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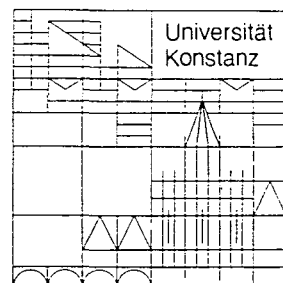
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Stanley L. Winer  
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Related Tax Instruments**

# **EXPLAINING THE USE OF RELATED TAX INSTRUMENTS**

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## ABSTRACT

A new view is emerging in the economic literature on how to analyze and interpret national and subnational revenue systems. Recent work has shown that such systems can be modelled successfully as sets of related policy instruments that are being shaped and used deliberately by vote-maximizing governments. We extend existing empirical work by estimating a two-equation system designed to investigate the use of related tax instruments by U.S. states. The model focuses on two decisions: how much to rely on personal income as a tax base and whether to introduce an income tax credit or rebate for local property taxes. We also raise some general methodological problems that empirical research in the expected vote-maximizing tradition must deal with in the future.

JEL Classification: H11, H20, H71

## 1. Introduction

A new perspective is emerging in the economic literature on how to analyze and interpret national and subnational revenue systems. Recent work has shown that such systems can be modelled successfully as sets of related policy instruments that are being shaped and used deliberately by democratic governments. The new theoretical understanding is giving rise to a growing body of empirical work that aims to explain major aspects of public revenue systems observed in western countries.

Since the new view emphasizes political factors along with economic ones, a theoretical framework is needed that can accommodate both types of influences, while also successfully explaining political choices among complex objectives. Most recent research on revenue systems uses a version of the spatial voting model as the underlying theoretical framework. In this model, voting is probabilistic and governments are regarded as expected vote-maximizers that choose tax instruments, debt and public expenditures so as to maximize their chances of winning the next election. In making fiscal choices, which must be continually readjusted in response to changing circumstances, such governments are subject to the constraints of existing political institutions and of the general equilibrium structure of the economy.

Although applied studies only rarely spell out the link to theoretical work on probabilistic voting models, they do owe an intellectual debt to recent research by Coughlin and Nitzan (1981), Enelow and Hinich (1989), Coughlin, Mueller and Murrell (1990) and others, who have provided a formal underpinning for the approach with the analysis of specific election games underlying expected vote maximization (for a survey, see Coughlin 1990a and 1990b). Like other research tying public sector outcomes to voting, initial work on revenue systems relied on the median voter model. Since the model forces all choices into a single dimension, it was suitable only for the study of

*re. fiscal tax*  
carefully selected aspects of tax systems and could not be used to explain the general nature of revenue structure, which is inherently complex and multi-dimensional.

The new view is reflected in research on revenue systems that is being carried out in the United States, Canada and Europe. While it would take us too far afield to mention all relevant articles, or to give credit to all authors that have made or are making contributions, we want to briefly illustrate the variety and scope of recent work in the area.

In our previous research, we have developed the theoretical implications of expected vote maximization for revenue structure (Hettich and Winer 1988) and applied the approach in econometric studies using cross-sectional data for U. S. state governments (Hettich and Winer 1984) and time series data for the federal government of Canada (Winer and Hettich 1991). Pommerehne and Schneider (1983) have combined expected vote maximization with the view that reelection pressure is weak between scheduled elections to model the revenue choices of the Australian federal government. Inman (1989) has formulated a detailed and rather different model of fiscal choices applying to large American cities and incorporating distributional considerations. In two unpublished papers, Chernick (1991a, 1991b) combines the focus on distribution found in Inman with elements emphasized in our work to provide a new analysis of tax structure at the state level.

A quite different approach is taken by Moomau and Morton (1992) who analyze voter choices on the adoption of a specific feature of property taxes in a referendum. Van Velthoven and Van Winden (1991) adapt the interest group model developed by Van Winden (1983) for the Netherlands in order to formulate a theoretical analysis of tax reform. And Gillespie (1991) employs expected vote maximization as a framework in detailed research of a historical nature on the evolution of Canadian federal tax policy.

While the work cited above indicates that research informed by the new view is proceeding

vigorously, there is much that remains to be resolved. In the present paper, we attempt both to make a specific contribution to the study of revenue systems at the state level and to raise some of the broader questions that face empirical work based on the new perspective.

The paper examines differences in the joint use of two tax instruments among state governments: reliance on the personal income tax base and the granting of income tax relief for property taxes paid at the local level. The analysis differs from earlier work by presenting a framework allowing explicitly for the simultaneity of instrument choice and by focusing on linkages among fiscal systems at different levels of government. Some more general questions concerning research in this area are raised in a final section.

## **2. Tax Rates and Special Provisions**

A vote-maximizing government will balance two competing aims in creating a revenue system (Hettich and Winer 1988). On the one hand, it would prefer to differentiate as much as possible among diverse tax payers with the aim of minimizing political opposition to its tax policy. On the other hand, it must consider the transaction and enforcement costs caused by giving special treatment to different taxpayers. The resulting compromise is a complex tax structure containing all the essential elements of revenue systems observed in the real world, namely multiple tax bases, separate rate structures and a variety of special provisions. Actual revenue systems must be interpreted as the outcome of simultaneous choices across all three of these policy dimensions.

It is not surprising that existing empirical research based on the vote-maximizing model does not reflect the full simultaneity of policy choices implied by formal reasoning: theoretical complexity, data limitations, as well as difficulties related to econometric procedure, prevent implementation of a fully comprehensive approach. In designing empirical work, one is thus faced with the necessity



of limiting oneself to a particular aspect of the larger system. So far, most statistical studies dealing with fiscal systems at the state level have focused on what determines the pattern of revenues. Special provisions, although an important element in practice, have not as yet been integrated separately into the analysis.

The income tax represents one of two revenue sources that predominate at the state level. (The other major source is general sales taxation). Yet we observe considerable variation among states in the relative reliance on this base, making it a significant subject for study in the present context.<sup>1</sup> State credits and rebates for property taxes paid at the local level are of particular interest because they have become a widespread feature of state tax systems, and because they provide a direct link to local taxation. One should also note that Moomau and Morton (1992) have shown the existence of provisions of this nature to be consistent with vote-maximizing behavior.

While this paper attempts to extend empirical research falling into the vote-maximizing tradition, it also has a relation to work on state finance based on other approaches. There is an extensive literature dealing with selected aspects of state fiscal systems, such as interstate tax competition and the federal offset for state income taxes, which does not model political behaviour in formulating estimating equations. Since the same factors also play a role in our analysis, we shall make reference to this literature whenever appropriate in the section discussing the choice of explanatory variables.

### **3. The Model for Empirical Estimation**

#### **A. General Framework**

Consider a political system in which taxpayers vote on the basis of how policy proposals affect their utility and in which voting decisions are seen as probabilistic from the perspective of

political parties. Assume that competition for power forces political parties to propose policies so as to continually maximize expected votes. Under appropriate conditions concerning the expected vote function for any party, there exists a unique set of policy platforms representing a Nash equilibrium for this political system (see, for example, Coughlin, Mueller and Murrell 1990). Existence of the equilibrium depends on the continuity of expected vote functions, a continuity that stems from the probabilistic nature of voting behavior. Uniqueness of the program proposed by any party is assured if the expected vote function of any candidate or party is strictly concave in its own policies and strictly convex in the platform of the opposition.

Given this view of the process determining equilibrium policy outcomes, the equilibrium fiscal system proposed by the government can be characterized as a set of policies that maximize expected votes for the governing party subject to a budget restraint and the general equilibrium structure of the economy.<sup>2</sup> Let  $f = \{f_1, f_2, \dots, f_k\}$  be the proposed tax system, where  $f_j$  is a typical element or instrument such as a tax base, a tax rate or a special provision; let  $G$  be the level of public goods and services; and assume  $X$  represents the vector of all variables exogenous to the government. For convenience, the general equilibrium structure which relates  $f$ ,  $G$  and  $X$  is substituted into the government's problem rather than left as an explicit constraint on political optimization. We can then write the indirect utility function of a typical voter as  $v_i = v_i(f, G, X)$  for  $i = 1, \dots, n$  (the number of voters) after substitution of the general equilibrium structure. Let  $R(f, X)$  represent total revenues including the issue of debt and  $A(f, G, X)$  represent total administration costs, with both of these functions incorporating relevant general equilibrium relationships. (Since we are interested in modelling tax structure, it is convenient to represent expenditure structure as consisting only of an aggregate purchase of goods and services  $G$  and to ignore the possible influence of  $G$  on  $R$  through the general equilibrium structure of the economy). The politically optimal fiscal system

{f,G} is one that will:

$$\underset{\{f,G\}}{\text{Maximize}} \quad EV(f,G,X) \quad (1)$$

where

$$EV = EV \{ v_1(f,G,X), \dots, v_n(f,G,X) \} \quad (2)$$

subject to

$$R(f,X) = G + A(f,G,X) \quad (3)$$

and

$$f_j \geq 0, \quad j = 1,2,\dots,k. \quad (4)$$

The non-negativity constraints in (4) are included to acknowledge the possibility that it may not always be optimal for the government to use all feasible tax instruments. It is implicitly assumed that G is always positive.

The first order conditions for the above problem consist of the constraints (3) and (4) above along with:

$$\frac{\partial EV}{\partial f_j} / \left\{ \frac{\partial R}{\partial f_j} - \frac{\partial A}{\partial f_j} \right\} \leq -\lambda \quad (5)$$

and

$$\frac{\partial EV}{\partial G} / \left( 1 + \frac{\partial A}{\partial G} \right) = \lambda. \quad (6)$$

where it is understood that all partial derivatives incorporate the full equilibrium consequences of

changes in  $f_j$  and  $G$ . These conditions indicate that in a competitive political system, the government will be forced to adjust tax structure and the level of public purchases until the marginal effect on expected votes per dollar of net revenue (net of the change in administration costs) is equalized across all fiscal instruments in use. When talking about revenue structure, which is the focus of this paper, we can interpret the first order conditions as indicating that a government chooses tax structure so as to minimize the total loss in support caused by the raising of revenue.

### B. Estimating Equations

One way of representing the solution to the first order conditions, assuming that a solution exists, is by a set of simultaneous semi-reduced form equations of the following kind:

$$f_j = f_j (f_1, f_2, \dots, f_{j-1}, f_{j+1}, \dots, f_k, G, X) ; f_j \geq 0 \quad (7)$$

$$G = G (f_1, f_2, \dots, f_k, X) ; G > 0 \quad (8)$$

In this paper we are interested in the effect on the equilibrium tax system  $\{f_1, f_2, \dots, f_k\}$  of changes in selected exogenous factors included in the vector  $X$ , and in the interdependence of selected tax instruments.

While the system of equations represented by (7) and (8) is very general and must be greatly simplified before empirical work can be conducted, it is by no means a completely general statement of the politically optimal fiscal system. As already noted, the structure of expenditures and the relationship between expenditure and revenue structures have been suppressed in order to focus on the revenue side of the fiscal system. In addition, no account is taken of the fact that the revenue instruments  $f_j$  in (7), representing features such as the definition of a particular tax base, are

themselves the result of optimizing decisions by the fiscal authorities, who continually adjust the precise specification of the components of the revenue system to accommodate changes in administration costs, the structure of the economy and the composition of the electorate (Hettich and Winer 1988).

While being fairly complicated, the two-equation model that we estimate forms only a small part of the more complex system represented by equations (7) and (8). The model represents a first step in exploring the connections between decisions by U.S. states on how much to rely on the personal income tax base, represented by the ratio of personal income tax revenue to personal income, and decisions concerning the precise structure of the personal income tax, represented by the presence or absence of a credit or rebate for the payment of the local property tax.

A complete explanation of state tax systems would include the determination of federal and local fiscal systems which are connected to the state system through tax deductions and credits granted by one level of government for taxes paid to other levels, and via intergovernmental grants. Moreover, a full model would also include strategic competition over tax bases between levels of government. In such a situation, it is necessary to simplify by focusing on interdependencies that seem particularly relevant, and by looking at selected parts of the larger system, while being aware of the general equilibrium nature of the fiscal system in the country as a whole.

The specific model that we consider can be written briefly as follows. Here  $YRATE^*$  reflects the (unobserved) political pressure to rely on personal income as a tax base in order to minimize the loss in support due to the raising of revenue.  $YRATE$ , which may be zero, is the actual reliance on the income tax base as measured by the ratio of personal income tax revenue to personal income in the state.  $CREDIT^*$  represents (unobserved) political pressure to grant local property tax relief in the form of a credit or rebate against the payment of state taxes, and  $CREDIT$  is a dichotomous variable

which takes the value one, if property tax relief is actually given, and the value zero, if it is not.  $Z$  is a vector of endogenous, continuous variables; the  $X_i$  are vectors of exogenous variables, all of which are discussed at length in the next section; and the  $\epsilon_i$  are error terms. Subscripts denoting state and time are omitted for convenience:

$$YRATE^* = \alpha_0 + \alpha_1 CREDIT^* + \alpha_2 Z + \alpha_3 X_1 + \epsilon_1 \quad (9)$$

$$YRATE = YRATE^* \text{ if } YRATE^* > 0; = 0 \text{ if } YRATE^* \leq 0,$$

and

$$CREDIT^* = \beta_0 + \beta_1 YRATE^* + \beta_2 X_2 + \epsilon_2 \quad (10)$$

$$CREDIT = 1 \text{ if } CREDIT^* > 0; = 0 \text{ if } CREDIT^* \leq 0.$$

Equation (9) is a Tobit estimating equation, while (10) is a Probit equation. It should be noted that the unobserved (starred) values of the dependent variables, not their observed (unstarred) counterparts, appear on the right side of the equations.

The use of censored and dichotomous dependent variables acknowledges that due to the particular characteristics of voters in a state, coupled with fixed administration costs or other constraints on the design and implementation of tax instruments, particular instruments may not be in use in all states. Even when the effect of an instrument on expected votes is not sufficient to justify its use as part of the equilibrium structure in a state, however, that instrument will still have a potential, unobserved effect on expected support. For example, at a low level of income taxation there may be 'pressure' from some voters (which ideally would be measured in terms of the loss in expected votes) for a credit against the payment of property taxes, even though that pressure is not sufficient to lead to use of such a credit as part of the state tax system. This unobserved effect on

political support is represented in the model by the (starred) unobserved values of the policy instruments.

The model allows for the possibility that the decision on how much to rely on personal income will play a role in the decision on whether to give property tax relief by introducing a special provision into the tax base. The granting of property tax relief may simultaneously influence the loss in support from, or political opposition to, reliance on personal income as a tax base.

Through the variables in Z and X, the model also admits the possibility of links to the rest of the state fiscal system and to the fiscal system of the federal and local governments, as well as to various exogenous factors.

### **C. Detailed Discussion of Explanatory Variables.**

Since the effect on expected votes associated with changes in different components of the revenue system cannot be observed directly, the analyst must adopt an indirect approach. Empirical research can proceed by identifying factors that vary among political units and that may explain different equilibrium choices for fiscal instruments.<sup>3</sup>

Determinants relevant to the analysis, and the corresponding explanatory variables, will be discussed according to the type of influence that they represent. We begin with an examination of determinants underlying equation (9) which is designed to explain variations in the reliance on personal income as a tax base. To help the reader gain an overview, the presentation of explanatory variables is summarized in the accompanying Table 1. All variables in the table have been defined independently of state size or have been normalized, where appropriate, by state income or population in order to minimize problems due to heteroscedasticity in cross-section samples.

[Table 1 here]

The existence of special provisions in the personal income tax will influence reliance on income taxation. As already noted, we focus on such provisions for property owners. Information on special treatment is summarized by the dichotomous variable CREDIT introduced above. Since the theory suggests that special provisions are created as a means of lowering opposition to the use of particular tax bases, we expect a positive sign for CREDIT.

As is now accepted practice in the literature, we also include factors that reduce opposition by lowering effective tax rates for state taxpayers at the expense of those who live elsewhere. We consider two ways in which state governments may shift a part of the fiscal burden. The first one concerns the existence of a federal tax deduction for income taxes paid to state governments, lowering the cost of state tax liabilities for those who itemize on their federal returns. This aspect of fiscal policy has received much attention in the literature on state finance in recent years [see for example, Feldstein and Metcalf (1987), Chernick (1991a), Lindsay (1988), Holtz-Eakin and Rosen (1988), Pollock (1991) and Metcalf (1991) among others].

TAXPRICE is the average federal tax price, equal to  $(1 - p \cdot m)$ , where  $p$  is the proportion of itemizers in a state and  $m$  is the average federal marginal tax rate of itemizers (Feldstein and Metcalf 1987, p. 712). Because the decision by a state to rely more heavily on the personal income tax will influence the individual taxpayer's decision on whether or not to itemize, and because it will also influence the federal marginal tax rate faced by itemizers (since that marginal rate depends on the magnitude of deductible state income taxes), TAXPRICE is an endogenous variable in the equation for YRATE\*. In the estimation of that equation by the instrumental variable methods described below, we follow Feldstein and Metcalf in employing as one of the instruments a synthetic tax-price constructed by using the TAXSIM model of the National Bureau of Economic Research, for the calendar year preceding the fiscal year covered by the dependent variable. This synthetic tax-



price is highly correlated with TAXPRICE but is uncorrelated with the error term in the YRATE equation.<sup>4</sup>

Taxing visitors (and interstate commerce in general - see McLure, 1967) represents a second way in which fiscal burden may be moved to nonresidents. To indicate a state's potential for such shifting, we include TRAVEL, defined as domestic travel-generated business receipts per dollar of state personal income, following work by Gade and Adkins (1990) on the same subject. A negative sign is predicted.<sup>5</sup>

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The reliance on a particular base is also influenced by the availability of alternative ways for raising revenues from state residents. A vote-maximizing government will use available tax bases until the marginal loss in expected votes per dollar raised is equalized across all revenue sources. Since opposition is influenced by the full cost of taxation (tax payments plus welfare loss), and since welfare losses grow more than proportionately as greater reliance is placed on a particular base, we would expect governments having better alternatives to place less emphasis on the income tax. As in Hettich and Winer (1984) and in several papers by other authors since, we represent potential alternatives by RBY, the ratio of the state's resource tax base to personal income and by SBY, the state's sales tax base relative to personal income. In both cases, negative signs are expected. In addition, we introduce a variable related to the state's ability to raise revenues through debt, since borrowing is a policy instrument that can substitute for taxation. It is represented by BONDLIMIT and has been based on recent work by von Hagen (1991), who provides a classification of constitutional and other restrictions applying to state debt. Since the variable assumes a value of one if the state is subject to nominal debt limits or percentage limits, while being zero otherwise, we expect a positive sign.<sup>6</sup>

The variability of a base may also be expected to influence its relative use, a point initially

made in the context of state tax systems by Vogel and Trost (1979). Taxpayers, as well as public decision makers, will prefer tax systems yielding stable revenue streams to those giving fluctuating receipts in order to avoid the continuing costs of adjustment associated with fluctuating revenues.<sup>7</sup> A similar argument also applies to any given tax base, with states that have a more stable experience with a particular tax base placing greater reliance on it. We represent base variability for the income tax with STD, the standard deviation for the period from 1970 to 1986 in the annual change of real personal income. A negative sign is predicted.

Recent work by Inman (1989) and Chernick (1991a, 1991b) raises the possibility that distributional considerations may enter fiscal choices directly. Since income taxation represents a favoured tool to carry out distributive policies, greater pressure for adoption of such policies may result in greater reliance on personal income as a tax base. We test for the possibility of this effect by including POOR/RICH, defined as the ratio of the number of taxpayers with less than \$25,000 in adjusted gross income to the number whose adjusted gross income exceeds \$50,000.<sup>8</sup> Higher values of POOR/RICH are likely to be associated with greater pressure for reliance on income taxation and thus with higher income-tax rates.<sup>9</sup>

The literature on state and local taxation contains many references to tax competition among governmental units at the same level (see, for example, Tannenwald 1991 and Gold 1991). Because such competition can assume many different forms, it is difficult to formulate variables that fully capture the influence of competitive forces of this nature. Interstate competition may involve many aspects of the fiscal system and not just the tax instruments represented by the dependent variables in our equations. Nonetheless, we investigate competition with respect to the use of the personal income tax.

Since interstate competition is likely to be more intense in situations where labour mobility

is less costly, it seems reasonable to use a variable that reflects the use of the income tax in neighbouring states to indicate the nature of regional tax competition. We use REGION, the average YRATE in such states as an indicator of geographical tax competition. If a state's neighbours raise their tax rates, it will be also be possible for this state to increase rates, and thus tax revenues<sup>10</sup>, without precipitating politically damaging migration.<sup>11</sup> A positive sign is expected.

Taxpayers (and firms) who are considering a move somewhere within the country as a whole may face fixed costs that are greater than those associated with moves to nearby locations, especially when interstate commuting is feasible.<sup>12</sup> But once the decision to move has been taken, the marginal costs associated with changing the distance moved may be quite low. In this case, as argued in Hettich and Winer (1984), states may also be forced to compete with all other states, regardless of the distances involved. To reflect national competition for taxpayers who are highly mobile, we use NATIONWIDE, the YRATE in the state with the most similar social conditions, as reflected by the ratio of poor to rich taxpayers (i.e., with the most similar POOR/RICH). As in the case of REGION, a positive coefficient is expected on NATIONWIDE.<sup>13</sup>

The final explanatory variable in the equation explaining reliance on the income tax base represents total state expenditures per capita, GN. It is included to reflect possible scale effects that may operate in fiscal choices across states. Since it is an instrument chosen by the state along with tax structure, as in the system of equations (7) and (8), GN is regarded as an endogenous variable.

The second statistical relationship (10) in the system of two simultaneous estimating equations is designed to explain variations in the pressure on public decision makers for adoption of a property tax credit or rebate (CREDIT\*). We should note that YRATE\*, the dependent variable in the first equation, is included on the right hand side of (10). Greater pressure for a state to rely on income taxation as a revenue source will create increased pressure to create special provisions in the income

tax base, making it more likely that property tax credits or rebates will be instituted. A positive sign is predicted.

Since pressure to introduce a special provision granting property tax relief emanates from a particular group of taxpayers, namely homeowners, explanatory variables must relate primarily to the characteristics of that group. The first one in this category, HOUSEPRICE, defined as the percentage change of average house prices in the state from 1970 to 1980, reflects recent growth in the property tax base.<sup>14</sup> We expect a positive sign since such growth tends to cause higher property tax bills, thus creating increased pressure for relief. The variable OWNERSHIP, defined as the proportion of a state's housing that is owner-occupied, represents the relative size of the target group. Again, a positive relationship is expected. A similar argument applies to the third variable, OVER65, standing for the percent of the state's population over 65 years of age. Taxpayers in this age group frequently are homeowners, while also being politically active. Since many will be on fixed incomes, they may react more strongly to increases in property tax bills than the general population and constitute a vocal subgroup of those interested in property tax relief. A positive sign is predicted.

The equation also includes an explanatory variable of a more general nature. LOCAL represents the ratio of local public expenditures to total expenditures by governments at both the state and local levels. It stands for the relative size of the local sector and is assumed to be largely independent of tax structure choices at the state level. We expect higher values to result in greater pressure for tax relief, since a larger local share generally implies higher property tax rates. A positive coefficient is expected.<sup>15</sup>

As a final variable, we include BONDLIMIT, which also appears in the first equation, in order to represent the possible influence of such restrictions on the structure of the income tax base.

In the past, the effects of bond limitations have been investigated in order to analyze the ability of states to avoid them by engaging in off-budget activities (Bennet and DiLorenzo 1983). Attempts have also been made to determine whether per capita debt figures, or debt to income ratios, are lower where bond limitations are more severe (von Hagen, 1991). When we are concerned with revenue structure, we must expect a more pervasive effect since the various components of the revenue system are interrelated. In consequence, we test for the possibility that constraints on the ability to issue debt will make it less likely for a state to yield to pressure for property tax relief. A negative sign is expected on the coefficient of BONDLIMIT in the CREDIT\* equation.

#### **4. Data and Estimation Results**

The data consist of observations on the 50 states for the years 1985 and 1986. These years precede the Tax Reform Act of 1986 and follow adjustments to the severe recession of 1980-82, thus representing a period of relative stability in the tax systems of the states (Gold 1991, 206).

Table 2 summarizes selected aspects of state reliance on the personal income tax for the fiscal year 1985. As a proportion of total revenues including borrowing, income tax revenues in 1985 vary widely across states, going from zero to 64 percent. Six states do not tax any component of income, while Alaska raises a very small residual amount from a recently discontinued income tax. The corresponding average tax rates (YRATE) assume values from zero to 3.86 percent of personal income. Although these rates also vary somewhat across the two years of the sample, the main source of variation derives from the cross-section component of the data.

[Table 2 here]

Thirty-one states have a credit or rebate (CREDIT) for the payment of local property tax in 1985.<sup>16</sup> Note that Nevada and South Dakota have a rebate, but no income tax. The value of

CREDIT for each state is the same for both years of the sample.

Estimation of the two equation system (9) and (10) is complicated substantially by the censored and dichotomous nature of the dependent variables revealed by Table 2. Since the model is formulated using the unobserved values of dependent variables on the right side of the equations, there are no 'unique solvability' or 'consistency' requirements to be met by the estimated coefficients (see, for example, Schmidt 1983).<sup>17</sup> As Maddala (1983, 246) points out, however, devising consistent estimators of the coefficients along with appropriate standard errors is a difficult task. We use two quite different estimation procedures. The simpler method, the results of which are given in Table 3, consists initially of estimating a reduced form Tobit equation for YRATE and a reduced form Probit equation for CREDIT. Then the actual values of the dependent variables on the right side of the system (9)-(10) are replaced by the predicted values of these variables from the reduced form estimation. Equation (10) is then estimated by the Probit method. Since equation (9) contains continuous dependent variables TAXPRICE and GN besides CREDIT\*, and since it has only six censored observations for YRATE\*, it is estimated by two-stage least squares. (The instruments used are listed in the notes to the table). As the equations are estimated by instrumental variables methods, no account is taken here (or below) of possible cross-equation correlation of errors.<sup>18</sup>

[Tables 3 and 4 here]

The second method, reported in Table 4, employs the orthogonality condition, instrumental variables estimators in the Hotztran statistical program (Avery and Hotz 1985). This includes an further allowance for heteroscedasticity in addition to the normalization of variables by income or population noted earlier. To insure convergence of the non-linear optimization algorithm that minimizes the weighted sum of orthogonality conditions, most variables that are insignificant in Table 3 in the YRATE equation are omitted in the estimation recorded in Table 4. In addition, achieving

convergence requires the use of reduced form, predicted values of dependent variables as instruments rather than a set of exogenous variables. While this means that the reported standard errors are not completely correct, the close agreement of the results in both tables suggests strongly that our conclusions would not be overturned by the use of some other estimation method.

The signs of coefficients in Tables 3 and 4 generally correspond to the predicted signs in Table 1, and several of the results are of particular interest. Because the signs and significance of coefficients are quite similar across estimation methods, the following discussion of the results refers to both Table 3 and Table 4 unless otherwise stated.

The results indicate that reliance on personal income, as measured by YRATE, has a significant and positive effect on the decision to give a CREDIT for the payment of the local property tax. It would appear, however, that the decision to introduce a credit or rebate is not a significant determinant of how much states rely on income as a base, at least not relative to other factors included in the YRATE equation. One should note that such a provision is just one of many special features of the state income tax structure, and that it may not have a detectable influence by itself on opposition to the income tax.

Judging by the standardized coefficients in column (1a) of Table 3, the factors most influential in the decision about reliance on the income tax base are the price (TAXPRICE) of federal public services facing state taxpayers, a result which emphasizes the importance of acknowledging links between fiscal systems at different levels in a federation, the size of the natural resource tax base relative to personal income (RBY)<sup>19</sup>, and competition with neighbouring states (REGION). Tax competition with other states in the country as a whole (NATIONWIDE) and the variability of the income tax base (STD) are of somewhat lesser importance.

The reliance on income as a base does not appear to be significantly related to the existence

of bond limits (BONDLIMIT), the relative number of poor taxpayers (POOR/RICH), nor to the size of the state's public sector (GN).

The sign of the coefficient on REGION, the variable representing competition for mobile factors within a region of contiguous states, is the only one differing from what is predicted in Table 1. In both Tables 3 and 4, REGION has a negative and significant coefficient. Contrary to our hypothesis, higher tax rates in a state's geographic neighbours appear to lead to a lower rate in that state. On the other hand, NATIONWIDE, which represents competition within the country as a whole, has the expected positive, significant sign.

The results given in the Tables are based on the assumption that REGION is an exogenous variable. It is possible, however, that tax rates of geographically neighbouring states are correlated because of the existence of economic shocks that affect several neighbouring states at the same time, or because of strategic interaction between the tax policies of neighbouring states (Besley and Case 1992). In either case, REGION will be correlated with the error term in the equation for YRATE and should be considered an endogenous variable. To allow for this possibility, the predicted values of tax rates from a reduced form Tobit equation were used to form an instrument for REGION. This instrument was then used in the two-step estimation procedure described above, in which REGION was added to the list of endogenous right-hand side variables. Results are essentially the same as reported in columns (3a) and (4a) of Table 3 and so are not given here. It appears that the sign of the coefficient on REGION does not depend on whether this variable is treated as exogenous or endogenous.<sup>20</sup>

The results with respect to both geographic neighbours and competition within the country as a whole are similar to those obtained by Chernick (1991a, 1991b), who suggests that the negative sign on (his version of) REGION may be the consequence of a 'tax haven effect'. If income is taxed



at the location of employment and if there is interstate commuting, an incentive could exist for states with the most employment to keep rates high and for residential states to keep them low. Examples (Chernick 1991a, 27) may be New Hampshire with a YRATE of 0.16 percent and Massachusetts with a rate of 3.33 percent in 1985. Other low-high pairings include Connecticut (YRATE = 0.50 in 1985) as against New York (3.71), and Washington (no tax) as against Oregon (3.86). If confirmed by other studies, such a pattern of results could serve as the starting point of further theoretical work on interstate tax competition. As yet, it remains unclear what theoretical model could produce this type of tax competition.<sup>21</sup>

The equation explaining the decision to grant property tax relief also works well. Only the variable representing house ownership (OWNERSHIP) is clearly insignificant. Coefficients on other variables have the expected signs, including BONDLIMIT which is significant at 10 percent in some equations. While the results in the tables constitute only a first step in integrating structural features of the tax system into empirical research, they indicate that it is possible to jointly model the structure of a tax base together with the decision about the relative reliance on that base.

As a final comment on the results, we note that state property tax relief may have a substantial influence on the structure of local tax systems, while the decision to grant a CREDIT for local property taxes does not appear to influence the overall pattern of state revenue sources. This is another link between fiscal systems in a federation that may deserve further investigation.

## 5. Concluding Remarks

In this paper we view the revenue system as a set of related instruments, including tax bases, rate structures and special provisions. The use of these instruments depends on political objectives and is constrained by competition between political parties, existing political institutions and the

general equilibrium structure of the economy. Being a mix of policy instruments, fiscal systems cannot be described adequately by a unique parameter. Understanding a tax system requires the study of at least two instruments and explicit allowance for their interdependence.

The approach to the modelling of fiscal systems that incorporates political decision making within an equilibrium context, termed in the paper the new view, is being applied by a growing number of researchers. We have formulated a two-equation model in this tradition that is designed to investigate the simultaneous choice of a tax share and a special revenue provision. The model deals with the decision by U.S. states on how heavily to rely on income as a tax base, and the related decision on whether to introduce a credit or refund for the payment of local property taxes. The analysis acknowledges the possibility of links among different state revenue systems arising from tax competition. In addition, it allows for connections between state fiscal systems and those of federal and local governments, which may result from specific structural features present at each level.

Three types of results stand out concerning state tax systems. First, the relative size of tax bases (and beneath this the structure of economic activity) is an important factor in determining the relative reliance on different bases, probably because of the implications for the overall welfare cost of the tax system. Second, the explicit allowance at the federal level for taxes payed at other levels of government has a substantial effect on state fiscal systems by changing the burden of state taxes. And finally, tax competition between neighbouring states seems to proceed in a quite different manner than interstate competition within the country as a whole. This last finding may be related to the fact that migration between neighbouring states is subject to different fixed and marginal costs than migration within the country as a whole, as well as to the asymmetry in size between many neighbouring states.

While the empirical results in this paper indicate that applied research on the joint use of

instruments is feasible and can yield significant conclusions, the investigation also points to some unresolved difficulties. As indicated in the earlier discussion, probabilistic voting and expected vote maximization provide the theoretical background for research based on the new view. As yet, there have been few attempts to link this more general approach to the functioning of institutions for which a detailed decision structure has been spelled out.<sup>22</sup> While estimating equations used in most empirical work informed by the new view are based on broad principles consistent with the underlying theory, they do not represent the unique product of a decision framework reflecting actual institutional detail. It remains to be seen whether future work will forge a more direct link between institutional arrangements and econometric research.

Limited structural detail may be related to a second question that should be of interest to future researchers. At present, analyses of state revenue systems informed by the new view stand side by side with studies of fiscal characteristics that make no allowance for political decision making in formulating empirical models. Nevertheless, these studies may arrive at quite similar estimating equations and may obtain comparable statistical results. Research on how to distinguish more clearly between different types of models and their predictions would be a valuable addition.

Finally, the focus on policy instruments as part of a larger equilibrium system raises two related difficulties for research. The first one is of a statistical nature. Since a particular instrument may not be used by all decision makers in the sample, dependent variables may be censored or dichotomous. As illustrated in the paper's empirical analysis, this can lead to systems of simultaneous equations where both these types of dependent variables are present, requiring the use of special estimation techniques.

The second problem is of a more conceptual nature. In a world in which fiscal structure is an equilibrium outcome of political and economic competition, it is necessary to study the nature of

links empirically in order to find those that are most important. At the state level, this requires studying interdependencies between instruments at the same level of government as well as between levels of government. The basic techniques are similar to those used in other investigations of equilibrium systems: one can analyze the effects on the system as a whole of changing exogenous factors that have an impact on particular parts of the system; and one can consider the strength of interdependencies by estimating structural or semi-reduced form relationships. Additional work that would guide empirical researchers in choosing relevant parts of the system for study and in their selection of estimating equations would be of great help in advancing research in this area.

The study of particular fiscal choices is of interest in its own right, but it can also serve a broader purpose. Advances in the analysis of revenue instruments and of their simultaneous use may have applications in other areas of the public sector, and may thus lead to a better theory of policy choice in general. Perhaps this prospect will provide sufficient motivation for researchers to overcome the theoretical and technical problems outlined above.

## Endnotes.

1. In addition, the focus on the income tax allows us to compare the present work with our own earlier research (Hettich and Winer 1984).
2. Strictly speaking the expected vote function for the government depends on the policies proposed by the opposition as well as the government's policies. However, if in equilibrium the proposals of all parties converge, as we shall assume, we may characterize expected votes as a function of the unique equilibrium policy platform.
3. The research in this paper takes its departure from an earlier study of tax structure for state governments (Hettich and Winer 1984). Although the econometric model has been expanded significantly for the present work, the original discussion continues to provide a useful background for the choice of explanatory variables. One should note, however, that several new variables have been added and that the formulation of some variables used previously has been amended in the light of analysis published by other authors since the appearance of the earlier study.
4. Both the 'first-dollar' synthetic tax-price and the 'average-dollar' tax-price were employed as instruments in the estimation with similar results. The exact definition of these variables is given in Feldstein and Metcalf (1987, 722). We are indebted to Gilbert Metcalf for constructing these variables using the TAXSIM model of the National Bureau of Economic Research.
5. As in Gade and Adkins (1990) and in Hettich and Winer (1984), we also constructed an updated version of the variable first suggested by McLure (1967) to reflect the potential for exporting of state taxes through interstate commerce; the value added in manufacturing for national markets as a proportion of total value added in the state. Though Gade and Adkins found this variable useful in estimating their own model, it was not significant in initial estimation of the model considered here and is not included in the tables of results.
6. If one thinks of debt as a tax on future economic activity, the relative size of the potential 'base' on which debt is levied should be included in the equation. However, it is very difficult to define and measure the appropriate potential base in this case.
7. As Barro (1979) has noted, governments can lower the overall burden of taxation by using debt to smooth total revenues when tax revenues fluctuate. But they may also try to adjust tax structure in order to reduce reliance on tax sources that are relatively unstable.
8. These ratios are based on data from TAXSIM supplied by Gilbert Metcalf.
9. Of course it is possible to increase the progressivity of the marginal rate structure without changing the average rate. If pressure for redistribution is mainly reflected in choice of marginal rate structures at a given average tax rate, we will not observe a relationship between POOR/RICH and YRATE. YRATE remains the appropriate dependent variable in the present context however, since our focus in the YRATE equation is on the decision about reliance on personal income as a source of revenue. In a study focusing on the redistributive content of the fiscal system, one may wish to use measures of the progressivity of the tax system as dependent variables, as in Chernick (1991b), or public expenditures which are closely associated with aid for poorer people, as in Kristov, Lindert

and McClelland (forthcoming).

10. In a model based on expected vote-maximization, it is not rational for governments to levy tax rates that place themselves on the backward (or downward) sloping part of any Laffer curve, since they can then increase revenue and political support by cutting tax rates (Hettich and Winer, 1988). In such a model, therefore, tax rates and total tax revenues will always be positively correlated.

11. California is used as the neighbour for Hawaii, and an average of YRATE in Washington and Oregon is used as the value of REGION for Alaska. While REGION is treated as an exogenous variable here, the possibility exists that neighbouring states will be subject to common omitted shocks, the most likely of which are those related to regional variations in the level of aggregate economic activity. Such shocks may be captured by variables already included in the equation, such as RBY, SBY or TRAVEL, while it is difficult to know what instruments to use in allowing for REGION to be endogenous. If one uses averages over neighbouring states of the same variables in the equation for YRATE, the low  $R^2$ 's in the auxiliary regressions suggest there is a serious possibility of introducing error of some unknown type into the equation.

12. For example, the psychological and travelling costs of commuting to a neighbouring state to work may be low compared to the corresponding costs of changing both one's place of work and residence in order to move to a more distant location.

13. Another possible basis for identifying competitor states might involve looking at a broad indicator of industrial structure, such as value added for national markets, as in Hettich and Winer (1984). We tried this variable in place of POOR/RICH without success. Other ways of judging the identity of a state's most important competitors could involve the use of racial composition or per capita income (as in Case, Hines and Rosen, 1989). In all cases a clear theoretical argument for choosing a particular variable is absent.

14. The dates are determined by the availability of data.

15. In a completely general model, one might in principle allow for a relationship between the relative size of the various levels of government and the income tax structure chosen by each level. One might also want to endogenize the size of alternative tax bases as well, such as resources or retail sales, in such a complete model. Our choice of what variables to treat as exogenous reflects, as usual, a judgement made on the basis of the availability of instruments, of degrees of freedom, and intuition about which interdependencies that are not formally modelled are likely to be important to the process determining the structure of the state income tax.

16. Of the 31 states with a value of CREDIT = 1, 15 states have a rebate only while the rest have a tax credit or both a credit and a rebate (ACIR 1986, Table 71). The value of credit for Wyoming is set to zero because the rebate is for sales and property tax, and we could not discover which aspect of the rebate was dominant. This one observation is not likely to affect our conclusions.

17. If the actual values of YRATE and CREDIT had appeared instead on the right side, the system of qualitative variables would have to be recursive, with either YRATE or CREDIT absent from the right side of the system. The results in Tables 3 and 4 do suggest that the model could be reformulated without CREDIT in the YRATE' equation, and with YRATE instead of YRATE' on

the right side of the CREDIT<sup>\*</sup> equation. The formulation we have presented seems more natural to us however.

18. Fixed effects for each state are not part of the equations as the number of observations obviously does not permit an additional 50 dummy variables to be added to the equations. In any case, caution in using fixed effects is always warranted in cross-section studies. Whether some causes of cross-section variation should be treated as a fixed effect because it cannot be explained, or rather should be attributed to the set of included explanatory variables, is often as much a conceptual issue as it is a statistical issue.

19. When Alaska is omitted from the sample the coefficient on RBY is somewhat less important, but still significant.

20. Using time series data, Besley and Case (1992) find that increases over time in individual tax liabilities in a given state are **positively** associated with increases in tax liabilities in neighbouring states. Such a result is not inconsistent with the negative coefficient on REGION in the cross-section study reported here. (We use two years of data, but most of the variation in the data comes from the cross-section component). Taking the results of both investigations at face value suggests that an equilibrium tax rate or tax liability differential between competing neighbouring states exists and is maintained over time. When one state deviates 'too far' from this equilibrium differential, it seems that the reaction of voters forces the state to bring its tax structure back into line.

21. Bucovetsky (1991) has investigated tax competition between states of unequal population in a paper that may be relevant to the present context. In his model, the smaller state levies the lower rate. It should also be noted that Ladd (1991) has found that competition between counties in large metropolitan areas (who are assumed not to compete with central cities) operates in the 'usual' manner, with higher tax burdens in each county being positively associated with higher burdens in neighbouring counties. Whether this contradicts the results for REGION found here, or rather indicates that competition between suburban counties that do not compete with central cities operates differently than interstate competition, is not clear.

22. An exception is provided by Inman's 1989 statistical study of local tax systems in the U.S., where a complex and rather specialized governing structure is specified, and by Winer and Hettich's (1990) qualitative investigation of congressional and parliamentary government in explaining differences in tax structure between the U.S. and Canada.

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**Data Appendix.**

All data is on a state by state basis for calendar years 1985 and 1986 unless otherwise stated.

**Variable: Definition: and Source(s).**

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**CREDIT:** 1 if credit or rebate for the payment of local property tax; 0 otherwise: (1).

**BONDLIMIT:** 1 if either nominal dollar or percentage (of state funds, tax revenue or state or taxable property) limitation on issue of debt: (2).

**FIRST:** Synthetic 'first dollar' federal taxprice (Feldstein and Metcalf 1987, 721-22) constructed using the TAXSIM model (N.B.E.R), 1984 and 1985: (8)

**GN:** Total state expenditures (fiscal year basis) per capita: (3)/(4).

**HOUSEPRICE:** Percent change in house prices, 1970-80: (5)

**LOCAL:** Ratio of local government expenditures to state expenditures (fiscal year basis): (6)

**MCAP:** State highway miles per capita, 1985: (7)/(4).

**NATIONWIDE:** YRATE in state with most similar value of POOR/RICH (fiscal year basis): as for YRATE.

**OWNERSHIP:** Percent of housing that is owner occupied: (5).

**OVER65:** Percent of population over age 65: (6)/(4).

**PMAR:** fraction married: (8).

**POOR/RICH:** Ratio of number of taxpayers with less than \$25,000 adjusted gross income to number with more than \$50,000: (8).

**POP:** Population: (4).

**POPNW:** Population non-white in 1988: (9).

**POVERTY:** Percent of population below poverty level: (5).

**P25; P50; P100:** Fraction of federal income tax returns with adjusted gross income between \$25,000 and \$50,000; between \$50,000 and \$100,00; over \$100,000 : (8).

**RBV:** Mineral production per dollar of personal income: (6).

**REGION:** Average of YRATEs in geographically neighbouring states: same as YRATE.

**SBY:** Retail trade per dollar of personal income: (6).

**SMSA:** Percent of population in SMSA: (6).

**STD:** Standard deviation of percent year over year change in real personal income, 1970-1986:

**TAXPRICE:** 1 - (proportion of itemizers times average federal marginal tax rate of itemizers): (8)

**TRAVEL:** Travel-generated business receipts per dollar of personal income: (10)/(6)

**YRATE:** Average personal income tax rate = ratio of personal income tax revenue to personal income (fiscal year basis): (11)/(6).

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#### Sources:

- (1) Significant Features of Fiscal Federalism 1985, Tables 70 and 71.
- (2) Von Hagen (1991), Table 1.
- (3) State Government Finances, 1985 and 1986, Table 9.
- (4) Significant Features of Fiscal Federalism, 1989, vol. 2, Table 2.
- (5) State and Metropolitan Area Data Book, 1986.
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- (8) Data supplied by Gilbert Metcalf using the TAXSIM model (N.B.E.R.), calendar years 1984 and 1985.
- (9) Current Population Report 1988, P-25, Tables 1 and 2.
- (10) The Impact of Travel on State Economies, 1985 and 1986, Table 5.
- (11) State Government tax Collections, 1985 and 1986, Table 3.

**Table 1**  
**Explanatory Variables\***

		<b>Predicted Sign</b>	<b>Definition</b>
<b>YRATE Equation</b>			
<b>Endogenous:</b>	CREDIT	+	1 if credit or rebate for the payment of local property tax
	TAXPRICE	-	1 - (proportion of itemizers times average federal marginal tax rate of itemizers)
	GN	?	total expenditures per capita
<b>Exogenous:</b>	TRAVEL	-	travel-generated business receipts per dollar of personal income
	RBY	-	mineral production per dollar of personal income
	SBY	-	retail trade per dollar of personal income
	BONDLIMIT	+	1 if either nominal dollar or percentage (of state funds, tax revenue or state or taxable property) limitation on issue of debt
	STD	-	standard deviation of percent year over year change in real personal income, 1970-1986
	POOR/RICH	+	ratio of number of taxpayers with less than \$25,000 adjusted gross income to number with more than \$50,000
	REGION	+	average of YRATEs in geographically neighbouring states
	NATIONWIDE	+	YRATE in state with most similar value of POOR/RICH
<b>CREDIT Equation</b>			
<b>Endogenous:</b>	YRATE	+	Average personal income tax rate (ratio of personal income tax revenue to personal income)
<b>Exogenous:</b>	HOUSEPRICE	+	Percent change in house prices, 1970-80
	OWNERSHIP	+	Percent of housing that is owner occupied
	OVER65	+	Percent of population over age 65
	LOCAL	+	Ratio of local government expenditures to state expenditures
	BONDLIMIT	-	as above

\* All variables are defined on a state by state basis

TABLE 2

## ASPECTS OF STATE PERSONAL INCOME TAX STRUCTURE, FISCAL YEAR 1985

STATE	YTR	YRATE(%)	CREDIT	STATE	YTR	YRATE(%)	CREDIT
Alabama	0.22	1.65	0	Montana	0.26	1.99	1
<b>Alaska<sup>(1)</sup></b>	<b>0.00</b>	<b>0.01</b>	<b>0</b>	Nebraska	0.22	1.53	0
Arizona	0.20	1.49	1	<b>Nevada<sup>(4)</sup></b>	<b>0.00</b>	<b>0.00</b>	1
Arkansas	0.25	1.90	1	New Hampshire <sup>(2)</sup>	0.04	0.16	0
California	0.34	2.55	1	New Jersey	0.20	1.45	0
Colorado	0.36	1.91	1	New Mexico	0.05	0.52	1
Connecticut <sup>(2)</sup>	0.07	0.50	1	New York	0.44	3.71	1
Delaware	0.44	4.02	0	North Carolina	0.37	2.77	0
<b>Florida</b>	<b>0.00</b>	<b>0.00</b>	<b>0</b>	North Dakota	0.09	0.93	1
Georgia	0.35	2.28	0	Ohio	0.27	1.96	1
Hawaii	0.28	2.94	1	Oklahoma	0.21	1.81	1
Idaho	0.33	2.38	1	Oregon	0.64	3.86	1
Illinois	0.25	1.53	1	Pennsylvania	0.24	1.61	1
Indiana	0.29	1.88	0	Rhode Island	0.20	2.12	1
Iowa	0.27	2.28	1	South Carolina	0.29	2.38	0
Kansas	0.32	1.78	1	<b>South Dakota<sup>(4)</sup></b>	<b>0.00</b>	<b>0.00</b>	1
Kentucky	0.24	1.94	0	Tennessee <sup>(3)</sup>	0.02	0.12	1
Louisiana	0.10	1.04	0	<b>Texas</b>	<b>0.00</b>	<b>0.00</b>	<b>0</b>
Maine	0.29	2.15	1	Utah	0.30	2.46	1
Maryland	0.38	2.52	1	Vermont	0.27	2.19	1
Massachusetts	0.40	3.33	0	Virginia	0.40	2.36	0
Michigan	0.33	2.40	1	<b>Washington</b>	<b>0.00</b>	<b>0.00</b>	<b>0</b>
Minnesota	0.42	3.77	1	West Virginia	0.27	2.58	1
Mississippi	0.14	1.07	0	Wisconsin	0.34	3.19	1
Missouri	0.27	1.58	1	<b>Wyoming<sup>(5)</sup></b>	<b>0.00</b>	<b>0.00</b>	<b>0</b>

Notes: YTR = relative reliance on personal income taxation (personal income tax revenue ÷ total state revenue including the issue of debt); YRATE = reliance on income tax base as measured by the average personal income tax rate (personal income tax revenue ÷ personal income, in percent); CREDIT = 1 if there exists a circuit-breaker property tax relief program (a tax credit or a direct payment to qualified individuals); = 0 otherwise).

- (1) The actual figure for YTR = .0006, representing residual collections on repealed tax.
- (2) Income tax applies to interest and dividend income only.
- (3) Income tax on certain interest or dividends only.
- (4) Property tax credit takes the form of a rebate given to selected homeowners.
- (5) Rebate is for sales as well as property tax payed.

Sources: see Data Appendix.

TABLE 3

INCOME TAX STRUCTURE, U.S. STATES, FISCAL YEARS 1985 AND 1986  
TWO-STEP ESTIMATION

2SLS: Average Personal Income Tax Rate (YRATE)								Probit: Credit or Rebate for Local Property Tax (CREDIT)				
Explanatory Variables	(1)	(1a)	(2)	(3)	(3a)	(4)	(4a)	Explanatory Variables	(5)	(5a)	(6)	(7)
CREDIT	-0.32 (0.11)	-0.01	0.09 (0.03)	0.01 (0.00)	4.11 (1.41)	-0.15 (-0.05)	3.40 (1.18)	YRATE	0.05 (2.31)	0.46	0.05 (2.38)	0.04 (2.21)
TAX-PRICE	-288.30 (-1.70)	-0.40	-260.07 (-3.48)	-260.44 (-3.49)	-229.99 (-3.18)	-282.30 (-4.39)	-288.41 (-4.59)	HOUSE-PRICE	0.02 (3.49)	1.91	0.02 (3.49)	0.01 (3.22)
TRAVEL	-15.22 (-1.09)	-0.09	-16.57 (-1.20)	-17.09 (-1.27)	-21.46 (1.61)	-17.04 (-1.26)	-21.00 (-1.57)	OWNER-SHIP	-0.01 (-0.45)	-0.51		
RBV	-24.26 (-2.53)	-0.37	-25.66 (-3.51)	25.75 (-3.53)	-26.97 (-3.82)	-23.07 (-4.12)	-19.99 (-3.56)	OVER65	21.18 (2.82)	1.45	20.55 (2.76)	21.33 (2.89)
SBY	-2.50 (-0.53)	-0.04						LOCAL	2.46 (1.57)	0.54	2.51 (1.60)	2.66 (1.62)
BOND-LIMIT	0.18 (0.10)	0.01	0.30 (0.16)					BOND-LIMIT	-0.51 (-1.60)	-0.18	-0.55 (-1.76)	
STD	-1.00 (-1.61)	-0.15	-1.01 (-1.62)	-0.98 (-1.64)	-1.43 (-2.40)	-0.84 (-1.54)	-1.02 (-1.89)					
POOR/RICH	0.11 (0.25)	0.05										
REGION	-0.60 (-3.69)	-0.34	-0.61 (-4.18)	-0.62 (-4.33)	-0.63 (-4.45)	-0.61 (-4.27)	-0.60 (-4.29)					
NATION-WIDE	0.18 (2.37)	0.18	0.19 (2.48)	0.18 (2.51)	0.19 (2.66)	0.18 (2.44)	0.17 (2.46)					
GN	0.001 (0.42)	0.06	0.001 (0.57)	0.001 (0.57)	0.002 (1.61)							
$\bar{R}^2$	0.45		0.46	0.46	0.48	0.46	0.48	$\chi^2$	22.35 (6D.F.)		22.14 (5D.F.)	18.97 (4D.F.)
S	7.69		7.72	7.72	7.61	7.77	7.64	$R^2_{cu}$	0.27		0.27	0.24
								PREDICT	0.76		0.74	0.65

Notes to Table 3/..

### Notes to Table 3:

Estimation using SHAZAM (White, 1990).

The constant term is not reported. "t" statistics are in brackets.  $R^2$  is adjusted; S is the standard error of the estimate;  $X^2$  is the likelihood ratio test statistic;  $R^2_{cu}$  is the Cragg-Uhler R-square; PREDICT is the percent of correct predictions (using 0.5 as the critical probability). Columns (1), (2), (3) and (4) are based on two-stage least squares with the predicted value from a reduced form probit equation for CREDIT used as one of the instruments. Column (1a) reports standardized (beta) coefficients corresponding to column (1). Columns (3a) and (4a) report estimates based on use of the set of variables {HOUSEPRICE, OWNERSHIP, OVER65, LOCAL} as instruments in place of the predicted value from the reduced form probit for CREDIT. Other instruments used in columns (1) to (4a) are given below. Columns (5) and (6) are based on probit estimation with predicted values from a reduced form tobit equation for YRATE used as an explanatory variable. Column (5a) reports the elasticity of the index at the means of the right hand side variables.

Instruments used in addition to exogenous variables in Table 1 (see the Data Appendix for definitions): FIRST, P25, P50, P100, PMAR, POP, POPNW, SMSA, POVERTY, MCAP.



TABLE 4

INCOME TAX STRUCTURE, U.S. STATES, FY 1985 AND 1986  
INSTRUMENTAL VARIABLES, ORTHOGONALITY CONDITION ESTIMATION\*

Tobit: Income Tax Rate (YRATE)			Probit: Credit for Local Property Tax (CREDIT)			
Dependent Variable	(1)	(2)	Dependent Variable	(3)	(4)	(5)
CREDIT	-0.72 (-0.29)	-0.72 (-0.28)	YRATE	0.05 (2.53)	(.05) (2.58)	0.04 (2.30)
TAXPRICE	-377.71 (-2.57)	-330.40 (-4.57)	HOUSEPRICE	0.02 (4.03)	0.02 (4.15)	0.01 (3.45)
TRAVEL	-32.30 (-1.89)	-33.40 (-1.94)	OWNERSHIP	-0.01 (-0.48)		
RBY	-26.12 (-3.41)	-27.89 (-4.69)	OVER65	22.68 (2.47)	22.14 (2.48)	22.63 (2.73)
STD	-0.83 (-1.60)	-0.77 (-1.52)	LOCAL	2.65 (1.81)	2.71 (1.82)	2.77 (1.82)
POOR/RICH	0.17 (0.34)		BONDLIMIT	-0.49 (-1.52)	-0.52 (-1.67)	
REGION	-0.66 (-3.03)	-0.70 (-3.86)				
NATIONWIDE	0.18 (2.44)	0.18 (2.43)				
R <sup>2(LATENT)</sup>	0.50	0.49	R <sup>2(LOG-LIKE)</sup>	0.24	0.24	0.20
Log L	-526.44	-527.47	Log L	-53.15	-53.27	-54.69

\*Notes to Table 4:

Estimation using HOTZTRAN (Avery and Hotz, 1985). The estimates reported are based on use of optimal weighting of orthogonality conditions (OPTWT = 0 in Hotztran). The instrument for CREDIT (YRATE) is the predicted value from the reduced form Probit (Tobit) equation.

"t" statistics are in brackets. R<sup>2(LATENT)</sup> is the latent R<sup>2</sup> reported by Hotztran. R<sup>2(LOG-LIKE)</sup> is the log-like R<sup>2</sup> reported by Hotztran. Log L is the log-likelihood.

University of Konstanz  
Sonderforschungsbereich 178  
"Internationalization of the Economy"

**Workshop on  
International Political Economics of Taxation**

July 2-3, 1992  
University of Konstanz  
Großer Sitzungssaal, V 1001

**Thursday, July 2, 1992**

- 10.00 Opening Address  
Hans-Jürgen Vosgerau (Speaker of the SFB 178)  
Introduction  
Bernd Genser (SFB 178)
- 10.30 *Chair: Bernd Genser (SFB 178)*  
"Intergovernmental Tax Competition"  
Bruno S. Frey (University of Zürich)
- 11.30 "International Tax Competition and Public Goods Supply:  
Alternative Views of Government Behaviour"  
Andreas Haufler (University of Konstanz)
- 12.30-14.00 Lunch (IBZ, University of Konstanz)
- 14.00 *Chair: Gebhard Kirchgässner (University of St.Gallen)*  
"Explaining the Use of Related Tax Instruments"  
Stanley L. Winer (Carleton University/Ottawa) and Walter  
Hettich (California State University/Fullerton)
- 15.00 "Intertemporal Commitment Problems and Voting on  
Redistributive Taxation"  
Amihai Glazer (Carnegie Mellon University/Pittsburgh)  
and Kai A. Konrad (University of München)
- 16.00-16.30 Coffee Break
- 16.30 *Chair: Friedrich Breyer (University of Konstanz)*  
"The Effects of Tax Administration on Tax Morale"  
Werner W. Pommerehne (University of Saarbrücken)  
and Bruno S. Frey (University of Zürich)
- 17.30 "Fuel Taxation in EC Countries: A Political-Economy  
Approach"  
Bernd Genser and Hannelore Weck-Hannemann (SFB 178)
- 19.30 Dinner (Schwedenschenke, Insel Mainau)

**Friday, July 3, 1992:**

- 08.30 *Chair: Heinrich Ursprung (SFB 178)*  
"Fiscal Policy During the Transition in Eastern Europe"  
Roger H. Gordon (University of Michigan/Ann Arbor)
- 09.30 "Corporate Income Tax Competition, Double Taxation  
Treaties, and Foreign Direct Investment"  
Eckhard Janeba (University of Bonn)
- 10.30-11.00 Coffee Break
- 11.00 *Chair: Hannelore Weck-Hannemann (SFB 178)*  
"The Development of the Shadow Economy under Changing Tax  
Systems and Structures: Some Theoretical and Empirical  
Results for Austria"  
Friedrich Schneider (University of Linz) and Reinhard Neck  
(University of Bielefeld)
- 12.00 Closing Address  
Bernd Genser (SFB 178)
- 12.30 End of Workshop
- 13.00 Lunch (Hotel Mainaublick, Egg)

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