THE EFFECT OF STATE APPORTIONMENT FORMULAE ON INVESTMENT/LOCATION DECISIONS OF MULTI-STATE CORPORATIONS

By

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1. INTRODUCTION

1.1 Background on Formulary Apportionment

It has always been standard corporate management policy to increase the "bottom line". Firms want to increase revenue while cutting costs, which include both controllable and non-controllable expenses. Taxes are generally considered to be non-controllable because they are set by law. Domestic multi-state businesses encounter a wide range of state corporate income tax apportionment rules and rates. Because these rates and rules differ across states, they present choices for a multi-state firm and transform taxes into a somewhat controllable expense. As Schoettle (1991) observes:

> Businesses are continually reallocating their physical and human resources, adding to their physical plant here, adding or subtracting an employee there, and generally responding to the market. Each week, thousands of decisions are made that involve taxes in one way or another. The effect of taxes on any one of these decisions may be quite small. However, over a decade or so, the cumulative effect of a particular tax system entering into millions of decisions will be to make the world a different place than if some different tax system had been in effect.

An example of Schoettle's observation is the opportunity for domestic multi-state businesses to manipulate profits through location decisions. The differing apportionment formulae that affect the state corporate income tax base offer strategies to minimize a firm's total state corporate income tax liability.

The size and importance of the state corporate tax liability has increased significantly over the last thirty years. Since 1970, revenues from state corporation income taxes have increased by more than 580 percent (Significant

Features of Federalism, 1992). Galginaitis (1992) examines the size of state tax payments and notes that state taxes have increased more rapidly than federal taxes. From 1968 to 1989, nominal state corporate income taxes grew by a factor of ten while nominal federal corporate income taxes grew by a factor of three. The rise in state corporate income tax is further exacerbated by reductions in the federal tax rate, thus diluting the effectiveness of state tax deductibility on the federal return. It is not surprising that Coopers and Lybrand LLP(1996) report that America's fastest growing companies reveal state and local taxes represent their most rapidly growing tax burden with a 15.3 percent average increase during 1995. This trend magnifies the importance of studying multi-state corporate taxation.

The unitary business principle drives the current philosophy behind multi-state taxation. Viewing the multi-state firm through this principle, the business is seen as a whole, made up of parts (or activities) within states. Simafranca (1995) maintains that the unitary business principle prevents corporations from manipulating income by capturing all of the business from the entire unitary business. This same unitary principle also protects the corporation by limiting the state's authority to tax activities outside that state.

Using the unitary business principle, the corporation defines the scope of its unitary business, then apportions that unitary income between the taxing states. Problems begin to arise when the corporation applies the differing state tax statutes. The Committee On State Taxation (1995) named differing state

apportionment as the number one reason for lack of uniformity between the state corporate tax codes.

The Uniform Division of Income for Tax Purposes Act (UDITPA) was written by a group of state lawmakers at the 1957 National Conference of Uniform State Laws in an effort to bring uniformity to the states' tax codes. Its purpose was to provide simplification and equity in state income taxation. The UDITPA's suggested apportionment model for the states is a three-factor equally weighted formula for determining the firm's total income subject to a state's tax. The model sales factor is the ratio of total gross receipts from sales to in-state customers divided by total gross receipts from sales. The payroll factor is the ratio of compensation paid to employees working in-state divided by total compensation. The property fraction is the ratio of the cost of real or tangible personal property located in-state divided by the total cost of such property. The UDITPA's apportionment percentage is calculated as follows:

$$\frac{\frac{\text{in-state property}}{\text{total property}} + \frac{\text{in-state payroll}}{\text{total payroll}} + \frac{\text{in-state sales}}{\text{total sales}}}{3} = \text{Apportionment Percentage}$$

Each apportionment percentage is then applied to the corporation's taxable income and the result is the corporation's tax base in that state.

Adoption of the UDITPA by the states is voluntary. Most states use some form of the three-factor formula that includes sales, payroll and property factors.

More than half of the states do not equally weight these factors but emphasize more heavily the sales made in that state. Three states tax corporations solely on the sales factor. TABLE I (Federal Tax Administration) displays the variety in state formulary apportionment in 1999.

Federal courts have not required the states to adopt uniform apportionment formulae as evidenced in *Moorman Manufacturing Co. v. Bair, Director of Revenue of Iowa, 437 U.S. 267 (1978).* In this case, the Supreme Court upheld the validity of Iowa's single-factor sales formula and ruled that it was not in violation of the Commerce Clause. Simafranca (1995) believes that if the Supreme Court heard *Moorman Mfg. Co.* today it would conclude that the single-factor sales formula used by Iowa, as well as the double-weighted sales formula, violate the Commerce Clause of the Constitution. Simafranca contends the resulting effect of these apportionment formulae on interstate commerce would be seen as discrimination against out-of-state businesses. He cites numerous cases that show a tendency in the positions of the Supreme Court Justices to both hear and rule on interstate tax issues. Simafranca suggests the courts would identify the use of differing formulary apportionment as disguised state tax incentives favoring in-state industry and would mandate uniform apportionment.

1.2 Purpose

The study examines the effects of varying state formulary apportionment statues on investment decisions of domestic multi-state businesses. It investigates whether domestic multi-state businesses make investment decisions to manipulate the states' corporate tax allocation factors and thereby reduce overall state corporate taxes. (TABLE 2 illustrates the benefits of strategically locating in a state with an apportionment formula favoring in-state firms)

Investment behavior theory suggests several factors other than state taxes affect the firm's investment decision. However, with the increasing magnitude of state taxes as a percentage of the "bottom line" and the increased mobility of society, businesses may not only consider but react to state tax allocation factors in the investment decision. Shackleford (1993) suggests,

> Businesses have incentives to organize their affairs so that the overall tax burden is reduced. For multi-state taxes, the reorganization focuses on the allocation factors. This process of reorganization can lead to administrative, compliance, and efficiency costs as well as transfers of wealth to taxpayers who can more easily rearrange their affairs.

1.3 Contributions

If firms have invested in states where apportionment formulae favor instate businesses, these firms will have increased their wealth by reducing their overall state corporate tax liability. This result would be useful to at least three

groups of decision makers: state governments, federal lawmakers, and the courts. These groups could use these results in making future decisions.

If apportionment formulae prove to be a significant factor in the investment decision, state governments could use the results of the study to support their use of apportionment formulae as economic development tools. Strategic location not only benefits the business but the taxing state. Considering the budget, tax and welfare reform currently occurring at the federal level, states will likely need to increase tax revenues, and tax exporting through manipulation of apportionment formulae accomplishes this goal.

The lawmaking body of the federal government and/or the courts might use the results of this study in a different light. If it can be shown that businesses invest to take advantage of differing apportionment formulae, this result could be used as evidence to support the argument that differing apportionment rules violate the Commerce Clause and justify the need for a uniform apportionment rule. On the other hand, if no significant result is obtained, this indicates that the investment decision is not sensitive to differing state corporate apportionment rules and federal lawmakers do not need to enforce a uniform apportionment rule.

The remainder of the study is organized as follows. Section 2 provides a review of the literature relating to taxes and their role in the investment decision. Section 3 presents the hypotheses to be tested and explains the research design. Construction of the data base is discussed in section 4, and the results

of the study are presented in section 5, with conclusions offered in Section 6. Finally, section 7 addresses limitations of the study and suggests avenues for future research.

2. LITERATURE REVIEW

The literature review of the impact of state and local taxes on the investment/location decision is divided into four sections: 1) studies before 1980, 2) studies after 1979, 3) studies that considered formulary apportionment in some way, and 4) limitations of previous studies.

2.1 Studies before 1980

Due (1961) reviews the early literature focusing on the impact of state and local taxes on investment/location decisions. He concludes that interview/survey studies generally reveal that firms "say" that taxes make a difference in where they invest. But he believes the anti-tax attitude of many businessmen condition them to "stress the tax factor, as does the belief that their answers may influence the conclusions of the survey and thus ultimately bring lower taxes." Due (1961) cites numerous studies prior to 1961 which conclude that state taxes are not as important in the investment decision process as many other variables. He states, "...while the statistical analysis and study of investment/location factors are by no means conclusive, they suggest very strongly that the tax effects cannot be of major importance." The average calculated state corporate tax

rates during 1948-1961 ranged from 1.6% to 2.5% (Galginatis, 1992). These rates are the lowest since the states have been taxing corporate profits.

Wasylenko (1981), reviews the literature on location decisions from 1962-1978 and concludes "empirical evidence that taxes affect interregional business investment/location decisions is almost nonexistent." Benson and Johnson (1986) reason that interstate business competition during this period may have kept state and local taxes close enough that tax differentials that did exist were not large enough to cause major locational advantages for the businesses. Their study of new investment in plant and equipment reported by *Survey of Manufacturers* across 48 states over the period *1966-1978* suggests that taxes negatively affect economic activity. They defined each state's tax variable as the total tax revenue collected at the state and local level divided by total state personal income. State corporate tax rates increased during 1966-78 from 2.4% to a high of 5.9% (Galginaitis, 1992)

2.2 Studies after 1979

Since 1979 average state corporate tax rates have increased from 6.1% to a high of 9.3% in 1982 falling back to 7.7% in 1989, (Galginaitis, 1992). A study by Swenson (1997) reveals state corporate income tax of as much as 8.4% in 1993. A review essay by Bartik (1992) summarizes recent research on the effects of state and local taxes on business activity. He examines 57 studies since 1979 that have estimated the effects of an increase in state and local taxes

on some measure of state or local business activity. Roughly 70% of these studies reveal at least one statistically significant tax effect that has a negative impact on economic growth. Bartik (1992) then uses 48 of the 57 studies to calculate an "implied long-run elasticity of state and local business activity with respect to state and local taxes." The mean long-run elasticity was determined to be -.25. This suggests that if business taxes are reduced by 10%, there should be a long-run increase in business activity of about 2.5%.

Using a meta-analysis of the Bartik (1992) studies, Phillips and Goss (1995) derive a more precise estimate of the tax elasticity, and determine how the inclusion and omission of key variables in the estimated equations influences the elasticity estimate. Their estimate of tax elasticity for inter-regional studies was -.22, compared to Bartik's -.25. This result is still statistically significant but indicates slightly less of an effect on business activity.

The literature after 1979 strongly suggests a change in the importance of state taxes in the investment/location decision and a contrast between early studies and those reviewed by Bartik. Fleischman (1995) provides an overall historical review of the literature on the impact of state and local taxation on industry investment/location decisions; dividing the research into categories of intra and inter-regional studies before 1980 and after 1979. His study reveals that 65% of the inter-regional studies have significant tax variables. He further divides the studies into cross-sectional, longitudinal, or pooled cross-

section/time series and finds that 80% of the pooled studies have significant tax variables.

Fleischman points out differences in findings of studies before 1980 and those done after 1979. Because of a change in the Federal tax law, which began to shift costs to the states; growing state and local taxes should have a greater impact on location/investment decisions after 1979. Fleischman (1995) shows at least one significant tax variable in only 38% of the pre-1980 studies while 79% of the post-1979 studies record a significant tax variable. This increase in the significance of the tax variables as documented by Bartik (1992), Phillips and Gross (1995) and Fleischman, along with the growth of corporate state tax liability during this period, accentuate the need for further study of this area.

Bartik (1985) examines the key characteristics of a state and their influence on the investment/location decision. He employs a conditional logit model using individual-plant data on fourteen state specific characteristics to estimate how the opening of a new branch plant is influenced by these characteristics. With a sample of 1,607 plants Bartik finds a negative effect of raising corporate taxes. A 10% increase in a states corporate tax rate causes a 2-3% decrease in the number of new plants in that state. Of the other thirteen state specific characteristics tested by Bartik, six were found to have significant influence on the decision to invest/locate in a particular state. These were: average wage rate, existing manufacturing, land area, percentage of unionization, highway miles per square mile, and property taxes. This study

contradicted the common view in existence at that time that state and local taxes exert no influence on business location patterns.

Two other studies (Wasylenko and McGuire, 1985 and Testa, 1989) found that state and local taxes influence manufacturing investment/location decisions more than non-manufacturing investment/location decisions. Manufacturers generally have more capital invested in property, plant and equipment, making both property taxes and the state corporate apportionment factors more relevant.

2.3 Studies Which Considered Formulary Apportionment

Apportionment tax theory was developed by McLure (1981 and 1980). In these analytical papers, he relates each factor of the apportionment formulae to the statutory tax rate, showing mathematically that the state corporate income tax under apportionment is actually composed of three separate smaller taxes. Using this reasoning, management should realize the tax on the property factor increases the cost of capital or property in the state. The same is true of the payroll factor for wages. Instead of increasing cost, the tax on the sales factor simply reduces sales revenues.

Mieszkowski and Morgan (1984) carry McLure's analysis a step further examining the incidence of the apportionment factor taxes on a national level. They show the national overall effect is to increase the cost of capital as the

burdens caused by the sales and payroll factors are offset when firms move from state to state.

Several recent studies have examined state formulary apportionment and its effects on multi-state businesses. Lopez and Martinez-Vazquez (1998) simulate each state's actual apportionment procedure for 20 manufacturing industries during the period 1972-1987. They report that, with the exceptions of the tobacco and textile mill industries, all multi-state corporate taxes were underapportioned for the entire 16 year period. This underapportionment averages 3.5 percent. Lopez and Martinez-Vazquez estimate that this percentage would have represented about $280 million in "unpaid (saved)" taxes by the corporations in 1985. They reason that as more states switch to a double-weighted-sales-factor formula, apportionment factors among the states become more uniform and corporate apportionment inches closer to 100 percent.

A study by Gupta and Mills (1998) provides the first firm-level evidence of state tax planning through multi-state apportionment. Survey responses from 674 firms during 1992 and 1996 show lower tax burdens for firms doing business in more states and lower state tax burdens for firms with higher sales intensity. The authors suggest that there is a point of diminishing returns where filing returns in too many states dilutes the opportunity to reduce the overall tax burden.

Klassen and Shackelford (1998) collected data for all states and the District of Columbia, and created panel data from 1983-1991. The sales factor was their variable of interest. Using a regression analysis they found a negative relationship between manufacturing sales and the policy to increase the weight on that factor. This finding is consistent with apportionment tax theory established by McLure (1980).

Goolsbee and Maydew (1998) focus only on the payroll factor of the apportionment formula in their study of manufacturing data from 1978-1994, examining all states that assess a corporate income tax. Using this panel data they regress the log of employment against the weighted average tax burden on payroll for each state. They find that reducing the weight on the payroll factor from a fraction of 1/3 to 1/4 (as illustrated in TABLE 2) increases manufacturing employment in the state by about 3%. The authors contend that this result is solely because of the changes in apportionment formulae and not because of changes in the statutory tax rate itself. Goolsbee and Maydew point out that by increasing employment in a state, these policies also create more personal income revenue, sales tax revenue, and property tax revenue for the state. These increased sources of revenue overshadow the loss of revenue from the decrease in the payroll factor.

Lightner (1999) measures the percentage change in manufacturing employment from 1994-1995, for all fifty states and the District of Columbia, as a proxy for new business growth. Her results contradict Goolsbee and Maydew

(1998), showing that the apportionment formula exercised by the state seems to have little effect on employment growth. Using regression analysis, she also finds that a strong negative relationship exists between the corporate state statutory tax rate and new business growth.

The body of research which considers the effects of state apportionment formulae on investment/location decisions was initiated by Vasquez and deSeve (1977). They use a model developed to simulate the economic activity of a firm over a 60 year period. The model allows them to alter characteristics of the specific firms as well as the taxes of different states and localities. Three (3) hypothetical firms were simulated in 13 study states. First the firm operates, sells, and expands in a single state and then in a separate scenario the firm is multi-state with sales in more than one state. The model measures after-tax rate of return on new investment to determine the optimal site location for that firm. They conclude that a firm's unique set of characteristics causes its investment/location decision to be different from any other company contemplating a similar location. Their results indicate that a multi-state firm will fare better relative to other firms when income is allocated and the home state has an apportionment formula where payroll and property are a smaller part of the apportionment percentage.

The appropriate measure of tax variables is considered by Papke (1987) in his regression analysis of investment location decisions. He proposes that the tax variable must be determined within the context of the actual location

considered. Like Vasquez and deSeve (1977), he uses simulation to determine the amount of total state business tax in a specific location. He then calculates an after-tax rate of return for each location. This rate of return (AFTAX) is used in the estimation of new capital investment in a location, which serves as a proxy for the choice of location. Papke (1987) finds the AFTAX variable positive and significant, indicating an effect of state and local taxes on the location decision. Although both Vasquez and deSeve (1977) and Papke (1987) consider the differing apportionment formulae of the various states in investment/location decision making, neither study isolates this part of the tax so that its effect can be analyzed.

Weiner (1996) is the first to use an empirical study to analyze how apportionment affects investment. Her paper looks at three questions about formulary apportionment. First, she examines manufacturing industries in 35 states during 1977 to find out whether variations in state formulae and tax rates influence the variation in capital-labor ratios. The estimates show that the states which placed more weight on the sales factor appear to have positively influenced their own capital-labor ratio. Weiner's second question tests both a heavier weighting of the sales factor and deletion of the worldwide unitary tax to see if these policies increase capital spending in the state. The worldwide unitary tax, exercised in most states during the 70s and 80s, allocated foreign income to the states. She looks at cross-sectional data from firms that changed their formula, and or worldwide unitary tax between 1982 and 1990. Using a

regression equation similar to that used in this study, she then measures new capital spending per capita in each state for 1990. Her results indicate that states can increase the weight on the sales factor to attract investment and gain greater capital spending than states that do not change their policies. Finally, she examines the uniform apportionment system of Canada during the years 1962-1992 to see if competitive tax rates and investment tax credits stimulate new investment. Her study shows that both reducing the tax rate and providing investment tax credits stimulated private capital spending in Canada.

2.4 Limitations of Previous Studies

The literature examining the relationship between investment/location decisions and state and local taxes is plentiful. Yet, after 40 years there is no clear or consistent conclusion about the impact these taxes have on this decision. It seems there is a distinct change in findings in studies done after 1979 from those done prior to 1980. Studies done prior to 1980 showed state and local taxes had little or no impact on the investment/location decision. But studies after 1979 revealed state and local taxes have become a more important consideration and a significant variable in plant investment and location.

Most early studies which evaluated formulary apportionment have done so through individual firm simulation models or firm surveys. The simulation studies along with the survey evidence furnished by Gupta and Mills provide a necessary link between state taxes and the investment/location decision, paving

the way for an empirical study that examines the aggregate effects of formulary apportionment on that decision.

Mieszkowski and Morgan (1984) analytically build on the theory of McLure (1981 and 1980) showing that the apportionment effects of the state corporate income tax on labor and sales wash out. They contend that the consumer bears the burden of the additional tax on sales and that employees bear the burden of the tax on payroll, but the firm cannot pass on the effects of the additional tax on property, and therefore the burden stops at the firm level. Consumer's losses in the jurisdiction of sales will be offset by consumers' gains in other states, just as labor's losses in the source state will be offset by labor's gains in other states. Because property is less mobile than the labor force, only the base effect on capital or investment remains. One avenue of relief for the multi-state firm is to invest or locate in a state where this tax is less or nonexistent, minimizing the effects of the overall burden. Their work accentuates the importance of the weight attached to the capital factor in the state formulae. The most recent apportionment studies focus solely on the sales factor (Klassen and Shackelford, 1998), or the payroll factor (Goolsbee and Maydew ,1998, and Lightener, 1999). Only Weiner (1994,1996) singled out the apportionment factor on capital and observed its effects on investment spending. She shows that states that put a relatively low weight on property have significantly greater new capital spending. Her study, however is limited to only 1990 and includes the effects of a change in the worldwide unitary tax method.

By 1991 the national government and business influence had eliminated the worldwide unitary tax from the state tax systems.

This study contends that the burden of the apportionment tax on the property factor is enough to cause significant investment spending differences among the states. The research continues Weiner's work, incorporates variables from the findings of Bartik (1985), and observes data for each of the 48 contiguous states and the District of Columbia over a period of eight years (from 1990-1997). The elimination of the unitary tax from state tax codes in the late 1980s should clarify the effects of the apportionment tax since the presence of the worldwide unitary tax was found to have significantly decreased investment spending. Unlike Weiner (1994), this study considers the effects of no state income tax and three different kinds of apportionment factor combinations, and examines the lagged effects of the independent variables on investment spending.

3. RESEARCH DESIGN

3.1 Hypothesis Development

The theory of investment behavior can be used to explain the nature of investment/location decisions. Jorgenson (1996) has studied investment behavior since the 1960s and maintains that an econometric model based on current formulations of the neoclassical theory of optimal accumulation of capital provides a better explanation of investment expenditures than competing

theories. According to the theory, the rule for optimal accumulation is to maximize the present value of the firm. To accomplish this, the multi-state firm will employ the amount of capital and labor necessary to maximize the present value of discounted cash-flows from its operations in all states. Selecting capital and labor at each point in time according to its own unique production function, the firm considers it's marginal cost of each factor. McLure (1980) shows state corporate income tax is a part of the cost of those factors.

Using the neoclassical theory of optimal accumulation of capital investment behavior theory, Weiner (1994) builds a model of a multi-state firm's investment decision from the analytical work of McLure (1980), Mieszkowski and Morgan (1984), and Gordon and Wilson (1986). She shows how the apportionment system translates the state corporate income tax from a tax on income into a tax on the factors included in the apportionment formula. This increases the tax burden on the factor, and with all else equal, lowers the amount of that factor hired in the state. Weiner's model, as shown below, maximizes the present value of the discounted cash-flows (*V*) from its combined operations in all states.

$$Max V_t = \int_0^{\infty} \exp(-N_t)(1-\tau_t)[p_t f(KL) - w_t L] - q_t(1-u_t) I_t dt$$
$$\{K_t, L_t\}$$
$$s.t.\ I_t = (K_t - K_{t-1}) + \sigma K_t; and K_0 = K(0)$$

Where

N = the opportunity cost of capital;
τ = the apportionment tax rate applied to the firm's profits;
p = the output price;
K = the capital stock;
L = the number of production workers;
w = the wage rate;
q = the price of new capital goods;
u = the investment incentives offered by the state; such as ITC and federal tax deductibility
I = gross investment
σ = the physical rate of depreciation.

Weiner assumes the competitive firm takes output prices and total sales as given, making the production and sales decisions separate. The return to capital is assumed to be fixed. The firm then will choose capital and labor at each point in time subject to its production function and the capital accumulation conditions above.

The "apportioned tax" encourages profit seeking companies to move both capital and labor out of high-tax-states into low-tax-states. She also argues that because a small marginal change in factor use does not significantly alter the average tax rate, the decision on where to increase capital or labor is independent of the amount of capital and labor already in place.

Papke (1987) contends that under the standard model of firm behavior, there are two separate facets of the profit-maximizing firm's decision process. Initially the firm will choose a location in which to invest, then the firm will decide how much capital to invest. Weiner (1994) shows analytically that deciding how

much capital to invest depends on the marginal state tax rate on capital. This tax on capital differs based on the construction of the apportionment formula.

There are four basic groupings for the apportionment formulae: 1) States that have no state corporate income tax and therefore no apportionment formulae, 2) States using "sales" only to apportion income, 3) states using three factors, but double weighting sales, and 4) states using three equally weighted factors. Investment theory suggests that firms will maximize profits by choosing the lowest cost of the production factors. Researchers have shown the apportionment tax is an additional factor cost. If, according to the investment theory above, firms make location decisions to optimize the states' different corporate tax allocation factors, there should be a difference between states that assess a state corporate income tax and those that do not. Of the states that do impose a corporate income tax, there should also be an identifiable difference between the three groups of states that apportion the tax differently. The hypothesis stated in alternative form for this group of variables follows:

H1: There is a significant association between the type of apportionment formulae a state uses and the amount of new investment made in that state by manufacturers.

Bartik (1985) found six state characteristics that significantly influence a firm's decision to invest/locate in a state. Weiner (1994) employed some of the same variables in her statistical model with similar results. Along with the allocation factors, this study includes Bartik's significant characteristics and two

education related variables to measure the effect of education on the amount of new investment per manufacturing employee.

Weiner (1994) also includes state specific tax variables she believes influence the amount of new investment in a state. Some states offer investment tax credits and some allow the federal income tax as a deduction in calculating corporate income. This study will also include indicator variables for investment tax credits allowed and a deduction for federal income tax on the state corporate return.

3.2 Dependent Variable

"New Investment" is the gross book value of new capital expenditures per year scaled by total manufacturing employment in a state. This value has been used in prior investment/location decision studies as the dependent variable for regression models (Benson and Johnson, (1986) Papke, (1987), and Weiner (1994)). New investment is the amount of increase in the value of property, plant and equipment, one of the factors in the apportionment formula. It is also an indicator that there are payroll costs associated with the investment in property. Manufacturers have both significant property and payroll. The total number of production workers was chosen to control for the state size, since the percentages are always the same in respective apportionment formulae for both property and payroll.

3.3 Independent Variables

This study uses essentially the same definitions and sources of independent variables as found in Bartik (1985) with the addition of state corporate tax apportionment variables, indicator variables for investment tax credit and federal tax deductibility states. Unlike Bartik (1985), all of the independent variables are lagged one year. Capital Investments are not made immediately. At the time investment/location decisions are made, only prior years' data are available. Therefore, it seems plausible to assume that investments made in the current year were influenced by last year's state data.

As noted above, Phillips and Goss (1995) looked at the inclusion of variables other than taxes. They conclude the most influential factor in the location decision is labor wage rate. They echo Bartik's (1991) suggestion that a location decision study should include some assessment of public service and a measure of potential sites such as " land area" with a control variable for quality of sites such as "road miles". This study will examine these state characteristics.

3.4 The Model

Weiner builds her linear estimating model on the assumptions of the neoclassical model of investment behavior and the second facet of Papke's assertion. She calculates the first order conditions, defining the optimal choice of inputs. These conditions are then solved to yield a system of optimal demand

equations. By substituting the demand equations into the maximizing equation above, the firm determines the highest value of profits in the appropriate state. This final stage is the selection of a state or group of states and the optimal capital to invest. Weiner's estimating equation is the linearized form of the demand equation for capital as shown below:

$$(NCAP/POP)_j = b_0 + b_1 PROPERTY_j + b_2 WWTAX_j + b_3 TAX_j + b_4 LPROD_j + b_5 ENERGY_j + b_6 SPENDPC_j + \sum b_h REG_k + \epsilon_j$$

Where:

NCAP/POP = *New capital spending per capita in the manufacturing sector in state j in 1990.*

PROPERTY= *one if state weights property by less than one-third, 0 otherwise.*

WWTAX= *One if state taxes on a worldwide unitary basis during 1982-1984.*

TAX= *The state's unitary or statutory tax rate*

LPROD= *Labor productivity*

ENERGY= *Energy prices*

SPENDPC= *Public sector spending per capita*

REG = *k fixed regional characteristics for the eight census regions*

She has added explanatory variables to capture regional effects and state characteristics. Observing new capital spending per capita she shows the effects of apportionment factor weights. The aggregate amounts of new capital spending then reflect the choice states of the investing firms.

This research analyzes the responsiveness of actual investment spending in each state to the difference in apportionment factor weights. As Weiner found, a higher weight on the property factor should result in less investment spending.

The statistical model used in this study is based on the theory developed by Weiner (1994) and draws from the empirical work of Bartik (1985). Since the primary motivation in this paper is to estimate the importance of the weight on the property factor in the apportionment formula to investment spending, the total amount of new investment by manufacturers in each particular state each year is the variable of interest. Jorgenson (1996) states, "To evaluate the effects of particular tax measures, it is useful to assess the response of investment quantitatively." The regression equation below does just that, modeling the factors and their relationships in this decision. It has been constructed based on the investment behavior theory of optimal accumulation of capital, incorporating variables used by Bartik (1985) and adding a set of dummy variables representing various apportionment formulae and specific state tax policy. This study assumes that investors make the investment decision based on the prior year's information; therefore, all independent variables have been lagged one year.

$$Newman_{it} = b_0 + b_1 Wage_{it-1} + b_2 Energ_{it-1} + b_3 Union_{it-1} + b_4 CorpTx_{it-1} + b_5 Land_{it-1} + b_6 RdMi_{it-1} + b_7 Edat_{it-1} + b_8 Edsp_{1it-1} + b_9 DT_{it-1} + b_{10} DA_{1it-1} + b_{11} DA_{2it-1} + b_{12} DITC_{it-1} + b_{13} DFDC_{it-1} + e_{it}$$

Where:

Newman$_{it}$ = *New capital expenditures by manufacturing firms in the **i**th state in year **t** divided by total manufacturing employment in the **i**th state in year **t.***

Wage$_{it-1}$ = *Average hourly earnings for production workers in the **i**th state in year **t-1**.*

Energ$_{it-1}$ = *Cost of electric energy purchased by manufactures per killowat in the **i**th state in year **t-1***

Union$_{it-1}$ = *Percent employed in manufacturing that are union members in the **i**th state in year **t-1**.*

CorpTx$_{it-1}$ = *Marginal corporate income tax rate in the **i**th state in year **t-1***

Land$_{it-1}$ = *State land area (excluding federal land) in the **i**th state in year **t-1***

RdMi$_{it-1}$ = *Total Highway mileage in the **i**th state in year divided by state land area **t-1***

Edat$_{it-1}$= *Percent of persons 25 years and over attaining high school graduate or more in the **i**th state in year **t-1***

Edsp$_{it-1}$= *Per pupil expenditure for public school elementary-secondary education in the **i**th state in year **t-1***

DT$_{it-1}$ = *1 if State levies corporate income tax, 0 if otherwise in the **i**th state in year **t-1***

DA1$_{it-1}$ = *1 if Three Factor with Sales Factor doubled, 0 if otherwise in the **i**th state in year **t-1***

DA2$_{it-1}$ = *1 if Three Factor apportionment, 0 if otherwise in the **i**th state in year **t-1***

DITC$_{it-1}$ = *1 if investment tax credit is offered, 0 if otherwise in the **i**th state in year **t-1***

DFDC$_{it-1}$ = *1 if federal corporate tax is allowed to be deducted on the state return, 0 if otherwise in the **i**th state in year **t-1***

$e_{it=}$ *random error term for the **i**th state in year **t***

This equation pools time-series and cross sectional data examining the data for the contiguous forty-eight United States and the District of Columbia (***i*= *49***) which are divided into four groups based on the makeup of their state corporate tax apportionment formula. The data covers a period of eight years, from 1991-1998 for the dependent variable and 1990-1997 for the lagged independent variables (***t*= *8***). Manufacturing firms are isolated in this study since they would be most susceptible to all of the factors in the state apportionment formulae. They not only would have sales but also considerable property and payroll.

The pooling of time series with cross sectional data is the preferred method when modeling tax policy over time and its effect on variables of interest. Fleischman (1995) believes that pooling provides increased explanatory power as stated by Carroll and Wasylenko (1994):

> Pooling cross-sectional and time-series data has the primary advantage of providing a greater number of observations to disentangle the systematic relationship between tax policy variables and the dependent variable.

While the state apportionment variables are themselves Dummy Variables, differences in their coefficients should indicate whether a relationship exists between the type of formulae the state uses and the amount of new investment made in that state by manufacturers. This relationship is examined over time and as these apportionment formulae have changed among the states.

The explanatory variables are made up of the factors researchers have found to be the most powerful influences on the location decision. Bartik (1985) found six of these characteristics to be significant. Energy costs were not significant in his study but were significant in the study by Weiner (1994) so they are included here.

The multiple regression model described above was estimated using the Ordinary Least Squares (OLS) estimator. However, the OLS estimator does not control for heteroscedasticity, a common problem with cross-sectional data. Heteroscedasticity exists when the error variance is not constant. If heteroscedasticity is present, the OLS estimator is no longer the most efficient estimator, producing either an understatement or overstatement of the true sampling variability. The errors from the OLS model were regressed against years and states to determine their influence on the model. This procedure produced evidence that years were not causing unexplained variances but that state specific characteristics were contributing complications in the error term. For this study, it is likely that the variance is not constant across the states (i.e., the model fits some states better than others). This may cause confidence intervals and hypothesis tests to be misleading. Therefore, a more efficient estimator is needed. Judge (1988) suggests that the maximum likelihood estimator is more efficient than the OLS when heteroscedasticity exists.

To allow for a random error associated with a particular "state" the Nonlinear Mixed (NLMIXED) procedure was used. This technique is available in

SAS v. 8 and allows both fixed and random effects to enter the model nonlinearly.

> PROC NLMIXED fits nonlinear mixed models by maximizing an approximation to the likelihood function. Successful convergence of the optimization problem results in parameter estimates along with their approximate standard errors based on the second derivative matrix of the likelihood function (SAS 2000).

The NLMIXED procedure corrects for multiplicative heteroscedasticity using a maximum likelihood estimator allowing the mean and variance equations to be estimated simultaneously.

4. DATA AND SAMPLE COLLECTION

TABLE 3 defines each of the variables and describes their source. The above equation regresses ***Newman***, which is the gross book value (in million dollars) of new capital expenditures per year divided by total manufacturing employment (in thousands of employees), per state as reported by the *Census of Manufacturing* and the *Annual Survey of Manufactures*. New investment is divided by the total manufacturing employment in that state to control for state size. Total manufacturing employment acts as a proxy for both state population and existing manufacturing in the state. The *Census of Manufacturing* has been collected every five years since 1967. In this study the *Geographic Area Series of the* 1992 and 1997 census were used. The census covers all establishments with one or more paid employees primarily engaged in manufacturing. The *Annual Survey of Manufactures* collects statistics for the years between the

census from a sample of the 400,000 establishments covered in the census. For unknown reasons, the 1993 *Annual Survey of Manufactures* was not done. All data from this source for 1993 used in this study was estimated using an average of the reported 1992 and 1994 data.

Wages indicates the average hourly earnings (in dollars) of production workers in a particular state, and was taken from the 1996 and 1998 *Statistical Abstract of the United States*. An increase in this factor has been found in previous studies to have a significantly negative effect on New Investment.

Energy costs tend to be a heavy expense for most manufacturers and therefore, it is expected that the higher these costs in a state the lower the predicted new investment. This variable was included because of inconsistent results in past studies. Bartik (1985) found it to be insignificant while Weiner (1994) found higher energy cost indicate lower new investment in the state. These costs are entered as cost (in dollars) per killowat of electric energy purchased by manufacturers for the year per state and found in the *Census of Manufactures* and the *Annual Survey of Manufactures*.

Union is the percentage employed in manufacturing that are union members in the state and data is from the *Union Membership and Earnings Data Book* published by the Bureau of National Affairs, Inc. This information was not published for 1992, therefore data for that year is an estimate based on the average of 1991 and 1993 data. Since the presence of a union historically increases the cost of labor, this factor should show a significantly large negative

coefficient indicating the higher the percentage unionized the lower will be the new investment in a state.

The tax factor used in the model is ***Corptax***. It is the state's highest marginal corporate income tax rate (expressed as a percentage) as reported in CCH's *State Tax Guide* and *State Tax Reporter*. This factor should have a negative effect on New Investment.

Land is referred to by Bartik (1985) as the "dart-board" factor because states with larger land area should have more firms investing since there are more possible sites. State land area (in millions of acres), excluding federal land, is used here and is reported in the annual *Public Land Statistics* by the US Dept of Interior, Bureau of Land Management. Data for 1993 was not published and is an estimate based on 1992 and 1994 information.

Total highway mileage per state is data published annually by the US Federal Highway Administration in *Highway Statistics*. ***RdMi*** is total highway actual mileage per state divided by state land area (in thousands of land acres). The coefficient of ***RdMi*** is expected to be positive and is an indicator of public spending in the state.

Another variable included by Batik is the ***Education*** variable. This research uses two measures of education: ***Edat*** is the percent of persons in a state that are 25 years and over who have attained a high school degree or more, and ***Edsp*** is the per pupil spending per state for public elementary-secondary education (in thousands of dollars). ***Edat*** was collected from the 1990

Census of the Population and *Current Population Reports* published by the US Census Bureau. ***Edsp*** was found in the annual *Public Education Finances* published by the US Dept. Of Commerce, Bureau of the Census. Higher values for both these variables should be desired by those seeking to locate or remain in a state. Therefore, the effect of both education variables should be positive.

The dummy variable ***DT*** is 1 if the state levies a state corporate income tax and 0 if it does not. Intuitively, a negative coefficient for this base variable should indicate a preference by firms to locate where there is not a corporate state income tax. Since all of the remaining dummy variables in the model assume the existence of a state corporate income tax, the regression model is run initially with only the ***DT*** dummy and the state characteristic variables.

A second specification of the model is run again using data from only the forty-two (42) states that do levy a state corporate income tax. The set of Dummy variables ***DA1*** and ***DA2*** represent the various apportionment formulae adopted by the states. States that use "sales" only to apportion multi-state firms' income will be the base for the set and ***DA1*** and ***DA2*** will be both be 0 if the apportionment formulae is "sales" only. States using three factors, but double weighting sales are indicated with a value of 1 for ***DA1***. ***DA2*** is the variable that represents the group of states with three equally weighted factors in the apportionment formula and since it yields the highest weight on the property apportionment tax factor, should have the highest negative coefficient of the group. Data for types of apportionment formulae was collected using the 1990-

94 *Significant Features of Fiscal Federalism* published by the US Advisory Commission on Intergovernmental Relations and 1995-97 CCH's *State Tax Guide* and *State Tax Reporter*.

Finally, ***DITC*** is an indicator variable which is 1 if the state offers an investment tax credit, and 0 if not. If the state allows federal income tax as a deduction on the corporate state tax return ***DFDC*** will be 1, or 0 if the deduction is not allowed. Data for the construction of these variables was collected using the 1990-94 *Significant Features of Fiscal Federalism* published by the US Advisory Commission on Intergovernmental Relations and actual 1995-97 State Income Tax forms. TABLE 4 presents the descriptive statistics for the dependent and independent variables reporting their means, standard deviations and variances.

The matrix of correlation coefficients is presented in TABLE 5. Measuring the strength of the linear association, the coefficients in this table are highest for ***Corptax*** and the dummy variable, ***DT***, indicating the presence of a state corporate income tax, which is expected. Also expected, is the high negative correlation between the apportionment dummy variables, ***DA1*** and ***DA2***. ***Wage*** and ***Union*** and ***Wage*** and both of the education variables, ***Edat*** and ***Edsp*** are slightly correlated. This data shows there is a positive relationship between a higher wage rate and a higher percent of high school graduates and greater education spending within a state. ***Union*** is also associated with ***Edsp***

indicating the more a state spends on education the higher is the percent of union workers in that state.

5. RESULTS

5.1 Association Between New Investment and the Presence of a State Corporate Income Tax

A restricted form of the model is first used to identify the effects, if any, of the presence of a state corporate income tax. All of the state characteristics are included, but the only dummy variable used is ***DT***. Results of the regression model using ordinary least squares (OLS) method are shown in the first two columns of TABLE 6. The estimated coefficient of the dummy variable ***DT*** is negative, as expected, and is significant at .05 level. This suggests the intercept for the linear new investment per manufacturing employee function for the forty-two (42) states and District of Columbia that levy a state corporate income tax is lower than the intercept for the linear new investment per manufacturing employee function for the six (6) states that do not require the tax. This indicates a preference by firms to locate where there is not a corporate state income tax.

The presence of heteroscedasticity in the results caused another estimator to be needed at this point. The model was run again using the NLMIXED, Nonlinear Mixed procedure (Appendix). The second two columns of TABLE 6 show the results of the Nonlinear Mixed (NLMIXED) procedure; and ***DT*** is again significant. Because the outcomes of both models indicate that the

presence of a state income tax influences the investment decision, the full version of the model, omitting ***DT,*** was used again with the forty-two (42) states that levy a state corporate income tax, plus the District of Columbia.

5.2 Association Between New Investment and the Effects of the State Apportionment Formula, State Investment Tax Credit and the Deductibility of the Federal Tax

The first two columns of TABLE 7 provides the results of the OLS specification of the model showing an adjusted R square of .3915. With this specification of the model, about 39% of the variation in new investment per manufacturing employee is explained by the variables. The focus of this study is the influence of the lagged apportionment formulae on new investment spending. Using data from the states that levy a state corporate income tax the table shows coefficients for the dummy variables DA1 and DA2 are significantly different from zero. Consistent with Weiner (1994) the OLS specification of the model indicates the method of apportionment has a meaningful effect on the amount of new investment per manufacturing employee. The parameter estimates for the set of dummy variables DA1 and DA2 represent the amounts of new investment per manufacturing employee for states using the different apportionment formulae. This outcome indicates that the function new investment per manufacturing employee was higher in states that apportion using three factors and double weighting sales (DA1), and in states that apportion using three equally weighted factors (DA2) , but lowest in states that

apportion using the sales factor only (where both DA1 and DA2 are zero). The signs for both dummy variables in the OLS model however, are not negative, as hypothesized. A significant negative association between the type of apportionment formulae a state uses and the amount of new investment made in that state by manufacturers was not detected.

Again tests for heteroscedasticity in the OLS results proved positive and the NLMIXED procedure was used on the second specification of the model (Appendix). Data from the forty-two (42) states that levy a state corporate income tax, plus the District of Columbia generated the results shown in the second column of TABLE 7.

The most obvious difference between the OLS and the NLMIXED results can be seen in the estimates for the set of dummy variables, DA1 and DA2. The allocation variables, which are the focus of this study, are not significant at any level in the NLMIXED model. This finding conflicts with the OLS estimates. By allowing the variance equation to be estimated simultaneously with the regression equation, the NLMIXED model filters out effects that these dummy variables were picking up in the OLS model possibly caused by some other unidentified state specific or regional variables. These results of the aggregate state-level data suggest that differing allocation factors in the state corporate tax calculation does not matter to firms in their decision of how much to invest or whether or not to locate in a state.

The F tests for differences in the coefficients of the dummy variables show no significant difference in the intercept for the functions of new investment where states apportion using all three factors either equally weighted (DA2) or doubling sales (DA1). But with both the OLS and NLMIXED methods there are significant intercept differences between the functions for states that apportion using sales only and either of the other two methods. These results suggest that manufacturers invest more in states that use either the equally-weighted three factor formula or the three factor-double-sales formula. Investment behavior theory suggests that apportioning the state corporate income tax using the sales factor alone generates the lowest weight on the property factor and should result in the highest new investment in states that levy a state corporate income tax. This finding in this study could be explained by noting that when a state elects to use sales only to apportion, it increases weight on the sales factor and may alter key aspects of the relationship between the formula and new investment. Weiner (1994) points out that states choosing to apportion with the sales factor only often raise the state corporate income tax rate thereby eliminating the perceived advantage of this apportionment scheme. For example, Iowa with a sales only apportionment formula, leads the states with the highest marginal tax rate of 12 per cent for all eight years tested.

According to profit maximization theory, states that offer an investment tax credit should have a positive and higher intercept than states that do not. The OLS results shown in TABLE 7 are consistent with that theory and significant,

but results from the NLMIXED model show a coefficient that is negative and only slightly significant. The NLMIXED results for this variable are not as hypothesized.

The OLS results of this study also indicate that states that allow federal income tax as a deduction on the state return have a significantly positive influence on new investment per manufacturing employee. Again, the NLMIXED results conflict showing this coefficient positive as predicted, but not significant.

The Nonlinear Mixed procedure produces very consistent results for all of the state corporate income tax variables showing no influence of the corporate tax rate, the apportionment (allocation) indicator variables and the indicator variables for investment tax credits and federal deductibility of the state tax. The obvious conclusion is that the assessment of a state corporate income tax makes little, if any difference when the profit maximizing firm chooses where and how much new investment to make in a state. While this finding conflicts with Weiner (1994), the previous literature offers many studies to support the NLMIXED results for state corporate income tax in this study.

Weiner's study is the result of a fixed effects model only. She uses regional dummy variables to control for state specific effects, also finding that there is heteroscedasticity and that state-specific effects are present. Use of the NLMIXED procedure allows for the estimation of a model similar to Weiner's while allowing for an additional random error effect. As mentioned previously, this finding indicates that the investment decision is not sensitive to differing

state corporate apportionment rules and federal lawmakers do not need to enforce a uniform apportionment rule. While state governments may use tax apportionment formulae as an incentive to draw new business into a state, these results suggest that firms in the aggregate are not influenced by differences in state income tax apportionment formula.

5.3 Other State Specific Characteristics that Affect New Investment

Both the OLS and NLMIXED models in TABLE 7 show wage rate per hour is a significant influence on the new investment per employee in a state. Even though it is statistically significant, the coefficient is positive rather than the predicted negative. Weiner (1994) uses a different measure for wages, labor productivity. Her study finds that states with more productive workers tend to have high amounts of new capital spending. This finding suggests a possible explanation that the new jobs being created in manufacturing require more highly skilled workers that are using or interacting with computers. While the profit maximizing firm will logically seek the lowest wage, it may be necessary to invest more per manufacturing employee in states where the wage rates are the highest to hire the qualified employees necessary to manufacture the product.

Energy costs, represented in the model as cost of electric energy per kilowatt, were found to be significant at the .05 level in the OLS model and significant at the .10 level in the NLMIXED. This finding follows the theory of cost minimization in production, and is consistent with Weiner (1994).

The effect of a state's unionization shows differing results in the two models. The OLS estimated unionization to be statistically significant and negative. While the estimate for the NLMIXED model is also negative, it is not significant. Historically, the presence of a union has caused not only an increase in the average wage rate but also an increase in other employee costs. As with Bartik (1985) the OLS evidence suggests that when businesses choose among states, unionization may be a consideration when striving for profit maximization. This conclusion is weakened by the NLMIXED findings indicating that the effects identified by the OLS model may be other unidentified state specific influences.

The effects of the marginal corporate tax rate are difficult to explain. While TABLE 6 indicates the presence of a state corporate income tax is important, TABLE 7 shows that the parameter estimate for ***CorpTx*** is both insignificant and of the wrong sign in both models. This finding is consistent with Weiner (1996) who found that the impact of changing the apportionment property factor was not influenced by the level of the corporate state tax rate or whether or not the state had increased that rate. She suggests that in states where tax rates have increased there may have also been a reduction in the weight of the apportionment property factor (i.e., the state of Iowa).

Land area and road miles per acre are related variables that may also be capturing the effects of some important unmeasured regional characteristics. Land area is positive, but not significant in the NLMIXED model. This result

compares with Bartik (1985) where an increase in potential land area caused an increase in new manufacturing plants. Conversely road miles per acre is not positive, as predicted, but rather it is negative and statistically significant. It seems that the more paved road miles per acre in a state the less will be the new investment per manufacturing employee. Road Miles per acre serves as a proxy for a state's infrastructure and as a measure of public spending. Estimated effects of this variable can be compared to Weiner's (1994) measure of public sector spending per capita. She also finds spending on public welfare to have a negative impact on new investment.

Education was not found to be an influential factor in previous investment/location studies but theory suggests that it should be. This study looks at two measures of education (education attainment and education spending) and their effect on the investment/location decision. Contrary to prediction both variables are negative, and only education spending is significant at the .05 level, and only in the OLS model. The NLMIXED results show coefficients for both education variables to be negative, and both are insignificant. This finding is difficult to explain in conjunction with the results for wage rates considering the correlation of both education variables with wage rates. If spending on education goes up one would expect the level of attainment to also go up and as a result the average wage rate. As already reported, an increase in the wage rate resulted in an significant increase in new investment per manufacturing employee, while an increase in either of the

education variables corresponded to a decrease in new investment per manufacturing employee.

6. CONCLUSIONS

Tax policy decisions for state governments are difficult. In particular, raising revenue for state governments through a state corporate income tax can be a two-edged sword. Without the needed revenue, important state programs are either cut or must operate with reduced funding. If state corporate income taxes are too high they can be detrimental in luring new corporate business to the state and reduce other sources of tax that would have been generated by the increased business and employment. This study, which focuses on the apportionment factors of the state corporate income tax, uses a new statistical procedure (NLMIXED) along with OLS to examine the relationship of those apportionment factors to the investment/location decisions of multi-state corporations. Little evidence was found that domestic multi-state manufacturing corporations manipulate profits using formulary apportionment. Therefore, the hypotheses put forth in this study proposing that there is a significant association between the type of apportionment formulae a state uses and the amount of new investment made in that state by manufacturers is rejected. Even in a period where state and local income taxes were on the rise, the NLMIXED procedure produces results showing no significant influence of the apportionment formulae used by a state on the amount of new investment made in that state. Contrary to

Lightner (1999), but consistent with Weiner (1996), the state corporate income tax rate, ***CorpTx***, showed no significance in either of the models. In addition, whether a state allows the federal income tax as a deduction on the state corporate return seems to make no difference to the investing firm. The only tax factor tested that proved slightly significant was the investment tax credit.

In terms of state tax policy, this study provides evidence that states should spend economic development funds for other forms of enticements to new multi-state manufacturing businesses. The tax cutting ploy may not be working as presumed. While profit maximization may still be the underlying reasons for investment/location decisions, some choices may not always initially reflect that theory. In fact, a very significant finding of this study reveals the value now placed by manufacturers on a quality labor force rather than a cheaper labor force. Energy prices, as they rise, are likely to become one of the most important considerations for manufacturers. Investment tax credits in this area may be a wise policy move for future-looking states.

This study contributes to the large body of existing literature examining the effects of state corporate income taxes on the investment/location decision. It extends the research of Weiner (1994 and 1996), examining the lagged effects of formulary apportionment on investment spending over an eight year period. In doing so, a new nonlinear estimator (NLMIXED) is used to control for multiplicative heteroscedasticity and provide a more efficient measure of these lagged effects. The NLMIXED results in this study are notably different from the

results of the traditional OLS model also used in this study and in previous studies. OLS is a fixed effects model where random errors can show up as effects of the independent variables causing their coefficients to be higher or lower than the actual. This new method (NLMIXED) offers a more efficient measure of linear relationships, allowing for both fixed and random effects to be estimated. The results generated by this new procedure call to question the results of earlier studies based only on a fixed effects model and offer an improved methodology for future regression models.

7. LIMITATIONS AND FUTURE RESEARCH

7.1 Limitations of This Study

The multiple regression model used in this study employs aggregate data. Both Bartik (1991), and Phillips and Goss (1995) point out the difficulty of modeling complex individual decisions using aggregate data. They contend that the investment/location decision is an individual, firm-specific decision but also point out that these decisions affect aggregate measures of growth. Every location decision is an individual firm decision. By looking at the aggregate, some of the individual reasoning is clouded, making it impossible to be aware of all of the factors involved in making the new investment in a specific state.

State corporate tax apportionment formulae manipulation is not the only practice used by policy makers to entice businesses to locate in their state. KPMG Peat Marwick LLP, (1995) surveyed senior financial and tax executives in

over 200 large companies and found these executives believe state and local governments are more likely now to offer tax incentives than they were five years ago. These incentives however, did not seem to make that much of a difference. Eighty-one percent of those surveyed did not view the incentives as giving them a competitive advantage, and as many as 36% said they would not relocate solely for incentives. Research in the area of new business tax incentives is very limited, isolated to a few program specific studies, [Ambrosius(1989), Feiock (1989), Luger (1987)]. Bartik (1991) points out the difficulty in measuring the effects of firm specific types of tax incentives.

> Only one state (Michigan) systematically collects data on the magnitude of property tax abatements to businesses, and no state systematically collects data on the magnitude of other special tax incentives to new business investment.

He believes the main reason this data is not being collected is because the dollar amounts of these tax breaks may be politically unattractive. Since the data on tax incentives is not consistently available, and the overall effects are questionable, this study ignores specific business tax incentives as a determinant of new investment in a state. This study focuses on the use or misuse of formulary apportionment as a way of attracting business to a particular state.

States without a state corporate income tax may have other business taxes, reflected here in the error term, that could be significantly more than another state. Specifically, this study ignores the presence and relative size of a local property tax, franchise tax or a payroll tax.

Another limitation of this study is the failure to consider interactions between the allocation factors and other tax factors. For example, a firm might locate its property and plant in a state because the property taxes are low even though the apportionment factors may or may not be favorable to property and plant.

7.2 Future Research

Because of the scarce amount of empirical research in the area of apportionment factors, several possible avenues of future research exist. One avenue would be to investigate the effect of apportionment factors on the investment/location decisions of other specific business segments such as the service industry or banking industry. Both of these industries are not as capital intensive as manufacturing and would be expected to react differently to states that apportion income based on the sales factor only or weighting of the payroll factor.

Another avenue to pursue would be to observe one state over time that had changed their apportionment formula. The researcher could examine all relevant taxes and control for variables that are not available for all states. Possibly a state that changed apportionment factors could be compared with a control state that did not change their apportionment factors.

A study looking only at one or more individual firms analyzing the way investment/location decisions are made would be valuable to see all the factors

considered and the weight attached and order in the process. A survey type study would work well for this kind of research.

Weiner (1994) found that regional differences help explain the amount of new investment spending. Adding regional dummies to the NLMIXED specification that allows variances to be nonlinear would give an additional finding for comparison purposes and may account for some of the inherent state differences.

Investment/location has an abundant supply of factors that have been hypothesized to influence the decision to invest. A factor analysis could be helpful in determining a group of control variables to improve the explanatory power of the regression models.

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APPENDIX

SAS program used for NLMIXED procedure in Table 6

```
DATA STATES;
INPUT YEAR STATE $ NEWINV LAND RDMI UNION CORPTX PROPTX WAGE ENERG
EDAT EDSP DT DA1 DA2 DITC DFDC MANEMP;
NEWMAN= NEWINV/MANEMP;
RDMI=RDMI/LAND;
Land = land/1000;
EDSP=EDSP/1000;
list;
cards;
-------------------------DATA ------------------------------
TITLE 'OLS PROCEDURE FOR LAGGED STATE DATA 1991-1998 (all states)';
PROC SORT DATA=STATES OUT=SORTED;
BY STATE;

PROC NLMIXED COV DATA=SORTED;
BOUNDS s2u>0;
PARMS b0=4.93832 b1=1.36014 b2=-35.43695 b3=-0.19810 b4=0.20937 b5=0.00365 b6=-
0.16001
b7=-0.08364 b8=-0.23067 b9=-1.76923
a0=-0.54025 a1=0.28994 a2=-15.60365 a3=-0.04864 a4=0.18508 a5=-0.01128 a6=-0.03735
a7=0.01141
a8=-0.16489 a9=-2.21071
s2u=9.30877;
mean=b0+b1*wage+b2*energ+b3*union+b4*CORPTX+b5*lAND+b6*RDMI
+b7*EDAT+b8*EDSP+b9*DT+u;
s2e=exp(a0+a1*wage+a2*energ+a3*union+a4*CORPTX+a5*lAND+a6*RDMI+a7
*EDAT+a8*EDSP+a9*DT);

Model newman ~ NORMAL(mean, s2e);
Random u ~ NORMAL(0, s2u) subject=STATE;
RUN;
QUIT;

run;
```

SAS program used for NLMIXED procedure in Table 7

```
DATA STATES;
INPUT YEAR STATE $ NEWINV LAND RDMI UNION CORPTX PROPTX WAGE ENERG
EDAT EDSP DT DA1 DA2 DITC DFDC MANEMP;
NEWMAN= NEWINV/MANEMP;
RDMI=RDMI/LAND;
Land = land/1000;
EDSP=EDSP/1000;
If DT=1;
list;
cards;
-----------------------------------DATA----------------------------------------
PROC REG DATA=STATES;
MODEL NEWMAN= WAGE ENERG UNION CORPTX LAND RDMI EDAT EDSP DA1 DA2
DITC DFDC;
OUTPUT OUT=STATES2 RESIDUAL=EHAT;
DATA STATES;
SET STATES2;
EHAT2=LOG(EHAT*EHAT);
PROC REG DATA= STATES;
MODEL EHAT2= WAGE ENERG UNION CORPTX LAND RDMI EDAT EDSP DA1 DA2 DITC
DFDC;
TITLE 'OLS PROCEDURE FOR LAGGED STATE DATA 1991-1998 (tax states only)';
PROC SORT DATA=STATES OUT=SORTED;
BY STATE;
PROC NLMIXED COV DATA=SORTED;
BOUNDS s2u>0;
PARMS b0=-2.07774 b1=1.47040 b2=-31.81859 b3=-0.17584 b4=0.13498 b5=-0.01566 b6=-
0.13702
b7=-0.05146 b8=-0.51632 b9=3.06660 b10=2.80635 b11=0.89357 b12=2.06190
a0=-5.44166 a1=0.25222 a2=-19.01298 a3=-0.05434 a4=0.14836 a5=-0.02254 a6=-0.02468
a7=0.04633
a8=-0.24396 a9=0.73846 a10=1.15981 a11=0.67053 a12=0.76981
s2u=7.72314;

mean=b0+b1*wage+b2*energ+b3*union+b4*CORPTX+b5*lAND+b6*RDMI
+b7*EDAT+b8*EDSP+b9*DA1+b10*DA2+b11*DITC+b12*DFDC+u;
s2e=exp(a0+a1*wage+a2*energ+a3*union+a4*CORPTX+a5*lAND+a6*RDMI+a7
*EDAT+a8*EDSP+a9*DA1+a10*DA2+a11*DITC+a12*DFDC);

Model newman ~ NORMAL(mean, s2e);
Random u ~ NORMAL(0, s2u) subject=STATE;

RUN;
QUIT;

run;
```

Table 1
State Apportionment of Corporate Income
January 1, 1999

Alabama	3 factor	**Montana**	3 factor
Alaska	3 factor	**Nebraska**	Sales
Arizona	Double wtd sales	**Nevada**	No state Income tax
Arkansas	Double wtd sales	**New Hampshire**	Double wtd sales
California	Double wtd sales	**New Jersey**	Double wtd sales
Colorado	3 Factor	**New Mexico**	3 Factor
Connecticut	Double wtd sales	**New York**	Double wtd sales
Delaware	3 factor	**North Carolina**	Double wtd sales
Florida	Double wtd sales	**North Dakota**	3 factor
Georgia	Double wtd sales	**Ohio****	60% sales, 20% property and payroll
Hawaii	3 factor	**Oklahoma**	3 factor
Idaho	Double wtd sales	**Oregon**	Double wtd sales
Illinois**	66.7% sales, 16.6% property and payroll	**Pennsylvania**	Double wtd sales
Indiana	3 factor	**Rhode Island**	3 factor
Iowa	Sales	**South Carolina**	Double wtd sales
Kansas	3 Factor	**South Dakota***	3 Factor
Kentucky	Double wtd sales	**Tennessee**	Double wtd sales
Louisiana	Double wtd sales	**Texas***	Sales
Maine	Double wtd sales	**Utah**	3 Factor
Maryland	Double wtd sales	**Vermont**	3 Factor
Massachusetts	Double wtd sales	**Virginia**	3 Factor
Michigan*	90% sales, 5% property and payroll	**Washington**	No State Income Tax
Minnesota**	70% sales, 15% property and payroll	**West Virginia**	Double wtd sales
Mississippi	3 factor	**Wisconsin**	Double wtd sales
Missouri	3 factor	**Wyoming**	No State Income Tax
		Dist. of Columbia	3 factor

Source: Compiled by FTA from various Sources

*No State Corporate income taxes were levied in these states during 1990-1997

**These states were included as Double wtd sales for this study.

Table 2
An Illustration of Bistate Corporation
(Dollar amounts are expressed millions)

Bistate's average annual taxable income is $40 million.

	State A	State B	Total
Gross Receipts from sales	$800	$800	1,600
Payroll expense	200		200
Property cost	3,000		3,000
Apportionment formula	3 factor with double sales	3 factor	
State Corporate tax rates	6%	6%	

Each state's apportionment percentage is computed as follows:

	State A	State B
Sales factor	50% ($800/$1,600)	50% ($800/$1,600)
Payroll factor	100%	0%
Property factor	100%	0%

State A: $\frac{2(50\%) + 100\% + 100\%}{4} = 75\%$ State B: $\frac{50\% + 0\% + 0\%}{3} = 16.67\%$

Total corporate state tax liability assuming the plant is located in State A but sales are made in both states is as follows:

State A:	$40 X 75% = $30 X 6% =	$1.8
State B:	$40 X 16.67% = $6.67 X 6% =	.4
Total		$2.2

Total corporate state tax liability assuming the plant is located in State B, but sales are made in both states is as follows:

State A: $\frac{2(50\%) + 0\% + 0\%}{4} = 25\%$ State B: $\frac{50\% + 100\% + 100\%}{3} = 83.33\%$

State A:	$40 X 25% = $10 X 6% =	$ .6
State B:	$40 X 83.33% = $33.33 X 6% =	2.0
Total		$ 2.6

The difference in corporate state tax liability due to apportionment is $ .4 million. As this example illustrates, Bistate can save significant tax dollars by locating its physical facilities in a state where property and payroll factors are a smaller percentage of the apportionment factor. If Bistate locates in State B, 108.33% of its taxable income is taxed by the states, but if Bistate locates in State A only 91.67% of its taxable income is taxed.

Table 3
Description of Variables and Source of Data

Variable	*Definition*	*Expected effect on location*	*Source*
NEWMAN (dependent)	Expenditures for new and used buildings, machinery, and equipment (in million dollars) divided by the number of full-time and part-time employees of manuf. establishments(in thousands)		1991-98 Census of Manufacturing and Annual Survey of Manufactures
WAGE	Average hourly earnings of Production workers in manufacturing (in dollars)	-	1996 and 1998 Statistical Abstract of the United States
ENERG	Cost of electric energy purchased by manufacturers per kilowatt (in dollars)	-	1990-97 Census of Manufacturing and Annual Survey of Manufactures
UNION	Percent employed in manufacturing that are union members	-	Union Membership and Earnings Data Book, by The Bureau of National Affairs, Inc.
CORPTX	Highest Marginal state income tax rate (expressed as a percentage)	-	1990-97 Commerce Clearing House, *State Tax Guide and State Tax Reporter*
LAND	Acreage Not Owned by Federal Government (in millions of acres)	+	Annual *Public Land Statistics*, US Dept. of the Interior, Bureau of Land Management
RDMI	Total actual Highway Mileage divided by thousands of land acreage not owned by Federal Government	+	Annual *Highway Statistics,* US Federal Highway Administration and Annual *Public Land Statistics*, US Dept. of the Interior, Bureau of Land Management
EDAT	Percent of persons 25 years and over attaining high school graduate or more	+	*1990 Census of the Population* and *Current Population Reports,* US Census Bureau

Table 3 (continued)
Description of Variables and Source of Data

Variable	*Definition*	*Expected effect on location*	*Source*
EDSP	Per pupil amounts of Public School System Expenditure for Elementary-Secondary Education (in thousands of dollars)	+	Annual *Public Education Finances* US Dept. of Commerce, Bureau of the Census
DT	Indicator variable 1 if state has corporate income tax 0 if not	–	1990-97 Commerce Clearing House, *State Tax Guide and State Tax Reporter*
DA1	Indicator variable 1 if 3 allocation factors with sales double weighted 0 if not	–	1990-94 *Significant Features of Fiscal Federalism*, US Advisory Commission on Intergovernmental Relations 1995-97 Commerce Clearing House, *State Tax Guide and State Tax Reporter*
DA2	Indicator variable 1 if 3 equally weighted allocation factors 0 if not	–	1990-94 *Significant Features of Fiscal Federalism*, US Advisory Commission on Intergovernmental Relations 1995-97 Commerce Clearing House, *State Tax Guide and State Tax Reporter*
DITC	Indicator variable 1 if investment tax credit is offered 0 if not	+	1990-94 *Significant Features of Fiscal Federalism*, US Advisory Commission on Intergovernmental Relations 1995-97 State Income Tax Returns
DFDC	Indicator variable 1 if state allows federal income tax as a deduction 0 if not	+	1990-94 *Significant Features of Fiscal Federalism*, US Advisory Commission on Intergovernmental Relations 1995-97 State Income Tax Returns

Table 4
Descriptive Statistics for Dependent (1991-1998) and Independent (1990-1997)Variables

Variable	Mean	Standard Deviation	Variance
New Investment/ Manufacturing Emp	7.624	3.638	13.23
Wage	11.77	1.517	2.301
Energy	.0489	.0152	.0002
Union	14.91	6.782	45.99
Corporate Tax	6.718	3.257	10.61
Land	30.99	25.08	628.8
Road Miles	3.995	5.668	32.12
Educational Attainment	80.68	5.482	30.05
Education Spending	5.303	1.243	1.546
Presence of Corp Tax (DT)	.8775	.3282	.1077
Allocation Factor 1 (DA1)	.3673	.4827	.2330
Allocation Factor 2 (DA2)	.4592	.4989	.2489
ITC Factor (DITC)	.3877	.4878	.2380
Deductibility of Fed Tax Factor (DFDC)	.0842	.2780	.0773

PROC UNIVARIATE from SAS v. 8.0 was used to calculate these statistics.
N = 392

Table 5
Matrix of Pearson Correlation Coefficients
for Dependent (1991-1998) and Independent (1990-1997) Variables

VARIABLE	NEW MAN	WAGE	ENERG	UNION	CORP TAX	LAND	RDMIL	EDAT	EDSP	DT	DA1	DA2	DITC	DFDC
NEW MAN	1.000													
WAGE	0.261	1.000												
ENERG	-0.268	0.036	1.000											
UNION	-0.174	0.479	0.124	1.000										
CORP TAX	-0.083	0.046	0.386	0.092	1.000									
LAND	0.135	-0.160	-0.291	-0.174	-0.357	1.000								
RD MIL	-0.234	0.205	0.318	0.127	0.227	-0.304	1.000							
EDAT	0.110	0.471	0.057	0.120	-0.065	-0.024	-0.106	1.000						
EDSP	-0.144	0.527	0.507	0.480	0.311	-0.343	0.484	0.272	1.000					
DT	-0.108	-0.143	0.204	-0.088	0.772	-0.338	0.104	-0.185	0.039	1.000				
DA1	0.047	0.175	0.151	0.181	0.336	-0.171	-0.056	0.017	0.212	0.285	1.000			
DA2	-0.081	-0.262	0.035	-0.237	0.103	-0.094	0.142	-0.198	-0.168	0.344	-0.702	1.000		
DITC	0.091	0.081	0.169	0.108	0.296	-0.122	-0.056	0.022	0.142	0.297	0.034	0.118	1.000	
DFDC	0.177	-0.003	-0.133	-0.081	0.225	0.073	-0.077	-0.064	-0.189	0.113	-0.193	0.052	0.098	1.000

PROC CORR from SAS v. 8.0 was used to calculate these statistics.
N = 392

Table 6
Estimated Effects of The Presence of a State Corporate Income Tax on New Investment
1990-1997

(Using both OLS and NLMIXED Procedures)

Dependent Variable (New Investment/Total Manufacturing Employment)

Variable	OLS Parameter Est. (St. Error)	OLS t Statistic	NLMIXED Parmeter Est. (St. Error)	NLMIXED t Statistic
Wage	1.360 (0.146)	9.34***	1.433 (0.155)	9.24***
Energy	-35.437 (12.937)	-2.74***	-35.466 (18.479)	-1.92*
Union	-0.198 (0.028)	-7.02***	-0.012 (0.016)	-0.80
Corporate Tax	0.209 (0.085)	2.47**	0.115 (0.086)	1.34
Land	0.004 (0.007)	0.51	0.003 (0.017)	0.19
Road Miles	-0.160 (0.033)	-4.78***	-0.123 (0.049)	-2.53**
Educational Attainment	-0.084 (0.034)	-2.44**	-0.049 (0.033)	-1.47
Education Spending	-0.231 (0.207)	-1.11	-0.027 (0.121)	-0.23
Presence of State Corporate Income Tax (DT)	-1.769 (0.818)	-2.16**	-4.56 (1.709)	-2.67**
Intercept	4.938 (2.619)	1.89*	0.470 (2.569)	0.18

*** Significant at .01
** Significant at .05
* Significant at .10
OLS R-Square = .3128
OLS Adjusted R-Square = .2966
N = 392 observations

Variance equation with standard errors in parenthesis:

$$ehat^2 = \exp(\underset{(1.537)}{-6.721} + \underset{(0.089)}{0.821}WAGE \underset{(8.615)}{-17.363}ENERG \underset{(0.023)}{-0.128}UNION + \underset{(0.067)}{0.256}CORPTX \underset{(0.011)}{-0.016}LAND \underset{(0.004)}{-0.0256}RDMI$$
$$+ \underset{(0.023)}{0.0539}EDAT \underset{(0.129)}{-0.482}EDSP \underset{(0.561)}{-2.659}DT$$

Table 7

Estimated Effects of The State Apportionment Formula, State Investment Tax Credit and Deductibility of the Federal Tax on New Investment 1990-1997

(Using both OLS and NLMIXED Procedures)

Dependent Variable (New Investment/Total Manufacturing Employment)

Variable	OLS Parameter Est. (St. Error)	OLS t Statistic	NLMIXED Parmeter Est. (St. Error)	NLMIXED t Statistic
Wage	1.470 (0.171)	8.59***	1.442 (0.137)	10.52***
Energy	-31.819 (13.368)	-2.38**	-31.689 (17.840)	-1.78*
Union	-0.173 (0.029)	-5.87***	-0.015 (0.015)	-0.96
Corporate Tax	0.135 (0.086)	1.56	0.002 (0.086)	0.02
Land	-0.016 (0.012)	-1.35	0.002 (0.022)	0.07
Road Miles	-0.137 (0.033)	-4.16***	-0.139 (0.044)	-3.15***
Educational Attainment	-0.051 (0.037)	-1.39	-0.031 (0.031)	-1.01
Education Spending	-0.516 (0.211)	-2.45**	-0.125 (0.102)	-1.22
Allocation Factor DA1	3.067 (0.814)	3.77***	0.666 (0.524)	1.27
Allocation Factor DA2	2.806 (0.775)	3.62***	0.039 (0.483)	0.08
ITC Factor	0.894 (0.320)	2.79***	-0.486 (0.274)	-1.78*
Deductibility of Fed Tax Factor	2.062 (0.649)	3.18***	1.438 (1.115)	1.29
Intercept	-2.078 (2.583)	-0.80	-4.237 (2.189)	-1.94*

*** Significant at .01 OLS R Square = ..4128

** Significant at .05 OLS Adjusted R Square = .3915

* Significant at .10 N = 344 observations

Variance equation with standard errors in parenthesis:

$$ehat^2 = \exp(\underset{(1.599)}{-10.748} + \underset{(0.103)}{0.816}WAGE \; \underset{(9.961)}{-25.921}ENERG \; \underset{(0.027)}{-0.094}UNION + \underset{(0.072)}{0.305}CORPTX \; \underset{(0.007)}{-0.015}LAND \; \underset{(0.022)}{-0.014}RDMI + \underset{(0.023)}{0.057}EDAT \; \underset{(0.163)}{-0.578}EDSP + \underset{(0.518)}{1.264}DA1 + \underset{(0.474)}{1.342}DA2 \; \underset{(0.216)}{-0.103}DITC \; \underset{(0.394)}{-0.660}DFDC)$$

VITA

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