Abstract - Using an eight–region, eight–sector applied general equilibrium model, we find that when imposed independently, single–factor sales policies may have substantially positive economic development impacts in the very long run, but that the magnitude of these effects varies considerably across regions according to their individual characteristics. If all regions act simultaneously, however, there are very clear winners and losers, and the competitive economic development landscape is markedly reshaped. In essence, the apportionment game is a prisoner’s dilemma: regardless of the strategies of other states, each state’s best economic development strategy is single factor sales. Moreover, we find that the revenue consequences of strategic apportionment policies, which have been under appreciated in both the literature and in state legislatures, are much more substantial in magnitude than are the economic development impacts, and tend to be felt immediately, while economic development benefits are much longer term in nature.

INTRODUCTION

The U.S. uses a formulary method to apportion the taxable income of multistate corporations, with the allocation of income to each state based on the relative distribution of the firm’s sales, payroll, and property in that state. Generally states will apportion “business income” and apply specific allocation to “nonbusiness income.” See Pomp and Oldman (2000) or Healy (2001) for details. States traditionally have given each of these factors equal weight in the apportionment formula, but the trend in recent years has been to place a heavier weight on the sales factor (with uniformly lower weights on payroll and property). This policy is intended both to stimulate economic development and to export part of the corporate tax burden out of the state by providing favorable tax treatment to in–state firms. Of the 47 states (including the District of Columbia) that currently impose a corporate income tax, 34 weight the sales factor more heavily than the payroll and property factors, and as used here, in–state firms have relatively more productive activity in the state than sales. As described later in the paper, it is not the favorable treatment of in–state firms per se that stimulates economic development.
most made the switch from a uniform formula in the 1990s. The most common formula places a double-weight on the sales factor, although several states now employ a single-factor sales formula (100 percent weight on sales).

Despite the interest in strategic modification of apportionment formulas among state legislatures, the economics literature has only recently begun to examine the issue. A series of earlier papers by McLure (1980, 1981), Mieszkowski and Zodrow (1985), and Gordon and Wilson (1986) established that, to the extent tax rates vary across jurisdictions, formula-apportioned corporate income taxes are similar in their incidence to a set of implicit excise taxes on the apportionment factors. These results suggest that if disproportionately heavy weighting of the sales factor reduces these implicit excise tax rates on payroll and property, then the policy will reduce the cost of production, and hence stimulate economic development.

Although theory suggests that heavier sales factor weights (relative to weights on productive factors) should stimulate productive activity, the empirical evidence is mixed in its conclusions. In a 1994 cross-sectional study, Weiner found no relationship between the choice of apportionment formula and investment. She did find some evidence of a link in a later study (1996), but the effects were very small and only marginally significant. Goolsbee and Maydew (2000a), on the other hand, who utilized panel data for the U.S. states from 1978–1994, found that the payroll factor weight is a significant determinant of state manufacturing employment, suggesting that for the average state, reducing the payroll factor weight from 1/3 to 1/4 (double-weighted sales) results in a 1.1 percent increase in manufacturing employment. Lightner (1999) found somewhat conflicting results, although she utilized a cross-sectional analysis, while Goolsbee and Maydew were able to take advantage of a richer, more detailed panel data set (see also Klassen, 1999). Finally, Gupta and Hofmann (2000) found the elasticity of new capital expenditures with respect to the property burden (defined as the product of the property factor weight and the top statutory tax rate) to range between 0.05 and 0.35.

While this recent work has added great insight into the economic effects of modifying corporate income tax apportionment formulas, important issues remain. First, although recent empirical literature largely points to a moderate positive economic development stimulus from strategic apportionment policies, the literature remains somewhat limited in quantity and scope, and more research is needed to establish some consensus on the impact of modified apportionment formulas on economic development (Klassen, 1999). This paper offers additional insights in the debate by bringing a very different methodological approach to bear on the issue.

Second, the multi-region simulation framework we employ allows us to extend previous work for a more detailed examination of the role of regional characteristics in explaining differences in the effectiveness of strategic apportionment policies across states. Anand and Sansing (2000) demonstrate analytically that, from a welfare perspective, “importing” states have incentives to increase sales factor weights, while “exporting” states have in-

---

4 Iowa was the first state to employ a single-factor sales formula, which passed U.S. Supreme Court muster in 1978 [Moorman Manufacturing Co. v. Blair (437 U.S. 267)]; for discussion, see Hellerstein and Hellerstein (2000). In addition to Iowa, Massachusetts, Missouri, Nebraska, Texas, Maine, Illinois, and Connecticut have adopted single-factor sales formulas (Brunori, 2001). Single-factor sales formulas have been proposed in Arizona, Pennsylvania, Wisconsin, Oregon, New York, and Georgia. For analyses of proposals in Wisconsin and Georgia, see Goolsbee, Maydew, and Schadenwald (2000) and Edmiston (2001), respectively.
Strategic Apportionment of the State Corporate Income Tax

centives to reduce the weights on productive factors. The Goolsbee and Maydew (2000a) empirical study distinguishes the effects of double-weighted sales across the durable manufacturing, nondurable manufacturing, and non-manufacturing sectors. Our study offers additional insights into the role of states' industrial structures by disaggregating the effects of strategic apportionment to the 1-digit SIC level and disentangling this effect from that of the "importing" or "exporting" nature of the state, as defined by Anand and Sansing. Further, we explore other regional characteristics as well, including region size and the level of tax rates.

Third, while Goolsbee and Maydew (2000a) note that a gain to one state from disproportionately heavy sales factor weighting is a loss to another, and that this suggests a "prisoner's dilemma writ large" (p. 140), little else has been done to suggest how the policies of neighboring states influence the effectiveness of strategic apportionment policies. Through simulation, we are able directly to examine the effects of one state's policy on others in terms of economic development, revenue, and welfare. This is accomplished by simulating the economic effects of strategic apportionment policies when imposed independently by states versus simultaneously across all states. An understanding of the effects of simultaneity in apportionment policies is a crucial missing link in the literature given the large number of states moving to double-weighting or single factor sales formulas in recent years. The economic effects of strategic apportionment policies are also measured against those of alternative policies, such as lowering corporate income tax rates.

Fourth, although states generally will prepare fiscal notes highlighting the revenue implications of tax bills such as modifying apportionment formulae—some more successfully than others—there has been little attention paid to the magnitude of associated revenue impacts within a general framework in the economics literature. In this study we are able not only to estimate revenue impacts, but also to decompose revenue effects into the static effects arising directly from changes in the factor weights and dynamic effects arising from changes in the location of factors and production and changes in profitability.

Fifth, Anand and Sansing (2000) provide an insightful theoretical contribution to our understanding of the welfare effects of strategic apportionment policies, but to date there is no sense of the magnitude of these welfare changes. By valuing explicit indirect utility functions, we are able to estimate directly the equivalent variation. Moreover, as noted by Goolsbee and Maydew (2000a, 140n), "the true [dead-weight loss] from state corporate income taxation would need to account for . . . the general equilibrium effects arising from taxing different firms differently in the same states and even the states' relative rates of personal taxation." The level of

5 "Exporting" states are those in which multijurisdictional firms produce relatively more than they sell.
6 See Edmiston (1999) for an analysis of formulary apportionment in a prisoners' dilemma framework. In a related study, Omer and Shelley (2001) investigate the interdependence of decisions by states to alter their formula.
7 See also Goolsbee and Maydew (2000a) and Goolsbee, Maydew, and Schadewald (2000). For examples of revenue impact studies prepared for single states, see Edmiston (2001); Goolsbee, Maydew, and Schadewald (2000); Meyer and Oshiro (1996); and Maury and Graiser (1993). Goolsbee and Maydew (2000a) estimate changes in corporate income tax collections arising from the imposition of double-weighted sales formulas, but given the empirical basis of their work, their estimates are necessarily that of an average state. Our simulations demonstrate that the impact of strategic apportionment policies on corporate tax collections vary widely across states. Furthermore, while Goolsbee and Maydew do conjecture about wider, more indirect revenue effects, specifically the individual income tax, we are able to effectively size changes in individual income tax collections by comparing them to changes in corporate income tax collections.
8 See also Anderson and Meyer (1997) and Goolsbee (1998).
disaggregation in our applied general equilibrium model allows us to account for these effects, which is intractable in analytical models such as Anand and Sansing (2000) and impossible in empirical models such as that of Goolsbee and Maydew (2000a).

Finally, our analysis highlights important situating issues that, while critical for a complete understanding of the economic development, revenue, and welfare consequences of strategic apportionment, as we show below, are under appreciated and generally overlooked in the formal economic literature.

The remainder of the paper is structured as follows. The next section seeks a richer technical understanding of formula apportionment by examining individual firm responses to changes in corporate income apportionment formulas in a partial equilibrium setting. These results are then incorporated in a more formal, applied general equilibrium model, which is presented in the third section. Simulation results and policy appraisals are presented in the fourth section, followed by concluding remarks in the fifth section.

THE MECHANICS OF STRATEGIC APPORTIONMENT

Tax Differentials: A General Framework for Analysis

Consider a multistate firm that produces and/or sells in M states and optimizes an objective function given by:

\[ \max_{\phi_j} \pi = (S - P)[1 - \sum_j t_j \phi_j] - R \quad j = 1, ..., M \]

where states are indexed by \( j \); \( S = q \sum K_j L_j \), \( P = w \sum L_j \), and \( R = r \sum K_j \) are the firm’s sales, payroll, and property nationally, where \( F(*) \) is the production function and \( r, w, \) and \( q \) are market prices for capital (\( K \)), labor (\( L \)), and output, respectively; \( t_j \) is the corporate tax rate in state \( j \), and \( \phi_j \) is the apportionment of the firm’s taxable profits (defined as \( S - P \)) to state \( j \):

\[ \phi_j = f_j^s \left( \frac{S_j}{S} \right) + f_j^p \left( \frac{P_j}{P} \right) + f_j^R \left( \frac{R_j}{R} \right) \]

The terms \( f_j^s, f_j^p, \) and \( f_j^R \) are state \( j \)’s weights on sales, payroll, and property factors, respectively, in its apportionment formula; and \( S_j, P_j, \) and \( R_j \) are the firm’s sales, payroll, and property in state \( j \). First-order conditions obtained from maximization of \([1]\) with respect to capital and labor utilization in each state illustrate the complicated incidence of the formula–apportioned corporate income tax, which can be seen to be equivalent to four separate firm–specific taxes: a nation–wide profits tax rate given by:

\[ \tau^p = \sum_h t_h \phi_h \]

and excise taxes (or subsidies) on sales, payroll, and property in each state \( j \) given by:

\[ \tau^s_j = \left( \frac{\pi}{S} \right) \left[ t_j f_j^s - \sum_h \left( \frac{S_h}{S} \right) t_h f_h^s \right] \]

\[ \tau^p_j = \left( \frac{\pi}{P} \right) \left[ t_j f_j^p - \sum_h \left( \frac{P_h}{P} \right) t_h f_h^p \right] \]

\[ \tau^R_j = \left( \frac{\pi}{R} \right) \left[ t_j f_j^R - \sum_h \left( \frac{R_h}{R} \right) t_h f_h^R \right] \]

The profits tax rate is given by the weighted average corporate tax rate across all states where the firm does business, where the weights are the apportionment percentages as measured in \([2]\). The excise taxes (subsidies) arise from deviations from this average.10 Only in the case of uniform tax rates and apportionment formulas will the excise effects disappear,

---

9 Similar observations are reported in Mieszkowski and Morgan (1984), Gordon and Wilson (1986), and Weiner (1994, 1996). The idea that a formula–apportioned corporate income tax can be decomposed into profits tax and excise tax effects was first noted by McLure (1980). Details of the derivation of these implicit tax rates are not shown for the sake of brevity, but are available from the author upon request.

10 These implicit excise taxes and subsidies for each apportionment factor sum to zero across states.
and a system of formula–apportioned corporate income taxes resembles a corporate tax levied at the national level.

Now consider a move by state \(j\) to increase its sales factor weight and uniformly lower the payroll and property factor weights (strategic apportionment). Noting that the apportionment factor weights sum to one, which implies that \(df_j^s = df_j^r = -(1/2) f_j^S\), we use equations [3]–[6] to examine how this policy affects the implicit tax assessments on productive factors, sales, and profits.\(^\text{11}\)

Consider first the change in profits tax assessment (holding other factors constant), given by:

\[
\frac{\partial \tau_\pi}{\partial f_j^S} = t_j \left( \frac{S_j}{S} - \left( \frac{1}{2} \right) \left( \frac{R_j}{R} \right) \right) - \left( \frac{1}{2} \right) \left( \frac{P_j}{P} \right) t_j. \tag{7}
\]

Whether or not the firm’s profits tax burden increases, decreases, or stays the same depends on the relative magnitudes of state \(j\)’s share of the firm’s total sales, property, and payroll. If these shares are equal, then there will be no change in the firm’s profits tax burden. However, if state \(j\)’s share of the firm’s total sales is relatively larger (smaller) than its share of the firm’s total property and payroll, then the firm’s profits tax burden will increase (decrease) in state \(j\).\(^\text{12}\)

The effects of an increase in the sales factor weight on a firm’s “excise tax” burdens are determined by differentiating the implicit excise tax rates arising from formula apportionment with respect to the sales factor weight, giving:

\[
\frac{\partial \tau_j^S}{\partial f_j^S} = \left( \frac{\pi}{S} \right) [1 - \left( \frac{S_j}{S} \right)] t_j > 0 \tag{8}
\]

\[
\frac{\partial \tau_j^R}{\partial f_j^S} = \left( \frac{-1}{2} \right) \left( \frac{\pi}{R} \right) [1 - \left( \frac{R_j}{R} \right)] t_j < 0 \tag{9}
\]

\[
\frac{\partial \tau_j^P}{\partial f_j^S} = \left( \frac{-1}{2} \right) \left( \frac{\pi}{P} \right) [1 - \left( \frac{P_j}{P} \right)] t_j < 0. \tag{10}
\]

These effects elucidate the incentives to place proportionately greater weights on sales factors. By doing so, the implicit excise burdens associated with productive activity are reduced, and hence economic development is encouraged.\(^\text{13}\) However, these economic development incentives come at a cost of discouraging sales in the state and raising tax–inclusive consumer prices. It is important to note that disproportionately heavy sales factor weighting encourages all firms to produce more in that state, regardless of the effect of the policy on their overall tax liability. Even for firms that have relatively more sales than productive activity in the acting state, tax liabilities are diminished by shifting production there.

**Situsing Issues**

The preceding analysis assumed that sales are sitused at destination rather than at origin. Although a destination rule generally is used for the purposes of apportionment, it is administratively difficult to situs some sales at destination, so they must be situs on an origin basis, similar to the situsing of payroll and property.\(^\text{14}\) When sales are situs at destination, the implicit property and payroll excise taxes are independent of the implicit sales tax because the situsing of sales

\(^\text{11}\) As a general rule, factor weights sum to one in all states that impose a corporate income tax. In rare special cases, such as the tax on banking institutions in the State of New York, apportionment weights may sum to some number less than one. In this paper, it is assumed that factor weights sum to one, although qualitatively the results make little difference (a sum less than unity is equivalent to a lower tax rate).

\(^\text{12}\) If \(S_j/S > [(R_j/R) + (P_j/P)]/2\), which implies that [7] is positive, then we say that the firm is market–intensive in state \(j\). Otherwise we say the firm is production–intensive in state \(j\).

\(^\text{13}\) “Economic development” is defined here as an influx of productive factors, capital and labor, which leads to an increase in output levels.

\(^\text{14}\) Generally sales are situs at origin under three scenarios. First, some states situs sales of goods at the point where the buyer takes possession. If the buyer takes possession at the factory gate, sales are situs at origin. Second, if a throwback rule is in place, many states will situs sales at origin if the seller is not taxable in the

---

243
is independent of the location of production. When sales are situated at origin, however, the independence no longer holds, and the implicit sales tax becomes a cost of production. That is, the implicit excise tax cost associated with a marginal increase in the use of capital in some state \( j \) is the implicit excise tax on one unit of capital \([6]\) plus the implicit sales tax on the marginal revenue product arising from the use of that capital \([4]\). An increase in the sales factor weight (and uniform reduction in property and payroll factor weights) encourages the use of capital in state \( j \) only if the positive impact of the reduction in the implicit excise tax on property outweighs the negative impact of the implicit excise tax on production (disguised as an origin-based tax on gross receipts), or

\[
[11] \quad (1/2)(\pi/R)[1 - (R_j/R)]r > (\pi/S)[1 - (S_j/S)]q.
\]

If \([11]\) is not satisfied, then disproportionately heavy weighting of the sales factor will discourage productive activity for firms in which sales are situated at origin. Even if \([11]\) is satisfied, the stimulative effect of strategic apportionment policies will be much smaller in the case of origin-based situsing than in the case of destination based situsing.

**Alternatives**

Of course, from an economic development perspective, the analysis above begs the question: Are there better, alternative policies that could be employed to encourage local production? While there are a multitude of alternative policies, one is particularly pertinent to the analysis at hand: lowering the statutory corporate income tax rate. The excise effects, which would be identical in sign for all apportionment factors, can be shown by looking at the property factor only:

\[
[12] \quad \frac{\partial \tau^p}{\partial t_j} = (\pi/R)[1 - (R/R)]f^p_j > 0.
\]

Thus, the implicit excise tax rates on sales, payroll, and property all fall unambiguously when the statutory corporate income tax rate is reduced. Comparing \([12]\) with \([9]\), it is clear that by lowering its statutory corporate income tax rate by 25 percent, a state could produce an excise effect on payroll and property that would be identical to the effects of double-weighting the sales factor. In general, the excise effects of any change in the sales factor weight are identical to the excise effects of lowering the statutory corporate income tax rate such that:

\[
[13] \quad \frac{dt_j}{t_j} = -(\frac{df_j}{f_j}).
\]

The difference, however, is that the implicit excise tax on gross receipts is also reduced in the case of lowering the statutory corporate income tax rate, while it is increased in the strategic apportionment case. Moreover, tax collections are certain to fall in the former case, while the effect on corporate tax collections is ambiguous in the latter.

**THE APPLIED GENERAL EQUILIBRIUM MODEL**

The primary interest in this analysis is to simulate the final, long-run impact of changes in state corporate income tax apportionment formulas. Thus, the model developed and employed here is characterized by static, long-run equilibria. A short-run version of the model is also employed for comparison purposes.

The model consists of \( M \) regions (indexed by \( j \)), each of which contains a
Strategic Apportionment of the State Corporate Income Tax

A homogeneous cohort of citizens. Thus, household consumption choices in each region are described by the preferences of a single consumer. There are \( N \) industries (indexed by \( i \)), each of which is represented by a single corporation that operates nationally and produces and sells in every region, and \( M \) regionally autonomous unincorporated firms. Each region is governed by a single autonomous regional government.

**Government**

In an effort to isolate tax and expenditure incidence in the model, the government is assumed to operate under a "constant budget" constraint. That is, the government is assumed to purchase a fixed bundle of goods and services at market prices, and following a change in tax policy, obtains sufficient revenues from an alternative source to enable the purchase of this same bundle at the new equilibrium prices. Revenue sources include a formula–apportioned corporate income tax (at rate \( t_{ij}^c \)), an individual income tax (at rate \( t_{ij}^y \)), and a lump–sum tax (\( T_j^H \)) that accounts for all other revenue sources. In solving for counterfactual equilibria, the lump–sum tax is allowed to vary endogenously to balance the budget.

The formula–apportioned corporate income tax is incorporated in the model by inflating or deflating output and factor prices by their share of the tax in its ad valorem equivalent form. By [5] and [6], the relevant tax–inclusive factor prices for corporations are given by:

\[
\begin{align*}
    r_{ij}^* &= (1 + \tau_{ij}^R) r_j, \\
    w_{ij}^* &= (1 - \tau_{ij}^\pi + \tau_{ij}^R) w_j.
\end{align*}
\]

Similarly, the tax–inclusive price for corporate output sold in region \( j \) is given by:

\[
q_{ij}^* = q_j (1 - \tau_{ij}^p).
\]

The normal profits of unincorporated firms, representing sole proprietorships and partnerships, are taxed as personal income at rate \( t_{ij}^y \). As such, the tax–inclusive prices are given by:

\[
\begin{align*}
    r_{ij}^* &= r_j, \\
    w_{ij}^* &= [1 + t_{ij}^y] w_j, \\
    q_{ij}^* &= q_j (1 - t_{ij}^y).
\end{align*}
\]

**Production**

Production technology for each firm is characterized by a linearly homogeneous value–added function given by \( g(K_j, L_j) \), where \( K_j \) and \( L_j \) are capital and labor employed in region \( j \). Because firms are assumed to operate with linear homogeneous technology, industry behavior is identical to firm behavior, and industries are treated as optimizing firms in the model. In an effort to capture the long–run effects of apportionment policies, both factors are assumed to be homogeneous across industries and regions, geographically mobile, and fixed in national supply. The exception is mining capital, which is assumed to be industry specific, geo-

---

15 Consumers are assumed to be identical in preferences nationally, but per–capita incomes may vary across regions.

16 Corporate and noncorporate production are determined, by industry, according to the breakdown of gross receipts by sector in IRS (1995a). This distribution is assumed to be the same across all regions in the model.

17 The rationale behind using a lump–sum tax to balance the budget is similar to that of using a constant government budget constraint—our goal is to isolate the incidence of apportionment changes from the incidence of other tax changes, and if labor is immobile, as in our base case, lump–sum taxes entail no excess burden.

18 The taxes implicit in [14]–[16] are endogenous to the model. Simple (but tedious) algebra demonstrates that \( qQ - \sum_j (r_j^K + w_j^L) = (S - P)(1 - \sum t_{ij}^p) - R \), where \( Q \) is the aggregate production of the firm, thus ensuring that the formula–apportioned corporate income tax as written in [2] is equivalent to the tax structure given by [14]–[16].
graphically immobile, and fixed in regional supply. In the short-run version of the model, labor is assumed to be graphically immobile (but mobile across industries), while capital retains its geographic mobility. The objective of each firm is to maximize after-tax economic profits. All industries operate in a competitive environment, which implies that net (of tax) economic profits are zero for all industries in equilibrium.

Corporations

Corporations follow a two-stage production decision process, optimizing not only the factor input mix, but also the location of production activity across the $M$ regions. There are many factors that enter into the firm’s location decision, including transportation costs, the quality of resources, the “friendliness” of civic leaders to business, and a host of other issues. These factors are summarized by a linearly homogeneous aggregation function given by:

$$Q = h(g(K_{1}, L_{1}), ..., g(K_{M}, L_{M})).$$

In the first stage, corporations optimize the input mix in each location, thus solving:

$$\min \{ r_{j}K_{j} + w_{j}L_{j} - \mu[g(K_{j}, L_{j}) - 1] \forall j,$$

which yields the cost-minimizing input requirements per unit of region $j$ output, $\hat{K}_{j}$ and $\hat{L}_{j}$. In the second stage, firms optimize the location of production, which is given by the solution of:

$$\max \{ q^{\prime}g(K_{j}, L_{j}) - r_{j}K_{j} - w_{j}L_{j} \},$$

where $\hat{q} = r_{j}K_{j}^{\prime} + w_{j}L_{j}^{\prime}$. Thus, the output in a given location is modeled as an intermediate input, and final national output is given by [20]. Input prices are then the minimum per-unit costs in each location, $\hat{c}_{j}$.

Unincorporated Firms

Because each unincorporated firm operates in geographic isolation, there is no location decision to be made for these firms, and the production location functions discussed in the context of corporations are not relevant. The production decision for unincorporated firms is thus given simply by the solution of:

$$\max q^{\prime}g(K_{j}, L_{j}) - r_{j}K_{j} - w_{j}L_{j}.$$

The inclusion of unincorporated firms ensures that any effects on the unincorporated firms arising from strategic apportionment policies via changes in relative prices are captured in the simulations. The economic development effects presented in the simulation results are totals for each region and account for changes in factor utilization and output for both incorporated and unincorporated firms. Further, the inclusion of an unincorporated sector allows us to more comprehensively investigate the government revenue effects of strategic apportionment policies because any changes in tax liability for unincorporated firms is captured in our calculations of individual income tax collections.

Households

The population of the nation is defined such that one unit of labor corresponds to one individual, and consumers are assumed to be homogeneous in preferences and income within the nation. These preferences are represented by a linearly homogeneous utility function $u(\cdot)$, with an inner nest $v(\cdot)$ that allows for substitution between corporate and noncorporate output. Consumers in each region maximize utility subject to budget constraints:

$$\max u(\{x_{c,j}, x_{nc,j}\}, v(\{x_{c,j}, x_{nc,j}\}))$$

$$- \lambda[q^{\prime}y_{j} - y_{j}],$$
where $\tilde{q}_j$, is the vector of consumer prices in region $j$, $\tilde{x}$ is the vector of consumer demands, and personal income is given by:

$$y_j = [w_j + (rK/L)\tilde{L}](1 - t_j)^Y - (T_j/L),$$

where $t_j$ is the personal income tax rate in region $j$ and $T_j$ is the region $j$ lump-sum tax.

**Data and Calibration**

The model presented in this section was aggregated to eight regions and eight industrial sectors and was calibrated to data from the 1992 U.S. economy. The regions correspond to the geographic division employed by the Bureau of Economic Analysis (BEA), while the industries are aggregated at the SIC 1-digit level.19 The levels of aggregation for this analysis reflect a balance between choosing a model that is complex enough to capture all relevant implications of the policy issues being addressed and keeping the model tractable and analytically useful. The eight regions defined by the BEA are sufficiently diverse to capture the relationship between regional characteristics and the effects of apportionment policies, one of the primary focuses of the paper. A more aggregated model is unlikely to be sufficiently rich to isolate and differentiate countervailing effects, such as the effects of region size and levels of tax rates. At the same time, a 50-state model, while at least superficially more realistic, would unnecessarily complicate the analysis, presentation, and understanding of the results.

Sources for industry and consumption data include Friedenberg and Beemiller (1997) and various issues of the BEA’s *Survey of Current Business*, while data on taxes and public expenditures are derived from Internal Revenue Service (1994, 1995a, 1995b), and the U.S. Census Bureau (1993). Mathematical programming models were then employed to create a consistent benchmark equilibrium data set from the raw data. The idea behind these programming models was to define units in such a way that supply and demand are equal in every product and factor market in the benchmark with initial prices of unity.20

Tables 1 and 2 show the basic characteristics of the eight BEA regions for the benchmark year, including the distribution of industrial activity within regions. As seen in Table 1, mining activity comprises a relatively large share of produc-

### Table 1

<table>
<thead>
<tr>
<th>Region</th>
<th>New England</th>
<th>Mideast</th>
<th>Great Lakes</th>
<th>Plains</th>
<th>Southeast</th>
<th>South- west</th>
<th>Rocky Mountain</th>
<th>Far West</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>1.0</td>
<td>0.8</td>
<td>1.7</td>
<td>5.6</td>
<td>2.3</td>
<td>2.2</td>
<td>5.9</td>
<td>2.5</td>
</tr>
<tr>
<td>Mining</td>
<td>0.1</td>
<td>0.2</td>
<td>0.5</td>
<td>0.8</td>
<td>1.8</td>
<td>8.1</td>
<td>5.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Construction</td>
<td>3.6</td>
<td>3.9</td>
<td>4.3</td>
<td>4.4</td>
<td>4.6</td>
<td>4.6</td>
<td>15.2</td>
<td>4.3</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>20.0</td>
<td>16.3</td>
<td>27.5</td>
<td>22.3</td>
<td>22.7</td>
<td>16.9</td>
<td>13.1</td>
<td>15.5</td>
</tr>
<tr>
<td>TCPU</td>
<td>7.7</td>
<td>9.6</td>
<td>9.2</td>
<td>10.8</td>
<td>11.2</td>
<td>11.9</td>
<td>7.1</td>
<td>8.4</td>
</tr>
<tr>
<td>Trade</td>
<td>16.9</td>
<td>16.2</td>
<td>17.8</td>
<td>18.8</td>
<td>18.8</td>
<td>18.5</td>
<td>11.9</td>
<td>18.2</td>
</tr>
<tr>
<td>FIRE</td>
<td>25.7</td>
<td>27.5</td>
<td>18.5</td>
<td>17.4</td>
<td>18.0</td>
<td>17.1</td>
<td>18.4</td>
<td>25.1</td>
</tr>
<tr>
<td>Services</td>
<td>25.1</td>
<td>25.5</td>
<td>20.4</td>
<td>19.9</td>
<td>20.6</td>
<td>20.7</td>
<td>22.9</td>
<td>24.7</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Bureau of Economic Analysis, U.S. Department of Commerce.

19 The eight BEA regions are New England, Mideast, Great Lakes, Plains, Southeast, Southwest, Rocky Mountain, and Far West. Industries are agriculture; mining; construction; manufacturing; transportation, communications, and public utilities (TCPU); trade; finance, insurance, and real estate (FIRE); and services.

20 See Edmiston (1998), Chapter 4, for details.
tion in the Southwest region, which includes most oil and gas producing states, construction provides a relatively large share of total production in the Rocky Mountain region, and comparatively heavy emphasis is placed on agricultural production in the Plains and Rocky Mountain regions. Otherwise, the share of production attributable to any given industry tends to be very similar across the various regions. Calibrated corporate income tax rates vary from 0.67 percent in the Southwest region to 4.34 percent in the New England region (Table 2), while calibrated individual income tax rates range from a low of 0.48 percent in the Southwest region to 2.40 percent in New England.

Operatively, the aggregation function in [20] is given a constant elasticity of substitution (CES) formulation:

$$Q = \alpha \left\{ \sum_j \eta_j g(K_j, L_j)^{(\delta - 1)/\delta} \right\}^{\delta/(\delta - 1)}$$

where $\delta$ is the elasticity of substitution in the location of production, the $\eta_j$ are share parameters, and $\alpha$ is a shift parameter. A CES formulation for the aggregation function allows for varying degrees of substitutability in the shorter term versus the longer term, which is accomplished by altering the value of $\delta$. The very long run is likely to be characterized by full geographic mobility of capital and labor (with the exclusion of mining capital), and a relatively high degree of substitutability across production locations.

In the extreme long run, we might expect [26] to be linear in $g(\cdot)$; nevertheless, the infinite elasticity of substitution that would be implied is probably too generous: surely there is some limit to the ability of firms to alter the location of their productive activities even in the long–run, if for no other reason than the existence of positive transport costs and (personal) regional preferences of managers.21 For this reason, a value of $\delta = 5$ was chosen for the long–run specification. While perhaps somewhat arbitrary, [26] with $\delta = 5$ is sufficiently linear to allow for long–run responses, but still places some constraint on the flexibility of industries to respond to cost differences. In the shorter–run version of the simulation model, labor is geographically immobile and $\delta = 0.3$. The value of $\delta = 0.3$ is an approximation implied by Bartik’s (1991) central tendency estimate of the elasticity of production in a state with respect to the corporate tax liability.22

---

**Table 2**

<table>
<thead>
<tr>
<th>Region</th>
<th>Corp Inc Tax Rate (%) (Calibrated)</th>
<th>Ind Inc Tax Rate (%) (Calibrated)</th>
<th>Share of GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New England</td>
<td>4.34</td>
<td>2.40</td>
<td>5.76</td>
</tr>
<tr>
<td>Midwest</td>
<td>4.20</td>
<td>2.20</td>
<td>19.81</td>
</tr>
<tr>
<td>Great Lakes</td>
<td>4.33</td>
<td>1.82</td>
<td>15.93</td>
</tr>
<tr>
<td>Plains</td>
<td>2.87</td>
<td>1.91</td>
<td>6.62</td>
</tr>
<tr>
<td>Southeast</td>
<td>2.56</td>
<td>1.30</td>
<td>21.30</td>
</tr>
<tr>
<td>Southwest</td>
<td>0.67</td>
<td>0.48</td>
<td>9.75</td>
</tr>
<tr>
<td>Rocky Mountain</td>
<td>1.96</td>
<td>1.94</td>
<td>2.69</td>
</tr>
<tr>
<td>Far West</td>
<td>4.27</td>
<td>1.79</td>
<td>18.14</td>
</tr>
</tbody>
</table>

---

21 See Fox and Murray (1990) for more on the role of regional preferences of managers in firm location.

22 Bartik’s (1991) estimate was $\varepsilon = -0.3$. It is assumed that the elasticity of production in a given location with respect to the cost per unit in that location would be identical to the tax elasticity $\varepsilon$. That is, firms should not be expected to react to changes in tax liability any differently than other (per–unit) costs of production. Because $\delta$ cannot be derived from $\varepsilon$ without knowing the share parameters ($\eta_j$), and the calibration of share parameters in turn depends on the value of $\delta$, it was decided to set $\delta = \varepsilon$. Of course, in the limit, as the number of regions $M$ gets arbitrarily large, $\delta \to \varepsilon$. 

248
SIMULATION RESULTS

Approach

As noted in the introduction, the trend in state corporate income apportionment suggests that all states will eventually employ a single factor sales formula. The general idea of this study is to compare the long–run economic equilibrium in a world with single–factor sales formulas to a world in which states employ equally weighted three–factor formulas. Thus, in calibrating the benchmark equilibrium data set, it is assumed that all regions employ an equally weighted three–factor apportionment formula. The policy simulations then involve (1) each region independently moving to a single factor sales formula, and (2) all regions simultaneously moving to a single factor sales formula. The counterfactual results, when compared with the benchmark solution, then provide a means for evaluating the impact of strategic apportionment on economic development, corporate tax revenues, and regional welfare.

Strategic Apportionment’s Impact on Economic Development: More Evidence on an Unresolved Issue

The economic development impact of the single factor sales policy was evaluated by measuring percentage changes in the capital stock, labor force, and the value of output for each region.

As seen in Table 3, the long–run economic development impact of independently moving from an equally weighted three–factor formula to a single factor sales formula can be quite significant. Simulation results suggest that an independent move to a single factor sales formula by the New England region, for example, would result in a 1.5 percent increase in the capital stock over the base case where all regions maintain an equally weighted formula. Percentage changes in the labor force and the value of output were similar in magnitude, 1.3 percent and 1.4 percent, respectively. While consistent in terms of sign, economic development impacts varied substantially in magnitude across regions. The Southwest region, for example, which was the worst performer, saw a long run impact of 0.2 percent for all measures. Explanations for these differences across regions are discussed in a later section.

While the long–run economic impacts are fairly substantial, impacts were considerably smaller in magnitude in the short–run version of the model. From a short–run economic development perspective, all regions benefited by indepen-

<table>
<thead>
<tr>
<th>Acting Region</th>
<th>%Δ Capital</th>
<th>%Δ Labor</th>
<th>%Δ Value of Output</th>
<th>%Δ Capital</th>
<th>%Δ Labor</th>
<th>%Δ Value of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>New England</td>
<td>1.51</td>
<td>1.28</td>
<td>1.37</td>
<td>0.34</td>
<td>0.28</td>
<td>0.31</td>
</tr>
<tr>
<td>Mideast</td>
<td>1.25</td>
<td>1.04</td>
<td>1.12</td>
<td>0.29</td>
<td>0.24</td>
<td>0.26</td>
</tr>
<tr>
<td>Great Lakes</td>
<td>1.38</td>
<td>1.18</td>
<td>1.26</td>
<td>0.35</td>
<td>0.30</td>
<td>0.33</td>
</tr>
<tr>
<td>Plains</td>
<td>1.03</td>
<td>0.88</td>
<td>0.94</td>
<td>(0.20)</td>
<td>(0.18)</td>
<td>(0.18)</td>
</tr>
<tr>
<td>Southeast</td>
<td>0.75</td>
<td>0.66</td>
<td>0.69</td>
<td>(0.32)</td>
<td>(0.28)</td>
<td>(0.29)</td>
</tr>
<tr>
<td>Southwest</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
<td>(0.90)</td>
<td>(0.87)</td>
<td>(0.88)</td>
</tr>
<tr>
<td>Rocky Mountain</td>
<td>0.39</td>
<td>0.54</td>
<td>0.56</td>
<td>(0.44)</td>
<td>(0.39)</td>
<td>(0.40)</td>
</tr>
<tr>
<td>Far West</td>
<td>1.27</td>
<td>1.08</td>
<td>1.16</td>
<td>0.31</td>
<td>0.27</td>
<td>0.29</td>
</tr>
</tbody>
</table>

23 The results for “double–weighted sales” differ from “single factor sales” only in magnitude, and hence are not presented here. The trend seems to be for all states to eventually go to a single factor sales formula, and the simulations are designed to get a sense of the final long–run impact of apportionment competition.

24 Details of the short–run results are not provided for the sake of brevity but are available from the author upon request.
ently moving to a single factor sales formula, but percentage changes in capital stocks (from the base case) ranged from a low of 0.02 percent in the Southwest region to a high of only 0.16 percent in the New England region. The explanation for the considerably smaller magnitudes is the geographic immobility of labor in the short–run, coupled with a much smaller degree of substitutability of production across locations, which accounts for the constraints on firms imposed by large fixed costs and more defined regional preferences (input supplies, marketing channels, etc.).

The overall results of these simulations, specifically the large differences in the short–term and long–term effects of strategic apportionment, offer an explanation for the sometimes conflicting results of existing empirical work in this area (in addition, perhaps, to differences in methodological approach across the studies). If the empirical models and data are picking up short–term responses to strategic apportionment policies, one should not be surprised by the weak effects picked up by Weiner (1994, 1996) and Lightener (1999). On the other hand, if the empirical framework and data pick up longer–term responses to strategic apportionment, one should not be surprised to find evidence of larger–scale impacts, such as those found in Goolsbee and Maydew (2000a) and Gupta and Hofmann (2000). Our simulation results are roughly consistent with Goolsbee and Maydew’s longer run estimate of the impact of double–weighting on state manufacturing employment (2.8 percent), but their short–run (defined as one year) impact of approximately 0.7 percent is relatively large. By our estimation, the elasticity of substitution between locations of production would have to be greater than 10.0 with full labor mobility to achieve a similar result in any of the eight regions we have defined, implying a substantial degree of locational flexibility.25

Independent vs. Simultaneous Moves to Single Factor Sales

While the long–run impact of independently enacted single factor sales policies is fairly substantial, our simulations are able to demonstrate that simultaneous action by all regions yields an economic development impact that is considerably different. As shown in Table 3, only four regions (New England, Mideast, Great Lakes, and Far West) enjoyed economic development gains from simultaneous movement to single factor sales formulas, and all gains were less than 0.4 percent in magnitude. Other regions suffered significant losses in capital, labor and production, which for the most part were much larger in (relative) magnitude. The results suggest that stocks of capital and labor, and the intensity of production in the Southwest region, for example, would be almost 1 percent smaller with simultaneous moves by all states to a single–factor sales formula than would be the case if all regions were to maintain equally weighted three–factor formulas. Relative magnitudes (across regions) were similar in the short–run case.

This is not to say that all states do not benefit (from an economic development perspective) with a single factor sales formula when the environment is especially competitive. When “loser” regions such as Southwest and Southeast maintain equally weighted three–factor formulas in

25 In our simulations, the effects of (independently) moving from an equally weighted formula to a double–weighted sales formula (as evaluated by Goolsbee and Maydew), with $\delta = 10$ and full labor mobility would range from a 0.10 percent increase in capital stocks in the Southwest region to a 0.74 percent gain in the Northeast region. In the case where all regions move to double–weighted sales, the production aggregation function would have to be nearly linear in the parameters to achieve the Goolsbee and Maydew result, which implies little or no constraints on firms in changing their location of production over the course of one year.
the face of aggressive apportionment policies by their competitors, their losses are even more substantial than in the case where they follow suit.

In reality, the simultaneous action case is the likely scenario. As stated in the introduction to the paper, most states have already moved to a double-weighted sales factor formula, and several have either moved to a single factor sales formula or are contemplating doing so. We have shown that from an economic development perspective, all states are better off with a single factor sales formula, but seeing the likely end result, many states would have been best off if the apportionment game had never begun. That is, once one state moves to a single-factor scheme, all other states gain from doing so as well. However, states that lose out in the case where all states move to a single factor sales formula, represented by the Southwest, Southeast, Plains, and Rocky Mountain regions in the model, would have been better off if all states had maintained an equally weighted three-factor formula.26 In essence, the apportionment game is a prisoner’s dilemma (Edmiston, 1999): regardless of the strategies of other states, each state’s best economic development strategy is single factor sales, and thus a dominant strategy equilibrium exists with universal single factor sales formulas.

**Situsing Issues**

In an effort to highlight the role of situsing issues, as discussed in the second section, the model assumes that sales of the services industry are sitused on an origin basis, as is true for most services firms in most states. As a result, greater weights on the sales factor operate to raise the implicit production tax on services output, which negates much of the positive impact that lower implicit property and payroll taxes have on services production in the acting region. In theory, the overall impact on production from heavier sales factor weights is ambiguous under a origin-based situsing rule, as demonstrated in equation [11]. Numerically, however, the positive impact of lower implicit excise taxes on payroll and property outweighs the negative impact of a higher “production tax.” Thus, services production is likely to be stimulated by strategic apportionment policies, but clearly not to the degree in which production in other (destination-based) industries is stimulated.

**Regional Characteristics and Differential Impacts**

Table 3 shows large discrepancies in the economic development impact of strategic apportionment policies across regions. The most salient factors in differentiating the interregional impacts are differences in industrial structure, the level of statutory corporate income tax rates, and region size.

**The Role of Industrial Structure**

Clearly regions with heavy concentrations of mining activity would see smaller economic development impacts because mining capital is fixed. The reasoning behind the “fixed mining capital” assumption in the simulation model is that while the use of land is likely to be substitutable across most industries, the mining industry requires land with very specific attributes, namely the existence of ore, oil, gas, etc. More than 8 percent of total production in the Southwest region is attributable to mining activity (Table 1), so it is no surprise that the Southwest saw a substantially smaller economic development impact with a single-factor sales formula.

---

26 This scenario would arise, for example, if the federal government were to impose an equally weighted three-factor formula on the states.
than did other regions. While on the surface this result is rather obvious, it is important to bring out because it highlights the crucial role that industrial structure plays in the degree of development success that strategic apportionment policies have across regions or states. For states in which a large share of productive activity is relatively fixed in location, whether that be oil extraction in Texas or large-scale manufacturing complexes in the New England and Midwestern states, a policy appraisal based on the experience of other states is likely to substantially over-estimate economic development impacts.

Table 4 shows the economic impact of strategic apportionment across all industries for the long-run version of the simulation model. With the exception of the mining and services, differences in impact across industries are proportional to their capital-labor ratios, which are reported for each industry in the final row of Table 4. This result is consistent with the findings of Goolsbee and Maydew (2000a), who show empirically that manufacturing enterprises are more responsive to changes in apportionment formula factor weights than non-manufacturing enterprises (using changes in employment as an indicator). The corporate tax is levied on normal profits, and therefore is effectively a tax on capital. Because capital bears the “average” corporate tax rate, it stands to reason that the more capital-intensive industries would see the greatest benefit from reallocating productive activities in the face of tax policy changes.27 Although mining is the most capital-intensive industry, the immobility of capital in that industry precludes relocation of productive activity to any large degree. The relatively small development impact for the services industry, on the other hand, is a result of an origin-based situsing rule imposed on sales in the model.

The Role of Statutory Corporate Income Tax Rates

Another critical determinant of the success of strategic apportionment policies in stimulating economic development is the level of statutory corporate tax rates in the acting region. Comparing Tables 2 and 3, it is clear that regions with relatively high tax rates, such as the New England, Midwest, Great Lakes, and Far West regions, see relatively larger gains in productive activity following the imposition of a single factor sales formula. In fact, the simple correlation between the statutory corporate income tax rate and the percentage change in capital stock yielded a value of 0.98. The explanation for this result can be found by looking at the impact of increased sales factor weights on existing tax differentials, which is given below for the property portion of the formula-apportioned corporate income tax:

$$\frac{\partial^2 \left[ f_j R_{jt} - \sum_h (R_h / R) f_h R_{ht} \right]}{\partial f_j \partial t} = (-1/2)(1 - (R_j / R)) < 0.$$  

When a high-tax state increases its sales factor weight, and thereby lowers the property factor weight, existing tax differentials are diminished, and therefore, excise tax effects become smaller relative to total factor costs. Likewise, when a low-tax region increases its sales factor weight, tax differentials on productive factors are exacerbated, and hence excise tax effects become larger relative to total factor costs.

To further examine this issue, we doubled, tripled, and quadrupled the tax rates for all regions, which had the effect

---

27 That is, capital bears the “profits tax” portion of the formula-apportioned corporate income tax, as defined in the second section of the paper. The “excise tax” effects are borne by the individual factors, depending of course on the mobility of those factors. See Mieszkowski (1972) for a similar view of the incidence of a general tax on capital and Mieszkowski and Zodrow (1985) for the case of formula-apportioned corporate income taxes.
<table>
<thead>
<tr>
<th>Region</th>
<th>Industry</th>
<th>Agriculture</th>
<th>Mining</th>
<th>Construction</th>
<th>Manufacturing</th>
<th>TCPU</th>
<th>Trade</th>
<th>FIRE</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>New England</td>
<td></td>
<td>1.59</td>
<td>0</td>
<td>1.24</td>
<td>1.75</td>
<td>2.48</td>
<td>1.72</td>
<td>1.60</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.28)</td>
<td>(1.82)</td>
<td>(1.03)</td>
<td>(1.64)</td>
<td>(2.79)</td>
<td>(1.59)</td>
<td>(1.43)</td>
<td>(0.44)</td>
</tr>
<tr>
<td>Mideast</td>
<td></td>
<td>1.38</td>
<td>0</td>
<td>1.02</td>
<td>1.48</td>
<td>2.02</td>
<td>1.42</td>
<td>1.28</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.36)</td>
<td>(1.72)</td>
<td>(0.86)</td>
<td>(1.41)</td>
<td>(2.26)</td>
<td>(1.33)</td>
<td>(1.11)</td>
<td>(0.34)</td>
</tr>
<tr>
<td>Great Lakes</td>
<td></td>
<td>1.41</td>
<td>0</td>
<td>1.10</td>
<td>1.48</td>
<td>2.20</td>
<td>1.52</td>
<td>1.45</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.33)</td>
<td>(1.73)</td>
<td>(0.90)</td>
<td>(1.35)</td>
<td>(2.47)</td>
<td>(1.40)</td>
<td>(1.32)</td>
<td>(0.40)</td>
</tr>
<tr>
<td>Plains</td>
<td></td>
<td>0.96</td>
<td>0</td>
<td>0.81</td>
<td>1.14</td>
<td>1.60</td>
<td>1.12</td>
<td>1.06</td>
<td>0.37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.84)</td>
<td>(1.17)</td>
<td>(0.66)</td>
<td>(1.06)</td>
<td>(1.78)</td>
<td>(1.03)</td>
<td>(0.96)</td>
<td>(0.29)</td>
</tr>
<tr>
<td>Southeast</td>
<td></td>
<td>0.75</td>
<td>0</td>
<td>0.61</td>
<td>0.84</td>
<td>1.17</td>
<td>0.83</td>
<td>0.80</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.69)</td>
<td>(0.83)</td>
<td>(0.49)</td>
<td>(0.77)</td>
<td>(1.29)</td>
<td>(0.76)</td>
<td>(0.74)</td>
<td>(0.22)</td>
</tr>
<tr>
<td>Southwest</td>
<td></td>
<td>0.23</td>
<td>0</td>
<td>0.18</td>
<td>0.26</td>
<td>0.36</td>
<td>0.25</td>
<td>0.24</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.21)</td>
<td>(0.15)</td>
<td>(0.15)</td>
<td>(0.25)</td>
<td>(0.39)</td>
<td>(0.23)</td>
<td>(0.22)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Rocky Mountain</td>
<td></td>
<td>0.69</td>
<td>0</td>
<td>0.49</td>
<td>0.82</td>
<td>1.14</td>
<td>0.79</td>
<td>0.74</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.62)</td>
<td>(0.75)</td>
<td>(0.36)</td>
<td>(0.77)</td>
<td>(1.28)</td>
<td>(0.73)</td>
<td>(0.67)</td>
<td>(0.18)</td>
</tr>
<tr>
<td>Far West</td>
<td></td>
<td>1.30</td>
<td>0</td>
<td>1.06</td>
<td>1.54</td>
<td>2.14</td>
<td>1.46</td>
<td>1.35</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.18)</td>
<td>(1.56)</td>
<td>(0.86)</td>
<td>(1.47)</td>
<td>(2.42)</td>
<td>(1.34)</td>
<td>(1.19)</td>
<td>(0.36)</td>
</tr>
<tr>
<td>K/L Ratio</td>
<td></td>
<td>0.56</td>
<td>3.78</td>
<td>0.30</td>
<td>0.68</td>
<td>1.75</td>
<td>0.65</td>
<td>0.57</td>
<td>0.56</td>
</tr>
</tbody>
</table>
of grossly exaggerating tax differentials, and resimulated the strategic apportionment policy experiments. As expected, the sensitivity analysis showed that the responsiveness of firms to strategic apportionment policies is highly sensitive to the level of statutory tax rates. For every $\alpha$-fold increase in tax rates, economic development gains (measured as percentage changes in capital stocks) roughly increased $\alpha$-fold as well.28

The Role of Region Size

A final explanation for differences in economic development impact across regions is the relationship between these impacts and the size of the acting region (as measured by GDP share). While not readily perceptible from Tables 2 and 3, the results suggest an inverse relationship. The correlation between region size and the percentage change in capital stock was in fact found to be a statistically significant $-0.22$. Common sense suggests that the economic development impact of strategic apportionment policies would be proportional to region size, given fixed national stocks of capital and labor. That is, for any given inflow of capital, the percentage change in capital stock will be larger the smaller is the initial stock of capital. However, the initial level of capital explains only part of the greater elasticity in smaller regions because the inverse relationship held for absolute as well as relative changes in capital stock. The explanation here is that the degree to which capital flows from one region to another depends crucially on its gross-of-tax price elasticity. From the perspective of an entire region, and with a fixed national capital stock, this elasticity comes from inter-regional shifts in capital. A small region has much greater potential for capital inflow (e.g., take the case of a complete shift), and hence perceives a greater elasticity (Kanbur and Keen, 1993). This “perceived” elasticity is naturally incorporated through the endogenous tax structure of the simulation model via the $R_j/R$, $P_j/P$, and $S_j/S$ terms in the tax differentials, as shown in [14]–[16].

Strategic Apportionment and Public Revenues

Long-Run and Short-Run Corporate Income Tax Revenue Impacts29

As shown in Table 5, the revenue consequences of strategic apportionment policies can be considerable relative to the economic development impacts. While changes in capital stocks in the long-run (independent action) version of the model were on the order of 0.2–1.5 percent, percentage changes in corporate income tax revenues ranged from a 10.9 percent loss in the Southwest region to a 6.6 percent gain in the New England region. In the short-run version of the model, the contrast of magnitudes between revenue impacts and development impacts was even more stark. While percentage changes in capital stocks ranged between 0.02 percent and 0.16 percent, corporate income tax revenue impacts ranged from $-7.5$ percent to 4.4 percent. Finally, in the long-run version of the model where all regions simultaneously move to a single factor sales formula, revenue losses were exacerbated over the independent action case, while revenue gains were diminished.

28 Again, detailed numerical results are available from the author upon request.
29 The revenue analysis above ignores nexus issues that may arise in corporate income apportionment. Because entire industries are treated as optimizing firms in the simulation model, and thus have productive activity in every region, all firms meet the nexus standard and are taxed accordingly. To the extent that sales are allocated to states that have insufficient taxing nexus, revenue gains are over-estimated and revenue losses are under-estimated. Nevertheless, most states allow an exception to the destination rule, called a “throwback” provision, which allows untaxed sales to enter the sales factor (numerator) of the home state. The existence of these throwback provisions in most states mitigates the revenue impact estimation problem.
### TABLE 5
TAX REVENUE IMPACTS, BY REGION
$MILLIONS

<table>
<thead>
<tr>
<th>Region</th>
<th>Independent Action</th>
<th>Simultaneous Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Long-run version</td>
<td>Simultaneous Action</td>
</tr>
<tr>
<td></td>
<td>($\delta = 5$, labor mobile)</td>
<td>($\delta = 5$, labor mobile)</td>
</tr>
<tr>
<td></td>
<td>$\Delta$ Corp Inc Tax (% $\Delta$)</td>
<td>$\Delta$ Corp Inc Tax (% $\Delta$)</td>
</tr>
<tr>
<td></td>
<td>$\Delta$ Ind Inc Tax (% $\Delta$)</td>
<td>$\Delta$ Ind Inc Tax (% $\Delta$)</td>
</tr>
<tr>
<td></td>
<td>$\Delta$ Lump Sum Tax (% $\Delta$)</td>
<td>$\Delta$ Lump Sum Tax (% $\Delta$)</td>
</tr>
<tr>
<td></td>
<td>$\Delta$ Corp Inc Tax (% $\Delta$)</td>
<td>$\Delta$ Corp Inc Tax (% $\Delta$)</td>
</tr>
<tr>
<td></td>
<td>$\Delta$ Ind Inc Tax (% $\Delta$)</td>
<td>$\Delta$ Ind Inc Tax (% $\Delta$)</td>
</tr>
<tr>
<td></td>
<td>$\Delta$ Lump Sum Tax (% $\Delta$)</td>
<td>$\Delta$ Lump Sum Tax (% $\Delta$)</td>
</tr>
<tr>
<td>New England</td>
<td>$106.5$ ($6.64$)</td>
<td>$92.7$ ($5.77$)</td>
</tr>
<tr>
<td></td>
<td>$112.7$ ($1.28$)</td>
<td>$24.7$ ($0.28$)</td>
</tr>
<tr>
<td></td>
<td>$-217.0$ ($-0.83$)</td>
<td>$112.5$ ($-0.43$)</td>
</tr>
<tr>
<td>Mideast</td>
<td>$293.7$ ($5.48$)</td>
<td>$257.1$ ($4.80$)</td>
</tr>
<tr>
<td></td>
<td>$287.1$ ($1.04$)</td>
<td>$65.6$ ($0.24$)</td>
</tr>
<tr>
<td></td>
<td>$-569.0$ ($-0.75$)</td>
<td>$-308.3$ ($-0.41$)</td>
</tr>
<tr>
<td>Great Lakes</td>
<td>$213.5$ ($0.48$)</td>
<td>$-11.7$ ($-0.26$)</td>
</tr>
<tr>
<td></td>
<td>$213.5$ ($1.18$)</td>
<td>$53.9$ ($0.30$)</td>
</tr>
<tr>
<td></td>
<td>$-237.3$ ($-0.42$)</td>
<td>$-31.8$ ($-0.06$)</td>
</tr>
<tr>
<td>Plains</td>
<td>$-15.5$ ($-1.3$)</td>
<td>$-26.2$ ($-2.14$)</td>
</tr>
<tr>
<td></td>
<td>$69.4$ ($0.88$)</td>
<td>$-13.9$ ($-0.18$)</td>
</tr>
<tr>
<td></td>
<td>$-54.6$ ($-0.25$)</td>
<td>$44.2$ ($0.20$)</td>
</tr>
<tr>
<td>Southeast</td>
<td>$-92.5$ ($-2.61$)</td>
<td>$-119.4$ ($-3.38$)</td>
</tr>
<tr>
<td></td>
<td>$111.3$ ($0.66$)</td>
<td>$-47.8$ ($-0.28$)</td>
</tr>
<tr>
<td></td>
<td>$-26.1$ ($-0.03$)</td>
<td>$180.6$ ($0.22$)</td>
</tr>
<tr>
<td>Southwest</td>
<td>$-46.9$ ($-10.88$)</td>
<td>$-50.3$ ($-11.7$)</td>
</tr>
<tr>
<td></td>
<td>$5.3$ ($0.20$)</td>
<td>$-23.9$ ($-0.88$)</td>
</tr>
<tr>
<td></td>
<td>$41.1$ ($0.11$)</td>
<td>$79.5$ ($0.21$)</td>
</tr>
<tr>
<td>Rocky Mountain</td>
<td>$12.5$ ($3.81$)</td>
<td>$9.8$ ($3.01$)</td>
</tr>
<tr>
<td></td>
<td>$17.8$ ($0.54$)</td>
<td>$-13.0$ ($-0.39$)</td>
</tr>
<tr>
<td></td>
<td>$-30.3$ ($-0.30$)</td>
<td>$4.6$ ($0.05$)</td>
</tr>
<tr>
<td></td>
<td>$7.0$ ($2.15$)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$0.7$ ($0.02$)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$-7.0$ ($-0.07$)</td>
<td></td>
</tr>
<tr>
<td>Far West</td>
<td>$233.3$ ($4.71$)</td>
<td>$198.5$ ($4.01$)</td>
</tr>
<tr>
<td></td>
<td>$222.7$ ($1.09$)</td>
<td>$54.1$ ($0.26$)</td>
</tr>
<tr>
<td></td>
<td>$-446.9$ ($-0.72$)</td>
<td>$-241.1$ ($-0.39$)</td>
</tr>
<tr>
<td></td>
<td>$148.7$ ($3.01$)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$7.0$ ($0.04$)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$-148.8$ ($-0.24$)</td>
<td></td>
</tr>
</tbody>
</table>
Several factors are critical in determining the direction and magnitude of revenue changes under a strategic apportionment scheme. To explore these factors for each region, we decompose the change in a region’s tax base as follows:

\[
\sum_i (\phi_{i,t} \pi_{i,t} - \phi_{i,t-1} \pi_{i,t-1}) = \sum_i \left[ (\phi_{i,t} - \phi_{i,t}^E) \pi_{i,t} + (\phi_{i,t}^E - \phi_{i,t-1}) \pi_{i,t} + \phi_{i,t-1} (\pi_{i,t} - \pi_{i,t-1}) \right],
\]

where the subscript \(t\) denotes the counterfactual, the subscript \(t - 1\) denotes the benchmark, firms are indexed by \(i\), and the term \(\phi_{i,t}^E\) is the apportionment of firm \(i\)’s profits to the region in the counterfactual, but under an equally weighted three-factor formula.

Of the three terms on the right-hand side of equation [28], the first represents the change in taxable income that arises simply because the factor weights have changed, which we call the technical apportionment effect. This effect is in some sense a static effect in that it measures the change in taxable income that would come about under a single-factor sales scheme if there were no behavioral responses on the part of firms. The primary determinant of the magnitude of the technical apportionment effect is the market intensity \(\text{vis-à-vis}\) the production intensity of the region. That is, if the region in question is a “market region” rather then a “production region” (Lopez and Martinez–Vazquez, 1997), which implies that:

\[
\sum_j \left[ \pi_i S_{ij} / S_i > \left( R_{ij} / R_i \right) + (P_{ij} / P_i) / 2 \right] > 0,
\]

then the technical apportionment effect will be positive, and placing a heavier weight on the sales factor will lead to greater revenues, all else equal.

The second term in [28], which we term the location–of–factors effect, isolates the behavioral responses of firms and can be interpreted as the corporate income tax base of the region if firms were to respond to a single-factor sales tax, but in fact were to be taxed under an equally weighted three factor formula. Thus, the location–of–factors effect picks up changes in the corporate tax base that arise because sales are discouraged and production is encouraged by strategic apportionment policies.

The final term in [28] accounts for changes in the corporate tax base arising from changes in the profitability of firms in the region.

In both the short-run and long-run versions of the simulation model, the technical apportionment effect was the dominant effect. That is, market regions, as defined by [29], saw revenue gains with a single factor sales formula, while production regions generally suffered revenue losses. As demonstrated in Table 6, in no

<table>
<thead>
<tr>
<th>Region</th>
<th>Change due to Apportionment (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>New England</td>
<td>6.6</td>
</tr>
<tr>
<td>Mideast</td>
<td>5.5</td>
</tr>
<tr>
<td>Great Lakes</td>
<td>0.5</td>
</tr>
<tr>
<td>Plains</td>
<td>-1.3</td>
</tr>
<tr>
<td>Southeast</td>
<td>-2.6</td>
</tr>
<tr>
<td>Southwest</td>
<td>-10.9</td>
</tr>
<tr>
<td>Rocky Mountain</td>
<td>3.8</td>
</tr>
<tr>
<td>Far West</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Note that each region employs an equally weighted three–factor formula in the benchmark, and hence \(\phi_{i,t-1} = \phi_{i,t-1}^E\).
case did the technical apportionment effect contribute less than 80 percent (in magnitude) to the total change in corporate income tax collections, and with the exception of the Great Lakes region, the total effect moved in the same direction as the technical apportionment effect.\(^{31}\) Given the dominance of the static technical apportionment effect in the long–run version of the model, the static, short–term corporate income tax revenue impact studies of Maury and Graiser (1993), Meyer and Oshiro (1996), and Edmiston (2001) are likely to provide reasonable estimates even for the longer term.

Of course, any revenue declines (increases) generated from the technical apportionment effect are tempered (enhanced) by the smaller, yet significant location–of–factors effect. This effect is dynamic and thus its proportional contribution to the total revenue effect of strategic apportionment policies increases over time. In our model, increased production amplified the revenue gain for market regions (New England, Mideast, Rocky Mountain, and Far West) and tempered revenue losses for production regions (Plains, Great Lakes, Southeast, and Southwest). In the shorter–term, when economic development gains were small, all production regions suffered revenues losses, which ranged from 0.81 percent in the Great Lakes region to 7.51 percent in the Southwest region. With a sufficient time horizon for corporations to respond to new apportionment policies, however, the Great Lakes region enjoyed a net positive revenue impact, as the revenue gain from increased production levels outweighed the static revenue loss.

The impact picture was very different when all regions simultaneously moved to a single factor sales formula, however. Production regions that suffered from a revenue standpoint under the simultaneous action case (Plains, Southeast, and Southwest) saw very large revenue losses, as much as 11.0 percent for the Southwest region. Further, while all regions are better off matching the single factor sales policies of their competitors from an economic development perspective, production regions would be advised to maintain the less aggressive equally weighted three factor formula from a revenue perspective, even if their neighbors go to single factor sales.

**Individual Income Tax and Net Tax Revenue Impacts**

Equally important to the corporate tax revenue impact of strategic apportionment policies is the impact on other tax bases, in particular, the individual income tax base (Goolsbee and Maydew, 2000b). Strategic apportionment policies generate additional production, jobs, and capital investment, which in turn is likely to expand the taxable income of individuals. Perhaps more importantly, strategic apportionment policies are likely to affect unincorporated enterprises in important ways, through increased factor costs or intensified competition from the corporate sector. By including an individual income tax (with rates calibrated to actual collections) and an unincorporated sector for each industry, we are able to generate short–run and long–run estimates of policy–induced changes in individual income tax collections (Table 5).

In our long–run simulations, changes in individual income tax collections tended to be substantial relative to changes in corporate income tax collections in dollar terms, although magnitudes were considerably smaller in percentage terms. What this result suggests is that, at least in the long run, individual income tax collections may increase sufficiently to more than offset any revenue losses arising from

---

\(^{31}\) The technical apportionment effect in the Great Lakes region was especially small because it is only very weakly a “production region.”
a diminished corporate tax base. In fact, in our long–run simulations, only one of eight regions (Southwest) suffered a net revenue loss, which is picked up by changes in lump–sum tax collections. This change can be interpreted as the amount that non–income–based tax collections would have to increase or decrease to compensate for budget imbalances following the imposition of a single–factor sales formula. Our results suggest that most states would be able to reduce tax rates in the long–term under a single–factor sales apportionment scheme. In the case where all regions imposed a single–factor sales formula, one–half of the regions suffered net revenue losses, due in large part to much smaller gains in personal income tax collections. This result was paralleled in our short–run simulations, where again the net revenue impact was determined in very large part by changes in corporate income tax collections.

Strategic Apportionment and Welfare

The analysis of simulation results thus far has focused on economic development and revenue impacts; however, central to any policy appraisal is an adequate discussion of welfare impacts. In the simulation model, welfare impacts are measured by the percentage change in the value of the indirect utility function for the representative citizen in each region:

\[ V = \frac{\nu(p^*, y^*) - \nu(p^0, y^0)}{\nu(p^0, y^0)}, \]

where \( \nu \) indicates the utility function, \( p^* \) and \( p^0 \) are the equilibrium consumer price vectors in the counterfactual and benchmark, respectively, and \( y \) denotes income. Because consumer preferences are linearly homogeneous, the equivalent variation (EV) is given by \( EV = V^*y^0 \), where \( y^0 \) is the benchmark level of income. Thus, the measure of welfare changes given in [30] is simply the equivalent variation weighted by benchmark income.\(^{32}\)

In our simulations, independent moves to a single factor sales formula (where all other regions maintain an equally weighted three–factor formula) were welfare enhancing in every region in both the short and long terms, the gains being proportional to gains in economic development. Welfare was also enhanced in production regions to the extent that highly distortionary corporate income tax collections were replaced with lump sum taxes. Thus, economic development benefits outweighed the welfare reducing impact of higher tax–inclusive consumer prices. Nevertheless, relative changes in regional welfare were never greater than 0.1 percent in any case we examined. Loser regions suffered relatively greater welfare losses in the simultaneous case, while gainer regions still maintained welfare increases. From a national perspective, strategic apportionment of the state corporate income tax tended to be welfare neutral. That is, welfare losses in some regions tended to offset welfare gains in others.

Sensitivity Analysis

As in any applied general equilibrium analysis, the results presented here are, at least in magnitude, somewhat sensitive to the specification of the model and its calibration. Production and utility functions were parameterized with empirical estimates from the literature (Ballard et. al., 1985; Fullerton and Rogers, 1993) or from the data itself, but the elasticity of substitution in the production aggregation function [26] was necessarily assigned a predetermined value. This value, along with assumptions regarding the mobility of labor, in turn determined the time horizon of the policy analysis. In the short–run, the

\(^{32}\) Our measure of national welfare is given by the weighted (by population) average of regional welfare.
elasticity of substitution was given a value of $\delta = 0.3$ and labor was assumed to be geographically immobile. In the long–run version of the model, the elasticity of substitution was $\delta = 5$ and labor was assumed to fully mobile geographically. In an effort to capture the sensitivity of the results to labor mobility assumptions and specification of the elasticity of substitution in the production aggregation function, we recalculated counterfactual equilibria under two different assumptions regarding geographic labor mobility and several values for $\delta$, the results of which are presented in Table 7.

Qualitatively, the economic development results were the same regardless of the specific assumptions made about labor mobility and $\delta$, although the magnitudes of the policy impacts ranged widely. For example, capital inflows generated by a single–factor sales formula in New England ranged from 0.14 percent with $\delta = 0.3$ and immobile labor, to 7.61 percent with $\delta = 25$ and full labor mobility. What the sensitivity analysis tells us is that any economic development effects generated from strategic apportionment policies will depend crucially on the locational flexibility of firms, which means the policies would have their effect only very gradually over time. From a revenue perspective, however, corporate income taxes collections can be expected to see an immediate impact, and the magnitude of the (corporate tax) revenue effect should vary relatively little over time.

**CONCLUSION**

The economic development effects of strategic apportionment policies are clearly positive when states act independently, resulting in a net inflow of capital and increased employment and production. The analysis suggests that these gains are greater for relatively small states which have a capital–intensive production base and relatively high statutory tax

---

**TABLE 7**

<table>
<thead>
<tr>
<th>Labor Mobility</th>
<th>Elasticity of Substitution</th>
<th>Far West</th>
<th>Rocky Mountain</th>
<th>Mountain</th>
<th>Southwest</th>
<th>Southeast</th>
<th>Plains</th>
<th>Great Lakes</th>
<th>New England</th>
<th>Mid–Atlantic</th>
<th>Great Plains</th>
<th>Southeast</th>
<th>Rocky Mountain</th>
<th>Far West</th>
<th>Rocky Mountain</th>
<th>Mountain</th>
<th>Southwest</th>
<th>Southeast</th>
<th>Plains</th>
<th>Great Lakes</th>
<th>New England</th>
<th>Mid–Atlantic</th>
<th>Great Plains</th>
<th>Southeast</th>
<th>Rocky Mountain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully mobile</td>
<td>$\delta = 0.3$</td>
<td>0.14</td>
<td>0.14</td>
<td>0.14</td>
<td>0.16</td>
<td>0.16</td>
<td>0.14</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
<td>0.14</td>
<td>0.14</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
</tr>
<tr>
<td>Immobile labor</td>
<td>$\delta = 0.3$</td>
<td>0.14</td>
<td>0.14</td>
<td>0.14</td>
<td>0.16</td>
<td>0.16</td>
<td>0.14</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
<td>0.14</td>
<td>0.14</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
</tr>
</tbody>
</table>
rates. Economic development gains are diminished, however, to the extent that states situs sales on an origin vs. a destination basis. Moreover, the magnitude of economic development gains is highly dependent on the mobility of factors of production and the substitutability of production across states, as evidenced by the stark disparity in short–run and long–run simulations. Finally, although all states gain by an independent move to single–factor sales, a simultaneous switch to single factor sales yields both winners and losers.

Simulations show that the revenue impacts are much more substantial in magnitude than are the economic development impacts, especially in the short run. For production regions, particularly those that gain little from an economic development perspective with strategic apportionment policies, the revenue losses are quite substantial, up to 10.9 percent over the long term. While some regions also gain a substantial amount of revenues over the long term, the simulations must be taken with a grain of salt, as nexus requirements may render highly sales–intensive firms untaxable. Most importantly, revenue effects are shown to be immediate, while most economic development gains are much longer term in nature.

Finally, for an individual state independently pursuing a single factor sales apportionment policy, the welfare–enhancing economic development benefits tend to outweigh any welfare–reducing effects, namely, higher tax–inclusive consumer prices and in some states, larger corporate tax shares of the revenue stream. Changes in national welfare under apportionment competition appear to be negligible, however.

As strategic apportionment policies have become more and more popular, policy makers have proceeded under the assumption that what is good for some states is good for all. Simulations suggest, however, that many states would have been better off if the apportionment game had never started—in the end they are net losers from an economic development perspective. At the same time, once begun, every state has an incentive to move to a single factor sales formula, and barring any federal action, we should expect to see uniform single factor sales formulas in the future. What began as an attempt by a few states to gain an economic development edge will end up markedly reshaping the economic development landscape and the composition of state tax portfolios.

Acknowledgments

The author gratefully acknowledges useful comments and suggestions from James Alm, John Coalson, Bill Fox, Douglas Holtz–Eakin, Therese McGuire, Matthew Murray, David Sjoquist, Yongsheng Xu, and seminar participants at the University of Tennessee, Georgia State University, the Multistate Tax Commission, and the National Tax Association, and two anonymous referees. Any remaining errors or omissions are, of course, entirely the responsibility of the author.

REFERENCES


Strategic Apportionment of the State Corporate Income Tax

Bartik, Timothy J.

Brunori, David.

Edmiston, Kelly D.

Edmiston, Kelly D.

Edmiston, Kelly D.

Federation of Tax Administrators.

Fox, William F., and Matthew N. Murray.

Friedenberg, Howard L., and Richard M. Beemiller.

Fullerton, Don, and Diane Lim Rogers.

Goolsbee, Austan, and Edward L. Maydew.

Goolsbee, Austan, Edward Maydew, and Michael Schadenwald.


Gupta, Sanjay, and Mary Ann Hofmann.

Healy, John C.

Hellerstein, Jerome R., and Walter Hellerstein.

Internal Revenue Service.

Internal Revenue Service.

Internal Revenue Service.

Kanbur, Ravi, and Michael Keen.

Klassen, Kenneth J.
“Discussion of: The Effect of the Formula Apportionment System on State–Level Economic Development and Multijurisdictional...

Lightner, Teresa.

Lopez, Salvador, and Jorge Martinez–Vazquez.

Maury, Allen, and Laird Graiser.

McLure, Charles E., Jr.

McLure, Charles E., Jr.

Meyer, Georganna, and Ann Oshiro.

Mieszkowski, Peter M.

Mieszkowski, Peter M., and John Morgan.

Mieszkowski, Peter M., and George R. Zodrow.

Omer, Thomas C., and Marjorie K. Shelley.

Pomp, Richard D., and Oliver Oldman.

U.S. Bureau of the Census.

Weiner, Joann M.

Weiner, Joann M.