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6 Eliminating State and Local Tax Deductibility: A General Equilibrium Model of Revenue Effects

George R. Zodrow

6.1 Introduction

Much attention has been focused recently on the effects of eliminating or reducing federal deductibility of state and local taxes. Early congressional reform proposals recommended the elimination of deductibility for various state and local taxes, and the November 1984 Treasury proposal, as well as the May 1985 administration reform package recommended complete elimination. The Tax Reform Act of 1986 eliminates deductibility for general sales taxes, and further curtailment is frequently suggested as a means of reducing currently projected budget deficits.

Eliminating deductibility raises a host of troublesome issues, including a wide variety of allocational and distributional questions, which have been examined in the literature (see Kenyon 1986 and Advisory Commission on Intergovernmental Relations 1985a). This paper focuses primarily on the revenue issues raised in a recent paper by Feldstein and Metcalf (1987), who argue that changes in the revenue mix utilized by state and local governments will result in dramatic reductions in the federal revenue gained from eliminating deductibility, relative to revenue estimates that ignore such adjustments. Specifically, they argue that the elimination of deductibility of state and local personal taxes (income, property, and general sales taxes) will induce state and local governments to switch to business taxes which remain fully

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deductible against federal taxes under all the reform proposals. Since only the portion of personal taxes which are claimed by itemizers are deducted from the federal tax base while virtually all business taxes are deducted and at generally higher tax rates, this change in the state and local revenue mix potentially could have dramatic consequences for federal revenue. Indeed, Feldstein and Metcalf estimate that the change in the state and local revenue mix induced by eliminating deductibility would eliminate between one-half and all of the revenue gain predicted by "static" revenue estimating techniques which ignore such revenue mix effects.[1]

The impact of such a response on the extent to which marginal tax rates could be reduced within the context of a revenue-neutral tax reform is obviously significant. For example, Feldstein and Metcalf note that, by 1990, elimination of deductibility in the administration reform package would account for more than 85 percent of the revenue obtained from individual base-broadening items; the much more limited repeal of deductibility for only general sales taxes is predicted to raise approximately $4 billion by 1990.

There is a lack of consensus in the literature regarding the revenue effects of eliminating deductibility. The Feldstein and Metcalf results are in marked contrast to earlier studies by Zimmerman (1983), Hettich and Winer (1984), Noto and Zimmerman (1983), and Inman (1986), who find that the state and local revenue mix is not responsive (or responsive in the wrong direction) to changes in the effective cost of using various revenue instruments when the benefits of federal tax deductibility are taken into account; Feldstein and Metcalf provide a critique of these earlier studies. Other studies suggest that only certain taxes are responsive to changes in their effective costs due to changes in deductibility. For example, Kenyon (1986) finds that state use of income taxes is highly sensitive to changes in deductibility while state use of sales taxes is not, while Gade (1986) finds instead that state use of sales taxes is more responsive to changes in deductibility than is state use of income taxes; Holtz-Eakin and Rosen (in this volume) suggest that municipal use of deductible personal taxes is responsive to changes in federal deductibility, but the use of sources of finance that are not deductible at the personal level is not. Additional uncertainty is created by the fact that the estimated coefficients used by Feldstein and Metcalf to generate their revenue predictions are characterized by relatively large standard errors. Finally, the appropriate model of state and local government tax and expenditure determination is far from clear.

One frequently used candidate is the median voter model (e.g., see Gramlich 1985 and Zimmerman 1983); the median voter framework is utilized in this paper. However, several alternatives are equally plausible, including the "average voter" model (see Craig and Inman 1985) which accounts for the political influence of nonmedian voters on tax and expenditure policies, as well as various migration models (e.g., see Herzog and Schlottmann 1986) and "Leviathan" models of government behavior (e.g., see Romer and Rosenthal 1983). Since all these approaches have their proponents and detractors, any study based on a particular model is more likely to be viewed as simply providing another candidate for explaining the effects of eliminating deductibility rather than providing the definitive answer. For all of these reasons, it would seem fair to say that there is still some uncertainty regarding the effects of eliminating deductibility on the state and local revenue mix and on federal tax revenues.

In this paper, I construct a two-sector general equilibrium model which, although obviously not a substitute for the type of detailed revenue estimation performed by the Treasury, is designed to focus on these effects and to provide additional information relevant to the question of the directions and magnitudes of the revenue effects of eliminating deductibility. Three aspects of this approach differentiate it from previous analyses. First, the two-sector approach permits the modeling of two very different responses to the elimination of deductibility. In general it is clear that, within a framework where the government is acting to maximize the welfare of the median voter, the response will depend quite dramatically on whether the median voter is an itemizer. If this is the case, the median voter will experience a significant change in the effective price of government services—to a price of one from a price of one minus the individual marginal tax rate in the simplest case—while if the median voter is not an itemizer, eliminating deductibility will not directly affect the effective tax price for government services. The model is constructed to emphasize how the responses of jurisdictions where the median voter is an itemizer differ from the responses of jurisdictions where that is not the case, with the aggregate effects depending on the relative sizes of the itemizer and nonitemizer sectors.

Second, a general equilibrium approach permits an analysis of a number of endogenous responses to the elimination of deductibility, including the reallocation of capital which will occur in response to changes in state and local capital taxes and the associated changes in the net return to capital, wages, and income. These in turn permit an explicit calculation of the effects on both personal and corporate federal tax revenues, as well as a calculation of the reduction in tax rates made possible by eliminating deductibility when revenue mix and general equilibrium effects are taken into account. In addition, a general equilibrium analysis permits explicit calculation of the effects of the reduction in marginal tax rates on the endogenous variables in the model. As noted by Kenyon (1985), the effects of eliminating deductibility depend on views about incidence; the analysis in this paper provides an explicit calculation of these effects within the context of a Harberger-type general equilibrium model.

Third, in light of the uncertainty described above regarding the revenue effects of eliminating deductibility, the model may be useful in that it provides results that suggest what state and local governments "should" do in response to the elimination of deductibility if they are in fact following the median voter paradigm. The model makes explicit behavioral assumptions about governmental behavior, including the choice of revenue instruments, and then calculates the implications of those assumptions when deductibility is eliminated. To the extent the model and its behavioral assumptions are believable, some insight as to the optimal long-run response to eliminating deductibility may be obtained. In this sense, the paper is similar in spirit to the earlier work of Zodrow and Mieszkowski (1986), in which a general equilibrium framework is used to analyze the national effects of both tax and expenditure policies that are determined endogenously at the local level.

Before proceeding, it may be useful to comment briefly on the difficulties of using a Harberger-type model to analyze the effects of eliminating deductibility—in addition to the problem of determining which model of state and local tax and expenditure determination to employ. An obvious problem characteristic of such analytical models is that a very high level of aggregation is required; in the model analyzed, the economy is simply divided into two groups of states with each group assumed to act as a single sector with a government that is acting to maximize the welfare of a single median voter. Second, the initial equilibrium is necessarily characterized by existing taxes, expenditure levels, and policies regarding deductibility. As a result, the analytically convenient trick of assuming zero initial taxes and expenditures cannot be used; as is well known, this complicates the differential incidence analysis considerably. Third, in addition to the usual mix of prices and quantities in a general equilibrium model, state and local government behavior must be modeled endogenously. To examine the revenue mix question, a minimum of two tax variables in each sector is required; again, this complicates the differential incidence results. Moreover, an optimal tax problem must be formulated to determine how governments choose between taxes—in particular, an explanation must be found for why state and local governments use nonbenefit taxes on capital when, at least under certain circumstances, optimizing governments would avoid such taxes entirely if capital is perfectly mobile in the long run (see Zodrow and Mieszkowski 1983); one possibility is offered in the analysis below.

The paper is organized as follows. The assumptions and structure of the model are specified in the following section. Differential incidence results are presented in section 6.3, and numerical simulation results are presented in section 6.4. A brief concluding section summarizes the results and suggests directions for future research.

6.2 The Model

The analytical framework utilized in the paper is a two-sector general equilibrium model where expenditure and tax policies in each sector are selected to maximize the welfare of the median voter in that sector. The model is a highly aggregated one where the first sector represents a group of states where the median voter itemizes deductions for federal tax purposes, and the second sector represents the remaining group of states where the median voter is assumed to be a nonitemizer. The model is designed to analyze the effects of eliminating (or reducing) state and local tax deductibility on the mix and levels of state and local revenues and on federal tax revenue, with an emphasis on the differing responses of the two sectors and a variety of general equilibrium effects.

The model is constructed as follows. The fifty states and the District of Columbia are ranked in order of percentage of itemizers, with joint returns double-weighted to reflect the presence of two voters per return. The states are divided into two sectors indexed by j, with N^* states with a percentage of itemizers greater than some cut-off percentage (F^*) forming a sector ($j = 1$) where the median voter is assumed to be an itemizer, and the remaining $51 - N^*$ states forming a sector ($j = 2$) where the median voter is a nonitemizer.[2] The appropriate value of F^* and thus N^* is not entirely clear; however it is quite likely to be less than 50 percent if high-income individuals are more likely to vote or exert more influence in the political process (see Feldstein and Metcalf for a discussion of the role of the median voter in expenditure determination). Indeed, the new results presented by Lindsey (in this volume) are the first to provide an estimate of N^* (29) that reflects the fact that high-income individuals are much more likely to vote than are relatively low-income individuals.[3] In the simulations, results are presented for $N^* = 19$, 29, and 39; the results for $N^* = 19$ and $N^* = 39$ should bound the "true" value, with $N^* = 29$ providing the best point estimate.

Within each of the two sectors (hereafter, the "itemizer" and "nonitemizer" sectors), tax and expenditure policies are assumed to be set to maximize the welfare of a single representative median voter. The responses of each sector to changes in the federal deductibility of state and local taxes are thus determined by the effects of the policy change on each sector's median voter, subject to a sectoral government budget constraint. Such an approach should be viewed as suggestive since it is obviously subject to all the criticisms made of the median voter model (to even a greater extent since the level of aggregation is so great). Nevertheless, this application of the median voter framework makes the general equilibrium model analytically tractable, and focuses on how state and local government responses to the elimination of deductibility depend on whether the median voter is an itemizer.

The details of the model are as follows. The population is assumed to be fixed. Since most studies suggest that eliminating state and local deductibility is unlikely to result in much migration even within metropolitan areas (see Gramlich 1985, Herzog and Schlottmann 1986, and Chernick and Reschovsky 1987), an assumption of no interstate migration, which in turn implies no migration within the two-sector context analyzed here, seems plausible.

Production is modeled is as simply as possible. There is a single production good which is the numeraire. This single production good is produced with a Cobb-Douglas production function using a fixed factor (a composite of land and labor in each sector, hereafter referred to as labor and denoted as L_{Tj}) and capital (K_{Tj}), with the capital share parameter denoted as a. (In general, total quantities in a sector will be denoted with a T subscript, while median voter quantities will be denoted simply by the appropriate j subscript; for example, L_j refers to the amount of labor supplied by the median voter in sector j). Constructing a restricted profit function in each sector—$\pi_j(r_j, L_{Tj})$—implies that capital demands (K_{Tj}) and wages (w_j) are

(1) $$K_{Tj} = -\pi_{jr}(r_j, L_{Tj})$$

(2) $$w_j = \pi_{jL}(r_j, L_{Tj}) ,$$

where the subscripts following the j subscript denote differentiation with respect to the arguments of the restricted profit function in sector j.[4] The price elasticity of demand for capital is constant for the Cobb-Douglas production function and is denoted by μ_K,

$$\mu_K = (r_j/K_{Tj})(\partial K_{Tj}/\partial r_j) = -r_j\pi_{jrr}/\pi_{jr} = 1/(1 - a) > 0 .$$

Public services are modeled as publicly provided private goods—government purchases of the single production good which are shared equally within a sector (see Hamilton 1983 for a justification). Total public services are denoted as G_{Tj} and the median voter in sector j receives $G_j = G_{Tj}/N_j$, where N_j is the number of households in sector j. Thus, the model ignores any benefit spillovers or utility interdependencies associated with state and local public goods, as well as any cost differences across jurisdictions in producing such goods.

Capital is perfectly mobile across sectors and earns a net return r. The total supply of capital in the economy (K) is fixed. The fixed factor (L_{Tj}) in each sector earns a net return specific to that sector (w_j). Note that the model thus has the hybrid long-intermediate-run characteristics typical of Harberger-type models; in this case, labor and the aggregate capital stock are fixed as would be expected in an intermediate-run model, but the allocation of capital and the tax and expenditure policies of the state and local governments are free to vary as would be expected in a long-run model. The fixed factors in each sector are assumed to be locally owned, and capital ownership is assigned independently of jurisdiction of residence.

The median voter in each sector has a standard utility function defined over consumption of private and public goods—$U_j(C_j, G_j)$. The model assumes that the tax and expenditure policies of each sector are set by a single government which acts to maximize the utility of the median voter in that sector. Each government has two tax instruments. The first is a personal general sales or proportional income tax rate t_j (hereafter, all deductible personal taxes are referred to as "sales" taxes). There is no saving in the model and all goods are assumed to be purchased locally with no transportation costs for intersectoral sales; thus, sales and proportional income taxes are equivalent in the model. Since there is no housing in the single-good model, residential property taxes are not treated explicitly.[5] (One interpretation is that housing capital is fixed and residential property taxes should be included in deductible sales tax revenues; this is the approach followed in the simulations.) In the initial equilibrium, sales taxes are fully deductible against federal taxes for itemizers.[6]

The second tax instrument is the business capital income tax rate k_j, which reflects nonbenefit taxation of mobile capital in the form of corporate income taxes or nonresidential property taxes (hereafter, the "capital" tax). Capital taxes are fully deductible against federal corporate taxes, and all firms are assumed to be corporations. The only other source of revenue is federal grants; debt, user charges, severance taxes, selective sales taxes, and any other taxes are ignored.

The response expected by each government to a change in its capital tax rate is a critical element of the model. Capital income is assumed to be subject to a fixed federal corporate tax rate (κ), with state and local capital taxes fully deductible against federal taxes.[7] Thus, the relationship between the net return to capital (r) and the gross price of capital in each jurisdiction (r_j) is

$$r = r_j (1 - \kappa)(1 - k_j) . \tag{3}$$

In setting its capital tax rate k_j, each sectoral government perceives that an increase in k_j will be shifted to some extent. However, the expected extent of shifting is not constrained to be that which would correspond to a perfectly elastic supply of capital to that sector; instead the expected extent of shifting is determined (in a way that will be described below) from the revenue mix in the initial equilibrium. This modeling approach allows the two sectoral governments (and thus implicitly the individual jurisdictional governments which make up the two sectors) to differ in the extent to which they expect capital taxes to be shifted. This in turn allows the model to be consistent with the results presented by Lindsey (in this volume) which indicate that high-income states raise a higher amount of tax revenue per dollar of personal income (relative to low-income states) but that the extra revenue comes from relatively high business taxes rather than high personal taxes; one explanation for this phenomenon offered by Lindsey is that the high-income states expect that business firms are relatively immobile and that capital can be taxed relatively heavily. Within the context of the model in this paper, this interpretation would imply that the expected extent of shifting of capital taxes in the relatively high income itemizer sector would be greater than that in the relatively low income nonitemizer sector; this is indeed the pattern observed in the numerical simulation results reported below.

This expected or perceived extent of shifting of taxes on capital is modeled as a "gross" shifting parameter (μ_{Gj}) which equals the expected percentage change in the gross price of capital in response to a change in k_j—taking into account any expected reactions by other governments—or

$$\mu_{Gj} = (\partial r_j/\partial k_j)/r_j \ .$$

This definition implies the associated "net" shifting parameter (μ_{Nj})

$$\mu_{Nj} = (\partial r/\partial k_j)/r = \mu_{Gj} - 1/(1 - k_j) \ .$$

An expectation of full shifting by capital implies $\mu_{Nj} = 0$ or $\mu_{Gj} = 1/(1 - k_j)$, while an expectation of no shifting implies $\mu_{Gj} = 0$ or $\mu_{Nj} = -1/(1 - k_j)$. Thus, the expected ranges for these perception parameters are

$$0 \leq \mu_{Gj} \leq 1/(1 - k_j)$$

$$-1/(1 - k_j) \leq \mu_{Nj} \leq 0 \ .$$

As is shown in section 6.4, the initial values of these shifting parameters can be inferred from the mix of sales and capital taxes observed in the initial equilibrium. To calculate the new equilibrium, some assumption must be made regarding the behavior of these perception parameters. I assume that each government expects the degree of shifting, as measured by the negative effect of its capital taxes on the net return to capital, to be constant—that is, μ_{Nj} is assumed to be constant. This in turn implies that the government expects a larger impact on the gross return to capital (a larger μ_{Gj}) as the extent of capital taxation increases ($\partial\mu_{Gj}/\partial k_j = 1/(1 - k_j)^2 > 0$).

Thus, each sectoral government's optimization problem is to select k_j and t_j to maximize $U_j(C_j, G_j)$ subject to the constraint that total revenues cover own-expenditures on public services. Values of μ_{Nj} calculated in the initial equilibrium are used to calculate the equilibrium values of the endogenous capital tax rates when the extent of deductibility is altered by the federal government (as described in the following paragraph).

The federal government collects revenue from corporate and personal income taxes. Corporate taxes are assessed on capital income at a constant rate κ, and all state and local capital taxes paid are fully deductible. Personal income taxes have progressive marginal rates, with a fraction ϕ of state and local sales taxes deductible for itemizers; $\phi = 1$ in the initial equilibrium. The personal tax system is modeled as a multibracket structure where a constant marginal tax rate is assessed on income above an exemption amount in each bracket. For example, for the median voter in sector j, total personal income tax payments (T_j) are

(4) $$T_j = \theta\tau_j\,[Y_j - Z_j - \phi\,(t_jC_j)]\ ,$$

where Y_j is gross income, Z_j is the exemption amount, and $\theta\tau_j$ is the marginal tax rate with $\theta = 1$ in the initial equilibrium. The reform proposal analyzed is the reduction of deductibility of sales taxes (a lowering of ϕ), coupled with an equal percentage reduction in marginal rates (a lowering of θ), subject to a fixed federal revenue constraint; the case where ϕ is reduced to zero corresponds to complete elimination of deductibility of personal sales taxes.

To simplify considerably the analysis of the government's optimization problem as well as the differential incidence results, I assume that the median voter's income (Y_j) is derived purely from labor income ($Y_j = w_jL_j$);[8] since median voter income in the simulations is always \$20,000 or less, this assumption is not too unreasonable.[9] Gross expenditures on consumption for the median voter $(1 + t_j)C_j$ is equal to $Y_j - T_j$ which implies consumption of

(5) $$C_j = [(1 - \theta\tau_j)Y_j + \theta\tau_jZ_j]/[1 + (1 - \phi\theta\tau_j)t_j]\ .$$

Total sales tax revenues (R_{Cj}) are

(6) $$R_{Cj} = t_jC_{Tj} = t_jN_jC_j/\beta_j\ ,$$

where C_{Tj} is total consumption and β_j is the ratio of median voter consumption to consumption per household ($\beta_j = C_j/(C_{Tj}/N_j)$), while total capital tax revenues (R_{Kj}) are

(7) $$R_{Kj} = k_jr_jK_{Tj}\ .$$

Denoting lump-sum grants by S_j and assuming a matching rate of m_j for matching grants implies total government services of

(8) $$G_{Tj} = (R_{Cj} + R_{Kj} + S_j)/(1 - m_j) ,$$

with government services provided to the median voter (G_j) equal to G_{Tj}/N_j.[10] Note that equations (4) and (8) can be combined to yield

(9) $$C_j + [(1 - \phi\theta\tau_j)\beta_j(1 - m_j)]G_j = [(1 - \phi\tau_j)Y_j + \theta\tau_j Z_j] + (1 - \phi\theta\tau_j)\beta_j(S_j + k_j r_j K_{Tj})/N_j$$

or

(10) $$C_j + P_{Gj}G_j = Y_{Fj} ,$$

where P_{Gj} is the effective price of government services faced by the median voter in sector j and, following Craig and Inman (1985), Y_{Fj} is that individual's "full fiscal income," which includes the value of his share of capital tax revenue and federal revenue sharing.

Given these assumptions, the two-sector general equilibrium model is described by a system of six equations as follows. The first two equations are the first-order conditions for the sales tax rates t_j. The government assumes that β_j is constant.[11] Substituting from (5) and (8) into $U_j(C_j, G_j)$, differentiating with respect to t_j, and setting the result equal to zero yields the expected result that the marginal rate of substitution of the median voter equals the effective price ratio of government services to private consumption goods.

(11) $$U_{jG}/U_{jC} = (1 - \phi\theta\tau_j)(1 - m_j)\beta_j, \qquad j = 1, 2 .$$

Note that since $\phi = 0$ for the median voter in the nonitemizer sector, the relative price of government services reduces to

(12) $$P_{G2} = (1 - m_2)\beta_2 .$$

The next two equations are the first-order conditions for the capital tax rates k_j. Differentiating $U_j(C_j, G_j)$ with respect to k_j, setting the result equal to zero, substituting from (11), and using the definition of the shifting perception parameter μ_{Gj} yields

(13) $$\partial U_j/\partial k_j = -\alpha_j (1 - \theta\tau_j)\mu_{Gj} + (1 - \phi\theta\tau_j)\beta_j [1 - k_j\mu_{Gj}\mu_K + k_j\mu_{Gj}] = 0 ,$$

where $\alpha_j = L_j/(L_{Tj}/N_j)$ is the ratio of labor supply of the median voter to per capita labor supply in the sector. This expression indicates that raising the capital tax rate has two primary effects on the welfare of the median voter. The first term reflects the loss from reduced wage income as capital leaves the sector and lowers the marginal productivity of the fixed factor, thus lowering both private consumption and government services (because of lower sales tax receipts). The second term reflects the net effect of raising capital tax rates on capital tax revenues R_{Kj}, and has three components as reflected by the three terms in the brackets. The first is the positive revenue effect of the higher tax rate, the second is the negative effect of the loss of capital, and the third is the positive effect of an increase in the gross price of capital; since $(\mu_K - 1) = a/(1 - a) > 0$, the second effect dominates the third and the tax base declines unambiguously. Increasing k_j thus involves balancing the gains from greater expropriation of capital income with a higher tax rate against the losses from (1) a reduction in the capital income tax base, and (2) the associated reduction in consumption and sales tax revenues due to the lower wages caused by capital emigration. Thus, the revenue mix chosen by the government can be viewed as a two-step process, where the capital tax rate is chosen to expropriate the income of capital owners to the optimal extent, and then the sales tax rate is chosen to allocate optimally the sector's resources across public and private uses.

Rearranging equation (13) and noting that $\phi = 0$ for $j = 2$ yields the expressions for the capital tax rates in the two sectors

$$(14) \quad k_1 = (\mu_K - 1)^{-1} (\alpha_1/\beta_1) \{ (\beta_1/\alpha_2 - \mu_{G1})/\mu_{G1} + [(1 - \phi)\theta\tau_1/(1 - \phi\theta\tau_1)]\}$$

$$(15) \quad k_2 = (\mu_K - 1)^{-1} (\alpha_2/\beta_2) [(\beta_2/\alpha_2 - \mu_{G2})/\mu_{G2} + \theta\tau_2] ;$$

note that the second term in (14) drops out in the initial equilibrium. These expressions indicate that the capital tax rates are inversely related to the perceived shifting parameters (μ_{Gj}). Moreover, the extent of deductibility (ϕ) plays a critical role. For sector one, a reduction in ϕ increases the capital tax rate; that is, as stressed by Feldstein and Metcalf, reducing the deductibility of personal sales taxes makes their use relatively less attractive and results in increased reliance on deductible business capital taxes. However, since personal sales taxes are not deductible in the initial equilibrium for the median voter in sector two, k_2 is initially high (relative to the case where the median voter is an itemizer) to reflect a preference for deductible capital taxes.

The fifth equation reflects the fixed national capital stock assumption

$$(16) \quad K - K_{T1} - K_{T2} = K + \pi_{1r} + \pi_{2r} = 0 .$$

Note that the shifting perception parameters are used only to determine the tax and expenditure policies of the sectoral governments; the capital market equilibrium equation reflects perfect capital mobility in the long run and a uniform net return (r) to capital in both sectors.

The final equation in the general equilibrium system is the federal government budget constraint. Assuming that federal revenue net of grants (R) is fixed yields

$$(17)\quad R = \sum_j [\gamma_{Yj}\theta\tau_j(Y_j - Z_j) - \gamma_{Cj}\phi t_j C_j + \kappa r_j(1 - k_j)K_{Tj} - m_j G_{Tj} - S_j],$$

where revenue sharing and the matching rates are assumed to be held constant, and γ_{Yj} and γ_{Cj} are multipliers which convert median voter personal income taxes (net of sales tax deductions) and sales tax deductions to the analogous quantities for the entire sector. The assumption of fixed federal revenue multipliers is made only to facilitate the differential incidence calculations, and is relaxed in the simulations where federal revenue effects are calculated explicitly. Note that in this formulation, federal matching grants are assumed to change when state and local revenues change although one could also assume that such grants are simply held constant; both approaches are analyzed in the simulations.

Thus, the model has a single exogenous variable ϕ (the extent of deductibility of state and local personal taxes), and six endogenous variables—t_1, t_2, k_1, k_2, r, and θ (which reflects the reduction in marginal tax rates made possible from the reduction or elimination of state and local tax deductibility).

6.3 Differential Incidence Results

The differential incidence results for the model are presented in a slightly unconventional format. Calculating expressions for the changes in the endogenous variables with respect to a change in the exogenous variable ϕ would be extremely cumbersome. Instead, the equations shown below separate the responses of various endogenous variables to changes in the two federal government instruments (ϕ and θ), and a final differential incidence equation calculates the endogenous response of θ (the reduction in marginal tax rates) to a change in ϕ (a reduction in the extent of state and local tax deductibility). Thus, the general form of the differential incidence expressions is

$$\hat{Z} = (\pm)\,\eta_{Z\phi}\,(-\hat{\phi}) + (\pm)\eta_{Z\theta}(-\hat{\theta})\ ,$$

where the "^" denotes logarithmic differentiation, and the expressions for the elasticities $\eta_{Z\phi}$ and $\eta_{Z\theta}$ are defined so they are either unambiguously positive or positive for plausible parameter values. All expressions are evaluated at the initial equilibrium ($\phi = \theta = 1$). The explanation assumes that reducing deductibility ($d\phi < 0$) raises revenue, which in turn permits a reduction in marginal tax rates ($d\theta < 0$).

Differentiating (14) yields

(18) $$\hat{k}_1 = \eta_{k1\phi}(-\hat{\phi}) > 0, \qquad (\eta_{k1\theta} = 0) ,$$

where

$$\eta_{k1\phi} = \frac{[(1 - a)/a](\alpha_1/\beta_1)[\tau_1/(1 - \tau_1)]/k_1}{1 + [(1 - a)/a][\mu_{G1}(1 - k_1)]^{-2}} > 0 .$$

Thus, reducing deductibility unambiguously increases the sector one capital tax rate, as the government substitutes away from now partially deductible sales taxes to fully deductible capital taxes. In contrast, differentiating (15) yields

(19) $$\hat{k}_2 = -\eta_{k2\theta}(-\hat{\theta}) < 0, \qquad (\eta_{k2\phi} = 0) ,$$

where

$$\eta_{k2\theta} = \frac{[(1 - a)/a](\alpha_2/\beta_2)\tau_2/k_2}{1 + [(1 - a)/a][\mu_{G2}(1 - k_2)]^{-2}} > 0 .$$

Thus, reducing deductibility unambiguously causes a decrease in the use of capital taxes in sector two. This occurs because the reduction in marginal tax rates which accompanies the reduction in deductibility increases the after-tax cost of reducing wages by driving out capital with high tax rates. In sector one, this cost increase is more than offset by the fact that reducing deductibility makes the use of non–sales taxes relatively more attractive to the median voter; this force does not operate in sector two where the median voter is a nonitemizer.

These two changes in capital tax rates have opposing effects on the net return to capital, as can be seen by differentiating equation (16) which yields

(20) $$\hat{r} = -[\lambda_1 k_1/(1 - k_1)]\eta_{k1\phi}(-\hat{\phi}) + [\lambda_2 k_2/(1 - k_2)]\eta_{k2\theta}(-\hat{\theta}) ,$$

where $\lambda_j = K_{Tj}/K$ is the fraction of the fixed capital stock initially in sector j. The net result depends on the relative magnitudes of the two effects, but generally one would expect the direct effect from the reduction in ϕ to outweigh the feedback effect from the reduction in θ; this implies a net increase in the average rate of taxation of capital in the economy which, in a Harberger-type fixed capital stock general equilibrium model, would be expected to be largely borne by capital.

Differentiating equation (3) yields the effects on the gross prices of capital

(21) $$\hat{r}_1 = [\lambda_2 k_1/(1 - k_1)]\eta_{k1\phi}(-\hat{\phi}) + [\lambda_2 k_2/(1 - k_2)]\eta_{k2\theta}(-\hat{\theta}) > 0$$

(22) $$\hat{r}_2 = -[\lambda_1 k_1/(1 - k_1)]\eta_{k1\phi}(-\hat{\phi}) - [\lambda_1 k_2/(1 - k_2)]\eta_{k2\theta}(-\hat{\theta}) < 0$$

which indicate that the gross price of capital unambiguously increases (decreases) in sector one (two) where the capital tax rate is rising (falling). As a result, the capital stock in sector one unambiguously declines while the capital stock in sector two unambiguously increases, as can be seen from differentiating (1) to yield

(23) $$\hat{K}_{T1} = -\mu_K \hat{r} < 0$$

(24) $$\hat{K}_{T2} = \mu_K \hat{r}_2 > 0 \ .$$

Calculation of the changes in the sales tax rates is somewhat more involved. Since by assumption median voter income is derived solely from returns to the fixed factor ($Y_j = wL_j$), calculation of the changes in median voter gross income follows straightforwardly from differentiating equation (2) and substituting into Y_j to yield

(25) $$\hat{Y}_1 = -\eta_{Y1\phi}(-\hat{\phi}) - \eta_{Y1\theta}(-\hat{\theta}) < 0 \ ,$$

where

$$\eta_{Y1\phi} = [a/(1-a)]\,[\lambda_2 k_1/(1-k_1)]\eta_{k1\phi} > 0$$

$$\eta_{Y1\theta} = [a/(1-a)]\,[\lambda_2 k_2/(1-k_2)]\eta_{k2\theta} > 0 \ .$$

Similarly,

(26) $$\hat{Y}_2 = \eta_{Y2\phi}(-\hat{\phi}) + \eta_{Y2\theta}(-\hat{\theta}) > 0 \ ,$$

where

$$\eta_{Y2\phi} = [a/(1-a)]\,[\lambda_1 k_1/(1-k_1)]\eta_{k1\phi} > 0$$

$$\eta_{Y2\theta} = [a/(1-a)]\,[\lambda_1 k_2/(1-k_2)]\eta_{k2\theta} > 0 \ .$$

Thus, median voter gross income unambiguously decreases in sector one, as wages fall in response to the outflow of capital induced by both the increase in the capital tax rate in sector one and the reduction in the capital tax rate in sector two; the opposing effects occur in sector two.

Differentiating equation (5), holding t_1 constant, and substituting from equation (25) yields the change in income net of federal taxes ($Y_{Nj} = (1+t_j)C_j$)

(27) $$\hat{Y}_{N1} = -\epsilon_{YN1\phi}(-\hat{\phi}) + \epsilon_{YN1\theta}(-\hat{\theta}) \ ,$$

where the ϵ notation indicates a partial elasticity holding the sales tax rate constant and

$$\epsilon_{YN1\phi} = \eta_{Y1\phi}(1-\tau_1)Y_1/[(1-\tau_1)Y_1 + \tau_1 Z_1] + \tau_1 t_1/[1 + (1-\tau_1)t_1]$$

$$\epsilon_{YN1\theta} = [\tau_1(Y_1 - Z_1) - \eta_{Y1\theta}(1-\tau_1)Y_1]/[(1-\tau_1)Y_1 + \tau_1 Z_1] - \tau_1 t_1/[1 + (1-\tau_1)t_1] \ .$$

The $\epsilon_{YN1\phi}$ expression reflects the reduction in net income due to lower wages and the reduction in sales tax deductions. The $\epsilon_{YN1\theta}$ expression reflects the increase in net income due to the reduction in marginal tax rates, which is offset by the reduction in wage income (due to capital outflow caused by the reduction in k_2) and the reduced values of the remaining sales tax deductions due to the reduction in θ.

Similarly, in sector two,

$$\hat{Y}_{N2} = \epsilon_{YN2\phi}(-\hat{\phi}) + \epsilon_{YN2\theta}(-\hat{\theta}) \, , \tag{28}$$

where

$$\epsilon_{YN2\phi} = \eta_{Y2\phi}(1 - \tau_2)Y_2/[1 - \tau_2)Y_2 + \tau_2 Z_2]$$
$$\epsilon_{YN2\theta} = [\eta_{Y2\theta}(1 - \tau_2)Y_2 + \tau_2(Y_2 - Z_2)]/[1 - \tau_2)\, Y_2 + \tau_2 Z_2] \, ,$$

with the terms in $\epsilon_{YN2\phi}$ and $\epsilon_{YN2\theta}$ reflecting increases in net income due to wage increases caused by the increase in k_1 and the reduction in k_2, and the increase in net income due to the reduction in θ. Substituting these expressions into the results of differentiating equation (5) yields the changes in consumption which are

$$\hat{C}_1 = -\epsilon_{C1\phi}(-\hat{\phi}) + \epsilon_{C1\theta}(-\hat{\theta}) - \{(1 - \tau_1)t_1/[1 + (1 - \tau_1)t_1]\}\hat{t}_1 \tag{29}$$

$$\hat{C}_2 = \epsilon_{YN2\phi}(-\hat{\phi}) + \epsilon_{YN2\theta}(-\hat{\theta}) - [t_2/(1 + t_2)]\hat{t}_2 \, . \tag{30}$$

Price changes follow directly from differentiating the P_{Gj} term in equation (9) which yields

$$\hat{P}_{G1} = [\tau_1/(1 - \tau_1)](-\hat{\phi} - \hat{\theta}) = \eta_{PG1}(-\hat{\phi} - \hat{\theta}) > 0 \tag{31}$$

$$\hat{P}_{G2} = 0 \, , \tag{32}$$

as the price of government services rises unambiguously for the median voter who itemizes, but is constant for the nonitemizing median voter.

The response of capital tax revenues must be obtained in order to calculate the change in government services provided to the median voter. Differentiating equation (7) yields

$$\hat{R}_{K1} = \eta_{RK1\phi}(-\hat{\phi}) - \eta_{RK1\theta}(-\hat{\theta}) \, , \tag{33}$$

where

$$\eta_{RK1\phi} = \{1 - [a/(1 - a)]\,[k_1/(1 - k_1)]\lambda_2\}\eta_{K1\phi} > 0$$

$$\eta_{RK1\theta} = [a/(1 - a)]\,[k_2/(1 - k_2)]\lambda_2\eta_{K2\theta} > 0 \, ,$$

indicating that capital tax revenues in sector one increase as a result of the increase in k_1 (for any reasonable parameter values—e.g., $a < 0.5$ and $k_1 < 0.5$ is a sufficient condition) but decrease because the reduction in k_2 causes an outflow of capital from sector one. Differentiating equation (8) and substituting from equations (27–29) yields

$$(34) \quad \hat{G}_1 = (-s_{C1}\epsilon_{C1\phi} + s_{K1}\eta_{RK1\phi})(-\hat{\phi}) + (s_{C1}\epsilon_{C1\theta} - s_{K1}\eta_{RK1\theta})(-\hat{\theta}) + \{s_{C1}/[1 + (1 - \tau_1)t_1]\}\hat{t}_1,$$

where s_{Cj} and s_{Kj} are the shares of sales and capital tax revenues in funds other than matching grants in sector j; that is, $s_{Cj} = t_jC_{Tj}/[(1 - m_j)\, G_{Tj}]$ and $s_{Kj} = k_jr_jK_{Tj}/[(1 - m_j)\, G_{Tj}]$.

Performing the analogous calculations in sector two yields

$$(35) \quad \hat{R}_{K2} = \eta_{RK2\phi}(-\hat{\phi}) - \eta_{RK2\theta}(-\hat{\theta}) ,$$

where

$$\eta_{RK2\phi} = [a/(1 - a)]\, [k_1/(1 - k_1)]\lambda_1\eta_{K1\phi} > 0$$

$$\eta_{RK2\theta} = \{1 - [a/(1 - a)]\, [k_2/(1 - k_2)]\lambda_1\}\eta_{K2\theta} > 0 ,$$

indicating that capital tax revenues fall in sector two because of the reduction in k_2 but rise because of the inflow of capital caused by the increase in k_1. Substituting into the result of differentiating (8) yields

$$(36) \quad \hat{G}_2 = (-s_{C2}\epsilon_{YN2\phi} + s_{K2}\eta_{RK2\phi})(-\hat{\phi}) + (s_{C2}\epsilon_{YN2\theta} - s_{K2}\eta_{RK2\theta})\,(-\hat{\theta}) + [s_{C2}/(1 + t_2)]\hat{t}_2 .$$

These results permit calculation of the change in the sales tax rates. Differentiating equation (11) and using the Slutsky equation as well as equation (32) yields the standard results

$$(37) \quad \mu_{GY1}\hat{C}_1 - \mu_{CY1}\hat{G}_1 - (\mu_{GPG1}/e_{C1})\hat{P}_{G1} = 0$$

$$(38) \quad \mu_{GY2}\hat{C}_2 - \mu_{CY2}\hat{G}_2 = 0 ,$$

where μ_{CYj} and μ_{GYj} are the income elasticities of demand (with respect to full fiscal income Y_{Fj}) for private and public services, μ_{GPG1} is the compensated price elasticity of demand for public services in sector one, and e_{Cj} is the share of full fiscal income spent on private consumption. Substituting from (29), (31), (34) and solving for the change in t_1 yields

$$(39) \quad \hat{t}_1 = -\eta_{t1\phi}(-\hat{\phi}) + \eta_{t1\theta}(-\hat{\theta}) ,$$

where

$$\eta_{t1\phi} = \{\epsilon_{YN1\phi}\,(\mu_{GY1} - \mu_{CY1}s_{C1}) + \mu_{CY1}s_{K1}\eta_{RK1\phi} + (\mu_{GPG1}/e_{C1})\,[\tau_1/(1 - \tau_1)]\}/D_1$$

$$\eta_{t1\theta} = \{\epsilon_{YN1\theta}\,(\mu_{GY1} - \mu_{CY1}s_{C1}) + \mu_{CY1}s_{K1}\eta_{RK1\theta} - (\mu_{GPG1}/e_{C1})[\tau_1/(1 - \tau_1)]\}/D_1$$

$$D_1 = [\mu_{GY1}(1 - \tau_1)t_1 + \mu_{CY1}s_{C1}]/[1 + (1 - \tau_1)\, t_1] > 0 .$$

These results are interpreted as follows. For $\eta_{t1\phi}$, the first term indicates that the sales tax rate t_1 (1) declines because of a negative "net income" effect which causes demand for government services to fall, with this effect tempered by the need to maintain the sales tax share of revenues in light of declining consumption; (2) declines because of a "revenue mix effect" which results in a shift to capital taxation; and (3) declines because the increase in the relative price of government services reduces demand. For $\eta_{t1\theta}$, the sales tax rate t_1 (1) increases because the reduction in marginal tax rates causes net income to increase, (2) increases (mitigating the analogous revenue mix effect above) because the decrease in k_2 causes capital tax revenues to fall since capital leaves sector one, and (3) decreases since the reduction in θ also increases the relative price of government services in sector one and thus reduces demand. Although the net effect is ambiguous, it is likely that income effects of the reduction in ϕ, the revenue mix effect in sector one, and the price effects will dominate the negative effects so that the sales tax rate in sector one declines.

The analogous derivation in sector two yields

$$\hat{t}_2 = \eta_{t2\phi}(-\hat{\phi}) + \eta_{t2\theta}(-\hat{\theta}) \,, \tag{40}$$

where

$$\begin{aligned}
\eta_{t2\phi} &= [\epsilon_{YN2\phi}(\mu_{GY2} - \mu_{CY2}s_{C2}) - \mu_{CY2}s_{K2}\eta_{RK2\phi}]/D_2 \\
\eta_{t2\theta} &= [\epsilon_{YN2\theta}(\mu_{GY2} - \mu_{CY2}s_{C2}) + \mu_{CY2}s_{K2}\eta_{RK2\theta}]/D_2 \\
D_2 &= (\mu_{GY2}t_2 + \mu_{CY2}s_{C2})/(1 + t_2) > 0 \,.
\end{aligned}$$

The interpretation of these results is analogous to that above; note that both net income effects are positive, the capital tax revenue effects imply an increase in t_2 due to the revenue mix effect in sector two (k_2 falls) but a reduction due to the increase in k_1 and the resulting increase in K_{T2}, and there are no price effects since the price of government services facing the nonitemizing median voter is unchanged.

Given the expressions for the changes in the four tax rate variables and the net return to capital, the changes in consumption and government service levels can be derived. Differentiating the definition of full fiscal income Y_{F1}, holding P_{G1} constant, yields

$$\hat{Y}_{F1} = -\epsilon_{YF1\phi}(-\hat{\phi}) + \epsilon_{YF1\theta}(-\hat{\theta}) \,, \tag{41}$$

where

$$\begin{aligned}
\epsilon_{YF1\phi} &= \{\epsilon_{YN1\phi}s_{C1}[1 + (1 - \tau_1)\, t_1] - s_{K1}\eta_{RK1\phi}(1 - \tau_1)t_1\}/ \\
&\qquad \{[1 + (1 - \tau_1)t_1]D_1\} \\
\epsilon_{YF1\theta} &= \{\epsilon_{YN1\theta}s_{C1}[1 + (1 - \tau_1)\, t_1] - s_{K1}\eta_{RK1\theta}(1 - \tau_1)t_1\}/ \\
&\qquad \{[1 + (1 - \tau_1)t_1]D_1\} \,.
\end{aligned}$$

Thus, there are four effects on full fiscal income in sector one. Reducing deductibility reduces Y_{F1} through a negative ϕ-net income effect because wages decline, but increases it through a positive ϕ-revenue mix effect because additional capital tax revenues are raised; the associated reduction in marginal tax rates directly increases Y_{F1} through a positive θ-net income effect but also reduces it through a negative θ-revenue mix effect due to the reduction in k_2 which causes an outflow of capital from sector one and thus reduces wages. The net effect is ambiguous, but is likely to be negative.

Similarly,

$$\hat{Y}_{F2} = \eta_{YF2\phi}(-\hat{\phi}) + \eta_{YF2\theta}(-\hat{\theta}) \,, \tag{42}$$

where

$$\eta_{YF2\phi} = [\epsilon_{YN2\phi}s_{C2}(1 + t_2) + t_2 s_{K2}\eta_{RK2\phi}]/[(1 + t_2)D_2] > 0$$

$$\eta_{YF2\theta} = [\epsilon_{YN2\theta}s_{C2}(1 + t_2) - t_2 s_{K2}\eta_{RK2\theta}]/[(1 + t_2)D_2] \,.$$

Thus, both the ϕ-net income and θ-net income effects are positive on full fiscal income in sector two, while the ϕ-revenue mix effect is positive (the increase in k_1 drives capital to sector two and increases wages) and the θ-revenue mix effect is negative (the reduction in k_2 reduces full fiscal income).

Substituting into (29–30) from (39) and (40–42) yields the changes in consumption and government services broken down into the appropriate income and substitution effects:

$$\hat{C}_1 = \mu_{CY1}[-\epsilon_{YF1\phi}(-\hat{\phi}) + \epsilon_{YF1\theta}(-\hat{\theta})] + \mu_{CPG1}\eta_{PG1}(-\hat{\phi}-\hat{\theta}) \tag{43}$$

$$\hat{G}_1 = \mu_{GY1}[-\epsilon_{YF1\phi}(-\hat{\phi}) + \epsilon_{YF1\theta}(-\hat{\theta})] - \mu_{GPG1}\eta_{PG1}(-\hat{\phi}-\hat{\theta}) \tag{44}$$

$$\hat{C}_2 = \mu_{CY2}[\epsilon_{YF2\phi}(-\hat{\phi}) + \epsilon_{YF2\theta}(-\hat{\theta})] \tag{45}$$

$$\hat{G}_2 = \mu_{GY2}[\epsilon_{YF2\phi}(-\hat{\phi}) + \epsilon_{YF2\theta}(-\hat{\theta})] \,, \tag{46}$$

where μ_{CPG1} is the compensated cross-price elasticity of demand for consumption with respect to the price of government services for the median voter in sector one. Assuming that the first term in brackets in (43) outweighs the second, the net income effects operate to reduce (increase) public and private consumption in sector one (two), while the substitution effects in sector one increase the relative demand for private goods.

The changes in sales tax revenues are obtained by substituting equations (39–40), (43), and (45) into equation (6) which yields

$$\hat{R}_{C1} = -\eta_{RC1\phi}(-\hat{\phi}) + \eta_{RC1\theta}(-\hat{\theta}) \,, \tag{47}$$

where

$$\eta_{RC1\phi} = \frac{\mu_{GY1}\,\epsilon_{YN1\phi}\,[1 + (1 - \tau_1)t_1] + \mu_{CY1}\,s_{K1}\,\eta_{RK1\phi} - (\mu_{GPG1}/e_{C1})\eta_{PG1}}{[1 + (1 - \tau_1)t_1]\,D_1}$$

$$\eta_{RC1\theta} = \frac{\mu_{GY1}\,\epsilon_{YN1\theta}\,[1 + (1 - \tau_1)t_1] + \mu_{CY1}\,s_{K1}\,\eta_{RK1\theta} + (\mu_{GPG1}/e_{C1})\eta_{PG1}}{[1 + (1 - \tau_1)t_1]\,D_1}$$

and

(48) $$\hat{R}_{C2} = \eta_{RC1\phi}(-\hat{\phi}) + \eta_{RC2\theta}(-\hat{\theta}) ,$$

where

$$\eta_{RC2\phi} = [\mu_{GY2}(1 + t_2)\,\epsilon_{YN2\phi} - \mu_{CY2}\,s_{K2}\,\eta_{RK2\phi}]/[(1 + t_2)\mathrm{D}_2]$$

$$\eta_{RC2\theta} = [\mu_{GY2}(1 + t_2)\epsilon_{YN2\theta} + \mu_{CY2}s_{K2}\eta_{RK2\theta}]/[\theta(1 + t_2)D_2].$$

The interpretation of the income, revenue mix, and price effects on sales tax revenues is analogous to the description of effects on sales tax rates above.

Finally, differentiation of the federal government budget constraint yields the reduction in marginal tax rates (θ) in response to the reduction in deductibility. Differentiating equation (17) yields

(49) $$\begin{aligned} &-f_{G1}\hat{G}_1 - f_{G2}\hat{G}_2 + f_{Y1}\hat{T}_{N1} \\ &+ f_{Y2}\hat{T}_{N2} - f_{C1}\,[\hat{R}_{C1} - (-\hat{\phi})] - f_{C2}[\hat{R}_{C2} \\ &- (-\hat{\phi})] + f_{K1}\,\hat{R}_{FK1} + f_{K2}\hat{R}_{FK2} = 0 , \end{aligned}$$

where $T_{Nj} = \theta\tau_j(Y_j - Z_j)$ is federal personal income taxes paid neglecting sales tax deductions in each sector, and $R_{FKj} = \kappa r_j(1 - k_j)K_{Tj}$ is federal corporate tax revenues paid in each sector. To solve for the changes in T_{Nj} differentiate the definition and substitute from equations (25–26) to yield

(50) $$\hat{T}_{N1} = -[Y_1/(Y_1 - Z_1)]\eta_{Y1\phi}\,(-\hat{\phi}) - \{1 + [Y_1/(Y_1 - Z_1)]\eta_{Y1\theta}\}\,(-\hat{\theta})$$

(51) $$\hat{T}_{N2} = -[Y_2/(Y_2 - Z_2)]\,\eta_{Y2\phi}(-\hat{\phi}) - \{1 - [Y_2/(Y_2 - Z_2)]\eta_{Y2\theta}\}\,(-\hat{\theta}).$$

Differentiating the definition of R_{FKj} and substituting from equations (18–24) yields

(52) $$\hat{R}_{FK1} = -\eta_{RFK1\phi}\,(-\hat{\phi}) - \eta_{RFK1\phi}\,(-\hat{\theta}) < 0$$

$$\eta_{RFK1\phi} = [1 + (\mu_K - 1)\lambda_2][k_1/(1 - k_1)]\eta_{K1\phi} > 0$$

$$\eta_{RFK1\theta} = (\mu_K - 1)\lambda_2\,[k_2/(1 - k_2)]\eta_{k2\theta} > 0$$

(53) $$\hat{R}_{FK2} = \eta_{RFK2\phi}\,(-\hat{\phi}) + \eta_{RFK2\theta}\,(-\hat{\theta})$$

$$\eta_{RFK2\phi} = (\mu_K - 1)\lambda_1[k_1/(1 - k_1)]\eta_{k1\phi} > 0$$

$$\eta_{RFK2\theta} = [1 + (\mu_K - 1)\lambda_1][k_2/(1 - k_2)]\eta_{k2\theta} > 0,$$

which indicates that federal corporate revenues decline because of the increased use of capital taxation in sector one, but increase because of the reduction in the use of capital taxation in sector two.

Substituting into equation (49) from equations (44), (46), and (50–53) yields

$$(54)\qquad (-\hat{\theta}) = \eta_\theta(-\hat{\phi}) = (\eta_{\theta n}/\eta_{\theta d})(-\hat{\phi}) ,$$

where

$$\eta_{\theta n} = [f_{G1}\mu_{GY1}\eta_{YT1\phi} - f_{G2}\mu_{GY2}\eta_{YT2\phi} + f_{G1}\mu_{GPG1}\eta_{PG1}]$$
$$- \{f_{Y1}[Y_1/(Y_1 - Z_1)]\eta_{Y1\phi} - f_{Y2}[Y_2/(Y_2 - Z_2)]\eta_{Y2\phi}\}$$
$$+ [f_{C1}\eta_{RC1\phi} - f_{C2}\eta_{RC2\phi}] - [f_{K1}\eta_{RFK1\phi} - f_{K2}\eta_{RFK2\phi}]$$
$$\eta_{\theta d} = f_{G1}\mu_{GY1}\eta_{YT1\theta} + f_{G2}\mu_{GY2}\eta_{YT2\theta} - f_{G1}\mu_{GPG1}\eta_{PG1}$$
$$+ f_{Y1}\{1 + [Y_1/(Y_1 - Z_1)]\eta_{Y1\theta}\} + f_{Y2}\{1 - [Y_2/(Y_2 - Z_2)]\eta_{Y2\theta}\}$$
$$+ f_{C1}\eta_{RC1\theta} + f_{C2}\eta_{RC2\theta} + f_{K1}\eta_{RFK1\theta} - f_{K2}\eta_{RFK2\theta} .$$

The terms in $\eta_{\theta n}$ indicate that, in each case, the effects on federal revenue due to changes in sector one are offset by analogous effects of opposite sign in sector two; the expression $\eta_{\theta d}$ is positive for any reasonable parameter values.

This general equilibrium multiplier for the reduction in marginal tax rates made possible by the elimination of deductibility can be compared to the analogous multiplier in the static case where revenue mix and general equilibrium effects are not considered. Although "static" could be defined in a variety of ways, suppose the static estimate simply ignores all changes in revenue mix, income, and consumption. In this case, the multiplier analgous to η_θ is

$$(55)\qquad \epsilon_\theta = (f_{C1} + f_{C2})/(f_{Y1} + f_{Y2}) .$$

A comparison of ϵ_θ and η_θ, assuming $\epsilon_\theta > \eta_\theta$, indicates the extent to which a static revenue estimate, in the specific sense defined above, overestimates the increase in federal revenues due to the elimination of state and local tax deductibility.

6.4 Simulation Results

Numerical simulation results with a version of the model described in section 6.2 are presented in this section. Since the model is fairly primitive and ignores a large number of features which would be included in a more complete representation of the U.S. economy, these results should be viewed as merely suggestive of the potential importance of the revenue and general equilibrium effects emphasized in the previous discussion.

The primary source of information was the data set on 1983 state personal income and sales taxes compiled by Daniel Feenberg and Harvey Rosen (1986) which the authors generously made available to me. Additional data was obtained primarily from various publications of the Advisory Commission on Intergovernmental Relations.

To determine the division of the fifty states and the District of Columbia into the itemizer and nonitemizer sectors, the states were ranked in decreasing order of percentage of itemizers, with joint returns double-weighted to reflect the presence of two voters; the percentage of itemizers varied from a high of 55.2 percent in Utah to a low of 19.9 percent in South Dakota. As discussed above, results are reported for $N^* = 19, 29$, and 39; the results presented by Lindsey (in this volume) suggest that $N^* = 29$ should be viewed as the best point estimate.[12] For a given N^*, states 1 through N^* were aggregated to form sector one (the itemizer sector), and states $N^* + 1$ through 51 were aggregated to form sector two (the nonitemizer sector).

The Feenberg-Rosen state and local data were divided into five adjusted gross income (AGI) brackets ($0–$10,000; $10,000–$15,000; $15,000–$20,000; $20,000–$30,000; and > $30,000) indexed by b. As indicated in equation (4), data on marginal and average tax rates were used to construct marginal tax rates (τ_{jb}) and exemption/deduction totals, net of sales tax deductions, for each bracket in the two sectors (Z_{jb}). Individuals are assumed to stay in the same income brackets, so that all changes in the personal tax structure are captured by changes in the θ variable. The value of the total nonresidential nonfarm capital stock in 1983 was determined from data on tangible asset holdings reported in Board of Governors of the Federal Reserve System (1986). Capital owners were assumed to receive a current net return of $r = 0.04$, and capital was allocated across states in proportion to the shares of nonresidential nonfarm property tax base reported in Advisory Commission on Intergovermental Relations (1986)—hereafter, ACIR (1986). Returns to capital were assumed to accrue entirely to individuals in the top two income brackets, with 81 percent of capital income assumed to be earned by individuals in the $30,000 and above class.[13] The remainder of AGI was attributed to earnings of the fixed factor (labor).

The determination of the sectoral tax rates in the initial equilibrium required a division of total property tax revenues into nonresidential and residential components. Feldstein, Dicks-Mireaux, and Poterba (1983) note that the correct way to perform this division is uncertain and argue that calculations which assume that the effective tax rate on nonresidential property ranges from one-third to three times the effective rate on residential property should bound the true value. Since I wish to emphasize the role of state and local capital taxation, and since Netzer's (1985) comments suggest that a value in the upper portion of this range would be realistic, I simply assume that the effective tax rate on nonresidential property is the upper bound of the range suggested by Feldstein, Dicks-Mireaux, and Poterba—three times that on residential property. The land component of these taxes is eliminated, assuming that it is proportional to the total land value reported in the Federal Reserve Board publication cited above. Data on tax bases and property taxes paid are from ACIR (1986).

Given this allocation of the property taxes paid, residential property taxes are included with general sales and personal income taxes and treated as deductible personal taxes, referred to in the text simply as sales taxes. State and local taxes are assumed to be proportional, so the sales tax rate in each sector (t_j) is calculated simply as an average tax rate; note however that the calculated rates are high in that no attempt is made to impute rents on owner-occupied housing and include them in gross income, even though residential property taxes paid are included in "sales" taxes.

The sectoral capital tax rates are also calculated assuming a proportional tax structure, where total "capital" taxes paid are the sum of nonresidential property taxes (excluding the land component), corporate income taxes, and corporate licenses, where data on the last two items are also obtained from ACIR (1986). Given the assumption regarding the split between residential and nonresidential property taxes described above, these tax rates are relatively high; however, note that no attempt was made to include the business capital share of selective excises, user charges, severance taxes, etc.

The calculations of the gross prices of capital, as specified in equation (3), and the value of the capital share parameter a in the Cobb-Douglas production function, require a value for the corporate tax rate. Since my primary concern is the federal revenue effect of changes in business taxes which are deductible at the statutory corporate tax rate, I simply assume that κ is the statutory rate in 1983 ($\kappa = 0.46$); this implies a nonresidential capital share of $a = 0.18$.

No attempt is made to account for other sources of state and local revenue, including user charges, selective excise taxes, gift and estate taxes, and severance taxes, as well as the land portion of business property taxes. The revenues that are included in state and local sales and capital taxes in the model represent roughly 60 percent of all state and local revenues.

The median voter was simply assumed to be the median income taxpayer for each sector. The utility function of the median voter is assumed to be a constant elasticity of substitution (CES) function, with an elasticity of substitution equal to 0.5. This implies an uncompensated price elasticity of demand of 0.5—toward the middle or upper portion of the range of published estimates (see Inman 1979, Ladd 1984, and Netzer 1985). The CES specification simplifies the analysis at the cost of assuming a unitary income elasticity, which is higher than that suggested by the literature; accordingly, the changes in government service demands are overstated in sector two (which gains income) but understated in sector one (which loses income).

Information on federal grants is obtained from *Advisory Commission on Intergovernmental Relations* (1985b), where revenue sharing is treated as lump-sum grants (S_j), and the remaining grants are treated as matching grants. To obtain realistic matching rates, the grants amount is reduced by the proportion of tax revenues which are not included in the above determinations of sales taxes and capital taxes. Total federal tax revenue is calculated using an expression analogous to equation (17) except that equation (4) is used to calculate explicitly federal personal income taxes paid for each bracket in the two sectors; the fraction of itemizers in each bracket is determined from the Feenberg-Rosen data, and is assumed to be constant throughout the simulations.

In the initial equilibrium, $\phi = \theta = 1$. The calculated initial values of the tax rates and other variables and parameters are substituted into equation (11) for $j = 1, 2$ to solve for the values of the distributive share parameters in the CES utility functions (which differ across the two sectors), and into equations (14–15) to solve for the values of the two "net shifting" perception parameters μ_{Nj}.[14] (Equations (16–17) are satisfied by construction in the initial equilibrium.) These values are then used to calculate new equilibria in response to exogenous reductions in the extent of state and local tax deductibility (ϕ).

Three sets of results are presented. The first set corresponds to an equilibrium situation where the government institutes the reduction in θ predicted by the static revenue described above and runs a deficit if revenues are insufficient. Matching grants are assumed to be constant for this calculation. These results are presented in tables 6.1a–c, where the three cases described above ($N^* = 29, 19, 39$) are considered. The values for $N^* = 29$ provide the best estimates, while the values for $N^* = 19$ and $N^* = 39$ provide reasonable bounds for the various quantities listed.

Several features of the results are common to all three cases. In terms of tax rates, the sector one revenue mix changes drastically as k_1 increases by 43 percent (41, 47) for $N^* = 29$ (19, 39) and t_1 falls by 30 percent (29, 32). The revenue mix in sector two changes less dramatically in the opposite direction, as k_2 falls by 11% (10, 14) and t_2 increases by 5% (5, 9). The effects on revenues are of course quite different in the three cases. When $N^* = 29$, the changes in total state and local capital and sales tax revenues due to changes in the sector one tax rates are offset by roughly 10–12 percent because of changes in the opposite direction in sector two. For example, R_{K1} increases by

Table 6.1a Equilibrium Effects of Eliminating Deductibility N* = 29, "Static" θ, Grants Constant

Variable	φ = 0:	j = 1	j = 2	φ = 1:	j = 1	j = 2
Capital tax rates		0.211	0.157		0.302	0.139
Sales tax rates		0.132	0.095		0.092	0.100
Gross wages		0.944	0.958		0.931	0.975
Capital fractions		0.577	0.423		0.534	0.466
Net return to capital		0.040	0.040		0.038	0.038
Tax rate variable θ		1.000	1.000		0.898	0.898

Variable	Change for j = 1	Change for j = 2	Net Change
Income			
Labor income	−13.2	11.5	−1.7
Capital income	—	—	−8.8
State/Local Tax Revenue			
Sales tax revenue	−32.9	3.3	−29.6
Capital tax revenue	18.1	−2.2	15.9
Total tax revenue	−14.8	1.1	−13.7
Federal Tax Revenue			
Personal tax revenue	−1.4	−1.9	−3.3
Corporate tax revenue	−9.6	2.1	−7.5
Total tax revenue	−11.0	0.2	−10.8

Notes: All revenue figures in tables are in billions of 1983 dollars; details may not add due to rounding. Predicted revenue gain is $28.6 billion.

Table 6.1b Equilibrium Effects of Eliminating Deductibility N* = 19, "Static" θ, Grants Constant

Variable	φ = 0:	j = 1	j = 2	φ = 1:	j = 1	j = 2
Capital tax rates		0.219	0.164		0.308	0.147
Sales tax rates		0.142	0.097		0.101	0.102
Gross wages		0.942	0.956		0.925	0.968
Capital fractions		0.431	0.569		0.390	0.610
Net return to capital		0.040	0.040		0.039	0.039
Tax rate variable θ		1.000	1.000		0.898	0.898

Variable	Change for j = 1	Change for j = 2	Net Change
Income			
Labor income	−13.0	11.3	−1.7
Capital income	—	—	−5.7
State/Local Tax Revenue			
Sales tax revenue	−25.5	4.2	−21.4
Capital tax revenue	13.2	−2.9	10.2
Total tax revenue	−12.3	1.2	−11.1
Federal Tax Revenue			
Personal tax revenue	0.3	−2.5	−2.2
Corporate tax revenue	−7.3	2.5	−4.9
Total tax revenue	−7.0	0.0	−7.1

Notes: All revenue figures in tables are in billions of 1983 dollars; details may not add due to rounding. Predicted revenue gain is $28.7 billion.

Table 6.1c **Equilibrium Effects of Eliminating Deductibility**
$N^*=39$, "Static" θ, Grants Constant

Variable	$\phi=0$:	$j=1$	$j=2$	$\phi=1$:	$j=1$	$j=2$
Capital tax rates		0.200	0.138		0.294	0.118
Sales tax rates		0.125	0.079		0.085	0.086
Gross wages		0.947	0.963		0.941	0.987
Capital fractions		0.803	0.197		0.774	0.226
Net return to capital		0.040	0.040		0.036	0.036
Tax rate variable θ		1.000	1.000		0.898	0.898

Variable	Change for $j=1$	Change for $j=2$	Net Change
Income			
Labor income	−8.9	7.6	−1.2
Capital income	—	—	−13.7
State/Local Tax Revenue			
Sales tax revenue	−44.3	1.6	−42.6
Capital tax revenue	26.2	−1.1	25.1
Total tax revenue	−18.0	0.6	−17.5
Federal Tax Revenue			
Personal tax revenue	−3.6	−1.1	−4.7
Corporate tax revenue	−12.9	1.3	−11.7
Total tax revenue	−16.5	0.2	−16.4

Notes: All revenue figures in tables are in billions of 1983 dollars; details may not add due to rounding. Predicted revenue gain is $28.5 billion.

$18.1 billion while R_{K2} decreases by $2.2 billion, and R_{C1} decreases by $32.9 billion while R_{C2} increases by $3.3 billion; total revenues fall by $14.8 billion in sector one while increasing in sector two by $1.1 billion for a net reduction in revenues of $13.7 billion. This corresponds to a reduction of 6.0 percent of the portion of own-revenues analyzed in the model. In contrast when $N^* = 39$, the sector one effects are more dominant, with much more dramatic effects on revenues; total capital tax revenues rise by $25.1 billion and total sales tax revenues fall by $42.6 billion for a net reduction of $17.5 billion or 7.6 percent of own-revenues. More modest revenue effects occur when $N^* = 19$, with a total net reduction of $11.1 billion or 4.9 percent of own-revenues. Note that the reduction in own-revenues is relatively large when virtually all states are modeled as itemizer states, since the increase in the tax price of government services is large for itemizers but zero for non-itemizers. Nevertheless, since the fraction of own revenues analyzed is only 60 percent, the net effect on total government expenditures is modest, and broadly similar to the types of responses suggested by Ladd (1984).

In both cases, the federal revenue gain predicted from the static estimate (as defined above) is approximately $28.6 billion; this implies that θ could be reduced from 1.0 to 0.898 without losing revenues from personal income taxation. Taking into account general equilibrium effects, personal tax revenues are lower in both jurisdictions because of the reduction in the net return to capital implied by the overall increase in taxation of capital (the effects of the increase in k_1 dominate those of the decrease in k_2), and lower in sector one because of lower wages with the opposite effect occurring in sector two. The net effect is a reduction in personal income tax revenues of \$3.3 (2.2, 4.7) billion when $N^* = 29$ (19, 39). (Note that personal tax revenues increase in sector one when $N^* = 19$ because this sector has a disproportionately large share of itemizers.) This revenue loss is increased because corporate revenues from sector one fall because business capital taxes are deducted at a higher k_1, and reduced because of the opposite effect in sector two. The net effect is negative in all three cases, as corporate revenues fall by \$7.5 (4.9, 11.7) billion when $N^* = 29$ (19, 39) as a loss of \$9.6 billion from sector one is partially offset by a gain of \$2.1 billion from sector two. The net effect on federal revenue when $N^* = 29$ (19, 39) is a \$10.8 (7.1, 16.4) billion shortfall or 38 percent (25, 58) of the predicted revenue gain from eliminating deductibility. Note that the revenue losses which occur as a result of general equilibrium effects on the net return to capital and wages are quite important, amounting to roughly 30 percent of the total revenue loss.

These results suggest that the revenue losses due to revenue mix and general equilibrium effects in response to an elimination of deductibility may be quite important. The second set of results pursues this issue further by presenting equilibrium values of the various endogenous variables when θ adjusts endogenously to balance the federal government budget. These results also assume that matching grants do not change in response to changes in own-financed levels of government service provision.

Tables 6.2a–c present equilibrium values for various variables for the same three cases analyzed in tables 6.1a–c ($N^* = 29, 19, 39$). When $N^* = 29$, the reduction in θ financed by the elimination of deductibility is reduced by roughly 43 percent once revenue mix and general equilibrium adjustments are taken into account ($\theta = 0.942$ rather than 0.898). When $N^* = 39$, the result is even more dramatic, as 65 percent of the reduction in marginal tax rates is eliminated, while when $N^* = 19$ only 29 percent of the reduction is eliminated. The increases in k_1 and the reductions in t_1 are larger than in the "deficit" case analyzed in tables 6.1a–c because, with a smaller than expected reduction in θ, the after-tax cost of reducing wages by driving out capital is reduced; for the same reason, the reductions in k_2 and the increases in t_2 are reduced.

The net effect of this greater reliance on capital taxation (relative to the deficit case) is a slightly larger reduction in the net return to capital. In all three cases, K_{T1} falls by roughly 4 percent, which implies an increase in K_{T2} of also roughly 4 percent. The corresponding reductions in sector one wages and increases in sector two wages are fairly modest.

Table 6.2a **Equilibrium Effects of Eliminating Deductibility**
N* = 29, θ Endogenous, Grants Constant

Variable	$\phi=0$:	$j=1$	$j=2$	$\phi=1$:	$j=1$	$j=2$
Capital tax rates		0.211	0.157		0.306	0.147
Sales tax rates		0.132	0.095		0.090	0.098
Gross wages		0.944	0.958		0.932	0.974
Capital fractions		0.577	0.423		0.534	0.466
Net return to capital		0.040	0.040		0.037	0.037
Tax rate variable θ		1.000	1.000		0.942	0.942

Variable	Change for $j=1$	Change for $j=2$	Net Change
Income			
Labor income	−13.0	11.3	−1.7
Capital income	—	—	−9.9
State/Local Tax Revenue			
Sales tax revenue	−44.3	1.6	−42.6
Capital tax revenue	26.2	−1.1	25.1
Total tax revenue	−18.0	0.6	−17.5
Federal Tax Revenue			
Personal tax revenue	6.0	2.5	8.5
Corporate tax revenue	−10.0	1.6	−8.5
Total tax revenue	−4.0	4.1	0.1

Notes: All revenue figures in tables are in billions of 1983 dollars; details may not add due to rounding. Predicted revenue gain is $28.6 billion.

Table 6.2b **Equilibrium Effects of Eliminating Deductibility**
N* = 19, θ Endogenous, Grants Constant

Variable	$\phi=0$:	$j=1$	$j=2$	$\phi=1$:	$j=1$	$j=2$
Capital tax rates		0.219	0.164		0.311	0.152
Sales tax rates		0.142	0.097		0.100	0.100
Gross wages		0.942	0.956		0.925	0.968
Capital fractions		0.431	0.569		0.390	0.610
Net return to capital		0.040	0.040		0.038	0.038
Tax rate variable θ		1.000	1.000		0.927	0.927

Variable	Change for $j=1$	Change for $j=2$	Net Change
Income			
Labor income	−12.9	11.2	−1.7
Capital income	—	—	−6.5
State/Local Tax Revenue			
Sales tax revenue	−26.4	2.8	−23.6
Capital tax revenue	13.6	−2.0	11.7
Total tax revenue	−12.8	0.8	−12.0
Federal Tax Revenue			
Personal tax revenue	4.1	1.6	5.6
Corporate tax revenue	−7.6	2.0	−5.5
Total tax revenue	−3.5	3.5	0.0

Notes: All revenue figures in tables are in billions of 1983 dollars; details may not add due to rounding. Predicted revenue gain is $28.7 billion.

Table 6.2c **Equilibrium Effects of Eliminating Deductibility N* = 39, θ Endogenous, Grants Constant**

Variable	φ = 0:	j = 1	j = 2	φ = 1:	j = 1	j = 2
Capital tax rates		0.200	0.138		0.301	0.131
Sales tax rates		0.125	0.079		0.083	0.081
Gross wages		0.947	0.963		0.941	0.986
Capital fractions		0.803	0.197		0.775	0.225
Net return to capital		0.040	0.040		0.036	0.036
Tax rate variable θ		1.000	1.000		0.964	0.964

Variable	Change for j = 1	Change for j = 2	Net Change
Income			
Labor income	−8.6	7.4	−1.2
Capital income	—	—	−15.3
State/Local Tax Revenue			
Sales tax revenue	−47.9	0.6	−47.3
Capital tax revenue	28.3	−0.2	28.0
Total tax revenue	−19.7	0.3	−19.3
Federal Tax Revenue			
Personal tax revenue	11.5	1.4	12.9
Corporate tax revenue	−13.9	0.9	−13.0
Total tax revenue	−2.4	2.3	−0.1

Notes: All revenue figures in tables are in billions of 1983 dollars; details may not add due to rounding. Predicted revenue gain is $28.5 billion.

Moreover, the losses in sector one wages are roughly offset by increases in sector two wages. Thus, the primary effect on federal revenues from general equilibrium changes in income is due to changes in capital income, which falls by $9.9 (6.5, 15.3) billion when $N^* = 29$ (19, 39).

The general pattern of revenue changes is similar to that previously discussed. When $N^* = 29$, the increase in R_{K1} of $19.1 billion is offset roughly 6 percent by a reduction in R_{K2} of $1.1 billion for a net increase of $18.0 billion, while the reduction in R_{C1} of $34.7 billion is offset roughly 5 percent by an increase in R_{C2} of $1.8 billion for a net reduction of $32.9 billion. Thus total state and local revenues fall by $14.9 billion. The relatively small equilibrium reduction in marginal tax rates (to $\theta = 0.942$ rather than 0.898) implies an increase in federal personal tax revenues, with a corresponding reduction in federal corporate tax revenues, of $8.5 billion. Results which bound these are obtained for $N^* = 19$ and 39. For example, the increase in federal personal tax revenues and the corresponding decrease in federal corporate tax revenues are $5.5 (12.9) billion for $N^* = 19$ (39).

Finally, table 6.3 presents the same information (for $N^* = 29$) for the case where federal government matching rates are assumed to be held constant, but the dollar value of matching grants is reduced in response to the reduction in own-revenues raised by state and local

Table 6.3 Equilibrium Effects of Eliminating Deductibility
N* = 29, θ and Grants Endogenous

Variable	φ = 0:	j = 1	j = 2	φ = 1:	j = 1	j = 2
Capital tax rates		0.211	0.157		0.305	0.145
Sales tax rates		0.132	0.095		0.091	0.098
Gross wages		0.944	0.958		0.932	0.974
Capital fractions		0.431	0.569		0.534	0.466
Net return to capital		0.040	0.040		0.038	0.038
Tax rate variable θ		1.000	1.000		0.930	0.930

Variable	Change for j = 1	Change for j = 2	Net Change
Income			
Labor income	−13.0	11.4	−1.7
Capital income	—	—	−9.6
State/Local Tax Revenue			
Sales tax revenue	−34.2	2.2	−32.0
Capital tax revenue	18.8	−1.4	17.4
Total tax revenue	−15.4	0.8	−14.6
Federal Tax Revenue			
Personal tax revenue	4.0	1.3	5.3
Corporate tax revenue	−10.0	1.7	−8.2
Total tax revenue	−5.9	3.1	−2.9

Notes: The change in total federal revenue of −$2.9 billion is equal to the reduction in matching grants. All revenue figures in tables are in billions of 1983 dollars; details may not add due to rounding. Predicted revenue gain is $28.6 billion.

governments. Since the reduction in own-revenues is relatively large for median voter itemizers who experience a large change in the effective price of government services, the reduction in federal revenues needed to balance the budget is potentially important. When $N^* = 29$, the percentage of the predicted reduction in marginal tax rates which is eliminated is reduced to 32 percent from 43 percent (θ can be reduced to 0.930 rather than 0.942).

6.5 Conclusion

To the extent the model analyzed in this paper is suggestive of the actual response of state and local governments to the elimination of federal tax deductibility, the results indicate that the increase in federal revenue—or the permitted reduction in marginal tax rates—is likely to be less than that predicted by "static" revenue-estimating techniques. The revenue shortfall predicted ranges from 25–58 percent of the predicted static revenue gain from eliminating state and local tax deductibility; the results presented by Lindsey (in this volume) suggest that a 38 percent revenue shortfall is the best estimate. These results suggest a revenue shortfall larger than the revenue loss of 15–20 percent predicted by the Treasury in generating its revenue estimates (see Nester, 1987) and more in line with the magnitudes suggested by Feldstein and Metcalf (1987). Moreover, the model analyzed here considers only substitution by state and local governments into corporate taxes and nonresidential property taxes on capital; to the extent substitution would occur into revenue sources which are deductible by businessses, such as the land portion of nonresidential property taxes, severance taxes, business user fees, etc., further federal revenue shortfalls would be expected. The results also indicate that changes in federal grants policies are a significant factor. If matching rates stay constant and programs are not added or increased, reduced own-expenditures by state and local governments will reduce federal expenditures, thus attenuating revenue problems due to changes in the state and local revenue mix. However, one could easily argue that eliminating deductibility is likely to increase pressures for more "targeted" federal aid programs, and that increases in such programs will further exacerbate federal revenue shortfalls.

In any case, it is clear that the results of the fairly primitive model analyzed here should be viewed as suggestive. A variety of extensions would enhance the model; these can be divided into three groups. First, the model could be elaborated in a number of ways. Housing and property taxes could be treated explicitly, as could other sources of state and local revenue; this would require modeling of the state and local choice between the taxes analyzed here and other revenue sources such as user charges, selective sales taxes, severance taxes, the land portion of nonresidential property taxes, debt, etc. The determination of the amount of capital income as well as its allocation could be more exact, and a specification of saving behavior could be included so that sales taxes paid would not be overstated for savers. The progressive nature of state and local income taxes could be modeled explicitly, in the same way the progressive structure of the federal tax system is modeled above. A method of allowing for the reduction in the number of itemizers that would occur as the deduction for state and local taxes were eliminated could also be incorporated in the model.

Second, the assumptions regarding the determination of state and local tax and expenditure policy could be altered. For example, modeling a situation where the state and local governments act to maximize a welfare function which weights the utilities of various jurisdictional coalitions—along the lines of the "average voter" model—would seem to be a useful extension; in particular, it would be interesting to construct an average voter model where information regarding the existing mix of state and local taxes would be used to infer the weights in the governmental welfare function. Although the current model may have characteristics similar to an average voter model where itemizers are relatively important in the political process in one sector and nonitemizers are relatively important in the other sector, a formal analysis is required before any statements can be made with confidence.

Finally, it would be possible to analyze the model in much more disaggregated form, applying the general equilibrium modeling techniques popularized by Ballard, Fullerton, Shoven, and Whalley (1985). In addition (perhaps) to a larger number of production goods, such a treatment would allow a relatively large number of sectors composed of broadly similar states. Such a disaggregation would provide a much clearer picture of the effects of eliminating deductibility across specific states. This brief discussion suggests that, even if analysis is limited to the basic model structure utilized in this paper, there are quite a few directions for future research.

Notes

1. It should be noted that the extent to which Treasury revenue estimates are "static" is frequently overstated; see Nester (1986).

2. The assumption of a fixed N^* greatly simplifies the analysis. However, note that N^* ideally should be endogenous, since the number of itemizers in any jurisdiction will be affected by the elimination of the deduction for state and local taxes.

3. The value of $N^* = 29$ differs from Lindsey's value of 28 only because the District of Columbia is included in my sample. See Lindsey (in this volume) for the explanation of how this figure was derived.

4. See Diewert (1978) for a discussion of the properties of the restricted profit function.

5. Note that the absence of an explicit treatment of housing also implies that any effects of eliminating deductibility on the choice between owner-occupied and rental housing is ignored.

6. No attempt is made to account for either (i) any limitation on the extent to which sales taxes are only partially deductible because the tables of estimated sales taxes paid provided to taxpayers by the Internal Revenue Service understate actual sales taxes paid, or (ii) the fraction of sales taxes which are actually paid by businesses rather than individuals.

7. This formulation assumes federal taxes paid are not deductible against state and local taxes.

8. This assumption greatly simplifies the governmental optimization problem because the (relatively small) feedback effects of changes in the government's capital tax rate on the capital income of the median voter can be ignored.

9. The 1982 *Statistics of Income, Individual Income Tax Returns* issued by the Internal Revenue Service indicate that less than 9 percent of adjusted gross income in the \$15,000–\$20,000 income class is derived from interest, dividends, and net capital gains.

10. This approach assumes for simplicity that matching grants apply to lump-sum grant funds; since such funds are held constant throughout the analysis, the only effect of the assumption is that the matching rate is estimated con-

servatively. Also, note that no attempt is made to model the "flypaper effect" of lump-sum grants; that is, there is no tendency for higher expenditures out of lump-sum grants than out of own revenues.

11. Since the value of β changes 1 percent or less in all the simulations, this seems to be a reasonable assumption.

12. Note however that the results presented here are not directly analogous to those obtained by Lindsey since no attempt is made to weight taxpayers by their probability of voting in determining either the division of states into the itemizer and nonitemizer sectors or the median voter in each sector. Unfortunately, publication time constraints required that a full integration of the Lindsey results with those presented in this paper be left to future research.

13. This corresponds to the allocation of interest, dividends, and net capital gains across these two income classes reported in the 1982 *Statistics of Income, Individual Income Tax Returns* issued by the Internal Revenue Service.

14. For the various simulations reported below, the values of the CES distributive share parameters are around 0.95, the values of μ_{N1} are around -0.4, and the values of μ_{N2} are close to zero or slightly positive. The positive values of μ_{N2} suggest an expectation of greater than full shifting or, more likely, the fact that even jurisdictions where the median voter is a nonitemizer will take into account the fact that some residents are itemizers and use a higher t_2 and lower k_2 than implied in the analysis (a lower k_2 yields a lower implied value of μ_{N2} in the initial equilibrium). Another explanation, suggested by Lindsey (in this volume), is that the relatively low income states which constitute sector two maintain relatively low capital tax rates in the hope of attracting new firms from the relatively high income states that make up sector one.

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Comment Don Fullerton

For years, the Office of Tax Analysis (OTA) and the Joint Committee on Taxation (JCT) have had responsibility for estimating revenue and other economic effects of alternative tax policies. Academic economists have estimated efficiency and distributional effects of taxes, but they tend to regard tax revenue as a relatively uninteresting by-product or intermediate step in the maximization of social welfare. They have criticized government revenue-estimating models as ad hoc, with institutional detail rather than theoretical foundation, but they have provided few of their own as alternatives. Despite the interest of economists in overall welfare, the recent tax reform experience makes clear that important policy decisions are often based primarily on considerations of revenue. Thus academic economists are beginning to provide more research on the methodology of revenue estimation.

This paper, by George R. Zodrow, is a welcome addition to this relatively new line of research. It is also a unique addition. On the one hand, the revenue-estimating models of OTA and JCT use data with considerable disaggregation and computer programs with considerable coverage of tax law provisions. They incorporate behavioral adjustments, but elasticity parameters are prespecified. Analyses are typically based on partial equilibrium models. On the other hand, academic economists have provided econometric models, using past behavioral reactions to infer how agents would respond to proposed tax law changes.

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They use the latest statistical techniques, but typically the parameters are estimated from reduced form equations that are consistent with a number of alternative theories or structural models. The estimated elasticity parameters are essential for producing better revenue estimates, but often the data are not sufficiently robust to distinguish among these structural models. As a consequence, it is difficult to isolate exactly how and why behaviors adjust. These models also are typically partial equilibrium models.

In contrast, Professor Zodrow's paper provides neither elasticity estimates nor institutional detail, yet it nicely complements the other lines of research. It is a general equilibrium model. It uses exogenous behavioral parameters, specific functional forms for utility and production, and market-clearing equilibrium conditions, and it sorts out the net effects of tax changes in the pure world of the computer simulation model. It employs the minimum detail necessary to demonstrate exactly how and why various behaviors might adjust in response to tax policy.

The topic in this case is the repeal of deductibility at the federal level for state and local taxes paid by individuals. Despite Congress's rejection of the proposals by the Treasury and the president to repeal deductibility of all such taxes, the topic is still alive. Deductibility was repealed for selective excise taxes in 1964, for gasoline excise taxes in 1978, and for general sales taxes in 1986. The recent proposals have effectively put the deductibility of all state and local taxes on the table for the discussion with respect to future revenue needs.

The analysis in this paper is complicated by the fact that it deals with more than just individual behavioral adjustments that can be based on utility maximization. It also deals with the decisions of institutions for which there is no such solid theory of behavior. State and local governments are induced to switch from sales or personal taxes that have lost deductibility to business taxes that are still deductible. The model must therefore specify how different state and local governments react to voters that are affected in different ways, and how the economy reacts to the change in the tax mix. Hence a median voter model with two sectors (one controlled by itemizers, the other by nonitemizers), two tax instruments (one on individuals that loses deductibility, the other on businesses), and two factors (capital that is mobile, and labor that is immobile).

The paper does not answer all possible questions, however, and the author nicely recognizes its limitations. The paper points out how results are sensitive to certain parameter assumptions, how some state and local taxes are omitted, and how the current model might be changed to incorporate average voter behavior, more disaggregation, changes in the supply of labor and saving, progressive state and local taxes, explicit treatment of housing, and endogenous decisions to itemize. The remaining discussion will simply clarify and expand on potential limitations.

First, in the choice between a median voter model and an average voter model, the results often do not differ very much. Indeed, for many distributions, the mean and the median themselves do not differ very much. In this case, however, the models would be very different. In this median voter model, one sector is completely controlled by itemizers who want their government to switch from personal taxes to deductible business taxes, even though capital leaves the jurisdiction. The other sector is completely controlled by nonitemizers who are able to take advantage of the lower price for capital that enters the jurisdiction. In an average voter model, however, neither sector would be so extreme. Depending on the weights for itemizers and nonitemizers in each sector, all state and local governments might shift partially into deductible business taxes, instead of one sector shifting a lot. However, capital would not be able to avoid the tax by moving elsewhere, so factor prices and other results might be quite different. In fact, if both sectors were a mixture of itemizers and nonitemizers, it is not clear that there would be any point in having two sectors.

Second, as in all Harberger models of this type, it is difficult to interpret the length of the time period under consideration. Short-run aspects are mixed with long-run aspects. In particular, the time frame in this model allows all state and local governments to put the issue to the voters, to adjust their tax mix in response to that vote, to shift expenditures, and to change the size of the local public sector. It allows capital to flee from one sector to the other, and it allows labor to move within each sector to equalize the wage. However, this amount of time is not enough for labor to cross sectors, for technology to change, or for capital to grow. The odd result, to somewhat overstate the point, is that labor can move from New York to California if both are controlled by itemizers, but not from New York to Connecticut if the latter is controlled by nonitemizers.

Third, the model usefully concentrates on one kind of adjustment, but it therefore ignores others. In response to repeal of deductibility, state and local governments change their tax mix. Also, however, we might expect individuals to shift toward purchase of commodities for which prices implicitly or explicitly include taxes that are still deductible. Some at the margin might be induced to rent homes, so that landlords could deduct property taxes, rather than to own homes themselves. Others might change itemization status. It is the combination of many such effects that is incorporated in conventional econometric estimates, even though the exact source of the net effect is not always clear from these models.

Fourth, Professor Zodrow chooses to assume that all capital income is received by taxpayers in the top two tax brackets. As a consequence, the median voter never receives any capital income. The data generally show, however, that the ratio of capital income to labor income is quite high in low-income brackets that include many retired individuals. This ratio falls in middle-income brackets with predominately wage-earners, and it then rises again in high-income brackets. This U-shaped pattern could create serious difficulties for a median voter model. In general, for such a model, the voters must be ranked by a single criterion so that the voter with the median value can determine the outcome. Often we assume that income is the important criterion. If this reform affects relative factor returns, however, then the capital-labor ratio of income might be important. The ranking by income is not the same as the ranking by capital-labor ratio.

Fifth, despite my earlier comments that academics have overemphasized welfare effects while ignoring revenue-estimating techniques, this paper does the reverse. It provides revenue estimates that are based on a solid theoretical foundation of utility-maximizing individuals and profit-maximizing firms in competitive equilibrium. Given this foundation, it would be relatively straightforward to calculate equivalent or compensating variations for each group and thus show distributional and efficiency effects. In particular, the current deductibility of personal taxes only in the itemizer sector implies a differential subsidy to that sector. In the absence of offsetting externalities or other distortions, this differential subsidy would create a welfare loss. Its removal would increase efficiency in the sense that the gains to the nonitemizing sector would exceed the losses to the itemizing sector. Such calculations would not establish the absence of any spillover benefit of local public expenditure that could justify a differential subsidy, but they could quantify the implications of such an assumption. This is exactly the type of calculation provided in other general equilibrium models of taxation, so the results would be of further interest for comparison purposes.

Finally, this paper shows the degree of error associated with making static revenue estimates, but the definition of "static" is necessarily arbitrary. In fact, the term has become quite value-laden since government revenue estimates have been criticized as static for ignoring any number of possible behavioral adjustments despite the inclusion of many important ones. This paper compares results from the general equilibrium model to results assuming no behavioral adjustment. It implicitly criticizes an easy target, however, because nobody ever assumes such fixed behavior. In this case, government revenue estimates showed that 15–20 percent of revenue would be offset by certain behavioral adjustments. Other standards might be more useful for comparison. In particular, it is straightforward to incorporate behavioral adjustments in a partial equilibrium model, so the contribution here is the general equilibrium modeling rather than the behavioral adjustments per se. It might be interesting then to compare these general equilibrium results to analogous partial equilibrium results that assume the same type of behavioral adjustment.

I suspect that a set of good partial equilibrium models would provide many of the same qualitative results that are obtained here. Results would still be sensitive to the number of states dominated by itemizers, the elasticities of substitution, and the choice of mobility assumptions. The value of a general equilibrium model is to calculate plausible changes in relative prices.

These comments represent further discussion of the paper rather than criticisms of it. The question arises whether relative price results of the current model could be incorporated usefully into government revenue estimates. In this case, I think not. The relative price effects from this model capture a very interesting but very particular effect, not the overall impact on relative prices of complicated proposals for comprehensive tax reform. Since no general equilibrium model can be large enough or robust enough to calculate equilibrium wages and rates of return after tax reform, or even to establish unambiguously the direction of change, government revenue estimates might already incorporate the best available procedures by fixing those relative prices.