ECONOMIC EFFECTS OF APPORTIONMENT FORMULA
CHANGES: RESULTS FROM A PANEL OF CORPORATE INCOME TAX RETURNS

Kelly D. Edmiston†
Community Affairs Department
Federal Reserve Bank of Kansas City
925 Grand Boulevard
Kansas City, MO 64198-0001
Tel: (816) 881-2004
Fax: (816) 881-2704
E-Mail: kelly.edmiston@kc.frb.org

and

F. Javier Arze del Granado
The World Bank
1818 H Street NW
Washington, DC  20433
Tel: (202) 438-9282
E-Mail: FArzedelGranado@worldbank.org

December, 2004

Abstract

To date empirical studies of the economic effects of changes in state corporate income tax apportionment policies have used only highly aggregated, state-level data. This study uses data at the individual firm level, which is provided by a population of corporate income tax returns from the State of Georgia over the period 1992 – 2002, to evaluate the economic development and revenue aspects of increasing the sales factor weight (and uniformly lowering the weights on payroll and property) in state corporate income tax apportionment formulas. Looking at the firm level, we find elasticities sufficiently large to lead to substantial impact on local sales ( - 6.5 percent), payroll (2.0 percent) and property (2.1 percent) following a move to double-weighted sales. For the average firm, increases in Georgia payroll and property were $37,110 and $190,829, respectively, while the decrease in Georgia sales for the average firm was $634,367. Based on 1994 figures (the year prior to double-weighting), this amounts to state-wide increases in payroll and property of $0.6 billion and $3.1 billion, respectively, and a decrease in gross receipts of approximately $10.4 billion.

JEL: H25, H73

† The views expressed here are solely those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Kansas City, the Federal Reserve System, or the World Bank. We would like to thank participants of a general session at the 2004 National Tax Association annual conference for useful comments and suggestions.
1. Introduction

The corporate income tax has made a remarkable decline in its importance to state revenue coffers over the last two decades. In the late 1970s corporate income taxes contributed over 10 percent of total state tax collections, but today the corporate tax share has fallen to about 5 percent, despite relatively little change in tax rates. Part of this trend can be explained by changes in federal corporate income tax policy, but corporate tax collections also have responded to a myriad of state corporate tax policy changes designed to stimulate business investment and job creation in an increasingly competitive economic development environment (see Cornia et al., 2004). One tax-based economic development policy that has received an especially great deal of attention in state legislatures and the academic literature in recent years is the modification of apportionment formulae used to assign the taxable income of multistate corporations across the states in which they do business.

The formulary apportionment method assigns income to each state based on the state’s share of the firms’ total sales ($S$), payroll ($P$), and property ($R$) in that state. Formally, the apportionment of some firm’s net income to state $j$ ($\phi_j$) is:

$$\phi_j = f_j^S \left( \frac{S_j}{S} \right) + f_j^P \left( \frac{P_j}{P} \right) + f_j^R \left( \frac{R_j}{R} \right)$$

---

2 Perhaps chief among these are “check the box” rules and other incentives to avoid corporate income taxes altogether by passing income through directly to individuals via s-corporations, partnerships, and LLCs (see Fox and Luna, 2003). For example, Cornia et al. (2004) found that over the period 1991–2002, Georgia corporate income tax revenue losses from corporations switching from c-corp status to s-corp status amounted to approximately 9.5 percent of total 2002 corporate income tax revenue.
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 $j$.

Although traditionally states have given each of these factors equal weight (1/3) in the apportionment formula, a significant trend in recent years has been to place a heavier weight on the sales factor (and therefore uniformly lower weights on payroll and property). This policy is intended not only to stimulate economic development, but also 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, a large majority now weight the sales factor more heavily than the payroll and property factors. 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). Other states offer optional formulas with greater sales factor weights. In most states, the shift away from uniformly weighted apportionment formulas was made in the 1990s, which reflects the increasingly competitive nature of taxation and economic development across the states.

The use of formulary apportionment renders an incidence pattern for state corporate income taxes that is in many ways very different from the standard incidence results for corporate income taxes. A series of papers in the 1980s established that, to the extent tax rates vary across jurisdictions, formula-apportioned corporate income taxes

---

3 Iowa, Massachusetts, Missouri, Nebraska, Texas, Maine, Illinois, Connecticut, and South Carolina have adopted single-factor sales formulas, at least for some industries. Single-factor sales formulas have been proposed in Arizona, Pennsylvania, Wisconsin, Oregon, New York, and Georgia.

4 Omer and Shelley (2002) provide empirical evidence that states have changed their apportionment formulas at least in part for competitive reasons. Edmiston (1999) demonstrates that in a prisoners’ dilemma framework, all states would be expected to move to a sales only formula for economic development reasons in part to stave off losses from other states moving to sales only formulas.
are similar in their incidence to a set of implicit excise taxes on the apportionment factors (McLure, 1980; McLure, 1981; Mieszkowski and Morgan, 1984; Mieszkowski and Zodrow, 1985, Gordon and Wilson, 1986). That is, the economic effects mimic the effects of sales taxes, payroll taxes, and property taxes. It stands to reason that placing a relatively greater weight on the sales factor (with commensurate reductions in property and payroll factor weights) would diminish the implicit excise tax on productive factors and hence encourage business location or expansion. Moreover, firms with a large share of productive activity in the state relative to sales activity would see their tax liabilities diminish relative to sales-intensive firms, and hence corporate income taxes would in some sense be exported to out-of-state enterprises.

Empirical studies recently have surfaced to test the notion that heavier sales factor weights (relative to weights on productive factors) stimulate productive activity. Weiner (1994) found no relationship between the choice of apportionment formula and investment. Although she did find some evidence of a link in a later study (1996), the effects were very small and only marginally significant. Lightner (1999) also found little or no impact, suggesting that differences in apportionment factor weights do not have statistically significant explanatory power in cross-state employment equations once controls for tax *rates* are included in the analysis.\(^5\) Later work has been much more positive on the effects of apportionment formula changes. Goolsbee and Maydew (2000), 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. Specifically, their study suggests that for the average state, reducing the payroll factor weight from \(1/3\)

\(^5\) Goolsbee and Maydew (2000), discussed below, included controls for tax rates in their analysis as well, as did Weiner in her studies.
to 1/4 (double-weighted sales) results in a 1.1 percent increase in manufacturing employment. Further, Klassen and Shackelford (1998) provide evidence that companies have strategically structured their shipments in an effort to reduce sales in states that apply a relatively high assessment on gross receipts through the apportionment system. Finally, Gupta and Hofmann (2003) find 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.

In a very different methodological approach, Edmiston (2002) uses an eight-region applied general equilibrium model to simulate the effects of heavier sales factor weights on economic development and corporate tax revenues. He finds that while heavier sales factor weights may have a significantly positive impact on economic development in the very long run, the short run effects are negligible. Moreover, he finds that the economic development impact can vary substantially across states depending on the industrial structure and other characteristics of the state.

To date empirical studies of the economic effects of strategic apportionment policies have used only highly aggregated, state-level data. Our study uses data at the individual firm level, which is provided by a population of corporate income tax returns from the State of Georgia over the period 1992 – 2002. The benefits of using firm-level data are many. First, while studies utilizing state-level data are able to estimate the aggregate effect of strategic apportionment policies on capital, employment, or sales, they are not able to explore firm-level reactions to these policies, nor to control for firm-level characteristics that may affect the degree to which a given firm responds to policy changes. Second, and perhaps most importantly, previous empirical studies have used
the product of the tax rate and the factor weights to measure the excise-like effects of formula-apportioned corporate income taxes on the apportionment factors. Utilizing data from tax returns, we are able to much more closely approximate the actual tax differentials yielding these excise-like effects, and to use them in our empirical analysis. Third, the use of a very different and much richer data source should help to resolve the somewhat conflicting results of previous empirical studies and to help reach a consensus on the issue. Fourth, the firm-level data allows us to place actual dollar figures on the economic effects of strategic apportionment policies, both for individual firms and for the state as a whole.

Although the analysis examines a change in the apportionment formula in Georgia specifically, the data used in the analysis, as explained below, covers multistate corporations which, on average, have a very small portion of their total activity in the state. In 2002, in fact, the latest date for which complete data are available, the average firm in our data set had only 2.8 percent of its sales, less than 3.9 percent of its property, and about 4.4 percent of its total payroll in the State of Georgia (Table 1, Panel B, last column). We have no reason to expect that these national firms would respond to changes in the apportionment formula in Georgia differently than in other states in any non-trivial way.

2. Model, Data, and Econometric Issues

Data

The data used in this analysis consists of a panel of the population of multistate corporate income tax returns filed in the State of Georgia over the period 1992 – 2002,
which were provided by the Georgia Department of Revenue. The data includes all
information provided on the corporate tax return (Form 600) other than identifying
information such as company name and street address. The Georgia Department of
Revenue scrambled the federal taxpayer ID number in a consistent fashion, which
allowed us to construct a panel of individual corporations over time while maintaining
the anonymity of individual taxpayers. There were roughly 20 to 30 thousand individual
observations per year, ranging from a low of 19,350 in 1992 to a high of 28,058 returns in
2001. Table 1 provides a summary of the information reported on the tax returns over the
period, while Table 2 provides sample statistics for the data used in the analysis.

Model and Estimation

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

\[
\max_{K_j, L_j} \pi^* = \left(S - P\right)\left[1 - \sum_j t_j \phi_j \right] - R \quad j = 1, \ldots, M
\]

where states are indexed by \(j\); \(S = q \sum_j F(K_j, L_j)\), \(P = w \sum_j L_j\), and \(R = r \sum_j K_j\) are the
firm’s sales, payroll, and property nationally, where \(F(\bullet)\) 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 \(j\), as in (1).

Maximization of (2) yields the following first-order conditions:

\[
q F_{K_j} \sum_h \theta_h \left[1 - \sum_h t_h \phi_h - \left(\pi / S\right) \left(f_h \cdot t_h - \sum_h S_h / S f_h \cdot t_h\right)\right] = 0
\]
\[
\left[ 1 + \frac{\pi}{R} \left( f_j^\pi t_j - \sum_h (R_h / R) f_h^\pi t_h \right) \right]^r
\]

and

\[
(4) \quad q F_j \sum_h \theta_h \left[ 1 - \sum_h t_h \theta_h - \left( \frac{\pi}{S} \right) \left( f_h^S t_h - \sum_h (S_h / S) f_h^S t_h \right) \right] = \left[ 1 - \sum_h t_h \theta_h + \left( \frac{\pi}{P} \right) \left( f_j^P t_j - \sum_h (P_h / P) f_h^P t_h \right) \right]^w
\]

where states are indexed by \( h \) and \( h' \); \( \pi = S - P \) is taxable (normal) profits, and \( \theta_h \) is the proportion of marginal output sold in state \( h' \).

Equations (3) and (4) reflect the familiar result that the marginal revenue product of each factor should be equal to the marginal factor cost (net of taxes). These equations also elucidate two separate effects of the formula-apportioned corporate income tax. The first effect, which is represented by the \( \phi \) terms, captures the impact on the firm’s corporate income tax liability from the increased profits that arise when the firm employs additional capital or labor in the state (a profits tax effect). The second effect, which is represented by the parenthetical terms, reveals an implicit excise tax or subsidy on each factor that arises because the firm’s overall activity in state \( j \) increases relative to its activity in other states, as measured by the apportionment formula (an excise tax effect).

Thus, through these first-order conditions, the formula-apportioned corporate income tax can be seen to be equivalent to four separate firm-specific taxes (see Edmiston, 2002): a nation-wide profits tax rate given by

\[
(5) \quad \tau^\pi = \sum_h t_h \phi_h ,
\]

\[6\] The sum of these implicit excise taxes and subsidies for each apportionment factor sum to zero across states.
and excise taxes (or subsidies) on sales, payroll, and property in each state $j$ given by

$$
\tau^S_j = (\pi / S) \left[ t_j f^S_j - \sum_h (S_h / S) t_h f^S_h \right],
$$

$$
\tau^P_j = (\pi / P) \left[ t_j f^P_j - \sum_h (P_h / P) t_h f^P_h \right], \text{ and}
$$

$$
\tau^R_j = (\pi / R) \left[ t_j f^R_j - \sum_h (R_h / R) t_h f^R_h \right].
$$

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 (1). The excise taxes (subsidies) arise from deviations from this average. Only in the case of uniform tax rates and apportionment formulas will the excise effects disappear, and a system of formula-apportioned corporate income taxes resemble a corporate tax levied at the national level.

The tax differentials in (6) – (8) serve as the basis for our empirical analysis. Ideally, we would like to measure the tax differentials using (6) – (8) directly. Unfortunately we cannot construct the factor average across states with the available data, which includes only Georgia tax returns. Instead we use a relatively close variant:

$$
\tau_F = (\pi / F) t_{GA} f^F \left[ 1 - \frac{F_{GA}}{F} \right]
$$

where $F$ is the factor amount nationally ($i.e.$, nation-wide sales, payroll, or property) and $F_{GA}$ is the factor amount in Georgia.\(^7\) We add an additional term to reflect the taxes of other states:

\(^7\) Throughout the discussion of the model and results, we use “$F$” to represent an arbitrary factor (sales, payroll, or property).
where \( d_{j,GA} \) is the distance between the population centers of state \( j \) and Georgia (arc distance, in nautical miles) and \( GSP_j \) is the gross state product in state \( j \), which is the average effective tax on the factors, weighted by distance and size of the economy.

These tax variables are calculated for each firm for each year.

We choose as our dependent variable the factor amount in Georgia; that is, the value of property, payroll, and sales in Georgia for each firm \( i \) at each date \( t \). Given data requirements, our remaining explanatory variables must necessarily come from information on the tax returns. Fortunately, we are able with only these variables, as detailed below, to explain a substantial amount of the total variation in factor values across firms over time.

The amount of each factor any firm places in Georgia will depend in large part on its overall levels of the factors nationally. To account for this we include the national value of each factor in the regression equations (\( F_{Nat}^{i} \)).

Obviously, all else equal, firms with a larger share of their total economic activity in the state of Georgia also will have higher amounts of each factor in the state. We account for the overall presence of each firm in the state by including its apportionment percentage under an equally weighted three-factor formula:

\[
(11) \quad \text{Pres} = \frac{1}{3} \left[ \frac{S_{GA}}{S} + \frac{P_{GA}}{P} + \frac{R_{GA}}{R} \right]
\]
The profit margin on each factor is likely to influence the use of that factor, and thus we include the profit margin of the relevant factor \((\pi / F)\) as a separate regressor in addition to interacting it with the tax variable.

Finally, because of diminishing marginal factor productivity, we expect the capital-labor ratio, as proxied by the ratio of property to payroll \((R/P)\), to negatively effect the use of capital and to positively effect the use of labor. The capital-labor ratio is not expected to influence the amount of sales in the state.

Given these explanatory variables, we have a system of three separate regressions:\(^8\)

\[
S_{Gt} = \alpha_0 S^{\alpha_2} (\pi / S)^{\alpha_1} \text{Pres}^{\alpha_2} (R / P)^{\alpha_3} \exp(\varepsilon)
\]

\[
P_{Gt} = \beta_0 P^{\beta_2} (\pi / P)^{\beta_1} \text{Pres}^{\beta_2} (R / P)^{\beta_3} \exp(\varepsilon)
\]

\[
R_{Gt} = \gamma_0 R^{\gamma_2} (\pi / R)^{\gamma_1} \text{Pres}^{\gamma_2} (R / P)^{\gamma_3} \exp(\varepsilon)
\]

which we estimate in log-linear form. The error term is assumed to have a two-way fixed effects structure. That is,

\[
\varepsilon_{it} = \mu_i + \lambda_t + \nu_{it}
\]

where the \(\mu_i\) pick up non-time-varying firm-specific effects that are not captured by the data, and the \(\lambda_t\) pick up date-specific effects that do not vary across firms, such as macroeconomic conditions and other state policy changes that may have occurred over the period. The remaining error is assumed to have the following properties:

\[
\nu_{it} \sim N(0, d_i)
\]

\[
E(\nu_{it}, \nu_{is}) = 0 \quad \forall t \neq s
\]

\[
E(\nu_{it}, \nu_{jt}) = 0 \quad \forall i \neq j
\]

---

\(^8\) Firm and time subscripts are dropped for presentation.
Further, there is assumed to be contemporaneous correlation of errors across equations, \( i.e., E(\mathbf{v}\mathbf{v}') = \Sigma \), where \( \mathbf{v} = [(\mathbf{v}^x)' (\mathbf{v}^p)' (\mathbf{v}^h)']' \), and therefore the system is estimated using the seemingly unrelated regressions (SUR) technique of Zellner (1962).

4. Results and Analysis

The primary results from estimating the regressions in (12) are presented in columns A, C, and E of Table 3. The key variables in our analysis, the tax measures given in rows 3 and 4, are all statistically significant, have the signs we would expect, and have reasonable magnitudes.

The tax elasticities on payroll and property are \( \partial \log(P_{\text{Ga}}) / \partial \log(\tau^p) = -0.079 \) and \( \partial \log(R_{\text{Ga}}) / \partial \log(\tau^p) = -0.083 \), respectively, and both are significant at the 99 percent confidence level. Thus, lowering the factor weight on productive factors from 1/3 to 1/4 (a 25 percent reduction), lead to increases in Georgia payroll and property of 1.98 percent \((-0.079 \times 25)\) and 2.08 percent respectively, on average. Estimation of the magnitude of effects on payroll and property of a further change to a sales only formula would require an out-of-sample forecast, which would give highly questionable results. However, the results here do suggest that a switch to an even greater weight on sales relative to productive factors would likely stimulate payroll and property in the state, probably to an even greater degree, as such a move involves a 100 percent reduction in weights on payroll and property factors.

For the sales portion of the tax the elasticity is –0.129, which means that the average multistate corporation in Georgia decreased its sales in the state by 6.45 percent in response to the shift to double-weighted sales (recall that in moving from an equally
weighted formula to a double-weighted sales formula the sales portion of the tax increases by 50 percent). Theory seems to suggest that sales from multistate corporations should decline in the state following a move to double-weighted sales because the effective tax on in-state sales increases. However, if local sales are tied in some way to local production, then the sales portion of the tax is equivalent to a tax on output. For example, gross receipts from the services sector generally are sitused at origin (based on cost of performance). Our results suggest that the location of sales are not very closely linked with the location of production for multistate corporations (in particular, those with activities in Georgia).

An additional factor we considered as a regressor is the relative market or production presence in the state, as measured by

\[
Mkt = \frac{S_{Ga}}{S_{Ga}} / \left[ \frac{1}{2} \left( \frac{P_{Ga}}{P} + \frac{R_{Ga}}{R} \right) \right]
\]

A Value Mkt > 1 implies that a firm is relatively more sales-intensive in the state than production intensive, and a value Mkt < 1 implies that a firm is more production-intensive. Sales-intensive firms should have seen their overall corporate tax liability increase with a move to double-weighted sales, all else equal, while production-intensive firms should have seen their overall tax liability decrease with the change. The inclusion of this regressor significantly increased the \( R^2 \) of the sales equation and marginally increased the \( R^2 \) of the payroll and property equations (columns B, D, and F of Table 3).

The problem with including this variable is that the coefficient on the tax variable (\( \tau_F \)) must then be interpreted as the responsiveness of the factor (say, sales) to changes

---

\(^9\) But both types of firms, however, have an incentive to locate additional property and payroll in the state, as the change in implicit taxes on the factors does not depend on the relative sales- or production-intensity of the firm (see equations 6 – 8).
in taxes when the firm maintains the ratio of sales to production in the state. Of course, the sales portion of the tax becomes a tax on production in that scenario, which unsurprisingly results in a positive estimated elasticity for the tax variable in the sales equation (row 3, column B of Table 3). An effort to capture the behavioral effects of a change in apportionment formula requires the exclusion of this variable from the analysis.

As expected, and as suggested by previous research (Edmiston, 2002; Omer and Shelley, 2002), the location of sales, payroll, and property in the state is highly sensitive to the tax rates of other states. The elasticities with respect to the distance- and size-weighted average effective state corporate income tax rate are all positive and statistically significant, and very large for sales (2.3) and payroll (3.9). The location of property is relatively inelastic with respect to the taxes in other states (0.6). While the elasticities are substantial, it should be noted that fairly substantial changes in tax structures across states would be required before the distance- and size-weighted average effective state corporate income tax rate would change in any significant way. A move by next-door neighbor Alabama from an equally weighted formula to a double-weighted sales formula, for example, would increase this weighted average tax rate by only 0.002 percentage points (from 0.037142 to 0.037163 in 2002).

**Aggregate Effects on Sales, Payroll, and Property**

For the average firm, estimated increases in Georgia payroll and property arising from the shift to double-weighted sales are $37,110 ($1,874,220 x 0.0198) and $190,829 ($9,174,473 x 0.0208), respectively, while the estimated decrease in Georgia sales for the average firm is $634,367 ($9,835,147 x 0.0645). Based on 1994 figures (the year prior to
double-weighting), this amounts to state-wide increases in payroll and property of $0.6 billion and $3.1 billion, respectively, and a decrease in gross receipts of approximately $10.4 billion. Of course, there may have been some off-setting declines in payroll and property in the unincorporated sector or the local incorporated sector, which would mitigate these gains. We lack sufficient data to determine the degree to which this substitutability occurs, but we doubt it is very substantial, given that the firms are producing for and selling in national markets.

Revenue Effects

With an average effective personal income tax rate of 2.36 percent in the State of Georgia (Edwards and Wallace, 2004), the payroll increase amounted to an addition to state personal income tax coffers of $14.4 million in 1995.\textsuperscript{10} If half of this income was spent on sales-taxable items, an additional $500 thousand would likely accrue in sales tax receipts (at a combined state and local rate of 7 percent, the model rate in Georgia). The increase in corporate property undoubtedly had a positive impact on personal income tax and sales tax collections as well, but the owners of property (and producers of property) are distributed throughout the U.S. and the world, which makes the property impact on personal income tax collections impossible to estimate. To the extent this property is directly taxable, however, local governments likely enjoyed substantial gains in property tax collections. Finally, sales of corporations diminished in the state, which likely eroded the sales tax base to some degree. Without accurate data on the share of corporate gross receipts that are sales taxable (some goods and services are outside of the base or exempted), it is difficult to put even a rough estimate on the number. The number was likely substantial, however. If ten percent of the reduction in sales was sales-taxable, the

\textsuperscript{10} In reality the adjustment would likely occur over some period of time.
loss would have been $73.1 million. Again, there may have been some off-setting declines in payroll and property in the unincorporated sector, which would mitigate revenue gains, and offsetting gains in sales in the unincorporated sector, which would mitigate revenue losses arising from reduced sales tax collections.

Changes in corporate tax collections resulting from the change to double-weighted sales in 1995 (for the period 1995-2002), which we are able to calculate directly from the returns, ranged from – $11.5 million (2002) to – $52.2 million (1996). These amounts represent the difference between total tax collections under an equally weighted formula and a double-weighted sales formula.

Although the corporate income tax gains and losses tend to receive the greatest scrutiny in state governments considering a more aggressive apportionment formula, we show that changes in other tax bases may be much more substantial. An important consideration here, however, is that these numbers apply only to multistate corporations. To the extent that production and sales by local Georgia firms decreased in response to the change in corporate tax policy, the revenue figures for personal income tax, property tax, and sales tax may differ substantially from those estimated here.

Other Results

Despite the fact that our data choices were restricted to the information available on Georgia corporate income tax returns, we were able to put together regression equations that explained a significant amount of the total variation in Georgia factor use across firms over time. Although the individual adjusted $R^2$’s for the payroll and property equations may appear somewhat low at 0.26 and 0.18, the fixed effects (the means for each period and firm) were subtracted from the data prior to estimation, and
therefore the explanatory power of the fixed effects are not accounted for in the reported $R^2$s.

Most of our other explanatory variables were found to be statistically significant, with expected signs and reasonable magnitudes. The use of productive factors or sales in the State of Georgia tends to follow closely the use of productive factors and sales nationally, with elasticities that ranged from 1.1 to 1.4. Not surprisingly, more local firms, as measured by $Pres$, used more payroll and property and made more sales in Georgia than did firms with a lower presence in the state, all else equal. Finally, profitability tended to stimulate the use of payroll and property and sales in the state.

5. Conclusion

This paper utilizes panel data from a population of corporate tax returns filed in the State of Georgia over the period 1992 – 2002 in an effort to gauge the degree to which individual firms respond to aggressive apportionment policies, such as double-weighted sales. We find that the switch from an equally weighted formula to a double-weighted sales formula in 1995 had a significant positive impact on the use of productive factors by multistate corporations in the state and a significant negative impact on sales in the state. This, in turn, likely lead to significant changes in non-corporate-income tax bases.

The results of our analysis support the findings of Goolsbee and Maydew (2000), Gupta and Hoffman (2000), Weiner (1996), and Edmiston (2002) which suggests that increased sales factor weights (and therefore lower weights on productive factors) should have a positive impact on the utilization of productive factors in the acting state. The
results also support the findings of Klassen and Shackelford (1998) and Edmiston (2002) that suggest a detrimental effect on sales of increased sales factor weights in apportionment formulas. The magnitudes of the effects are relatively close to those found elsewhere, although slightly larger. Our work expands the existing literature by measuring firm-level behavioral responses to aggressive apportionment policies, and from there determining aggregate economic impacts. Looking at the firm level, we find elasticities sufficiently large to lead to substantial effects on sales (-6.5 percent), payroll (2.0 percent) and property (2.1 percent) following a move to double-weighted sales, and we are able, for the first time, to associate dollar amounts with apportionment effects, both for the average firm and in the aggregate.

Although these results are derived using Georgia data, we believe the results are applicable to other states, as the data contains only multistate firms with very little of their total activity occurring Georgia. We believe there is little reason to expect that these firms would react differently to an apportionment change in other states in any non-trivial way.
REFERENCES


### Table 1
Georgia Multistate Corporate Income Tax Returns


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Returns</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GA</td>
<td>285,477</td>
<td>300,640</td>
<td>429,014</td>
<td>459,745</td>
<td>348,576</td>
<td>351,899</td>
</tr>
<tr>
<td>Total</td>
<td>6,513,898</td>
<td>7,277,609</td>
<td>9,581,072</td>
<td>7,677,187</td>
<td>6,868,901</td>
<td>7,106,918</td>
</tr>
<tr>
<td>Share (%)</td>
<td>4.38</td>
<td>4.13</td>
<td>4.48</td>
<td>5.99</td>
<td>5.07</td>
<td>4.95</td>
</tr>
<tr>
<td>Property</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GA</td>
<td>149,763</td>
<td>156,956</td>
<td>187,035</td>
<td>179,970</td>
<td>191,082</td>
<td>188,135</td>
</tr>
<tr>
<td>Total</td>
<td>4,251,201</td>
<td>4,630,782</td>
<td>5,633,651</td>
<td>3,843,059</td>
<td>4,037,350</td>
<td>4,017,520</td>
</tr>
<tr>
<td>Share (%)</td>
<td>3.52</td>
<td>3.39</td>
<td>3.32</td>
<td>4.67</td>
<td>4.97</td>
<td>4.66</td>
</tr>
<tr>
<td>Payroll</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GA</td>
<td>32,177</td>
<td>32,670</td>
<td>37,874</td>
<td>40,838</td>
<td>41,120</td>
<td>40,017</td>
</tr>
<tr>
<td>Total</td>
<td>931,555</td>
<td>954,657</td>
<td>1,123,388</td>
<td>763,717</td>
<td>805,966</td>
<td>824,788</td>
</tr>
<tr>
<td>Share (%)</td>
<td>3.45</td>
<td>3.42</td>
<td>3.37</td>
<td>5.35</td>
<td>5.10</td>
<td>5.34</td>
</tr>
<tr>
<td>Fed. Tax. Inc.</td>
<td>34,119</td>
<td>113,674</td>
<td>195,476</td>
<td>84,398</td>
<td>85,342</td>
<td>96,004</td>
</tr>
<tr>
<td>Net Additions to Fed. Tax. Inc.</td>
<td>42,811</td>
<td>28,696</td>
<td>42,314</td>
<td>49,506</td>
<td>37,570</td>
<td>26,290</td>
</tr>
<tr>
<td>Specific Allocation to Georgia</td>
<td>53</td>
<td>60</td>
<td>86</td>
<td>90</td>
<td>4,813</td>
<td>164</td>
</tr>
<tr>
<td>Specific Allocations Total</td>
<td>7,597</td>
<td>15,469</td>
<td>16,496</td>
<td>11,102</td>
<td>15,328</td>
<td>14,252</td>
</tr>
<tr>
<td>Tax Credits</td>
<td>95</td>
<td>11</td>
<td>50</td>
<td>49</td>
<td>40</td>
<td>62</td>
</tr>
</tbody>
</table>

#### Panel B: 1998 – 2002

<table>
<thead>
<tr>
<th>Item / Year</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returns</td>
<td>26,074</td>
<td>26,206</td>
<td>27,367</td>
<td>28,058</td>
<td>22,931</td>
</tr>
<tr>
<td>Gross Receipts (millions)</td>
<td>261,637</td>
<td>280,612</td>
<td>389,165</td>
<td>306,708</td>
<td>186,074</td>
</tr>
<tr>
<td>Share (%)</td>
<td>2.95</td>
<td>3.12</td>
<td>3.34</td>
<td>2.87</td>
<td>2.79</td>
</tr>
<tr>
<td>Property</td>
<td>227,044</td>
<td>244,850</td>
<td>246,766</td>
<td>261,338</td>
<td>156,003</td>
</tr>
<tr>
<td>Share (%)</td>
<td>4.83</td>
<td>4.88</td>
<td>4.73</td>
<td>4.62</td>
<td>3.85</td>
</tr>
<tr>
<td>Payroll</td>
<td>50,546</td>
<td>52,154</td>
<td>56,501</td>
<td>57,510</td>
<td>35,921</td>
</tr>
<tr>
<td>Share (%)</td>
<td>5.31</td>
<td>5.08</td>
<td>4.85</td>
<td>4.98</td>
<td>4.38</td>
</tr>
<tr>
<td>Fed. Tax. Inc.</td>
<td>6,826</td>
<td>-10,813</td>
<td>-78,923</td>
<td>-186,191</td>
<td>-86,761</td>
</tr>
<tr>
<td>Net Additions to Fed. Tax. Inc.</td>
<td>9,336</td>
<td>2</td>
<td>12,151</td>
<td>40,812</td>
<td>44,104</td>
</tr>
<tr>
<td>Specific Allocation to Georgia</td>
<td>212</td>
<td>205</td>
<td>339</td>
<td>166</td>
<td>154</td>
</tr>
<tr>
<td>Specific Allocations Total</td>
<td>12,825</td>
<td>13,994</td>
<td>14,911</td>
<td>20,493</td>
<td>6,311</td>
</tr>
<tr>
<td>Tax Credits</td>
<td>70</td>
<td>87</td>
<td>99</td>
<td>96</td>
<td>26</td>
</tr>
</tbody>
</table>

Source: Georgia Department of Revenue, Corporate Income Tax Returns, Form F600, 1992 – 2002, Multistate Corporations
Table 2
Sample Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_{GA}$</td>
<td>11,070,629</td>
<td>124,720,181</td>
</tr>
<tr>
<td>$S$</td>
<td>368,081,456</td>
<td>6,043,888,295</td>
</tr>
<tr>
<td>$P_{GA}$</td>
<td>2,023,308</td>
<td>14,097,559</td>
</tr>
<tr>
<td>$P$</td>
<td>46,373,817</td>
<td>370,193,498</td>
</tr>
<tr>
<td>$R_{GA}$</td>
<td>8,960,629</td>
<td>243,693,211</td>
</tr>
<tr>
<td>$R$</td>
<td>219,635,491</td>
<td>2,068,696,758</td>
</tr>
<tr>
<td>$\pi$</td>
<td>11,790,368</td>
<td>109,337,764</td>
</tr>
<tr>
<td>Pres</td>
<td>0.168</td>
<td>0.274</td>
</tr>
<tr>
<td>Mkt</td>
<td>155.5</td>
<td>3,687.9</td>
</tr>
<tr>
<td>$\tau_S$</td>
<td>0.00075</td>
<td>0.00137</td>
</tr>
<tr>
<td>$\tau^*_S$</td>
<td>0.03803</td>
<td>0.00094</td>
</tr>
<tr>
<td>$\tau_P$</td>
<td>0.00197</td>
<td>0.00328</td>
</tr>
<tr>
<td>$\tau^*_P$</td>
<td>0.01876</td>
<td>0.00084</td>
</tr>
<tr>
<td>$\tau_R$</td>
<td>0.00109</td>
<td>0.00215</td>
</tr>
<tr>
<td>$\tau^*_R$</td>
<td>0.01897</td>
<td>0.00193</td>
</tr>
</tbody>
</table>

Source: Georgia Department of Revenue, Corporate Income Tax Returns, Form F600, 1992 – 2002, Multistate Corporations
<table>
<thead>
<tr>
<th>Variable</th>
<th>Sales</th>
<th>Payroll</th>
<th>Property</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.004)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>( \log(F_{Nat}) )</td>
<td>1.440**</td>
<td>0.944**</td>
<td>1.171**</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.006)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>( \log(\tau) )</td>
<td>-0.129**</td>
<td>0.089**</td>
<td>-0.079**</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.007)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>( \log(F_{\tau}) )</td>
<td>2.262**</td>
<td>3.013**</td>
<td>3.922**</td>
</tr>
<tr>
<td></td>
<td>(0.352)</td>
<td>(0.183)</td>
<td>(0.280)</td>
</tr>
<tr>
<td>( \log(\pi/F) )</td>
<td>0.082**</td>
<td>-0.049**</td>
<td>0.053**</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.004)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>( \log(\text{Pres}) )</td>
<td>2.218**</td>
<td>2.623**</td>
<td>2.080**</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.004)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>( \log(\text{Mkt}) )</td>
<td>1.224**</td>
<td>-0.459**</td>
<td>-0.459**</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>( \log(\text{PR}/F) )</td>
<td>0.026**</td>
<td>-0.005</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.005)</td>
<td>(0.013)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Adj. ( R^2 ) (Eq, OLS)</th>
<th>Adj. ( R^2 ) (System)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.40</td>
<td>0.30</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
** indicates significance at the 99 percent confidence level
* indicates significance at the 95 percent confidence level