent with the conclusion by Turnbull and Djoundourian (1994) that the aggregated municipal expenditures correspond better to the median voter hypothesis than any of the single spending categories.

4.4 Fiscal Illusion Effects Across Levels of Government

Comparison of the size and significance of the key parameter estimates allows us to assess how fiscal illusion varies across levels of government for the provision of general services and specific services. Table 4.8 compares the estimates of the spending equations for county and state general expenditures in 1970 and 1980. It shows that the median voter suffers from fiscal illusion stemming from the underestimation of the level of intergovernmental aid at the county and state level. We find the income elasticity to be significant only at the county level in 1970 and 1980. The elasticity estimates at the state level are positive but not significantly different from zero at the 95% confidence level. The relationship between intergovernmental aid and the level of general expenditures at the state and county level is positive and significant in both the 1970 and 1980 samples. This table also shows the aid estimates to be stable across the levels of government and across time.

The aid perception parameter (θ) indicates that the median voter underestimates the level of aid received for general expenditures at both the state and county levels for 1970 and 1980. The median voter perceives less of the intergovernmental aid at the county level

Table 4.8
Fiscal Illusion Effects
Across Level of Government
General Expenditure Results

1970	State	County
Income (A1)	0.18 0.155	.238* 0.043
Population (A2)	.247* 0.076	.307* 0.031
Price Elasticity (A3)	-.638* 0.086	-.728* 0.034
Aid (A4)	.570* 0.077	.536* 0.024
Aid Perception Theta	.779* 0.173	.643* 0.012
Flypaper effect	Positive	Positive

1980	State	County
Income (A1)	0.218 0.152	.303* 0.053
Population (A2)	405* 0.074	.187* 0.027
Price Elasticity (A3)	-.473* 0.082	-.831* 0.027
Aid (A4)	.466* 0.077	.589* 0.02
Aid Perception Theta	.426* 0.215	.646* 0.05
Flypaper effect	Positive	Positive

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

(64%) than at the state level (78%) in 1970. Interestingly, the 1980 sample yields the opposite result, with the median voter perceiving 65% of the aid at the county level and only 42% at the state level. We cannot, however, reject the hypothesis that $\theta=1$ using the 1980 state level data. Further examination of Table 4.8 reveals that intergovernmental aid is more stimulative than income on the level of general expenditures at the county and state levels for 1970 and 1980. The positive flypaper effect observed in both levels of government and in both samples is consistent with $\theta < 1$, but these results do not exhibit a consistent pattern of changes in the estimates from the county to the state level.

Comparisons of the state and county estimates for the five services categories using the 1970 and 1980 samples are presented in Table 4.9. The 1970 results show that the median voter consistently underestimates the level of aid received at both the state and county level. The aid perception estimates are all significantly different from zero at the 95% confidence level and are all less than one. This table also shows that the median voter perceives less intergovernmental aid at the state level than at the county level in all the service categories except education. This result is consistent with the hypothesis that the further the median voter is from the decisions concerning expenditures, the more imperfect the information. We also observe a positive flypaper effect at the state and county levels in 1970. The reason that aid is more stimulative than income is explained by the consistent underestimation of the level of intergovernmental aid.

The 1980 results yield a different pattern concerning the perception of intergovernmental aid by the median voter. These results show the perception of intergovernmental aid by the median voter to be very stable across levels of government in

Table 4.9
Comparison of Fiscal Illusion Effects
Across Level of Government

Service Category Resutls

	Aid Percption		Flypaper Effect	
1970	*State*	*County*	*State*	*County*
Education	.730*	.602*	Positive	Positive
Transportation	.397*	.774*	Positive	Positive
Public Safety	.322*	.788*	Positive	Positive
Social Services	.594*	.996*	Positive	Positive
Environmental	.444*	.833*	Positive	Positive

1980	*State*	*County*	*State*	*County*
Education	.645*	.646*	Positive	Positive
Transportation	.723*	.764*	Positive	Positive
Public Safety	.595*	.794*	Negative	Positive
Social Services	.441*	.447*	Positive	Positive
Environmental	.865*	.872*	Positive	Positive

all the services categories except public safety. For public safety, the median voter perceives less of the aid at the state level (60%) than at the county level (79%); a result consistent with the 1970 results. We also observe aid to be more stimulative than income on the level of specific services at the county and state level, with the exception of state level public safety expenditures. Unlike the results using the 1970 sample, we do find some uniformity between the state and county estimates using the 1980 sample.

Chapter Five

Fiscal Complexity and Fiscal Illusion

This chapter focuses on the issue of fiscal complexity as a possible source of fiscal illusion. We assume that voter imperfect information arises from the complicated structures of the government fiscal decision-making process [Wagner (1976), Winer (1983), Logan (1986), Oates(1979)]. To test this hypothesis, we employ Goldfeld and Quandt's (1973) switching regression technique to partition the sample by degree of fiscal complexity and then compare the size and significance of the fiscal illusion parameter estimates for both county and state general and specific service expenditures. Using two measures of fiscal complexity, we find strong evidence that the source of the fiscal illusion which stems from intergovernmental aid misperceptions by the median voter is positively related to the degree of budgetary complexity.

5.1 Fiscal Complexity as a Source of Fiscal Illusion

Wagner (1976) provides a conceptual and empirical exploration of one aspect of the theory of fiscal illusion. Fiscal illusion arises because the institutional manner in which citizens are required to pay for government can affect taxpayer perceptions of the price of government, thereby affecting the size of the public sector. Wagner (1976) focuses on how the differing degrees of complexity in the revenue structure affects the stock of taxpayer knowledge concerning tax prices of public goods.

According to Wagner, there are three reasons why fiscal illusion has not played a significant role in the agenda of fiscal analysis. First, fiscal analysis had been predominantly normative and only when the analysis becomes positive does fiscal illusion becomes pertinent. Second, fiscal illusion had been widely interpreted as implying irrational individual behavior. Finally, fiscal illusion had been largely devoid of empirical content.

The conceptual analysis about how consumers form a perception of tax price is a Kantian analysis in which perception entails the formation of a hypothesis about price. To form a hypothesis about the price of public output, a person must take primary sense data and create a pattern of interpretation. Thus, the ability of fiscal institutions to create fiscal illusion depends on the ability of these institutions to influence the hypothesis a person forms about the cost of government. The question is whether a particular revenue structure can affect this perception. A tax system is characterized as containing different Fiscal Extraction Devices (FEDs), and different tax structures can be conceptualized as differences in the placement of FEDs. Wagstaff (1965) has presented evidence that changes in the placement and operation of the FEDs can influence the hypothesis that a taxpayer will reach regarding price.

With only a single based revenue structure, the primary sense data is more easily attained by the consumers for it is concentrated. But in a complex fiscal structure, FEDs are numerous and accurate perceptions regarding price become more difficult. With a more complex revenue structure, there is increased temporal and spatial variation of the FEDs. Also, some FEDs may become less obtrusive. With this increased complexity of revenue structure, it becomes more costly for the taxpayer to inquire about the nature in which the

FEDs make their extractions. Thus, the accuracy of a persons perception of the cost of government will vary inversely with the complexity of the revenue structure.

The budgetary consequences will depend on the change in the hypothesis formed regarding the price of the public output. If the increased complexity causes the shift in the direction of higher costs of government, then lower budgets would result. If the hypothesis is toward lower costs of government, then larger budgets would result. Wagner asserts that the high cost of incorporating sense data from a more complex revenue structure is increased by the lessened importance of accurate perceptions in ***collective*** choice. In sum, the value to a citizen of forming an accurate hypothesis is less in collective choice than in market choice. Thus an increased complexity in government revenue structure is likely to diminish a citizens hypothesized cost of government resulting in increased budgetary size.

Wagner tests whether or not the simplicity of revenue structure will lead to decreased public expenditure using a model for public expenditure for the 50 largest American cities. The estimated linear equation uses current expenditures as the dependent variable with, income, intergovernmental revenue, percent of population below the poverty line, average wages, city population as a percent of SMSA population, population density, and simplicity of revenue structure as the independent variables. Wagner (1976) measures the simplicity of the revenue structure with a Herfindahl index of tax sources. He finds that increased simplicity or concentration in revenue structure is associated with a reduced level of public expenditure.

Wagner offers several interpretations of the empirical results. It might be the case that the larger the level of public expenditure, the more fragmented must revenue structures

become in order to minimize the excess burden of collection the given revenue. In order to use this implication, though, some assumptions about the actions of the public officials must be made. In this paper, no such examination is undertaken, rather the revenue structure is taken as given and the consequences are then examined. Munley and Greene (1978) re-examine the empirical tests employed by Wagner (1976) and introduce the concept of the degree of publicness in local public services into the model. Munley and Greene argue that Wagner's *ad hoc* model could have possibly left out some relevant independent variables from the estimating equation, resulting in biased estimates of coefficients and standard errors.

Munley and Greene (1978) also argue that omitting population as an independent variable in an equation explaining gross rather than per-capita expenditures constitutes a specification error. They re-examine Wagner's, taking into account the effects of population on the level of public expenditures, which they find to be negative and significant. What is particularly interesting is that, with the inclusion of population, they also find that the coefficient for revenue structure simplicity is no longer significant, although is does retain its negative sign.

Munley and Greene (1978) conclude that Wagner's fiscal illusion results may not be as strong as earlier thought, and that further empirical investigation should take aim to correctly specify the expenditure equation. However, Munley and Greene too merely add terms to the expenditure equation without trying to figure out how to structurally model the effects of revenue structure on the demand for public goods (Gramlich and Rubinfeld,

1982). These studies do not address the question of if the complexity of the revenue structure enters the taxpayer's utility function or the budget constraint.

In the body of his paper, Wagner (1976) takes the revenue structure as given, but in the conclusion, he does address the question of why revenue structures are the way they are. Differences in the revenue structure may be based on the actions of the public officials. The budget maximization hypothesis implies that public officials are self-interested, implying that increased fiscal illusion by the government will increase their utilities. The burden minimization hypothesis implies that public officials are benevolent, thus implying a more concentrated revenue structure.

Winer (1983) and Wagner (1976) suggest that fiscal illusion by the voter stems from the imperfect information that arises from public sector fiscal complexity which arises from the separation of taxing and spending functions. In contrast, Logan (1986) argues that the source of this illusion arises from the distribution of aid from the higher levels of government.

Turnbull (1992, 1993, 1996) states that the typical approach to modeling fiscal illusion is that the imperfect information is modeled as a non-stochastic wedge between average and marginal tax prices. Such a method of modeling imperfect information in a certainty framework implies a violation of the rationality implied by the utility maximization (Logan 1986). Turnbull (1992, 1993, 1996) uses the theory of demand under uncertainty to model imperfect information, thus no longer violating the rationality assumption. Within this framework, fiscal illusion represents the level of uncertainty facing the voters; different degrees of fiscal illusion can be thought of as differences in not only the mean but the

variances of the perceived distribution of possible outcomes. Also, he finds that the ability of the bureaucrats and politicians to exploit the imperfect information is limited by the offsetting risk effects of fiscal illusion on voter demand.

An important outcome of this line of literature is the creation of a measure of fiscal complexity, the tax concentration and the expenditure concentration term. The tax concentration measurement is used by Wagner (1976) as a measure of the complexity of the revenue side of the budget. The expenditure concentration measurement is used by Turnbull (1993) and Turnbull and Djoundourian (1994) to capture the complexity on the spending side of the budget. The contribution of these works is the ability to examine two types of fiscal complexity which may influence voter perceptions. This implies that the taxpayer-voter is not only unsure about how much he is paying, but what he is receiving as well (Turnbull 1996). These concentration terms also provide another way of empirically testing the hypothesis that fiscal illusion is a function of budget complexity.

5.2 Measuring Fiscal Complexity

Governments raising revenues from one source with expenditures primarily on one category of services exhibits the simplest fiscal structure. These governments more closely resemble the 'single-tax-single service' model. In these governments we expect voters to obtain information regarding marginal tax prices with less uncertainty. Governments with more sources of revenues and a wider array of services exhibit a more complex fiscal structure. In this environment, we expect voters to have a more difficult time obtaining more perfect information concerning marginal tax prices.

Budgetary or fiscal complexity is measured using two indexes, TAXCON and EXPCON, which are defined as Herfindahl indexes reflecting the concentration of own revenues raised by the government and the concentration of general expenditures as allocated to different service categories in the budget. The definitions of these indexes for county governments is:

$$(5.1)\quad TAXCON = \left(\frac{Property\ Tax}{Own\ Revenues}\right)^2 + \left(\frac{Other\ Tax}{Own\ Revenues}\right)^2 + \left(\frac{Charges}{Own\ Revenues}\right)^2$$

$$(5.2)\quad EXPCON = \left(\frac{Education\ Expenditure}{General\ Expenditures}\right)^2 + \left(\frac{Transportation\ Expenditure}{General\ Expenditures}\right)^2 + \left(\frac{Public\ Safety\ Expenditure}{General\ Expenditures}\right) \left(\frac{Social\ Service\ Expenditure}{General\ Expenditures}\right)^2 + \left(\frac{Environmental\ Expenditure}{General\ Expenditures}\right)^2$$

The definition of EXPCON (5.2) is the same definition used in the state government analysis. The TAXCON term for state governments varies slightly from (5.1) and is defined as

$$(5.3)\quad TAXCON = \left(\frac{Property\ Tax}{Own\ Revenues}\right)^2 + \left(\frac{General\ Sales\ Tax}{Own\ Revenues}\right)^2 + \left(\frac{Selective\ Sales\ Tax}{Own\ Revenues}\right)^2 + \left(\frac{Income\ +\ Other\ Tax}{Own\ Revenues}\right)^2$$

If fiscal illusion arises from voter uncertainty and voter uncertainty rises with government budgetary complexity, then the degree of fiscal illusion declines with greater TAXCON and EXPCON values.

In order to test the hypothesis that fiscal illusion is a function of fiscal complexity, the samples are sorted by TAXCON and EXPCON index values. Goldfeld and Quandt's (1973) switching regression technique is employed to find the optimal partition of the low and high TAXCON and EXPCON sub-samples. This technique allows us to examine if the key parameter estimates vary across the 'simple' (high) and 'complex' (low) budgetary regimes. We then estimate the appropriate state and county expenditure functions for each of the sub-samples, using the size and significance of the aid perception parameters across the sub-samples to analyze how fiscal complexity affects these key estimates.

5.3 County General Expenditure Results

The non-linear least squares estimates of (3.26) for the partitioned samples using 1970 county general expenditures are presented in Table 5.1. The estimates for the simple and complex sub-samples using the tax complexity measure appear in the first two columns and the estimates for the simple and complex sub-samples using the expenditure complexity measure are presented in the last two columns of the table. In both dimensions of fiscal complexity, there is an optimal partition between the simple and complex regimes. The sample partitions and the corresponding F-statistic for the structural change between the two regimes are reported in the last row of the table. The switching regression results find the aid perceived by the median voter to be significantly influenced by the complexity of the budgetary process.

Table 5.1
Fiscal Complexity Results
County General Expenditures
1970

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	-3.912*	-.274		-4.694*	-.678
	0.526	0.581		0.662	0.387
Income (A2)	.546*	0.086		.634*	.093*
	0.067	0.054		0.085	0.044
Population (A3)	.217*	.308*		.214*	.334*
	0.034	0.08		0.056	0.037
Price Elasticity (A3)	-.788*	-.741*		-.766*	-.721*
	0.036	0.089		0.06	0.042
Aid (A4)	.596*	.533*		.599*	.504*
	0.026	0.062		0.044	0.027
Aid Perception	.889*	.793*		.762*	.297*
	0.103	0.090		0.219	0.055
SSE	5.524	2.532		4.568	3.371
Log-likelihood Value	187.657	62.286		107.944	150.956
Ho: Theta = 1 Chi-Square Statistic	1.148	5.178		1.174	160.440
Partition	125,437	1,125		224,437	1,223
F-statistic	38.709			50.624	

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table 5.1 shows that the degree of fiscal complexity has little influence on the relationship between intergovernmental aid and the level of county general expenditures in 1970. The aid elasticity (A4) in the simple and complex tax and spending samples are positive and significantly different from zero. These estimates are stable across all the samples and range from .504 to .599. Further examination of this table reveals that the price elasticity estimates do not vary much with the degree of fiscal complexity. These estimates are significant and stable across the different samples with estimates ranging from -.721 to -.788. However, the relationship between the median voter's income and the level of county general expenditures does seem to be affected by the complexity of the budget; note the unstable estimates between the simple and complex samples. In the simple tax and simple spending samples, the estimates of the income elasticity are positive and significant and conform to values usually reported in the local public spending literature. In the complex tax sample the income elasticity of .086 is not significantly different from zero at the 95% confidence level. In the complex spending sample the income elasticity estimate is .093 but is significantly different from zero at the 95% confidence level.

Analysis of the aid perception parameter allows us to assess how the complexity of the budget affects the median voter's perception of the marginal tax price of county general expenditures. The aid perception by the median voter in the simple tax sample is .88, which is significantly different from zero at the 95% confidence level. However, the hypothesis that the median voter has perfect aid information ($\theta = 1$) cannot be rejected at the 95% confidence level with a chi-square statistic of 1.148. In contrast, under the complex tax structure the aid perception is .779. This estimate is significantly different from zero at the

95% confidence level and the hypothesis that $\theta = 1$ is rejected at the 95% confidence level with a chi-square statistic of 5.178. This indicates an underestimation of the true marginal tax price of county general expenditures in 1970 caused by an underestimation of the level of aid received. These results demonstrate that fiscal illusion is absent at lower levels of budgetary complexity, but arises at the higher level of budgetary complexity, as measured by the concentration of taxes.

The parameter estimates from the simple and complex spending samples also support the theory of budgetary complexity as a source of fiscal illusion. The aid perception parameter in the simple spending sample shows that the estimate of .762 is significantly different from zero but not significantly different from one at the 95% confidence level. The aid perception parameter estimate is .297 in the complex spending sample. This estimate is significantly different from zero and the hypothesis that $\theta = 1$ is rejected at the 95% confidence level with a chi-square statistic of 160.4. We observe a very strong underestimation of the level of aid (29%) in the complex spending sample and find no significant evidence of underestimation in the simple spending sample. Thus we conclude that fiscal complexity, measured by tax or spending complexity, is the source of fiscal illusion stemming from the underestimation of aid receipts by the median voter.

The non-linear least squares estimates of (3.26) for the partitioned samples using 1980 county general expenditures are presented in Table 5.2. An optimal partition between the simple and complex regimes is found in both dimensions of fiscal complexity. The sample partitions and the corresponding F-statistics testing for the structural change between the two regimes are reported in the last row of Table 5.2. The switching regression

Table 5.2
Fiscal Complexity Results
County General Expenditures
1980

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	-.550	-1.204		-1.824*	-1.929*
	0.658	0.626		0.664	0.546
Income (A2)	.197*	.307*		.412*	.294*
	0.083	0.072		0.078	0.066
Population (A3)	.213*	.165*		0.035	.305*
	0.047	0.032		0.043	0.035
Price Elasticity (A3)	-.829*	-.840*		-.994*	-.694*
	0.047	0.031		0.043	0.035
Aid (A4)	.577*	.584*		.725*	.497*
	0.035	0.026		0.033	0.027
Aid Perception	.983*	.655*		.782*	.634*
	0.088	0.095		0.13	0.103
SSE	2.251	4.001		2.155	3.982
Log-likelihood Value	98.574	209.561		116.325	195.68
Ho: Theta = 1 Chi-Square Statistic	0.033	13.001		2.806	12.384
Partition F-statistic	291, 437 37.589	1, 290		279, 437 45.329	1, 278

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

results find the aid perceived by the median voter to be significantly influenced by the complexity of the budgetary process.

Table 5.2 shows that the degree of tax complexity has little influence on the relationship between intergovernmental aid and the level of county general expenditures in 1980. The aid elasticity (A4) in the simple and complex tax and spending samples are positive and significantly different from zero. These estimates are stable across both samples and are similar to those found using the 1970 sample. The aid elasticity in the simple and complex spending samples do not exhibit the stability seen in the tax complexity samples. The aid elasticity estimates are positive and significant, but we find the relationship between intergovernmental aid and county general expenditures to be stronger in the simple spending sample. This table also reveals that the price elasticity estimates do no vary with the degree of fiscal complexity. The relationship between the median voter's income and the level of county general expenditures in 1980 does not seem to be affected by the complexity of the budget, given the more stable estimates between the simple and complex samples. In the simple tax and simple spending samples, the estimates of the income elasticity are slightly higher than in the complex tax and spending samples.

Analysis of the aid perception parameter allows us to assess how the complexity of the budget affects the median voter's perception of the marginal tax price of county general services. In the simple tax sample we find the aid perception by the median voter is .983, which is significantly different from zero at the 95% confidence level. However, the hypothesis that the median voter has perfect aid information ($\theta = 1$) cannot be rejected at the 95% confidence level with a chi-square statistic of .033. Under the complex tax structure

the aid perception is .655. This estimate is significantly different from zero at the 95% confidence level and the hypothesis that $\theta = 1$ is rejected at the 95% confidence level with a chi-square statistic of 13.001. This indicates there is an underestimation the true marginal tax price of county general expenditures in 1980 caused by an underestimation of the level of aid received. The aid perception parameter in the simple spending sample of .782 is significantly different from zero but not significantly different from one at the 95% confidence level. In the complex spending sample the aid perception parameter estimate is .634. This estimate is significantly different from zero and the hypothesis that $\theta = 1$ is rejected at the 95% confidence level with a chi-square statistic of 12.384.

The 1980 data shows the median voter underestimates the level of aid received in complex tax or spending regimes. This underestimation of aid causes the underestimation of the true marginal tax price of county general services. We find no evidence of fiscal illusion by the median voter in the simple tax or spending regimes. These results are consistent with the theory that the source of the fiscal illusion by the median voter arises from the complexity of the budgetary process.

5.4 County Service Category Results

Table 5.3 provides a summary of the aid perception parameter estimates from the estimation of (3.26) for the partitioned samples using 1970 county specific service category expenditures. A complete set of parameter estimates from the service category estimation is presented in Appendix Four. These results demonstrate a consistent pattern of underestimation of the level of aid by the median voter in complex budgetary regimes and little or no evidence of fiscal illusion in the simple budgetary regimes. In the simple tax

Table 5.3
Aid Perception Estimates
County Service Categories
1970

	Tax Concentration			Expenditure Concentration	
Service Category	Simple	Complex		Simple	Complex
Education	.818*	.609*		.925*	.605*
	0.210	0.112		0.151	0.126
Ho: Theta = 1					
Chi Square Statistic	0.748	11.967		0.24	9.678
Public Safety	.525*	.554*		.611*	.454*
	0.42	0.057		0.116	0.03
Ho: Theta = 1					
Chi Square Statistic	122.214	60.676		11.172	318.199
Transportation	.968*	.608*		.770*	.722*
	0.104	0.131		0.24	0.052
Ho: Theta = 1					
Chi Square Statistic	0.092	8.812		0.911	27.505
Social Services	.934*	.689*		.887*	.628*
	0.097	0.037		0.077	0.045
Ho: Theta = 1					
Chi Square Statistic	0.703	68.446		2.085	67.479
Environmental	.741*	.510*		.881*	.704*
	0.078	0.087		0.16	0.067
Ho: Theta = 1					
Chi Square Statistic	10.751	35.886		0.55	19.949

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

sample we reject the hypothesis that the median voter underestimates the level of aid in three of the service categories; education, transportation and social services. In the complex tax sample, the estimates show the median voter underestimates the level of aid for all five service categories. The estimates are significantly different from zero and are very stable across the categories. The hypothesis that $\theta = 1$ is rejected at the 95% confidence level for all five categories in the complex tax sample.

We do observe fiscal illusion concerning environmental expenditures in the simple tax sample, however, the estimates show the degree of fiscal illusion is greater in the complex tax sample (51% of the aid perceived) than in the simple tax sample (74% of the aid perceived). Public safety is the only spending category which does not demonstrate a higher degree of fiscal illusion in the complex tax sample.

In the simple spending sample we reject the hypothesis that the median voter underestimates the level of aid in all the service categories except public safety. In the complex tax sample, the estimates show the median voter underestimates the level of aid in all five service categories. The hypothesis that $\theta = 1$ is rejected at the 95% confidence level for all five categories in the complex tax sample. The service category results from 1970 confirm the general expenditure conclusions that fiscal illusion arises from the complexity of the budgetary process.

Table 5.4 summarizes the aid perception parameter estimates from the estimation of (3.26) for the partitioned samples using 1980 county specific service category expenditures. The results also provide strong evidence of budgetary complexity as the source of fiscal illusion by the median voter. In the simple tax sample the aid perception

Table 5.4
Aid Perception Estimates
County Service Categories
1980

	Tax Concentration			Expenditure Concentration	
Service Category	Simple	Complex		Simple	Complex
Education	.981*	.277*		.901*	.650*
	0.131	0.093		0.074	0.132
Ho: Theta = 1					
Chi Square Statistic	0.02	97.585		1.753	6.932
Public Safety	.962*	.435*		.950*	.426*
	0.055	0.027		0.074	0.063
Ho: Theta = 1					
Chi Square Statistic	0.451	432.37		0.432	87.755
Transportation	.951*	.621*		.909*	.583*
	0.118	0.06		0.086	0.103
Ho: Theta = 1					
Chi Square Statistic	0.168	38.864		1.098	16.155
Social Services	.700*	.716*		.897*	.625*
	0.061	0.038		0.046	0.055
Ho: Theta = 1					
Chi Square Statistic	23.421	55.083		4.774	46.37
Environmental	.875*	.590*		.754*	.427*
	0.089	0.085		0.142	0.073
Ho: Theta = 1					
Chi-Square Statistic	1.941	22.891		2.966	60.598

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

parameter is not significantly different from one in all categories except social services. This implies that the median voter does not underestimate the level of aid receipts. In the complex tax sample, the estimates of the aid perception are significantly different from zero and from one at the 95% confidence level; the median voter underestimates the level of aid in the complex regime, which leads to the underestimation of the marginal tax price of these services. The conclusions regarding budgetary complexity as the source of the underestimation of aid levels are the same using the expenditure dimension of budgetary complexity. The hypothesis that $\theta = 1$ cannot be rejected for all the service categories in the simple spending sample except social services. In the complex spending sample, the estimates of θ are significantly different from zero and one at the 95% confidence level for all five service categories.

The patterns exhibited by the service category estimates conform with those observed in the general expenditure case for 1970 and 1980. These results provide strong evidence that the source of the intergovernmental aid misperceptions stem from the complexity of the budgetary process at the county level. Using two popular measures of fiscal complexity, we find the median voter consistently underestimates the level of aid in the more complex budgetary regimes, and strong evidence of perfect aid information in the more simple regimes.

5.5 State General Expenditure Results

The nonlinear least squares estimates of (4.1) for the partitioned samples using the 1970 state general expenditures are presented in Table 5.5. An optimal partition between

Table 5.5
Fiscal Complexity Results
State General Expenditures
1970

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	-.543	-.943		0.095	0.098
	1.568	2.361		1.618	1.553
Income (A2)	0.263	0.239		0.067	0.184
	0.172	0.269		0.18	0.174
Population (A3)	0.132	.383*		.303*	0.19
	0.104	0.091		0.099	0.099
Price Elasticity (A3)	-.765*	-.440*		-645*	-.654*
	0.118	0.105		0.118	0.11
Aid (A4)	.660*	.380*		.544*	.604*
	0.100	0.105		0.11	0.102
Aid Perception	1.108*	.632*		.914*	.256*
	0.227	0.19		0.106	0.106
South (A5)	0.051	.263*		.122*	0.137
	0.052	0.071		0.069	0.098
West (A6)	0.07	0.018		0.083	-.059
	0.058	0.065		0.06	0.093
North (A7)	.110*	-.005		.204*	0.042
	0.054	0.06		0.046	0.098
SSE	0.22	0.075		0.107	0.114
Log-likelihood Value	29.614	25.612		38.175	23.233
Ho: Theta = 1 Chi-Square Statistic	0.006	3.727		0.65	48.767
Partition F-statistic	20, 48 17.098	1, 19		21, 48 29.461	1, 20

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

the simple and complex budgetary regime is found for both measures of fiscal complexity. The sample partitions and the corresponding F-statistic testing for structural change is reported in the last row of the table. The estimates in Table 5.5 exhibit a pattern similar to the 1970 county general expenditure results. We find that the level of intergovernmental aid for state general expenditures is significantly influenced by budgetary complexity

The income elasticities in all four samples are positive but not significantly different from zero at the 95% confidence level. The aid elasticity estimates are positive and significant and appear relatively stable across the samples. The price elasticity estimates exhibit the same pattern of stability across the samples, just like in the case of county general expenditures. The aid and price elasticity estimates are slightly lower in the complex tax sample.

Analysis of the aid perception parameter allows us to assess how fiscal complexity affects fiscal illusion. In the simple tax sample, the estimate of the perceived level of aid is 1.108. This estimate is significantly different from zero but the hypothesis that $\theta = 1$ is not rejected at the 95% confidence level with an F-statistic of .006. In the complex tax sample we find that the estimate of .632 for θ is significantly different from zero and one. This indicates the degree of tax complexity influences the flow of perfect information concerning intergovernmental aid to the median voter. Evidence of this relationship is stronger when analyzed from the spending concentration dimension of budgetary complexity. In the simple spending sample the hypothesis that the aid perception estimate of .914 is significantly different from one cannot be rejected at the 95% confidence level. The estimate of .256 in the complex spending sample is significantly different from zero and one. This means that

in complex expenditure regimes, the median voter perceives only 25% of the intergovernmental aid for state general expenditures. The results of the analysis based on the expenditure concentration measure of budgetary complexity for the 1970 state data is almost identical to those reported in the 1970 county sample. This evidence supports the notion that fiscal complexity is the source of fiscal illusion.

Table 5.6 presents the estimates of (4.1) for the partitioned samples using 1980 state general expenditures. The optimal sample partitions and the corresponding F-statistics are reported on the last row of the table. The switching regression results indicate the median voter's perception of intergovernmental aid is highly influenced by the complexity of the budget. The estimates reveal the median voter is totally unaware of aid receipts concerning state general expenditures.

Table 5.6 shows that the degree of tax complexity severely influences the income elasticity estimates. The income elasticity is negative and significant (-1.062) in the simple tax sample and positive (.274) and not significantly different from zero in the complex tax sample. The significant income elasticity estimate of .535 in the simple spending sample is more consistent with previously reported income elasticities using state data. The price elasticity estimates in the 1980 sample are lower than the estimates using the 1970 state sample. The price elasticity in the simple tax sample does not conform with previously reported estimates and implies that state general expenditures are price elastic. This same unusual pattern is seen in the aid elasticity estimates. In the simple tax sample, the aid elasticity estimate of 1.177 is significantly different than zero and does not conform with the estimates reported in the other samples. This unusual pattern of instability in the estimates

Table 5.6
Fiscal Complexity Results
State General Expenditures
1980

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	15.094*	-2.236		-4.185*	2.583
	4.778	1.419		1.579	2.408
Income (A2)	-1.062*	0.274		.535*	-.259
	0.426	0.151		0.17	0.244
Population (A3)	-.394	.435*		.440*	.462*
	0.284	0.069		0.069	0.124
Price Elasticity (A3)	-1.342*	-.439*		-.432*	-.443*
	0.298	0.083		0.072	0.132
Aid (A4)	1.177*	.438*		.420*	.464*
	0.271	0.079		0.069	0.122
Aid Perception	.939*	0.445		.970*	0.697
	0.24	0.305		0.248	0.51
South (A5)	0.096	0.122*		.178*	0.181
	0.1	0.043		0.04	0.094
West (A6)	-.176	.117*		-.046	-.051
	0.105	0.045		0.034	0.093
North (A7)	-.167	0.071		.146*	-.034
	.108	0.046		0.036	0.107
SSE	0.003	0.253		0.11	0.156
Log-likelihood Value	13.473	41.24		43.429	15.717
Ho: Theta = 1 Chi-Square Statistic	0.063	3.926		0.013	0.351
Partition F-statistic	39, 48 20.672	1, 38		18, 48 29.494	1, 17

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

leads us to question the reliability of the results from the tax complexity dimension of this analysis. However, there is little evidence suggesting the results from the expenditure dimension of this analysis are unreliable.

Analysis of the aid perception estimates indicate the median voter is confronted with complete fiscal illusion at the state level. The estimate for θ of .939 in the simple tax sample is not significantly different from zero and the hypothesis of perfect aid information cannot be rejected at the 95% confidence level. In the complex tax sample the θ estimate of .445 is significantly different from one, but we cannot reject the hypothesis that θ is significantly different from zero. The same results are observed in the expenditure dimension of this analysis. In the simple spending sample the estimate for θ of .970 is significantly different from zero but not significantly different than one at the 95% confidence level. In the complex spending sample we find the estimate of .697 is not significantly different than one and not significantly different from zero at the 95% confidence level. Although these results are not as stable as the 1970 results, they do suggest an increase in fiscal illusion. This result supports the hypothesis that the further the median voter is from the decision-making process, the more imperfect the voter's budgetary information.

The empirical results from the 1970 and 1980 state general expenditure samples provide strong evidence the median voter suffers from fiscal illusion. The source of the illusion stems from imperfect information about aid receipts. We find evidence that the source of the imperfect information stems from the complexity of the budgetary process. Using two measures of fiscal complexity, we find the median voter does not suffer from fiscal illusion in simple budgetary regimes, and find strong evidence of aid misperceptions

in complex regimes. These results support the findings of the county general expenditure analysis regarding the relationship between fiscal complexity and fiscal illusion.

5.6 State Service Category Results

A summary of the aid perception parameter estimates for the 1970 and 1980 specific state service functions is presented in Tables 5.7 and 5.8, respectively. The remainder of the parameter estimates from the estimation of (4.1) for the state service categories are presented in Appendix Four. These estimates are consistent with the conclusions drawn from the general expenditure results and show that the source of the aid misperceptions which lead to tax price misperceptions by the median voter stem from the complexity of the budgetary process. Using both measures of fiscal complexity, we find the median voter underestimates the level of aid in complex regimes and cannot reject the hypothesis of perfect aid information in the simple regimes.

In the simple tax sample in Table 5.7, we reject the hypothesis that the median voter underestimates the level of intergovernmental aid for all five service categories. In the complex tax sample, the hypothesis that $\theta=1$ cannot be rejected at the 95% confidence level in any of the five spending categories. The estimates of the perceived aid levels are significantly different from zero and are all less than one in the complex tax sample. This implies the median voter underestimates the level of intergovernmental aid. These results show the source of the fiscal illusion lies in the complexity of the budgetary process.

We observe this same pattern using the alternative definition of budgetary complexity. In the simple spending sample of Table 5.7, we cannot reject the hypothesis of perfect aid information in all the spending categories except public safety. In the complex

Table 5.7
Aid Perception Estimates
State Service Categories
1970

	Tax Concentration			Expenditure Concentration	
Service Category	Simple	Complex		Simple	Complex
Education	.679*	.521*		.845*	.415*
	0.243	0.124		0.175	0.136
Ho: Theta = 1					
Chi Square Statistic	1.723	14.722		0.774	18.275
Public Safety	.835*	.354*		.476*	.741*
	0.102	0.119		0.036	0.249
Ho: Theta = 1					
Chi Square Statistic	2.591	29.039		209.121	1.065
Transportation	.946*	.525*		1.005*	0.304
	0.397	0.132		0.21	0.107
Ho: Theta = 1					
Chi Square Statistic	0.018	12.765		0.0007	41.685
Social Services	.992*	.437*		.728*	.329*
	0.259	0.193		0.135	0.152
Ho: Theta = 1					
Chi Square Statistic	0.0007	8.486		2.969	19.298
Environmental	1.010*	.470*		.866*	.517*
	0.236	0.167		0.14	0.127
Ho: Theta = 1					
Chi Square Statistic	0.001	10.024		0.907	14.403

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table 5.8
Aid Perception Estimates
State Service Categories
1980

	Tax Concentration			Expenditure Concentration	
Service Category	Simple	Complex		Simple	Complex
Education	.892*	.541*		.485*	.450*
	0.311	0.171		0.297	0.16
Ho: Theta = 1					
Chi Square Statistic	0.043	7.115		2.98	11.749
Public Safety	.743*	.576*		1.115*	.633*
	0.202	0.208		0.164	0.227
Ho: Theta = 1					
Chi Square Statistic	1.603	4.12		0.888	2.588
Transportation	.946*	.518*		.814*	.194*
	0.344	0.232		0.287	0.053
Ho: Theta = 1					
Chi Square Statistic	0.024	4.299		0.418	226.071
Social Services	.904*	.608*		.805*	.343*
	0.279	0.127		0.171	0.113
Ho: Theta = 1					
Chi Square Statistic	0.116	9.334		1.291	33.353
Environmental	.870*	.673*		.506*	.905*
	0.215	0.181		0.199	0.447
Ho: Theta = 1					
Chi Square Statistic	0.362	3.232		6.122	0.044

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

spending sample, all the aid perception estimates are significantly different from zero and less than one. Additionally, we reject the hypothesis of perfect aid information for all categories except public safety. The unusual result observed for public safety however does not diminish the strong evidence of fiscal complexity as a source of fiscal illusion. The stability of the aid perception estimates in both complex samples provides strong evidence of the underestimation of aid by the median voter.

The aid perception estimates of the 1980 state service categories in Table 5.8 also support the positive relationship between the degree of fiscal complexity and the presence of fiscal illusion. The estimates of θ in the simple tax sample are significantly different from zero but not significantly different from one at the 95% confidence level which implies no fiscal illusion. In the complex tax sample, the median voter consistently underestimates the level of intergovernmental aid. These stable estimates are very similar to the estimates reported in the 1970 complex tax sample.

The switching regression results for the state service categories in 1970 and 1980 show the degree of fiscal complexity as the source of fiscal illusion by the median voter. The strong patterns exhibited in Tables 5.7 and 5.8 conform with the results observed in the state general expenditure analysis. Using two measures of fiscal complexity, we find that the median voter consistently underestimates the level of aid in the more complex budgetary regimes, and find evidence of perfect information in the simple budgetary regimes. These results support Wagner's (1976) theory concerning the relationship between fiscal complexity and fiscal illusion.

Chapter Six

Inter-temporal Stability

This chapter evaluates the inter-temporal stability of the estimates by examining the trend in size and significance of the key parameter estimates from previous chapters, using pooled cross-sectional data from 1970 and 1980 to test the inter-temporal stability of the estimates at the county and state level. The tests reveal inter-temporal instability. Nonetheless, the key parameter estimates show no systematic growth or decline in fiscal illusion at the county or state level for either the provision of general or specific services.

6.1 County Inter-temporal Analysis

Table 6.1 presents the estimates of the pooled data from 1970 and 1980 county general expenditures. Using a chow test to test the hypothesis that there is no structural change in the estimates over time, the hypothesis is rejected at the 95% confidence level with an F-statistic of 196.018. Casual observation of the estimates between the two periods, however, reflects a stable relationship between the county general expenditure estimates for many of the key parameters.

Table 6.2 compares the 1970 and 1980 county general expenditure estimates. It shows that there was only a slight increase in the income elasticity estimate, from .536 in 1970 to .589 in 1980. Comparison of the aid perception parameters between the two samples allows us to see if fiscal illusion increases or decreases over time. Table 6.2 shows that the estimates of the aid perception parameters are quite stable across time. Both are

Table 6.1
Pooled Regression Results
County General Expenditures

Constant (A0)	-2.027* 0.339
Income (A1)	.280* 0.039
Population (A2)	.243* 0.019
Price Elasticity (A3)	-.780* 0.019
Aid (A4)	.611* 0.014
Aid Perception Theta	.496* 0.100
F-statistic for Chow Test	196.018

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table 6.2
Inter-temporal Stability
County General Expenditures

	1970	1980
Constant (A0)	-1.718* 0.357	-1.444* 0.446
Income (A1)	.238* 0.043	.303* 0.053
Population (A2)	.307* 0.031	.187* 0.027
Price Elasticity (A3)	-.728* 0.034	-.831* 0.027
Aid (A4)	.536* 0.024	.589* 0.02
Aid Perception Theta	.643* 0.012	.646* 0.05
Log Likelihood Value	233.5894	289.3410
SSE	8.7846	6.8062

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

significant at the 95% confidence level and are less than one, indicating that the median voter perceives approximately 64% of the intergovernmental aid from higher level governments in each decade. The underestimation of the level of intergovernmental aid by the median voter regarding county general expenditures is consistent across time and yield additional support for this median voter model of county level fiscal behavior.

The chow tests for the pooled estimation of each of the county service categories also reveal a structural change over time. A comparison of the 1970 and 1980 key parameter estimates for the county service categories is presented in Table 6.3; the pooled regression results for the service categories are presented in Appendix Five. This table shows increasing income elasticities over time for all five service categories between 1970 and 1980. The most notable increases are seen in environmental and social service expenditures. The aid elasticities for county services between 1970 and 1980 appear stable. The aid elasticity estimates for transportation expenditures show the only significant decrease between the two decades with a decline from .950 to .669. Casual observation of these key parameter estimates finds a systematic increase in the relationship between the median voter's income and county service expenditures and a stable relationship between the amount of intergovernmental aid and county service expenditures from 1970 to 1980.

Looking at the aid perception parameters, we observe remarkable stability in the estimates across time and across the spending categories of education, transportation, and public safety. These robust estimates reflect a consistent pattern of underestimation of intergovernmental aid by the median voter, with the level of aid perceived ranging from 60% to 79%. These perception estimates are similar to the estimates found in the general

Table 6.3
Inter-temporal Stability
County Service Categories

	Income Elasticity		**Aid Elasticity**		**Aid Perception**	
	1970	*1980*	*1970*	*1980*	*1970*	*1980*
Education	.327*	.592*	.430*	.589*	.602*	.646*
Transportation	.242*	.403*	.950*	.669*	.774*	.764*
Public Safety	.188*	.436*	.544*	.585*	.788*	.794*
Social Services	.315*	.802*	.996*	1.056*	.777*	.447*
Environmental	.317*	.826*	.833*	.982*	.492*	.872*

* = *Coefficients that are significant at the 95% level*

expenditure analysis and exhibit the same consistent pattern. The degree of fiscal illusion increases over time for social service expenditures with the level of perceived aid falling from 77% in 1970 to 44% in 1980. We see the opposite trend concerning environmental expenditures, for which the median voter perceives 49% of the aid in 1970 and 87% in 1980. Although we find no definitive pattern of growth or decline in fiscal illusion between 1970 and 1980, the results still indicate that the median voter systematically underestimates the level of intergovernmental aid.

6.2 State Inter-temporal Analysis

Table 6.4 presents the estimates from the pooled state general expenditure sample for 1970 and 1980. Using a chow test to test the hypothesis that there is no structural change in the estimates over time, we reject the hypothesis that there is no structural change at the 95% confidence level, with an F-statistic of 25.868. Comparisons of the results from the two samples also support this conclusion.

Table 6.5 compares the 1970 and 1980 state general expenditure estimates to show that the income elasticity estimate remains statistically insignificant across both time periods. This result by itself appears to raise doubt about the strength of the median voter model for predicting state level behavior. The aid elasticities between the two time periods are quite stable with significant estimates of .570 for 1970 and .466 for 1980. The size and stability of the aid effects at the state level are very similar to the county general expenditure results in Table 6.2.

Comparison of the aid perception parameters between the two samples allows us to see if fiscal illusion increases or decreases over time. Table 6.5 shows a decrease in the level

Table 6.4
Pooled Regression Results
State General Expenditures

Constatn (A0)	-1.932 1.106
Income (A1)	.373* 0.114
Population (A2)	.121* 0.027
Price Elasticity (A3)	-.780* 0.028
Aid (A4)	.730* 0.029
Aid Perception Theta	.122* 0.044
South (A5)	.096* 0.033
West (A6)	-.087* 0.033
North (A7)	0.036 0.034
F-statistic for Chow Test	25.868

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

Table 6.5
Inter-temporal Stability
State General Expenditures

	1970	1980
Constant (A0)	-.339 1.412	-1.544 1.470
Income (A1)	0.18 0.155	0.218 0.152
Population (A2)	.247* 0.076	405* 0.074
Price Elasticity (A3)	-.638* 0.086	-.473* 0.082
Aid (A4)	.570* 0.077	.466* 0.077
Aid Perception Theta	.779* 0.173	.426* 0.215
South	.096* 0.042	.130* 0.042
West	-.045 0.051	-.059 0.042
North	0.07 0.046	0.062 0.044
Log Likelihood Value	46.6773	44.3996
SSE	0.4019	0.4419

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

of intergovernmental aid perceived by the median voter. Both estimates are significant at the 95% confidence level and are less than one. These estimates indicate the median voter perceives approximately 78% of the intergovernmental aid in 1970 and about 42% of the aid from higher level governments in 1980. Unlike the county sample, the state sample reflects an increase in fiscal illusion by the median voter from 1970 to 1980.

The chow tests for the pooled estimation of the state service categories also finds inter-temporal instability in the estimates. Table 6.6 provides a comparison between the 1970 and 1980 key parameter estimates for the state service categories; the pooled regression results for the service categories are presented in Appendix Five. The income elasticities support the chow test conclusions of inter-temporal instability. The income elasticity estimate for 1980 public safety expenditures is the only estimate which is positive and significant. The negative and significant income elasticities for environmental expenditures is the only evidence of inter-temporal stability in the income elasticity estimates for the individual spending categories.

The aid elasticity estimates for state services do not exhibit the same pattern observed for the county service categories. The aid elasticities reflect inter-temporal stability between 1970 and 1980 in only two categories, education and transportation. The aid elasticity estimates for social service expenditures decrease between the two decades with a fall from .860 to .514, while the aid elasticity estimates for environmental expenditures rise from .584 to .819. Casual observation of these key parameter estimates finds no systematic increase or decrease in the relationship between the median voter's

Table 6.6
Inter-temporal Stability
State Service Category Expenditures

	Income Elasticity		**Aid Elasticity**		**Aid Perception**	
	1970	*1980*	*1970*	*1980*	*1970*	*1980*
Education	0.052	-0.050	.324*	.336*	.730*	645*
Transportation	0.519	-.201*	.656*	.520*	.397*	.723*
Public Safety	0.516	.456*	0.147	-0.070	.322*	.595*
Social Services	0.442	-0.063	.860*	.514*	.594*	.441*
Environmental	-1.048*	-.961*	.584*	.819*	.444*	.865*

* = *Coefficients that are significant at the 95% level*

income or the level of intergovernmental aid and state service expenditures from 1970 to 1980.

Comparison of the aid perception parameters between the two samples for the state service categories allows us to see if fiscal illusion increases or decreases over time. We do not observe the same stability in the state estimates across time and category as we see in the county service category estimates. The degree of fiscal illusion increases over time for education and social service expenditures. The perceived level of aid falls from 73% in 1970 to 64% in 1980 for education expenditures and falls from 59% in 1970 to 44% in 1980 for social services. We observe the opposite trend concerning environmental, public safety, and transportation expenditures. The perceived level of aid in all three of these services categories doubles from 1970 to 1980 which indicates a decrease in fiscal illusion, which is just the opposite of what we find for the state general expenditures. Although there is no systematic pattern of growth or decline in fiscal illusion between 1970 and 1980 for the state service categories, the results still indicate that the median voter underestimates the level of intergovernmental aid.

Chapter Seven

Conclusion

This paper examines the nature of fiscal illusion, which is the notion that taxpayers misperceive the tie between public spending and the associated taxes, and its effect on local government spending. This study contributes to the recent literature concerned with empirically evaluating the strengths of the fiscal illusion effects, especially the strengths of the different channels of influence identified in the literature.

This dissertation provides both theoretical and empirical contributions to the growing body of literature on fiscal illusion. The theoretical contribution is a clarification of the parametric interdependence between price and income illusion. Traditional tax price, or grant illusion, stems from voter misperceptions about aid receipts and income illusion stems from the misperceptions of the taxes associated with aid. Holsey (1993) identifies grant and income illusion as independent and estimates local public demand equations derived from the Stone-Geary utility function. Taking her study as a point of departure, this dissertation shows that the two separate types of fiscal illusion are parametrically interdependent; the methodology employed by Holsey, therefore leads to inconsistent econometric estimates. It is shown that income illusion is actually tax price illusion. The empirical results show that the structural demand equations derived from the Stone-Geary Utility function which incorporates the relationship between grant and income illusion leads to fragile and unstable estimates.

The theoretical innovation provides a new way of estimating local public demand equations without positing a specific utility function. The analysis of fiscal illusion can be examined outside the context of a well defined structural model and extended into a less restrictive model specification, like the reduced form approach taken in this study. This reduced form approach exploits the derived relationship between grant and income illusion to test for the presence of different types of fiscal illusion. The results from the reduced form approach demonstrate that fiscal illusion is felt primarily through the traditional grant channel rather than Holsey's depiction of income illusion.

The empirical contribution is the estimation of demand equations using a reduced form approach, the log-linear model. The regressions are conducted using disaggregate county and state data from 1970 and 1980. This data set allows us to address issues ignored in earlier fiscal illusion analysis. For example, how do fiscal illusion effects vary between higher and lower levels of government, and does the degree of fiscal illusion vary with respect to the provision of general versus specific categorical expenditures? We examine how degrees of fiscal illusion can affect the crucial parameter estimates of fiscal illusion and test Wagner's (1976) hypothesis that the degree of fiscal complexity underlies taxpayer-voter fiscal illusion. This data set also provides the ability to test for inter-temporal stability of the estimates.

The empirical results from the estimation of the log linear model using the disaggregate county data from 1970 and 1980 show the median voter suffers from fiscal illusion. The source of this fiscal illusion stems from the voter's inability to perceive the full amount of intergovernmental aid. This misperception drives a wedge between the actual and

perceived marginal tax price of public goods. The results also show an underestimation of the level of aid received by the local government as the source of the flypaper effect, which is the empirical phenomenon of intergovernmental aid being more stimulative than income on the level of public expenditures. Thus we conclude that the flypaper effect is a result of fiscal illusion by the median voter. We find no evidence of Holsey's notion of income illusion which stems from the overestimation of the level of intergovernmental aid.

Another interesting result of this empirical analysis is the consistent manner in which the median model explains categorical spending at the county level. Turnbull and Djoundourian (1994) show that the median model tends to explain general expenditure better than specific spending behavior at the municipal level. At the county level, we find the median model a strong tool in predicating the behavior of the county fisc, but at the state level we find the median model does not perform well in explaining state level categorical spending.

The state level analysis also shows the median voter is confronted with imperfect information about aid receipts which leads to misperceptions concerning the marginal tax price of state level general and categorical expenditures. We do not find a consistent pattern of changes in the fiscal illusion estimates from the county to the state level, however we do find strong evidence of fiscal illusion at both levels of government.

Using two measures of budgetary complexity, we find strong evidence that the source of fiscal illusion which stems from intergovernmental aid misperceptions is positively related to the degree of budgetary complexity. The county level estimates find the median voter suffers from fiscal illusion in complex budgetary regimes and finds no evidence of fiscal

illusion in the simple budgetary regimes. The patterns exhibited by the county service category estimates conform with those observed in the general expenditure case in 1970 and 1980. The regression results for the state general expenditure and service categories in 1970 and 1980 also show the degree of fiscal complexity as the source of fiscal illusion by the median voter. These empirical results support Wagner's (1976) theory concerning the relationship between fiscal complexity and fiscal illusion.

The pooled regression results for both county and state general and categorical expenditures indicate inter-temporal instability in the estimates. Comparisons of the key parameter estimates also support the tests and show no systematic growth or decline in fiscal illusion at the county or state level for either the provision of general or specific services.

This dissertation shows that modeling local fiscal behavior under the assumption of perfect information is inappropriate and can lead to biased estimates. The evidence demonstrates that the median voter is confronted with imperfect aid information which leads to price distortions and, consequently, output effects. Thus, the output effects must be taken into account by policy makers when considering a system of unconditional block grants as a method of revenue sharing.

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Appendix One

Holsey (1993) uses a Stone-Geary framework and the median voter's demand function is derived by maximizing the median voter's utility subject to a budget constraint which incorporates imperfect voter information about intergovernmental grants. The estimable demand equation allows for the estimation of local public demand and incorporates parameters that allow for the estimation of price illusion due to grant receipts and income illusion due to tax payments. The innovation here is that the estimable demand equation is derived from a structural rather than a reduced form equation. The Stone-Geary utility function has well-known properties and is a homothetic function which facilitates the aggregation of preferences.

Voter's perceptions are assumed to equal some proportion of actual amounts and are measured throughout the model by the σ parameters. This assumption allows us to control for imperfect information that may arise from non-grant sources and imperfect knowledge concerning tax shares The parameter σ does not measure the price and income illusion due directly to the intergovernmental grant system.

A Stone-Geary framework is employed and the median voter's utility function can be stated as

$$(A1.1) \quad U = \beta_y \ln (Y - \tau_y) + \beta_q \ln (q - \tau_q)$$

where Y is the level of private goods, q is the voter's perceived level public goods. The β parameters measure the individual taste for each good, and the τ's are interpreted as the voter's minimum subsistence level of each good [see Samuelson (1947)]. The voter's perceived level of public goods, q, is equal to some share, μ_1[7], of the voters perceived level of the total quantity of public goods, $\sigma_Q Q$. Thus,

$$(A1.2) \quad q = \mu_1 \sigma_Q Q$$

The median voter will maximize his or her utility subject to the following budget constraint:

$$(A1.3) \quad I = P_y Y + \sigma_L w_L \pi_L T_L + \sigma_S w_S \pi_S T_S + \sigma_F w_F T_F$$

where P_y is the price of private goods and I is the pre-tax income. The w's represent the voters actual marginal tax shares, where marginal tax shares are assumed to be equal to average tax shares; the π's represent the voter's actual net burden after taxes and the awarding of local tax credits when paying state and federal income taxes. T_L represents the voter's perception of local tax collections, and T_S and T_F equal the voter's perception of total state and federal tax payments for grants. The σ's represent the proportion of effective local, state, and federal tax shares known to the voter. $\sigma_L w_L \pi_L T_L$ is the voters perceived level of local tax payments, $\sigma_S w_S \pi_S T_S$ is the perceived level of state tax payments for

[7] If $\mu_1 = 1$, this implies that education is a pure public good, and $\mu_1 = 1/N$, then education is a pure private good; where N is equal to the local population.

intergovernmental grants, and $\sigma_F w_F \pi_F T_F$ is the perceived level of federal tax payments for intergovernmental grants.

Local tax collections are then separated into its individual components.[8]

(A1.4) $T_L = (1-\alpha_S - \alpha_F)\, \sigma_P P_Q \sigma_Q Q - \theta_S L_S - \theta_F L_F$

where $(1-\alpha_S - \alpha_F)\, \sigma_P P_Q$ is the perceived price of education, $\theta_S L_S$ is the perceived state to local lump-sum grant amounts, and $\theta_F L_F$ is the perceived federal to local lump sum grant amounts. The α's estimate the proportionate reduction in price due to price illusion. Voter knowledge of state to local grants is estimated by θ_S, and voter knowledge of federal to local grants is estimated by θ_F. If the θ parameter is equal to 1, then this implies that the voter has perfect knowledge of the grant. Holsey's analysis states that when θ is equal to 0, the voter is totally unaware of the grant, and a value between 0 and 1 implies that the voter has imperfect information of grant amounts. The unknown aid, $(1-\theta_S)L_S$ and $(1-\theta_F)L_F$, is assumed to be spent on the public good. Mathematically this relationship can be written as $(1-\theta_S)L_S = \alpha_S P_Q Q$ and $(1-\theta_F)L_F = \alpha_F P_Q Q$.

State and federal tax collections for intergovernmental grants can also be separated into their individual components as follows:

(A1.5) $\hat{T}_S = (1+\Gamma_S \sum_j^m P_s^j)\Theta_S L_S$

---

[8] This expansion of the local tax term is and extension of Inman's methodology by Holsey.

$$(A1.6) \quad \hat{T}_F=(1+\Gamma_F\sum_{J}^{n} P_F^J)\Theta_F L_F$$

The distribution of grants amounts to this and other localities is taken into consideration in these two equations. L_S and L_F is the localities own lump-sum grant. ΣP_S and ΣP_F is the sum of the proportion of this localities grant which are received by the other m localities in the state and other n localities in the country. Lump-sum aid to all other localities then becomes $\Sigma P_S L_S$ and $\Sigma P_F L_F$. for federal and state respectively.

Included in (A1.5) and (A1.6) are the parameters that estimate voter knowledge of grant amounts received by other localities. Voter knowledge of the amount that other localities receive depends on how much knowledge the voter has of his or her own grants; measured by the θ parameters. The Γ parameter measures the voter's knowledge of the proportions of his or her own local grant which is received by other localities. As in the above analysis, the voter's perceived level of the proportions of his or her own grant which is received by other localities is assumed to be equal to some proportion of the actual amount. This implies that if the voter has perfect knowledge, the Γ's will be equal to 1, no knowledge implies a value of 0, and imperfect information implies a value between 0 and 1. As with the θ parameters, it is demonstrated in the following section that the value of Γ is not restricted to values between 0 and 1.

A.1 The Budget Constraint.

Substituting the expanded tax terms, (A1.4), (A1.5), and (A1.6), back into equation (A1.3) yields the voters perceived budget constraint.

$$P_Y Y + [(\sigma_L w_L \pi_L)(1-\alpha_S-\alpha_F)\sigma_P P_Q/\mu_1]q = I + [(\sigma_L w_L \pi_L \Theta_S) - (\sigma_S w_S \pi_S \Theta_S)(1+\Gamma_S \sum_1^m P_S^J)]L_S$$
$$+[(\sigma_L w_L \pi_L \Theta_F) - (\sigma_S w_S \pi_S \Theta_F)(1+\Gamma_F \sum_1^n P_F^J)]L_F \quad \text{(A1.7)}$$

Output in this equation, Q, is converted into the individual quantities, q. The constraint is interpreted as perceived payments for private goods plus perceived payments for public goods is equal to the consumers private income I plus the perceived net income from state and federal grants, respectively. The perceived net income terms are divided into two parts, the perceived amount of grant received less perceived payments for the grant.

The consumer maximizes his or her utility, (A1.1), subject to the perceived budget constraint (A1.7). Maximization of the utility function subject to the budget yields the following demand equation for local public expenditure:

$$P_Q Q \quad B_3 I\ \delta_L \quad B_3 P_Y \tau_1 \delta_L + P_Q \tau_Q (1-B_1) - \tau_Q (1-B_1)(1-\Theta_S)\frac{L_S}{Q} - \tau_Q (1-B_1)(1-\Theta_F)\frac{L_F}{Q}$$
$$+ [B_2\Theta_S+(1-\Theta_S)]L_S \quad (B_2\Theta_S\sigma_{SL}w_S\pi_S\delta_L)L_S - (B_2\Theta_S\Gamma_S\sigma_{SL}w_S\pi_S\delta_L\sum P_S^J)L_S \quad \text{(A1.8)}$$
$$+ [B_2\Theta_F+(1-\Theta_F)]L_F - (B_2\Theta_F\sigma_{FL}w_F\pi_F\delta_L)L_F - (B_2\Theta_F\Gamma_F\sigma_{FL}w_F\pi_F\delta_L\sum P_F^J)L_F$$

where $\delta_L = 1/w_L\pi_L$. The first term represents the income component and is followed by the $P_Y t_Y$ term and expanded version of the $P_q t_q$ term found in the traditional linear expenditure systems. These two terms can be interpreted as the minimum expenditure levels of each good and depend on price. The rest of the equation represents the expanded version of the

grant terms. The expanded grant terms include the change in local income due to the grant, the change in local income due to tax payments for the own local grant and the change in income due to tax payments for grants to other localities for state and federal grants respectively.

Holsey estimates demand using time series data on primary and secondary education finances from 40 U.S. states from 1966-1980. A two-stage non-linear least squares technique proposed by Amemiya (1974) is employed in order to be able to estimate the non-linear empirical specification of the model and the non-linearity of the endogenous variables L_S/Q and L_F/Q.

In order to conform to the local education data, Holsey aggregates all variables to the state level; as a result, $\sum P^i_S = 0$ and she could not estimate Γ_S. Her aggregation method also implies that a portion of grant received is equal to the tax payment for the grant, $L_S/w_L\pi_L = L_S/w_S\pi_S$. Since $\pi = 1$ for simplicity and it is assumed that marginal tax shares are equal to average tax shares, this implies that $w_L = w_S$, and the assumption of equal tax sharing implies that the tax share is equal to 1/N, where N is equal to the population of the jurisdiction in question. It is also assumed that voter knowledge of his or her local tax share is equal to knowledge about his or her state tax share; which implies that $\sigma_L = \sigma_S$. The consumer price index for each state serves as a proxy for the price of the private good which is aggregated into a composite good, Y. Also assumed is that knowledge about state and federal grants is the same in order for parameter identification to be possible, thus, $\theta_S = \theta_F$

.

Given these assumptions the estimable equation becomes:

$$
\begin{aligned}
(P_Q Q)/S = {} & A - [B_4]N/S + [(1-B_1)\tau_Q]P_Q/S - [(1-B_1)\tau_Q(1-\Theta)](L_S/Q)/S \\
& - [(1-B_1)\tau_Q(1-\Theta)](L_F/Q)/S + [B_3]NI/S + [1-\Theta]L_S/S \\
& + [(B_2\Theta)+(1-\Theta)]L_F/S - [B_2\Theta\sigma_{FL}](Nw_F L_F)/S \\
& - [B_2\Theta\Gamma_F\sigma_{FL}](Nw_F(\Sigma P_F)L_F/S + B_D D + B_T T + B_P P + \mu
\end{aligned}
\tag{A1.9}
$$

which is

$$
\begin{aligned}
\frac{Expendiutres}{Students} = {} & A - B_1\frac{Pop}{Students} - [(1-B_1)\tau_Q]\frac{Avg\ Teach\ Salary}{Students} - [(1-B_1)\tau_Q(1-\Theta)]\frac{(\frac{State\ grants}{Output})}{Students} \\
& -[(1-B_1)\tau_Q(1-\Theta)]\frac{(\frac{Federal\ grants}{Output})}{Students} - B_3\frac{Total\ Income}{Students} - [1-\Theta]\frac{State\ grants}{Students} - \\
& - [(B_2\Theta)+(1-\Theta)]\frac{Federal\ grants}{Students} - [B_2\Theta\sigma_{FL}]\frac{Population\ x\ Fed\ tax\ share\ x\ Federal\ grants}{Students} \\
& - [B_2\Theta\Gamma_F\sigma_{FL}](Population\ x\ Fed\ tax\ share\ )(\Sigma P_F^J)\frac{Fed\ grants}{Students} \\
& - State\ Dummies - Time\ Dummies - Characteristics\ of\ utility\ \&\ production
\end{aligned}
\tag{A1.10}
$$

where $\beta_1 = \beta_q/(\beta_Y+\beta_q)$, $\beta_2 = (\beta_1 / \sigma_P\sigma_Q)$, $\beta_3 = (\beta_2 / \sigma_L)$, $\beta_4 = \beta_3\tau_Y$, $\theta = \theta_S = \theta_F$.. w_F is the federal tax share which is proxied by 1 over the national population 1/N. The price of

education is measured by using the average teacher salary, and output, Q, is measured by taking total expenditures on education and dividing it by the average teacher salary.

The empirical results from the estimation of this demand equation finds both illusion parameters to be significant determinants of voter behavior. The unbiased estimates of this study predict that $.51 increase in per student education expenditure for a $1.00 increase in per student grants, of which $.12 is due to grant induced price illusion. These results differ from those of Filimon, Romer, and Rosenthal who predict a $.71 increase in expenditure per dollar of grants. However, in the Holsey study only the tax price and the θ coefficient is significantly different from zero. Thus the analysis which includes what is deemed "income" illusion using the non-significant coefficient Γ is questionable.

A.2 Empirical Results

A.2.1. Methodology and Assumptions

Estimation of the non-linear regressions is conducted using a maximum likelihood procedure.[9] It is assumed that the errors are additive and normally distributed. The algorithm employed in this procedure is a Quasi-Newton method and the convergence criterion for each coefficient is set equal to .00001. Non-linear regressions are conducted using the disaggregate county data from 1970 and 1980 described earlier. Several model specifications are estimated in order to examine the stability of the illusion parameter estimates. The results show that the size and significance of the illusion parameter estimates depend on certain assumptions about the knowledge of local, state, and federal marginal tax

[9] The regressions are programmed and executed using the SHAZAM econometrics computer program version 6.2.

shares as well as the definition of the crucial voter's income. Estimation of the full model allows for the interrelationship of all three levels of government to be assessed.

The full estimable equation now becomes:

$$(P_Q Q) = A - B_4\frac{P_Y}{w_L} + [(1-B_1)\tau_Q]P_Q - [(1-B_1)\tau_Q(1-\Theta_S)]\frac{L_S}{Q} - [(1-B_1)\tau_Q(1-\Theta_F)]\frac{L_F}{Q} + B_3 I$$

$$(A1.11) + [B_2\Theta_S+(1-\Theta_S)]L_S - [B_2\Theta_S\sigma_{SL}]\frac{w_S}{w_L}L_S - [(B_2\Theta_S\Gamma_S)\Sigma P_S^J]\frac{w_S}{w_L}L_S$$

$$+ [B_2\Theta_F+(1-\Theta_F)]L_F - [B_2\Theta_F\sigma_{FL}]\frac{w_F}{w_L}L_S - [(B_2\Theta_F\Gamma_F)\Sigma P_F^J]\frac{w_F}{w_L}L_F$$

where terms inside brackets represent estimable parameters. For simplicity, it is assumed that the actual net burden after taxes are equal ; thus $\pi_L = \pi_S = \pi_F$. The parameter w represents the marginal tax share for local, state, and federal tax payments respectively and is measured by 1 over the county, state, and national population respectively. L_S and L_F represent the level of aid received from the state and federal governments, respectively. Output, Q, can be derived by taking general expenditures and dividing it by the average wage of the county employee. The sum of the proportion of aid going to other jurisdictions is calculated by taking the total grant amounts less the locality's level of aid and dividing by the county level of aid from the state and federal government.

The knowledge of own grant amounts is measured by the θ_S and θ_F parameters and knowledge about the proportion of own state to local and federal to local grants received by other localities is measured by Γ_S and Γ_F, respectively. Under perfect information, θ and Γ are equal to 1. A value of θ or $\Gamma > 1$ implies an overestimation of aid and tax payments

for grants. A value of θ or $\Gamma < 1$ implies an underestimation of grant and tax payments for grants.

Thus the estimable equation becomes

$$
\begin{aligned}
\text{County Gen Exp} = {} & A - B_4 \text{county pop} + [(1-B_1)\tau_Q]\text{Avg county wage} \\
& - [(1-B_1)\tau_Q(1-\Theta_S)]\frac{IGR\ State}{Output} - [(1-B_1)\tau_Q(1-\Theta_F)]\frac{IGR\ Fed}{Output} + B_3 Income \\
& - [B_2\Theta_S + (1-\Theta_S)]IGR\ State - [[B_2\Theta_S\sigma_{SL})]\frac{County\ Pop}{State\ Pop}IGR\ State - [B_2\Theta_S\sigma_{SL}\Gamma_S(\Sigma P_S^j)]\frac{County\ Pop}{State\ Pop}IGR\ State \\
& - [B_2\Theta_F + (1-\Theta_F)]IGR\ Fed - [[B_2\Theta_F\sigma_{FL})]\frac{County\ Pop}{Natl\ Pop}IGR\ Fed - [B_2\Theta_F\sigma_{FL}\Gamma_F(\Sigma P_F^j)]\frac{County\ Pop}{Natl\ Pop}IGR\ Fed
\end{aligned}
\tag{A1.12}
$$

The full model, as described above, does not converge to a minimum of the sum of squared errors. The highly non-linear specification of the model may be the reason for the inability of the full model to converge, thus a series of more restrictive models is used. Model 2 assumes that the proportion of federal and state marginal tax shares known to the crucial voter are equal. This implies that $\sigma_S = \sigma_F$ and it follows that $\sigma_{SL} = \sigma_{FL}$. Model 3 assumes that proportion of marginal local, state, and federal tax shares known to the crucial voter are equal, therefore $\sigma_{SL} = \sigma_{FL} = 1$. Model 4 assumes that since ΣP^j_S and ΣP^j_F is calculated by implicitly assuming that state and federal lump-sum grants have the same effects on local public expenditure, then knowledge about the proportion of state and federal grants received by other jurisdictions should be the same; thus $\Gamma_S = \Gamma_F$. Model 5 incorporates the same assumptions as model 4 and adds the restriction that $\sigma_{SL} = \sigma_{FL} = 1$. Model 6 assumes that $\Gamma_S = \Gamma_F$ and that $\sigma_{SL} = 1$. Model 7 aggregates the state and federal

governments lump sum aid which implicitly assumes that the crucial voter does not differentiate between the behavior of the two levels of governments and implies then that $\theta_S = \theta_F$ and $\Gamma_S = \Gamma_F$. All model specifications are estimated using both average household and median family income as a measure of the crucial voter's income level.

A.2.2 General Expenditure Results in the Stone-Geary Model

Estimation of the expenditure function derived from the Stone-Geary utility function using the 1970 and 1980 county data identifies both grant and payment price illusion as significant determinants of voter behavior. Parameter estimates and t-statistics for the different model specifications using median family income are presented in Table A1.1 and Table A1.2 and estimates and t-statistics using average household income are presented in Table A1.3 and Table A1.4 for 1970 and 1980 respectively.

Examination of Table A1.1 indicates a significant and negative relationship between the voter's median family income, B_3, and general expenditures by the county for 1970. This relationship is stable across all model specifications with estimates ranging from -.348 to -.369.

Analysis of the θ and Γ parameters allows us to assess the impact of grant and payment price illusion on the level of county general expenditures. For 1970, grant induced price illusion becomes significant only under the assumption that the proportions of local, state, and federal marginal tax shares known to the voter are equal (models 3 and 6). These results show that the crucial voter underestimates the amount of aid coming from the state to the county, $\theta_S < 1$, causing an underestimation of the tax price to the voter and thus

Table A1.1

General Expenditures 1970

Median Family Income

Parameter	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	7558 (1.526)	-1252 (-1.168)	-3374 (-1.384)	**-5808*** (-3.134)	-3303 (-1.796)	2543 (0.982)
B2	**1.009*** (43.44)	**1.008*** (955.360)	**7.921*** (1.926)	**0.984*** (40.877)	**3.146*** (3.511)	**1.034*** (155.100)
Income	**-0.328*** (-3.719)	**-0.295*** (-2.982)	**-0.272*** (-2.488)	**-0.346*** (-3.792)	**-0.272*** (-2.716)	**-0.334*** (-3.353)
B4	**-0.349*** (-30.966)	**-0.348*** (-31.679)	**-0.369*** (-32.191)	**-0.352*** (-61.985)	**-0.369*** (-33.403)	**-0.369*** (-31.862)
Tax Price	-0.980 (-1.478)	**-0.055*** (-3.725)	0.060 (0.118)	0.587 (1.812)	0.053 (0.128)	**-0.184*** (-2.216)
State Aid Perception	1.614 (1.874)	**-1.364*** (-4.294)	-0.099 (-1.47)	0.162 (1.738)	**-0.322*** (-2.158)	
Federal Aid Perception	5.810 (1.373)	**135.31*** (5.176)	0.046 (0.993)	-6.332 (-1.589)	0.148 (1.467)	
Aid Perception						**7.503*** (6.118)
State Tax Perception	-4.516 (-0.623)	0.002 (0.334)				
Federal Tax Perception	32.466 (0.636)	-0.122 (-1.621)				
Tax Perception			**0.976*** (5.582)	-2.528* (-1.651)	**0.978*** (5.865)	0.242 (1.270)
Sigma SL			**1.281*** (5.607)			
Sigma FL			**105.51*** (2.063)		**82.602*** (2.610)	
Sigma	0.060 (0.665)					
SSE	.4662484 e11	.4445252 e11	.4629794 e11	.4766088 e11	.4629786 e11	.4764717 e11

t-statistics are in parenthesis

t-statistics 1.96 indicate significance at 95% condfidence level.

Table A1.2

General Expenditures 1980

Median Family Income

Parameter	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	5024 (0.647)	**125*** (124.100)	-10667 (-1.559)	2507 (0.335)	13210 (1.748)	3856 (0.392)
B2	**0.633*** (5.142)	**1.296*** (26.748)	0.226 (0.920)	**0.616*** (5.054)	**0.750*** (11.452)	**0.457*** (1.99)
Income	**-1.235*** (-3.459)	**-0.286*** (-4.343)	**-1.301*** (-3.719)	**-1.376*** (-3.719)	**-1.345*** (-3.353)	**-1.246*** (-3.362)
B4	**0.138*** (2.071)	**0.410*** (6.122)	**0.184*** (2.234)	**-0.215*** (-6.833)	0.057 (0.678)	**-0.327*** (-10.582)
Tax Price	**2.097*** (4.665)	-0.078 (-0.468)	**2.805*** (6.837)	**2.407*** (5.104)	**1.752*** (4.251)	**2.779*** (5.468)
State Aid Perception	**-0.257*** (-2.018)	**-2.376*** (-10.812)	**0.336*** (2.762)	**-0.060*** (-3.152)	**-0.524*** (-4.057)	
Federal Aid Perception	**-3.535*** (-3.018)	**6.901*** (7.493)	**-2.301*** (-3.397)	**-3.576*** (-3.329)	**-5.227*** (-3.370)	
Aid Perception						**-0.799*** (-2.314)
State Tax Perception	**1.148*** (5.951)	**0.737*** (17.324)				
Federal Tax Perception	**5.29*** (3.532)	**-10.663*** (-13.880)				
Tax Perception			**2.411*** (10.133)	**19.440*** (2.293)	**2.905*** (6.094)	36.859 (1.123)
Sigma SL			-9.613 (-0.785)			
Sigma FL			50.988 (0.726)		**5.854*** (2.823)	
Sigma	6.534 (1.589)					
SSE	.1719615 e12	.1656921 e12	.1735076 e12	.1838798 e12	.1790675 e12	.2267066 e12

t-statistics are in parenthesis

t-statistics 1.96 indicate significance at 95% condfidence level.

Table A1.3

General Expenditures 1970

Average HH Income

Parameter	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	**25153*** (4.895)	**10947*** (3.282)	**19703*** (2.883)	**12671*** (4.322)	**1226*** (4.244)	**11640*** (3.362)
B2	**1.029*** (20.955)	**1617.7*** (3.325)	**1.382*** (2.31)	**4.426*** (1.981)	**4.28*** (3.502)	**3.349*** (2.074)
Income	**-3.17*** (-7.359)	**-3.069*** (-7.303)	**-3.096*** (-7.407)	**-3.176*** (-7.387)	**-2.983*** (-7.592)	**-3.146*** (-7.278)
B4	**-0.35*** (-31.821)	**-0.355*** (-59.342)	**-0.357*** (-31.106)	**-0.338*** (-40.919)	**-0.364*** (-40.494)	**-0.335*** (-36.442)
Tax Price	0.507 (0.765)	**1.714*** (3.171)	0.909 (1.221)	**1.708*** (3.07)	**1.588*** (3.364)	**1.813*** (3.653)
State Aid Perception	-4.270 (-0.677)	**-0.0003*** (-2.693)	-1.509 (-0.755)	-0.139 (-1.509)	**-0.218*** (-2.148)	
Federal Aid Perception	-8.450 (-0.679)	-0.0001 (-1.449)	-0.394 (-0.383)	-0.055 (-0.854)	-0.0001 (-0.438)	
Aid Perception						-0.100 (-1.291)
State Tax Perception	9.005 (0.397)	**1.873*** (7.013)				
Federal Tax Perception	-74.358 (-0.381)	-122.660 (-1.362)				
Tax Perception			**1.494*** (3.707)	**1.582*** (5.597)	**1.242*** (7.212)	**2.053*** (3.231)
Sigma SL			0.350 (0.874)			
Sigma FL			-28.918 (-0.361)		-32161 (-0.443)	
Sigma	0.017 (0.352)					
SSE	.4273136 e11	.4354131 e11	.4261262 e11	.4400816 e11	.4276803 e11	.4478491 e11

t-statistics are in parenthesis

t-statistics 1.96 indicate significance at 95% condfidence level.

Table A1.4
General Expenditures 1980
Average HH Income

Parameter	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	-1470 (-0.179)	-6518 (-0.962)	-36244 (-5.078)	-3790 (-0.459)	6654 (1.099)	-2057 (-0.196)
B2	**0.635*** (5.015)	**1.290*** (26.55)	**-0.001*** (-4.649)	**0.621*** (4.833)	**0.754*** (12.685)	**0.480*** (2.092)
Income	**-0.836*** (-2.118)	0.090 (0.238)	-0.465 (-1.281)	**-0.980*** (-2.467)	**-1.120** (-3.071)	**-0.854** (-2.086)
B4	**0.146*** (2.200)	**0.416*** (6.578)	**-0.841*** (-29.507)	**-0.211*** (-5.977)	0.059 (0.709)	**-0.326*** (-10.21)
Tax Price	**2.000*** (4.628)	-0.104 (-0.688)	**3.044*** (7.492)	**2.300*** (4.523)	**1.690*** (4.506)	**2.657*** (5.076)
State Aid Perception	**-0.264*** (-1.987)	**-2.39*** (-11.086)	**0.857*** (6.659)	**-0.061*** (-2.679)	**-0.522*** (-4.089)	
Federal Aid Perception	**-3.598*** (-2.87)	**7.108*** (7.333)	**-1.595*** (-11.962)	**-3.674*** (-2.843)	**-5.376*** (-3.689)	
Aid Perception						**-0.843*** (-2.198)
State Tax Perception	**1.123*** (5.855)	**0.730*** (16.88)				
Federal Tax Perception	**5.282*** (3.607)	**-10.433*** (-13.113)				
Tax Perception			-0.434 (-1.520)	**18.778*** (1.988)	**2.889*** (6.219)	32.715 (1.132)
Sigma SL			**2405*** (4.957)			
Sigma FL			**57907*** (5.26)		**5.678*** (3.089)	
Sigma	6.453 (1.581)					
SSE	0.1743427 e12	.1658951 e12	0.1790438 e12	.1866211 e12	.1804055 e12	0.2293848 e12

t-statistics are in parenthesis
t-statistics 1.96 indicate significance at 95% condfidence level.

leading to larger general expenditures by the county government. However, model 3 also indicates that the amount of federal aid coming to the jurisdiction is overestimated, $\theta_F > 1$, causing an overestimation of the tax-price which induces lower levels of expenditures. In these two model specifications, knowledge about the proportion of own federal and state grants received by other jurisdictions, Γ_S and Γ_F, are not found to be significant at a 95% confidence level.

Payment price illusion becomes a significant determinant of voter behavior in only two model specifications, models 4 and 6. In both of these specifications, it is assumed that knowledge about the proportion of state and federal grants received by other jurisdictions is the same ($\Gamma_S = \Gamma_F$). The hypothesis that $\Gamma_S = \Gamma_F$ is rejected at the 95% confidence interval with an F-statistic of 30.89. The estimates of .976 and .978 lead to the conclusion that very little of the price illusion that is evident can be attributed to misperceptions about own grant amounts going to other jurisdictions.

Examination of Table A1.2 indicates a significant and negative relationship between the voter's median income and general expenditures by the local government for 1980. The estimates are stable in all the model specifications except in model 3 where the negative impact of median household income is smaller with an estimate of -.286. The other models estimate the negative impact of income on general expenditures to be between -1.235 and -1.376.

Table A1.2 shows that grant induced price illusion estimates are significant in all of the model specifications for 1980. The estimates of θ_S are not very stable and range from -.06 to -2.376. These results however are consistent in that they show the voter

underestimates the amount of aid coming from the state to the county. Examination of the estimates of θ_F appear more stable across the various model specifications with the exception of model 3. Model 3 reports that the crucial voter overestimates the amount of aid coming from the federal government to the county while the other models show the voter consistently underestimating the amount of aid coming from the federal government with estimates ranging from -2.031 to -5.227.

Estimates of Γ parameters are significant at the 95% confidence level in all but one of the model specifications, model 7, and imply that payment price illusion is a significant determinant of voter behavior. These estimates, like those of the grant illusion parameters, are unstable and vary with the specification of the model. With the exception of model 3, the estimates consistently predict that the crucial voter overestimates the proportion of own grants going to other jurisdictions. In model 3, the estimates show that the voter underestimates the proportion of state and federal aid going to other jurisdictions.

Models using average household income as the crucial voter's income drive different estimates of the key parameters for the 1970 data and are presented in Table A1.3. Models using average household income as the crucial voter's income have very little effect on the key parameter estimates using the 1980 data set. These estimates are presented in Table A1.4. The only significant difference in these results lie in the estimates of the income coefficient, B_3. The effect of the level of income on the level of expenditures is smaller and significant in only four of the six model specifications. The use of average household income appears to drive the estimates of the income effect downward.

These results support the theory developed earlier about the relationship between θ and Γ. Although the illusion parameter estimates are unstable across different model specifications, they reveal that an overestimation of the amount of aid going to other jurisdictions ($\Gamma > 1$) corresponds to an underestimation of the amount of aid received from the higher levels of government ($\theta < 1$). Only in model 3 does this inverse relationship not hold. The estimates using the 1970 data support the hypothesis that asymmetric information about aid receipts received by the county and asymmetric information about how much of own local grants are distributed to other jurisdictions cause a discrepancy between the actual and perceived price of county general expenditures. However, examination of these results shows that the significance and size of the estimates vary with certain assumptions about the knowledge of marginal tax shares and with the crucial voter's definition of income.

The estimates of the expenditure function using the 1980 data provides strong evidence that both grant and payment price illusion are significant determinants of voter behavior. These results show that there is a consistent underestimation by the crucial voter about the amount of aid received from higher levels of government. Corresponding to this underestimation about grant amounts received, is the consistent overestimation about the level of own grant amounts going to other jurisdictions. These results support the hypothesis that grant and payment price misperceptions are not independent of each other. Both types of misperceptions by the voter create a wedge between the actual and perceived price of the general services provided at the county level. The estimates of these coefficients

are fragile and vary with model specification, leading us to question the reliability of the estimates themselves for assessing the marginal impact of this illusion on the perceived price.

Appendix Two

Variables used in county and state regression analysis

- Median Family Income
- Population
- Tax Share = Median Value Home / Total Tax Base
- Average Wage of Employee
- General Expenditures
- Intergovernmental Aid from State Governments
- Intergovernmental Aid from Federal Governments
- Education Expenditures
- Social Service Expenditures
- Transportation Expenditures
- Environmental Expenditures
- Social Service Expenditures

Variables used in calculating concentration variables

- County
  - Own Revenues
  - Property Tax
  - Other Tax
  - Charges
  - Government Administration Expenditures
  - Other Expenditures
- State
  - Own Revenues
  - Property Tax
  - General Sales Tax
  - Special Sales Tax
  - Charges
  - Other Income
  - Government Administration Expenditures
  - Other Expenditures

Mean Values	1970	1980
County General Expenditures	44,963,000	105,850,000
County Aid Receipts	15,004,000	43,776,000
County Median Family Income	9,126	18,913

County Tax Share	.0001343	.00017754
State General Expenditures	3,266,300,000	4,219,900,000
State Aid Receipts	1,420,400,000	1,650,500,000
State Median Family Income	23,320	23,358
State Tax Share	.000003	.00001

Appendix Three

Table A3.1
Restricted Model Estimation
Log-Linear Model Specification
Specific County Services
1970

	Education	Transportation	Public Safety
Constant (A0)	-5.188* 0.503	0.804 0.993	-7.653* 0.829
Income (A1)	.321* 0.067	.283* 0.122	0.128 0.106
Population (A2)	.708* 0.039	-.377 0.063	.888* 0.058
Price Elasticity (A3)	-.238* 0.043	-1.286* 0.068	-.425* 0.064
Aid (A4)	.256* 0.033	.898* 0.052	.155* 0.050
SSE	17.80	48.51	41.34
Log Likelihood Value	79.31	-139.79	-104.83

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

Table A3.2
Restricted Model Estimation
Log-Linear Model Specification
Specific County Services
1970

	Social Services	Environmental
Constant (A0)	-6.753* 2.273	-12.501* 1.754
Income (A1)	-0.016 0.291	0.223 0.222
Population (A2)	.589* 0.179	1.189* 0.132
Price Elasticity (A3)	-.396* 0.196	-0.224 0.146
Aid (A4)	.883* 0.150	.352* 0.110
SSE	384.28	220.22
Log Likelihood Value	-591.99	-470.34

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

Table A3.3
Restricted Model Estimation
Log-Linear Model Specification
Specific County Services
1980

	Education	Transportation	Public Safety
Constant (A0)	-5.949* 0.732	0.914 1.281	-5.881* 1.179
Income (A1)	.484* 0.093	.317* 0.159	.320* 0.146
Population (A2)	.500* 0.043	-.025 0.075	.618* 0.072
Price Elasticity (A3)	-.460 0.043	-.913* 0.075	-.638* 0.071
Aid (A4)	.422* 0.034	.286* 0.059	.189* 0.056
SSE	19.66	57.83	49.66
Log Likelihood Value	57.56	-178.19	-144.92

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

Table A3.4
Restricted Model Estimation
Log-Linear Model Specification
Specific County Services
1980

	Social Services	Environmental
Constant (A0)	0.916 3.296	-8.122* 2.021
Income (A1)	-.146 0.4	.641* 0.252
Population (A2)	-.333 0.188	0.057 0.123
Price Elasticity (A3)	-1.350* 0.156	-1.185* 0.123
Aid (A4)	1.239* 0.144	.918* 0.095
SSE	375.94	143.21
Log Likelihood Value	-587.19	-376.31

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A3.5
Restricted Model Estimation
Log-Linear Model Specification
Specific State Services
1970

	Education	Transportation	Public Safety
Constant (A0)	-2.178 2.791	7.790* 3.707	-10.805* 3.069
Income (A1)	0.100 0.308	-0.625 0.407	.664* 0.334
Population (A2)	.627* 0.154	0.204 0.201	.944* 0.163
Price Elasticity (A3)	-0.170 0.173	-.614 0.223	0.117 0.18
Aid (A4)	0.229 0.157	.471* 0.201	-0.191 0.164
South	-0.044 0.089	0.097 0.116	.264* 0.108
West	-0.130 0.100	-0.030 0.123	.194* 0.097
North	-.241* 0.089	0.090 0.134	-.203* 0.093
SSE	1.63	3.53	1.85
Log Likelihood Value	13.02	-5.50	9.97

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A3.6
Restricted Model Estimation
Log-Linear Model Specification
Specific State Services
1970

	Social Services	Environmental
Constant (A0)	-2.138 4.482	11.515* 3.44
Income (A1)	0.157 0.494	-1.271* 0.375
Population (A2)	0.200 0.250	0.311 0.182
Price Elasticity (A3)	-.797* 0.276	-.537* 0.199
Aid (A4)	.699* 0.251	0.419 0.188
South	0.166 0.143	0.052 0.125
West	-0.111 0.157	.457* 0.122
North	.336* 0.150	0.141 0.107
SSE	4.15	2.19
Log Likelihood Value	-9.36	5.60

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

Table A3.7
Restricted Model Estimation
Log-Linear Model Specification
Specific State Services
1980

	Education	Transportation	Public Safety
Constant (A0)	-0.559 3.018	2.961 4.08	-9.072* 3.152
Income (A1)	-0.084 0.322	-0.175 0.428	0.500 0.328
Population (A2)	.607* 0.182	0.275 0.211	.992* 0.145
Price Elasticity (A3)	-0.215 0.204	-.458* 0.233	0.148 0.159
Aid (A4)	0.281 0.198	0.388 0.211	-0.136 0.152
South	0.068 0.086	.309* 0.13	.514* 0.08
West	0.002 0.09	0.025 0.125	.381* 0.084
North	-.328* 0.088	-0.069 0.132	.263* 0.092
SSE	1.26	3.53	1.78
Log Likelihood Value	13.14	-5.50	11.01

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A3.8
Restricted Model Estimation
Log-Linear Model Specification
Specific State Services
1980

	Social Services	Environmental
Constant (A0)	-2.031 2.688	11.221* 3.905
Income (A1)	-0.04 0.281	-1.024* 0.407
Population (A2)	.544* 0.139	-0.034 0.196
Price Elasticity (A3)	-.469* 0.152	-.789* 0.075
Aid (A4)	.469* 0.144	.751* 0.218
South	0.006 0.077	-0.015 0.115
West	-.256* 0.08	0.062 0.12
North	.164* 0.083	-0.16 0.123
SSE	1.50	2.83
Log Likelihood Value	14.99	-1.64

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Appendix Four

Table A4.1
Fiscal Complexity Results
County Education Expenditures
1970

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	-2.357*	-6.028*		-2.127*	-6.080*
	0.523	1.086		0.501	0.801
Income (A2)	.224*	.931*		.197*	.747*
	0.059	0.129		0.057	0.096
Population (A3)	.474*	-.092		.418*	.227*
	0.047	0.087		0.053	0.048
Price Elasticity (A3)	-.532*	-1.112*		-.587*	-.789*
	0.053	0.094		0.06	0.052
Aid (A4)	.341*	.769*		.423*	.517*
	0.036	0.068		0.043	0.035
Aid Perception	.818*	.609*		.925*	.605*
	0.21	0.112		0.151	0.126
SSE	10.395	2.24		6.355	3.700
Log-likelihood Value	97.439	61.183		98.816	107.721
Ho: Theta = 1 Chi-Square Statistic	0.748	11.967		0.24	9.678
Partition F-statistic	114. 437 50.570	1. 113		194. 437 146.4	1. 193

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.2
Fiscal Complexity Results
County Environmental Expenditures
1970

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	1.244	6.527*		-.580	4.320*
	1.383	0.914		2.448	0.798
Income (A2)	.679*	0.124		1.255*	.246*
	0.184	0.112		0.351	0.102
Population (A3)	-.792*	-.940*		-1.557*	-.605*
	0.077	0.103		0.183	0.053
Price Elasticity (A3)	-1.947*	-2.116*		-2.173*	-1.780*
	0.074	0.119		0.170	0.058
Aid (A4)	.992*	1.158*		1.753*	.820*
	0.072	0.113		0.165	0.056
Aid Perception	.741*	.510*		.881*	.704*
	0.078	0.087		0.16	0.067
SSE	51.185	9.805		19.415	29.258
Log-likelihood Value	-119.812	-19.661		-60.996	-72.683
Ho: Theta = 1 Chi-Square Statistic	10.751	35.886		0.55	19.494
Partition F-statistic	122, 437 1.112	1, 121		316, 437 0.098	1, 315

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.3
Fiscal Complexity Results
County Social Service Expenditures
1970

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	0.81	5.469*		-1.133	3.800*
	1.967	0.895		2.332	0.804
Income (A2)	0.404	.282*		1.273*	.230*
	0.267	0.109		0.314	0.100
Population (A3)	-.569*	-.964*		-1.499*	-.516*
	0.097	0.073		0.168	0.057
Price Elasticity (A3)	-1.819*	-2.207*		-2.696*	-1.715*
	0.085	0.078		0.16	0.061
Aid (A4)	1.096*	1.205*		1.756*	.807*
	0.086	0.073		0.153	0.054
Aid Perception	.934*	.689*		.887*	.628*
	0.097	0.037		0.077	0.045
SSE	19.544	26.247		21.302	27.463
Log-likelihood Value	-57.024	70.782		-66.922	-66.484
Ho: Theta = 1 Chi-Square Statistic	0.703	68.446		2.085	67.479
Partition F-statistic	266, 437 73.099	1, 265		303, 437 61.898	1, 302

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.4
Fiscal Complexity Results
County Transportation Expenditures
1970

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	2.333*	-3.655*		-6.114*	2.695*
	0.52	1.271		1.299	0.456
Income (A2)	.185*	.659*		.955*	.157*
	0.069	0.150		0.181	0.057
Population (A3)	-.434*	-.042		-.253*	-.416*
	0.036	0.103		0.113	0.03
Price Elasticity (A3)	-1.464*	-.994*		-1.182*	-1.437*
	0.038	0.116		0.112	0.034
Aid (A4)	.974*	.543*		.850*	.912*
	0.034	0.083		0.093	0.031
Aid Perception	.968*	.608*		.770*	.722*
	0.104	0.131		0.24	0.052
SSE	14.886	1.325		3.674	10.251
Log-likelihood Value	62.594	47.142		27.024	106.215
Ho: Theta = 1 Chi-Square Statistic	0.092	8.812		0.911	27.505
Partition F-statistic	78, 437 51.306	1, 77		333, 437 98.311	1, 332

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

Table A4.5
Fiscal Complexity Results
County Public Safety Expenditures
1970

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	-4.523*	-1.850*		-5.511*	-2.484*
	0.840	0.732		1.278	0.551
Income (A2)	.410*	0.096		.405*	.180*
	0.106	0.068		0.182	0.06
Population (A3)	.173*	.214*		0.249	.246*
	0.055	0.093		0.131	0.047
Price Elasticity (A3)	-1.060*	-1.012*		-1.005*	-.971*
	0.053	0.095		0.123	0.048
Aid (A4)	.592*	.565*		.615*	.482*
	0.041	0.072		0.101	0.035
Aid Perception	.525*	.554*		.611*	.454*
	0.042	0.057		0.116	0.03
SSE	12.568	4.185		5.291	10.458
Log-likelihood Value	48.212	47.050		22.271	84.675
Ho: Theta = 1 Chi-Square Statistic	122.214	60.676		11.172	318.199
Partition F-statistic	141, 437 27.318	1, 140		310, 437 50.687	1. 437

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.6
Fiscal Complexity Results
County Education Expenditures
1980

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	-5.903*	-3.971*		-3.286*	-3.273*
	1.711	0.623		0.548	1.611
Income (A2)	.901*	.443*		.464*	.436*
	0.222	0.07		0.066	0.177
Population (A3)	-.080	.264*		.143*	.240*
	0.147	0.035		0.036	0.083
Price Elasticity (A3)	-1.152*	-.711*		-.856*	-.829*
	0.146	0.035		0.036	0.086
Aid (A4)	.739*	.535*		.631*	.481*
	0.109	0.026		0.027	0.062
Aid Perception	.981*	.277*		.901*	.650*
	0.131	0.093		0.074	0.132
SSE	5.766	6.946		4.898	6.014
Log-likelihood Value	-7.103	193.502		207.643	11.075
Ho: Theta = 1 Chi-Square Statistic	0.02	97.585		1.753	6.932
Partition F-statistic	355, 4.37 125.101	1, 354		124, 437 189.741	1,123

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.7
Fiscal Complexity Results
County Environmental Expenditures
1980

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	-6.175*	1.66		-4.881*	-6.486*
	1.268	1.825		2.100	1.334
Income (A2)	.922*	0.27		.458*	.936*
	0.149	0.205		0.233	0.147
Population (A3)	-.509*	-.584*		-.325*	-.496*
	0.063	0.106		0.115	0.064
Price Elasticity (A3)	-1.649*	-1.721*		-1.519*	-1.636*
	0.056	0.099		0.106	0.06
Aid (A4)	1.011*	.976*		.982*	.946*
	0.052	0.089		0.098	0.056
Aid Perception	0.875	.590*		.754*	.427*
	0.089	0.085		0.142	0.073
SSE	22.617	11.943		9.591	28.718
Log-likelihood Value	-52.664	-10.822		-21.292	-66.881
Ho: Theta = 1 Chi-Square Statistic	1.941	22.891		2.966	60.598
Partition F-statistic	182, 437 63.24	1, 181		326, 437 13.866	1, 325

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.8
Fiscal Complexity Results
County Social Service Expenditures
1980

	Tax Concentration		Expenditure Concentration	
	Simple	Complex	Simple	Complex
Constant (A1)	3.467*	1.988	0.288	0.854
	1.181	1.151	1.496	2.064
Income (A2)	0.202	.570*	.899*	0.444
	0.231	0.175	0.177	0.239
Population (A3)	-.731*	-.613	-.981*	-.386*
	0.097	0.067	0.074	0.092
Price Elasticity (A3)	-1.975*	-1.666*	-2.094*	-1.532*
	0.086	0.063	0.071	0.086
Aid (A4)	1.272*	.850*	1.231*	.786*
	0.085	0.061	0.07	0.08
Aid Perception	.700*	.716*	.897*	.625*
	0.061	0.038	0.046	0.055
SSE	15.362	27.096	33.288	14.381
Log-likelihood Value	-42.585	-67.771	-97.452	-37.977
Ho: Theta = 1 Chi-Square Statistic	23.421	55.083	4.774	46.37
Partition F-statistic	291, 437 105.528	1, 290	147, 437 55.381	1, 146

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.9
Fiscal Complexity Results
County Transportation Expenditures
1980

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	-1.392	1.785*		-.339	1.704
	1.17	0.855		0.866	1.146
Income (A2)	.721*	0.153		.511*	0.14
	0.145	0.102		0.104	0.133
Population (A3)	-.520*	-.068		-.253*	-.159*
	0.071	0.041		0.053	0.052
Price Elasticity (A3)	-1.507*	-1.043*		-1.200*	-1.144*
	0.074	0.04		0.054	0.053
Aid (A4)	.927*	.529*		.650*	.686*
	0.063	0.035		0.045	0.044
Aid Perception	.951*	.621*		.909*	.583*
	0.118	0.06		0.086	0.103
SSE	6.158	9.017		12.416	3.496
Log-likelihood Value	12.564	107.582		58.853	47.916
Ho: Theta = 1 Chi-Square Statistic	0.168	38.864		1.098	16.155
Partition F-statistic	310, 437 54.21	1, 309		128, 437 27.457	1, 127

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.10
Fiscal Complexity Results
County Public Safety Expenditures
1980

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	-2.606*	-3.581*		-4.748*	-1.189
	0.91	1.188		0.92	1.178
Income (A2)	.424*	.365*		.613*	0.102
	0.112	0.133		0.107	0.134
Population (A3)	0.02	.205*		.676*	.186*
	0.053	0.084		0.062	0.061
Price Elasticity (A3)	-1.150*	-.942*		-1.079*	-.990*
	0.049	0.079		0.058	0.058
Aid (A4)	.635*	.507*		.595*	.562*
	0.04	0.065		0.04	0.047
Aid Perception	.962*	.435*		.950*	.426*
	0.055	0.027		0.074	0.063
SSE	10.021	6.49		13.041	4.094
Log-likelihood Value	39.235	58.216		49.962	44.399
Ho: Theta = 1 Chi-Square Statistic	0.451	432.37		0.432	87.755
Partition F-statistic	200.437 35.048	1.199		136.437 20.871	1.135

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.11
Fiscal Complexity Results
State Education Expenditures
1970

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	18.176*	-.176		-.845	-4.173
	4.835	2.981		3.189	2.991
Income (A2)	.956*	0.018		-.076	0.627
	0.425	0.338		0.35	0.328
Population (A3)	.767*	.585*		.698*	-2.18
	0.215	0.152		0.165	0.192
Price Elasticity (A3)	-.086	-.186		-.189	-1.076*
	0.235	0.172		0.197	0.218
Aid (A4)	0.071	0.137		0.135	1.509*
	0.197	0.153		0.166	0.205
Aid Perception	.679*	.521*		.845*	.415*
	0.243	0.124		0.175	0.136
South (A5)	0.232	0.005		-.031	0.222
	0.151	0.079		0.102	0.161
West (A6)	.473*	0.067		0.172	-.349*
	0.101	0.101		0.095	0.153
North (A7)	.241*	-.383*		-.124	.236
	0.075	0.100		0.089	0.151
SSE	0.104	0.744		0.677	0.167
Log-likelihood Value	11.436	18.736		18.33	11.121
Ho: Theta = 1 Chi-Square Statistic	1.723	14.722		0.774	18.275
Partition F-statistic	37, 48 34.056	1, 36		15, 48 32.612	1, 14

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.12
Fiscal Complexity Results
State Environmental Expenditures
1970

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	12.617*	6.876*		5.932	7.705*
	3.039	3.407		4.988	3.078
Income (A2)	0.475	-.468		-.816	-.731*
	0.362	0.39		0.55	0.336
Population (A3)	.570*	-.151		.615*	-.062
	0.23	0.143		0.171	0.166
Price Elasticity (A3)	-.284	-.948*		-.107	-1.006*
	0.26	0.168		0.188	0.195
Aid (A4)	0.184	.729*		0.131	.794*
	0.221	0.168		0.167	0.182
Aid Perception	1.010*	.470*		.866*	.517*
	0.236	0.167		0.14	0.127
South (A5)	-.016	.337*		0.027	0.037
	0.101	0.147		0.143	0.113
West (A6)	.558*	.274*		0.085	.345*
	0.112	0.098		0.094	0.1
North (A7)	0.033	.364*		-.423	0.137
	0.101	0.098		0.082	0.108
SSE	0.618	0.333		0.067	0.978
Log-likelihood Value	9.843	17.248		15.784	12.94
Ho: Theta = 1 Chi-Square Statistic	0.001	10.024		0.907	14.403
Partition F-statistic	25, 48 25.77	1, 24		36, 48 29.036	1, 35

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.13
Fiscal Complexity Results
State Social Service Expenditures
1970

	Tax Concentration		Expenditure Concentration	
	Simple	Complex	Simple	Complex
Constant (A1)	1.079	8.093	2.686	-2.432
	3.909	7.683	4.408	3.434
Income (A2)	0.215	-1.059	-.235	0.388
	0.433	0.897	0.487	0.381
Population (A3)	-.363	0.277	-.012	0.026
	0.243	0.251	0.237	0.216
Price Elasticity (A3)	-1.436*	-.873*	-1.195*	-.870*
	0.268	0.301	0.284	0.24
Aid (A4)	1.069*	.776*	.841*	.716*
	0.241	0.313	0.269	0.223
Aid Perception	.992*	.437*	.728*	.329*
	0.259	0.193	0.135	0.152
South (A5)	-.059	-.017	0.146	0.01
	0.127	0.254	0.18	0.214
West (A6)	-.079	-.009	0.156	-.113
	0.145	0.192	0.152	0.206
North (A7)	0.225	0.176	.523*	0.069
	0.129	0.179	0.125	0.217
SSE	1.639	0.501	0.923	0.502
Log-likelihood Value	2.138	4.993	8.835	7.541
Ho: Theta = 1 Chi-Square Statistic	0.0007	8.486	2.696	19.298
Partition F-statistic	17, 48 13.29	1, 16	20, 48 31.794	1, 19

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.14
Fiscal Complexity Results
State Transportation Expenditures
1970

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	18.645*	5.155		13.941	9.551*
	7.562	3.435		7.229	2.245
Income (A2)	-1.810	-.190		-1.051	-.925*
	0.824	0.395		0.808	0.254
Population (A3)	0.281	-.065		-.465	.455*
	0.355	0.169		0.303	0.135
Price Elasticity (A3)	-.556	-.934*		-1.561*	-.355*
	0.395	0.19		0.378	0.153
Aid (A4)	0.496	.639*		1.196*	0.235
	0.346	0.181		0.368	0.139
Aid Perception	.946*	.525*		1.005*	.304*
	0.397	0.132		0.21	0.107
South (A5)	0.146	0.11		-.421	0.134
	0.287	0.104		0.298	0.08
West (A6)	0.199	0.087		0.092	0.11
	0.219	0.123		0.226	0.098
North (A7)	0.109	-.173		-.263	0.157
	0.141	0.121		0.191	0.092
SSE	0.422	1.08		0.745	0.326
Log-likelihood Value	3.832	11.203		5.26	21.275
Ho: Theta = 1 Chi-Square Statistic	0.018	12.765		0.0007	41.685
Partition F-statistic	36, 48 11.281	1, 35		28, 48 34.288	1, 27

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.15
Fiscal Complexity Results
State Public Safety Expenditures
1970

	Tax Concentration		Expenditure Concentration	
	Simple	Complex	Simple	Complex
Constant (A1)	-10.549*	6.262	-1.283	-10.295*
	3.149	2.015	2.888	2.173
Income (A2)	.787*	-1.044*	-.348	.908*
	0.327	0.231	0.314	0.284
Population (A3)	.592*	.794*	.862*	0.203
	0.187	0.086	0.144	0.163
Price Elasticity (A3)	-.280	-.264*	-.142	-.642*
	0.209	0.11	0.166	0.187
Aid (A4)	0.157	0.015	-.015	.586*
	0.183	0.104	0.143	0.17
Aid Perception	.835*	.354*	.476*	.741*
	0.102	0.119	0.036	0.249
South (A5)	.436*	-.436*	-.007	.457*
	0.097	0.086	0.119	0.09
West (A6)	.310*	.326*	.304*	-.067
	0.105	0.047	0.088	0.074
North (A7)	0.143	-.211*	-.129	-.768*
	0.094	0.052	0.074	0.149
SSE	0.96	0.029	0.483	0.114
Log-likelihood Value	12.389	23.345	24.043	13.75
Ho: Theta = 1 Chi-Square Statistic	2.591	29.039	209.121	1.065
Partition F-statistic	15, 48 39.361	1, 14	15, 48 43.47	1, 14

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.16
Fiscal Complexity Results
State Education Expenditures
1980

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	3.484	0.896		-.067	-0.513
	3.786	3.245		2.96	4.54
Income (A2)	-.490	-.134		0.036	-.066
	0.372	0.362		0.326	0.449
Population (A3)	.577*	.575*		.519*	.628*
	0.187	0.177		0.163	0.191
Price Elasticity (A3)	-.366	-.205		-.234	-.161
	0.2	0.215		0.178	0.202
Aid (A4)	0.297	0.229		0.223	0.205
	0.185	0.211		0.169	0.184
Aid Perception	.892*	.541*		0.485	.450*
	0.311	0.171		0.297	0.16
South (A5)	0.347	0.07		0.115	0.265
	0.115	0.098		0.081	0.148
West (A6)	-.137	0.169		0.13	-.104
	0.081	0.114		0.08	0.143
North (A7)	-.401*	-.267*		-.367*	-.055
	0.1	0.11		0.086	0.159
SSE	0.28	0.837		0.73	0.272
Log-likelihood Value	10.754	11.993		17.033	7.711
Ho: Theta = 1 Chi-Square Statistic	0.043	7.115		2.98	11.749
Partition F-statistic	32, 48 22.48	1, 31		15, 48 26.475	1, 14

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.17
Fiscal Complexity Results
State Environmental Expenditures
1980

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	7.751	9.277		19.636*	12.007*
	4.461	5.238		4.292	5.334
Income (A2)	-.845	-1.082		-1.989*	-1.206*
	0.522	0.583		0.481	0.549
Population (A3)	0.352	0.182		-.044	0.23
	0.235	0.298		0.185	0.287
Price Elasticity (A3)	-.425	-.674		-1.031*	-.550
	0.264	0.352		0.193	0.314
Aid (A4)	0.387	.742*		.877*	0.503
	0.243	0.345		0.188	0.299
Aid Perception	0.870*	.673*		.506*	.905*
	0.215	0.181		0.199	0.447
South (A5)	0.107	-.097		-.335*	0.088
	0.121	0.159		0.116	0.221
West (A6)	0.249*	-.014		0.141	0.045
	0.095	0.185		0.098	0.212
North (A7)	0.284*	-.149		-.315*	-.023
	0.107	0.17		0.102	0.245
SSE	0.305	2.358		0.858	0.838
Log-likelihood Value	8.971	-3.683		11.596	1.455
Ho: Theta = 1 Chi-Square Statistic	0.362	3.232		6.122	0.044
Partition F-statistic	24, 48 11.22	1, 23		18, 48 26.748	1, 17

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

Table A4.18
Fiscal Complexity Results
State Social Service Expenditures
1980

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	2.556	-5.989*		-6.674*	7.791*
	5.037	2.697		2.716	3.212
Income (A2)	-.581	0.469		.583*	-1.151*
	0.471	0.3		0.289	0.312
Population (A3)	.887*	0.196		0.209	.816*
	0.279	0.151		0.146	0.16
Price Elasticity (A3)	-.112	-.845*		-.796*	-.169
	0.306	0.181		0.155	0.163
Aid (A4)	0.052	.849*		.777*	0.201
	0.282	0.178		0.147	0.147
Aid Perception	.904*	.608*		.805*	.343*
	0.279	0.127		0.171	0.113
South (A5)	0.227	-.074		0.021	.310*
	0.138	0.085		0.074	0.11
West (A6)	-.078	-.350*		-.032	0.104
	0.105	0.095		0.078	0.106
North (A7)	0.205	-.048		.242*	.314*
	0.126	0.089		0.078	0.13
SSE	0.373	0.637		0.54	0.21
Log-likelihood Value	7.357	17.245		19.882	11.95
Ho: Theta = 1 Chi-Square Statistic	0.116	9.334		1.291	33.353
Partition F-statistic	33, 48 17.545	1, 32		17, 48 32.006	1, 16

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.19
Fiscal Complexity Results
State Transportation Expenditures
1980

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	10.242*	-.732		14.257*	5.275
	5..096	5.233		5.987	3.779
Income (A2)	-.629	-.151		-1.606*	-.221
	0.484	0.587		0.635	0.401
Population (A3)	-.292	.631*		.541*	-.133
	0.254	0.275		0.236	0.222
Price Elasticity (A3)	-.977*	-.216		-.486	-.861*
	0.288	0.325		0.262	0.244
Aid (A4)	.926*	0.236		0.275	.772*
	0.269	0.321		0.248	0.228
Aid Perception	.946*	.518*		.814*	.194*
	0.344	0.232		0.287	0.053
South (A5)	-.002	.423*		0.105	0.302
	0.144	0.137		0.146	0.193
West (A6)	-.049	0.11		.280*	-.042
	0.107	0.18		0.126	0.188
North (A7)	-.005	0.06		-.028	-.045
	0.155	0.176		0.138	0.191
SSE	0.406	2.255		0.812	0.905
Log-likelihood Value	6.681	-2.966		8.157	3.877
Ho: Theta = 1 Chi-Square Statistic	0.024	4.299		0.418	226.071
Partition F-statistic	24, 48 8.512	1, 23		23, 48 25.147	1, 22

Standard Errors are reported beneath the estimates
** = Coefficients that are significant at the 95% level*

Table A4.20
Fiscal Complexity Results
State Public Safety Expenditures
1980

	Tax Concentration			Expenditure Concentration	
	Simple	Complex		Simple	Complex
Constant (A1)	10.321*	7.216*		-3.324	-22.261*
	5.246	2.77		2.838	8.134
Income (A2)	-.622	0.324		0.038	1.714*
	0.488	0.304		0.309	0.773
Population (A3)	-1.240*	1.131*		.853*	.992*
	0.388	0.127		0.15	0.32
Price Elasticity (A3)	-2.285*	.408*		0.024	0.153
	0.403	0.156		0.162	0.346
Aid (A4)	2.112*	-.366*		-.112	-.097
	0.381	0.157		0.152	0.311
Aid Perception	.743*	.576*		1.115*	.633*
	0.202	0.208		0.164	0.227
South (A5)	.597*	.447*		.408*	0.488
	0.096	0.091		0.079	0.273
West (A6)	0.087	.290*		.424*	0.246
	0.09	0.096		0.07	0.266
North (A7)	-.046	.211*		.169*	0.209
	0.094	0.094		0.081	0.292
SSE	0.14	0.727		0.599	0.693
Log-likelihood Value	12.36	17.116		20.413	1.175
Ho: Theta = 1 Chi-Square Statistic	1.603	4.12		0.888	2.588
Partition F-statistic	35, 48 36.05	1, 34		15. 48 20.275	1, 14

Standard Errors are reported beneath the estimates
* = *Coefficients that are significant at the 95% level*

Table A5.1
Pooled Regression Results
County Service Categories

	Income Elasticity	Aid Elasticity	Aid Perception
Education	0.052	.324*	.730*
Transportation	0.519	.656*	.397*
Public Safety	0.516	0.147	.322*
Social Services	0.442	.860*	.594*
Environmental	-1.048*	.584*	.444*

* = *Coefficients that are significant at the 95% level*

Table A5.2
Pooled Regression Results
State Service Categories

	Income Elasticity	Aid Elasticity	Aid Perception
Education	.327*	.592*	.430*
Transportation	.242*	.403*	.544*
Public Safety	.315*	.436*	.589*
Social Services	.188*	.802*	.585*
Environmental	.317*	.826*	1.056*

* = *Coefficients that are significant at the 95% level*

VITA

Peter Mitias graduated with a B.S. in Economics from Millsaps College in May of 1990. He entered the graduate program in Economics at American University in Fall of 1990. He transferred to Louisiana State University in the Spring of 1991. His fields of study include urban and regional economics, resource and environmental economics, and public policy. He has taught Introduction to Macroeconomics and Microeconomics, Intermediate Microeconomics and Law and Economics. He has received two Department of Economics Excellence in Teaching Awards and one College of Business Administration Partnership in Excellence Teaching Award. Peter is currently an Assistant Professor of Economics at Hampden-Sydney College. Peter is a member of Omicron Delta Epsilon, American Economic Association, and Southern Economic Association.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

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