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THE ROBUST RELATIONSHIP BETWEEN TAXES AND STATE ECONOMIC GROWTH

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Abstract

I estimate the relationship between taxes and economic growth using data from 1970-1999 and the forty-eight continental U.S. states. I find that taxes used to fund general expenditures are associated with significant, negative effects on economic growth. Further, this finding is robust across (i) alternative variable specifications, (ii) alternative estimation procedures, (iii) alternative ways of dividing the data into "five-year" periods, and (iv) allowing for individual-specific time and state effects. I also provide an explanation for why previous research has had difficulty identifying this "robust" relationship.

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> "Bartik (1994a,b) has suggested that the interregional elasticity of economic activity with respect to taxes is between -0.1 and -0.6 ….[However] the results are not very reliable and change depending on which variables are included in the estimation equation, or which time period is analyzed."
>
> -- Michael Wasylenko (1997, p. 38)

> "My conclusion…is that we are uncertain about the effects of economic development policies, including broad state fiscal policy, on economic growth. How does this conclusion translate into policy? My message to policy makers is that the effects of state and local tax policy are so uncertain that concern over this issue should not be a driving force in general policy decisions."
>
> -- Therese McGuire (1992, p. 458)

I. INTRODUCTION

A long-standing research enterprise has been devoted to estimating the effect of taxes on economic growth in U.S. states. To the extent a consensus exists, it is that taxes used to fund transfer payments have small, negative effects on economic activity. When used to fund productive expenditures, the associated tax effects are often estimated to vanish, or even become positive (Helms, 1985; Bartik, 1991; Phillips and Goss, 1995; Wasylenko, 1997). However, even this modest conclusion is disputed, since estimated effects vary widely across studies (Bartik, 1991; McGuire, 1992; Wasylenko, 1997).

Given the scores of studies that have investigated this issue, it is surprising that many important estimation issues have not been addressed. My study takes up several of these, and re-estimates the relationship between taxes and economic growth. I find that taxes used to fund general expenditures are associated with significant, negative effects on economic growth. Further, I show that these effects are robust across estimation procedures, alternative specifications of the regression equation, different time divisions of the data, and across time periods and states. I also provide an explanation for why previous research has had difficulty identifying these effects.

My analysis addresses the following estimation issues. First, it uses economic theory to derive an estimable equation. With respect to specification of the regression equation, theory has consequences for the following: (i) the inclusion/exclusion of labor, capital, and population variables along with or instead of underlying parameters such as saving, depreciation, and population growth rates; (ii) the inclusion/exclusion of a lagged dependent variable; and (iii) whether to include other explanatory variables in level or differenced forms. Much previous literature has been ad hoc in the selection of variables and the form in which they are employed.

A second specification issue concerns the role of time. Much of the previous literature has restricted taxes to have only contemporaneous effects on economic activity. My regression specifications allow for both contemporaneous and lagged effects. A related issue concerns how to define the length of a time period for time series observations of states. Previous research has relied almost exclusively on annual data. My study uses five-year periods consistent with most modern empirical growth studies. I show that this has important consequences.

A third issue is the selection of “control variables.” Growth theory is sufficiently general that a large number of variables can be -- and have been -- argued to be potential determinants. Previous research has been non-systematic in deciding which of these to study. However, it is well known that coefficient estimates are often highly dependent upon the particular set of variables included in the regression equation (Leamer, 1985; Levine and Renelt, 1992; Crain and Lee, 1999; Sali-i-Martin, 2004). My study uses model selection criteria to determine variable specification. Further, I investigate the robustness of my results to alternative variable specifications.

A fourth issue concerns the choice of estimation procedure. Panel data with fixed effects have been frequently employed in previous studies. Most previous research uses OLS, occasionally employing robust standard error estimators to address heteroscedasticity. In a few cases, dynamic panel data (DPD) estimators have been utilized to address bias that arises from including both a lagged dependent variable and fixed effects. My analysis tests for serial correlation, heteroscedasticity, and cross-sectional correlation in the error variance-covariance matrix and investigates the robustness of estimating tax effects using alternative, and appropriate, OLS, FGLS, and DPD estimators.

A fifth issue addresses the role of influential observations. Point estimates may mask the fact that results can be driven by just a few time periods, or just a few states. This is of particular importance to policy-makers who are interested in extrapolating the results of empirical studies to their own states and time periods. Previous research reports only average effects. In contrast, my analysis interacts tax variables with both time and state dummy variables and tests for robustness across these dimensions.

The paper proceeds as follows: Section II derives a model of economic growth that is general enough to encompass many of the models that have been used in previous research. Section III describes the data and discusses associated specification issues. Section IV presents the initial empirical results. Section V checks for robustness across (i) alternative specifications, (ii) alternative estimation procedures, (iii) different time divisions of the data; and (iv) across time periods and states. Section VI provides an explanation for why my study finds a robust relationship between taxes and economic growth while previous studies have not. Section VII concludes.

II. A MODEL OF ECONOMIC GROWTH

I assume that state income (Y_t) is determined by the following augmented, neoclassical production function,

(1) $$Y_t = A_t K_t^{\alpha} (L_t Q_t)^{\beta} = A_t Q_t^{\beta} K_t^{\alpha} L_t^{\beta},$$

where K_t and L_t are capital and employment, Q_t is the efficiency of labor, and A_t represents other factors that influence state incomes (e.g., human capital variables).

Dividing both sides by N_t gives

(2) $$\frac{Y_t}{N_t} = A_t Q_t^{\beta} \left(\frac{K_t}{N_t}\right)^{\alpha} \left(\frac{L_t}{N_t}\right)^{\beta} N_t^{(\alpha+\beta-1)}.$$

This can be expressed in log form as

(3) $$ln\left(y_t\right) = \alpha\, ln\left(k_t\right) + \beta\, ln\left(\ell_t\right) + \left(\alpha+\beta-1\right) ln\left(N_t\right) + ln\left(A_t\right) + \beta\, ln\left(Q_t\right)$$

where $y_t = \frac{Y_t}{N_t}$, $k_t = \frac{K_t}{N_t}$, and $\ell_t = \frac{L_t}{N_t}$.

Differentiating Equation (3) with respect to time yields

(4) $$\frac{\dot{y}_t}{y_t} = \alpha \frac{\dot{k}_t}{k_t} + \beta \frac{\dot{\ell}_t}{\ell_t} + \left(\alpha+\beta-1\right)\frac{\dot{N}_t}{N_t} + \left(\frac{\dot{A}_t}{A_t} + \beta \frac{\dot{Q}_t}{Q_t}\right)$$

It follows that

(5) $$\begin{aligned} \ln(y_t) - \ln(y_{t\text{-}L}) \cong \alpha\left[\ln(k_t) - \ln(k_{t\text{-}L})\right] + \beta\left[\ln(l_t) - \ln(l_{t\text{-}L})\right] + \\ \left(\alpha+\beta-1\right)\left[\ln(N_t) - \ln(N_{t\text{-}L})\right] + C_t \end{aligned},$$

where $C_t = [ln\,(A_t) - ln\,(A_{t-L})] + \beta[ln\,(Q_t) - ln\,(Q_{t-L})]$ and L = the length of the time period minus 1 (i.e., for a five-year period with t measuring calendar years, L = 4).[1,2,3]

Equation (5) identifies changes in capital, employment, and population as important determinants of economic growth. However, the last term, C_t, allows a role for other variables -- potentially many other variables -- to affect economic growth. It encompasses a number of models that appear in the literature (e.g., Holtz-Eakin, 1993; Garofalo and Yamarik, 2002; and Lee and Gordon; 2005).

III. DATA AND ESTIMATION ISSUES

My data consist of observations on 48 U.S. states from 1970-1999.[4] I decided on this particular time period because a longer time frame would have required me to omit many variables of interest. The respective thirty years of data are grouped into 6, five-year periods (1970-1974, 1975-1979, … , 1995-1999). Data for most of these variables were collected from original data sources.[5]

Using five-year rather than annual data offers several advantages: It (i) averages out "business cycle effects" (Grier and Tullock, 1989); (ii) minimizes errors from misspecifying lag effects; and (iii) reduces time-specification issues. Time-specification issues arise because data can have different start and end periods within a given calendar year. For example, state income data are defined over calendar years; state fiscal data are

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[1] In the subsequent empirical work, the difference in log values is multiplied by 100.

[2] An alternative specification solves for the steady state value of y as a function of state parameters, and then introduces convergence through the inclusion of a lagged value of the dependent variable. This both (i) imposes additional restrictions on the model and (ii) raises econometric issues of inconsistency from using both fixed effects and the lagged dependent variable as explanatory variables. Nevertheless, the approach of this paper is readily applied to selecting control variables for this, and other, specifications.

[3] I also check for robustness when $L = 5$, so that the endpoints and startpoints of the respective five-year periods coincide.

[4] Alaska and Hawaii were omitted, as usual in studies of U.S. state economic growth.

[5] The Appendix presents statistical descriptions of all the variables used in this study.

defined over fiscal years (which are different for different states); and other variables (e.g. employment, population data) may be measured at different points within the year (beginning/middle/end). In addition, a number of variables (e.g., variables based on decennial Census data) require interpolation in order to get a balanced panel. For all of these reasons, the use of five-year data should entail fewer estimation problems.

Following Equation (5), the general specification for the empirical models is[6]:

$$DLNY_t = \begin{bmatrix} \beta_0 + \beta_1 DLNK_t + \beta_2 DLNL_t + \beta_3 DLNN_t \\ + \, state\ fixed\ effects + time\ fixed\ effects \end{bmatrix} + \sum_d \delta_d \left(X_{d,t} - X_{d,t-4} \right) + \sum_l \lambda_l X_{l,t-4} + \varepsilon_t, \qquad (6)$$

where $t = 1974, 1979, 1984, 1989, 1994, 1999$; $DLNY_t$, $DLNK_t$, $DLNL_t$, and $DLNN_t$ are the respective difference quantities from Equation (5) multiplied by 100 (to give percent); $\left(X_{dt} - X_{d,t-4} \right)$ is the change in the explanatory variable over the five-year period ("differenced" form); and $X_{l,t-4}$ is the value of the explanatory variable at the beginning of the five-year period ("level" form). Note that the last two terms can also be thought of as capturing the "contemporaneous" and "lagged" effects of *X*.

As my measure of taxes, I use tax burden, defined as the ratio of state and local tax revenues to personal income. Tax burden is by far the most commonly employed measure of state taxation, and can be thought of as the "effective average tax rate" in a state (e.g., Helms, 1985; Mofidi and Stone, 1994; Mullen and Williams, 1994; Carroll

[6] In the estimated specification of Equation (6), I do not impose the restriction that $\beta_3 = \left(\beta_1 + \beta_2 - 1 \right)$ for two reasons. First, population growth could also be a factor included in C_t which, if true, would invalidate the restriction. Second, as a practical matter, this restriction is consistently rejected below the 1-percent significance level in all of the top model specifications.

and Wasylenko, 1994; Knight, 2000; Caplan, 2001; Yamarik, 2000, 2004; Tomljanovich, 2004; Alm and Rogers, 2005).[7]

IV. INITIAL EMPIRICAL RESULTS

TABLE 1 summarizes the initial results. The first column (Equation [7]), reports the results of estimating a narrowly specified version of Equation (6). The only explanatory variable from the set of differenced variables, $\{(X_{d,t} - X_{d,t-4})\}_d$, is the change in tax burden, *TaxBurden(D)*; and the only explanatory variable from the set of level variables, $\{X_{l,t-4}\}_l$, is the value of tax burden at the beginning of the period, *TaxBurden(L)*.

Both tax variables are negative and highly significant (the *t*-values are -4.38 and -2.25, respectively). This suggests that taxes have both an immediate and a persistent effect. The coefficient estimate for *TaxBurden(D)* indicates that a one percentage-point increase in tax burden over a five-year period is associated with lower real PCPI growth of 1.37 percent during that period. In addition, an increase in taxes raises the level of tax burden, which is associated with lower growth in future time periods. A state having a tax burden that is one percentage point higher than other states is estimated to have real PCPI growth that is lower by 0.90 percent in subsequent five-year periods.

Two points are worth noting. First, these effects represent the net effect of taxes and spending. Since expenditures variables are omitted from the specification, and since the relationship between U.S. state expenditures and revenues is generally one-to-one, the respective coefficients should be interpreted as an increase in taxes to fund general (unspecified) expenditures. Second, these estimated effects are sizeable. The mean value of the tax burden variable is 10.87, and the mean growth rate of real PCPI (*DLNY*) is 8.23

[7] Tomljanovich (2004) uses the ratio of total state tax revenues divided by GSP.

percent. Thus, tax variable coefficients in the range of -1.0 represent economically important relationships.

With respect to the rest of the equation, the results indicate that increases in a state's capital stock (*DLNK*), employed labor force (*DLNL*), and population (*DLNN*) are each associated with greater income growth. Overall, the equation has good explanatory power, though much of that comes from the state and time fixed effects.[8]

The estimated tax effects of Equation (7) hold constant any effects that taxes might have on investment, employment and population growth. One might reasonably expect taxes to be related to these as well. Equations (8) through (10) investigate this by respectively regressing each of these on the two tax variables plus state and time fixed effects. Across all three equations, we see that higher taxes are associated with lower investment, lower employment growth, and lower population growth.

Notably, there are differences in the timing of the respective estimated effects. Equations (8) and (9) report that an increase in tax burden is associated with a statistically significant decrease in investment and employment growth during the same five-year period. Beyond that period, the tax effects are smaller and statistically insignificant. In contrast, Equation (10) indicates that an increase in tax burden is estimated to have a negligible contemporaneous effect on population growth. However, there is some evidence to indicate that higher taxes lower population growth in later time periods (the respective *p*-value is 0.19). These results are consistent with expectations about how taxes might affect each of these variables: investment and employment are more easily adjusted in the short-run, while migration decisions respond more slowly and require more time to be realized.

[8] The R^2 value for the same specification without state and time fixed effects is 0.744.

The preceding results suggest that taxes influence state economic growth via two general channels. The first channel is associated with the term, C_t, which collects changes in the efficiency of labor (Q_t) plus the effects of other time-varying factors related to productivity (A_t). The second channel is via the terms *DLNK, DLNL,* and *DLNN*, which incorporate the effects of taxes on investment, employment and population growth. Ideally, one could measure the combined effect of tax burden on economic growth by estimating a structural system of equations with *DLNY, DLNK, DLNL,* and *DLNN* all treated as endogenous. Unfortunately, a lack of good instruments makes this approach unfeasible.

An alternative is to estimate a reduced form version of Equation (7), omitting the terms *DLNK, DLNL,* and *DLNN*. Equation (11) reports the results of this exercise. As expected, the combined effect of taxes is estimated to be substantially larger. A one percentage point increase in tax burden is associated with a contemporaneous, decrease of 2.59 percent in real PCPI growth. In addition, future five-year growth rates are estimated to be lower by 1.56 percent.

V. ROBUSTNESS CHECKS

<u>Robustness with respect to alternative specifications</u>. One concern with the previous set of results is that the estimated tax effects may suffer from omitted variable bias. It is thus important to control for the influence of other variables that may affect state economic growth. The subsequent analysis takes Equation (7) as its starting point, and appends this with theoretically appropriate control variables.

It is clear from Equation (5) that a large number of variables could be included as proxies for the unobserved term, C_t. Reed (2006) identifies thirty-two variables that have been used or suggested by previous studies. Eliminating the public sector variables (such as categories of public spending or taxes) -- since including these would change the nature of the tax variables -- leaves thirteen non-tax variables. These are identified in TABLE 2. Each of these can be argued to be included in differenced or level (initial value) form. If one also allows the initial value of income to be included as a regressor[9], and recalls that the differenced form of the population variable (*DLNN*) is already included in the core specification, one obtains a total of twenty-six possible control variables.[10]

While it is likely that many of these variables do not really belong in the regression equation, it is not apparent a priori which ones should be excluded. Choosing one or a few sets of control variables is potentially a problem, since previous literature (e.g., Leamer, 1985; Levine and Renelt, 1992; Crain and Lee, 1999; Sali-i-Martin et al., 2004) has demonstrated that estimated coefficients are often fragile, sensitive to the particular composition of conditioning variables.

The problem is complicated by the fact that there are $2^{26} \cong 67$ million ways to combine twenty-six variables, each one a possible regression specification. I address the issue of variable specification in the following way. First, I estimate a complete

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[9] Note that the interpretation of this variable should not be associated with convergence, since the model is not specified in steady-state form. Rather, this variable should be interpreted as proxying for the effect of omitted, initial-value variables.

[10] The variable *DLNN* potentially affects economic growth through two channels: (i) directly (cf. Equation [5]), and (ii) indirectly, through C_t. If *DLNN* did not exert a separate effect via C_t, then its associated coefficient would be $(\beta_1 + \beta_2 - 1)$ (cf. Equations [5] and [6]). However, this hypothesis is consistently rejected in the subsequent empirical analyses. The upshot is that one cannot estimate an analogue of Equation (10), appended with control variables, since *DLNN* would appear as one of the control variables.

specification that includes all twenty-six variables. Next, I identify and estimate the "best" specifications as determined by both SIC and AIC (corrected version) model selection criteria.[11] This produces three sets of regression results, each of which is reported in TABLE 3 (cf. Equation [12], [13] and [14]).

Of greatest interest are the first two rows of TABLE 3, which report the estimated coefficients of *TaxBurden(D)* and *TaxBurden(L)* after including alternative sets of control variables. Both tax coefficients are smaller in absolute value compared to Equation (7), where the estimated values are -1.37 and -0.90, respectively. Nevertheless, they remain negative across the expanded specifications of Equations (12) through (14). Further, they continue to be highly significant. In the "All Variables" specification of Equation (12), *TaxBurden(D)* and *TaxBurden(L)* have *t*-statistics(*p-values*) of, respectively, -2.58(*0.011*) and -2.87(*0.004*). The corresponding *t*-statistics are even higher in Equations (13) and (14). And while these latter two specifications are the product of sequential search, the *t*-statistics/*p*-values for the two tax variables can still be interpreted in the classical manner because the search procedure includes these two variables in every specification.

Turning to the other variables, we find that the estimated coefficients are generally consistent with the predictions of growth theory. Focusing on the coefficients from Equation (12) that are significant at the 5-percent level, we observe the following results (ignoring the distinction between initial levels and contemporaneous changes): higher educational attainment, a greater percentage of the population who are of working age, a greater percentage of the population that is nonwhite, a larger population, and a greater reliance on agriculture are all associated with higher economic growth. A larger

[11] This procedure, as well as the specific SAS program I use to implement it, is described in further detail in Reed (2006).

female population and a larger mining sector are both associated with lower economic growth. Lastly, ceteris paribus, states with a greater initial value of real PCPI grow slower than other states.

In conclusion, I find that the significant, negative tax effects reported in Equation (7) are robust to the inclusion of a wide variety of control variables. The next section investigates the robustness of the relationship between tax burden and state economic growth when alternative estimation procedures are employed.

Robustness with respect to alternative estimation procedures. The subsequent analysis selects Equation (13) as the best of the preceding specifications. This OLS equation displays good properties. It has a high R^2, the key explanatory variables all have large *t*-statistics, the Durbin-Watson statistic is close to 2, and a test of error normality fails to be rejected at the 5 percent level.[12] Potential (individual) heteroscedasticity is addressed by using robust (White) standard errors.

However, there are at least two concerns. First, panel data are often characterized by complex error structures. Using the residuals from Equation (13), I tested for (i) first-order serial correlation and (ii) cross-sectional correlation (which includes groupwise heteroscedasticity as a special case). I found no evidence of significant serial correlation (the estimated value of the AR(1) parameter was -0.02). However, I calculated an average, absolute value of cross-sectional correlation equal to 0.36 and strongly rejected the null hypothesis of no cross-sectional correlation. This raises worries about the inefficiency of coefficient estimates and biasedness in the estimates of standard errors.[13]

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[12] The Durbin-Watson statistic is 2.15; and the Jarque-Bera statistic is 5.07, with an associated *p*-value of 0.079.

[13] Note that "White standard errors" are robust only to individual heteroscedasticity, and not cross-sectional correlation.

Unfortunately, while one can estimate an error variance-covariance matrix that allows for cross-sectional correlation, one cannot invert that matrix, since $N=48 > T=6$. This precludes the use of Parks-type FGLS. However, there are several alternatives. One alternative is to continue to use OLS, but adjust the standard errors for cross-sectional correlation; either by using Beck and Katz's "panel-corrected standard error" procedure (Beck and Katz, 1995), or by using a more robust estimator of the error variance-covariance matrix. Another is to follow-up a suggestion by Greene (2003, pages 333f.) and use FGLS, weighting on groupwise heteroscedasticity while adjusting the standard errors for cross-sectional correlation. Accordingly, I check for robustness of the estimated tax effects across the following four alternative estimation procedures:

1. OLS with panel-corrected standard errors

2. OLS with robust estimation of the error variance-covariance matrix assuming cross-sectional correlation (i.e. "cluster" standard errors)

3. FGLS (weighted on groupwise heteroscedasticity) with panel-corrected standard errors

4. FGLS (weighted on groupwise heteroscedasticity) with "cluster" standard errors

There is also a second concern. Equation (13) includes both fixed effects and a lagged form of the dependent variable as explanatory variables. This generates correlation between the error term and the lagged form of the dependent variable, causing biased coefficient estimates (Nickell, 1981). To address this concern, I use a dynamic panel data (DPD) estimator -- specifically, the Arellano-Bond, two-step procedure.

TABLE 4 reports the estimates from these alternative estimation procedures. For comparison's sake, the first row duplicates the tax burden estimates from Equation (13) in TABLE 3. There are two main findings from this analysis: Both FGLS and DPD confirm earlier results in that they produce negative coefficient estimates for each of the tax variables. The FGLS estimates are similar in size to the OLS estimates, while the DPD estimates are larger (in absolute value). In addition, the statistical significance of the tax effects is confirmed across all alternative estimation procedures. Of the twelve *t*-statistics reported in TABLE 4, all are larger than 2 and only one is less than 3 in absolute value. Accordingly, I conclude that my main findings of negative, statistically significant tax effects are robust across alternative estimation procedures.

Robustness across alternative cuts of the data. The preceding analyses divide the thirty years of data from 1970-1999 into six periods of five-years each: 1970-1974, 1975-1979, … , 1995-1999. This section looks at two alternative ways of dividing the data. The first approach allows the endpoint of one five-year period to coincide with the beginning of the next five-year period. Following this approach, the data are divided as follows: 1970-1975, 1975-1980, 1980-1985, … , 1995-2000. A drawback of this approach is that it forces dependency between contiguous time periods. An alternative approach keeps the endpoints and beginning points of the periods separate, but shifts the data by a year: 1971-1975, 1976-1980, … , 1996-2000.

TABLE 5 reports the results. The first column of TABLE 5 uses FGLS (weighting on groupwise heteroscedasticity) with "cluster" standard errors to estimate the variable specification of Equation (13).[14] These results were previously reported in abbreviated form in TABLE 4 (cf. the next to last row). The subsequent two columns use the same estimation procedure and variable specification but employ different cuts of the data.

[14] I chose this estimation procedure given that testing of the residuals produced evidence of heteroscedasticity/cross-sectional correlation.

Alternative cuts of the data can make a difference. For example, the estimates for *Female(D)* change considerably, with the respective *t*-values ranging from -4.38 to -1.51. The coefficients for *Mining(D)* and *Diversity(L)* also show substantial variation, even switching signs. Indeed, the coefficient for *TaxBurden(L)* in Column (3) is less than half the size of the equivalent estimate in Column (1), with a correspondingly large change in the respective *t*-statistic.

Nevertheless, these estimates provide overall confirmation of the previous tax burden results. Across the alternative time divisions of the data, the coefficients of the two tax variables are negatively signed and statistically significant, always having a *t*-statistic larger than two in absolute value.

Robustness across time periods and states. A possible concern with previous estimates is that the results may be driven by a few time periods/states with particularly strong relationships between tax burden and economic growth, and may not be broadly representative for the majority of observations. Previous specifications assumed that the estimated tax effects were the same for all time periods and states. In this section, I use interaction terms to estimate individual time period and state effects.

I first check for robustness across time periods. There are a total of 6 five-year periods: (1970-1974, 1975-1979, 1980-1984, 1985-1989, 1990-1994, 1995-1999). I respecify Equation (13) and include time-interaction effects to capture changes in the tax burden/economic growth relationship over time. Following the previous results on estimation procedures, all coefficients are estimated using FGLS (with weighting for groupwise heteroscedasticity), with a White robust estimator for cross-sectional correlation used to calculate standard errors. I first estimate time-specific coefficients for the variable *TaxBurden(D)*. I then repeat the robustness check by estimating time-specification coefficients for the variable *TaxBurden(L)*.

TABLE 6 summarizes the results. Notably, each of the twelve corresponding time-specific coefficients is negative. Ten of the twelve are individually significant, and the time-specific interaction terms for both *TaxBurden(D)* and *TaxBurden(L)* are jointly significant at well below the 5-percent significance level.

These latter results suggest that the relationship between tax burden and economic growth varies over time periods. While the pattern isn't perfect, smaller estimated coefficients for *TaxBurden(D)* are generally accompanied by larger coefficients for *TaxBurden(L)*, and vice versa. A similar pattern is observable when I estimate state-specific interaction terms. An interpretation consistent with these results is that changes in tax burden take longer during some time periods to register their impact on economic growth. Even so, the most important observation from TABLE 6 is that the relationships between economic growth and both the differenced and level forms of tax burden are estimated to be negative in every time period.

TABLE 7 reports the results of a similar analysis using state-specific interaction terms. These are presented in summary form, rather than reporting state-specific coefficients for each of the 48 states. The estimates are not as one-sided as in TABLE 6, no doubt due in part to the fact that each of the state-specific coefficients relies on only six time-periods of data (compared to the time-specific coefficients, which use forty-eight state observations).

Even so, the results are consistent with tax burden being negatively associated with economic growth across most states. Of the forty-eight, state-specific coefficients for *TaxBurden(D)*, 72.9 percent are negative. Of these, fourteen are statistically significant, and twelve of these are negative (85.7 percent). The corresponding numbers for the *TaxBurden(L)* coefficients are 64.5 and 70.0 percent, respectively. Notably, there are no states that have positive, state-specific coefficients for both *TaxBurden(D)* and *TaxBurden(L)*.

In conclusion, these results suggest that the tax effects estimated in earlier specifications are generally robust across time periods and states, and are not driven by a few observations exerting a disproportionately strong influence.

VI. WHY HAVE PREVIOUS STUDIES FOUND IT DIFFICULT TO ESTIMATE ROBUST TAX EFFECTS?

In this section I provide an explanation of why I am able to find evidence of a robust negative empirical relationship between taxes and economic growth, when so many other researchers have not. Column (1) of TABLE 8 uses OLS to estimate an annual analogue to Equation (13). The data cover 1970-1999 and include the log of capital, employment, and population, along with state and annual time fixed effects and a number of other control variables. The dependent variable is the log of real PCPI. I begin by following the conventional practice of only including contemporaneous values of the explanatory variables.[15]

In contrast to the prior results, I now estimate a positive relationship between tax burden and state incomes. A one-percentage point increase in tax burden is estimated to increase real state PCPI by 0.16 percent. Further, the coefficient is significant well below the 5 percent level, with a *t*-value just over three.

[15] A notable exception is Tomljanovich (2004). However, he does not include any state-specific, time-varying variables other than tax, expenditure, and aid variables.

To check the sensitivity of this result, I drop various sets of variables from the specification of Column (1). Column (2) drops the capital, employment, population, and lagged income variables. Column (3) drops these, plus the control variables. Column (4) drops these, plus all fixed effects. While the statistical significance of the coefficient changes depending upon the specification, the finding of a positive relationship between tax burden and state income does not.

However, a different picture emerges when the specification is broadened to allow lagged effects. Column (5) reports the results of adding lagged values of the tax burden variable to the specification of Column (1). While the contemporaneous relationship between tax burden and economic growth remains positive, lagged values of tax burden are estimated to be negatively associated with state income.

A full reconciliation of my results with previous research lies beyond the scope of this study. However, this analysis suggests that prior studies failed to identify a robust, negative relationship between taxes and economic growth because they relied on specifications that did not allow for lagged tax effects, and used annual data. My analysis suggests that tax policies take time to work their full effects on the economy. When the specification is sufficiently general to pick up these effects, a negative relationship between taxes and economic growth emerges.

Further, a comparison of TABLE 8 with previous results indicates that the organization of the data into five-year periods is also important. This may be due to the fact that income and fiscal policy variables interact over time in complex ways that are difficult to model. A complementary reason is that the data do not line up well at an annual level: Income data are defined over calendar years. Fiscal data are defined over fiscal years which typically run from the mid-point of one calendar year to the mid-point of the next. Other variables such as employment and population are measured at different points in time. In addition, variables based on decennial Census data require interpolation to produce annual values. Organizing the data in five-year periods reduces the severity of these measurement problems.

VII. CONCLUSION

Using five-year data from 1970-1999 and the forty-eight continental states, I find strong evidence of a negative and statistically significant relationship between taxes and economic growth. Further, I find that this relationship is robust across (i) alternative variable specifications, (ii) alternative estimation procedures, (iii) alternative ways of dividing the data into "five-year" periods, and (iv) allowing for individual-specific time and state effects.

These results are surprising given that previous studies have had difficulty identifying a substantial relationship between state taxes and incomes. My analysis suggests that this may be because previous studies have tended to use specifications which did not allow for lagged tax variables, and used annual data. When I use annual data and restrict the analysis to contemporaneous tax effects, I find no evidence of a negative tax effect. When I include lagged values of the tax variable, a negative relationship between taxes and growth emerges. The organization of the data into five-year periods also matters. This might be because the variables interact over time in complex ways that are difficult to model. It may also be because the data -- for definitional and measurement reasons -- are not well-suited to relating to each other at the annual level.

Much work remains to be done before reliable estimates of tax effects can be obtained.[16] However, this study establishes that there is an important empirical relationship between taxes and U. S. state economic growth. Obtaining a better understanding of the nature and cause of that relationship is a potentially fruitful avenue for future research. It is hoped that this study will stimulate efforts towards that end.

[16] A key remaining issue is the problem of endogeneity between tax policy and economic conditions. Policy makers frequently raise taxes during economic downturns, and lower taxes during times of economic prosperity (Poterba, 1994). This generates a negative bias to estimates of contemporaneous tax effects. While this cannot explain why I find a negative, lagged effect for tax burden (cf. the coefficient for *TaxBurden[L]*), it may contribute to the estimated, negative effect for contemporaneous changes in the tax burden variable (cf. the coefficient for *TaxBurden[D]*).

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TABLE 1
Estimation of the Relationship Between Tax Burden and Economic Growth: Initial Results

	Equation (7)	***Equation (8)***	***Equation (9)***	***Equation (10)***	***Equation (11)***
	Dep. Variable = DLNY	***Dep. Variable = DLNK***	***Dep. Variable = DLNL***	***Dep. Variable = DLNN***	***Dep. Variable = DLNY***
DLNK	0.3304 (7.26)	----	----	----	----
DLNL	0.4258 (6.70)	----	----	----	----
DLNN	0.4241 (5.02)	----	----	----	----
TaxBurden(D)	-1.3660 (-4.38)	-2.5881 (-2.43)	-0.8380 (-2.71)	-0.0346 (-0.13)	-2.5925 (-4.31)
TaxBurden(L)	-0.8979 (-2.25)	-0.8318 (-0.88)	-0.3143 (-0.85)	-0.5907 (-1.31)	-1.5571 (-2.15)
R^2	0.850	0.345	0.629	0.766	0.528
SIC	729.84	----	----	----	1043.76
AICc	815.28	----	----	----	1156.85
Observations	288	288	288	288	288
Hypothesis Tests					
State effects = 0	χ^2 = 120.46 (*p*-value = 0.000)	χ^2 = 91.67 (*p*-value = 0.000)	χ^2 = 46.67 (*p*-value = 0.486)	χ^2 = 787.22 (*p*-value = 0.000)	χ^2 = 60.99 (*p*-value = 0.083)
Time effects = 0	χ^2 = 86.76 (*p*-value = 0.000)	χ^2 = 90.93 (*p*-value = 0.000)	χ^2 = 301.00 (*p*-value = 0.000)	χ^2 = 54.68 (*p*-value = 0.000)	χ^2 = 194.79 (*p*-value = 0.000)

NOTE: Coefficients are estimated using OLS. t-statistics are reported in parentheses and are calculated using White heteroscedasticity-robust standard errors. All equations include state and time fixed effects. AICc denotes the "corrected" version of the AIC. Summary statistics for each of the variables are reported in the Appendix.

TABLE 2
List of Potential Control Variables for the Core Specification of Equation (7)[17]

VARIABLE	*DESCRIPTION (ALL VARIABLES CALCULATED AS 5-YEAR AVERAGES)*	*SELECTED STUDIES WHICH HAVE USED THIS OR A RELATED VARIABLE*
Education	Percent of population (aged 25 and up) who have completed college (SOURCE: Census)	Wasylenko and McGuire (1985); Garcia-Milà and McGuire (1992); Crown and Wheat (1995); Phillips and Goss (1995); Dalenberg and Partridge (1995); Partridge and Rickman (1996); Clark and Murphy (1996); Ciccone and Barro (1996); Crain and Lee (1999)
Working Population	Percent of population between 20 and 64 years of age (SOURCE: Census)	Wasylenko and McGuire (1985); Mofidi and Stone (1990); Dalenberg and Partridge (1995); Crain and Lee (1999)
Nonwhite	Percent of population that is nonwhite (SOURCE: Census)	Mofidi and Stone (1990); Partridge and Rickman (1996); Crain and Lee (1999)
Female	Percent of population that is female (SOURCE: Census)	Mofidi and Stone (1990); Partridge and Rickman (1996); Clark and Murphy (1996)
Population	Log of total population (SOURCE: Census)	Ciccone and Hall (1996); Alm and Rogers (2005)
Population Density	Population density (SOURCE: Census)	Wasylenko and McGuire (1985); Carroll and Wasyenko (1994); Clark and Murphy (1996); Ciccone and Hall (1996); Crain and Lee (1999)
Urban	Percent of population living in urban areas (SOURCE: Census)	Holtz-Eakin (1993); Partridge and Rickman (1996); Crain and Lee (1999)

[17] This table is excerpted from Reed (2006).

VARIABLE	*DESCRIPTION (ALL VARIABLES CALCULATED AS 5-YEAR AVERAGES)*	*SELECTED STUDIES WHICH HAVE USED THIS OR A RELATED VARIABLE*
Agriculture	Share of total earnings earned in "Farm" and "Other Agriculture" industries (SOURCE: BEA)	Crown and Wheat (1995); Caselli and Coleman (2001)
Manufacturing	Share of total earnings earned in "Manufacturing" industries (SOURCE: BEA)	Crown and Wheat (1995); Crain and Lee (1999); Caselli and Coleman (2001); Stansel (2005)
Service	Share of total earnings earned in "Service" industries (SOURCE: BEA)	Clark and Murphy (1996)
Mining	Share of total earnings earned in "Mining" industries (SOURCE: BEA)	Holtz-Eakin (1993); Crown and Wheat (1995); Clark and Murphy (1996); Mitchener and McLean (2003)
Union	Percent of nonagricultural wage and salary employees who are union members (SOURCE: Hirsch, McPherson, and Vroman, 2001)	Plaut and Pluta (1983); Mofidi and Stone (1990); Dalenberg and Partridge (1995); Phillips and Goss (1995); Partridge and Rickman (1996); Clark and Murphy (1996)
Diversity	A measure of industrial diversity, $Diversity = \sum_i \left(\frac{Earnings\ in\ Industry_i}{Total\ Earnings} \right)^2$ (SOURCE: BEA)	Mofidi and Stone (1990); Garcia-Milà and McGuire (1992); Partridge and Rickman (1996); Crain and Lee (1999)

TABLE 3
Robustness Check Across Alternative Specifications

Variable Name[18]	*D/L*	*Equation (12) All Variables*	*Equation (13) Best SIC Specification*	*Equation (14) Best AICc Specification*
Tax Burden	***D***	-0.4240 (-2.58)	-0.5470 (-3.59)	-0.5368 (-3.36)
	L	-0.5838 (-2.87)	-0.6905 (-3.20)	-0.7045 (-3.39)
Education	***D***	1.2504 (1.99)	1.4766 (2.44)	1.1673 (2.00)
	L	1.2759 (6.84)	1.1221 (8.65)	1.2004 (7.06)
Working Population	***D***	1.3235 (3.51)	1.6503 (4.75)	1.3508 (4.21)
	L	0.9789 (4.42)	1.1264 (5.66)	1.0405 (4.89)
Nonwhite	***D***	1.1447 (2.27)	1.2900 (2.87)	1.0064 (2.20)
	L	-0.2699 (-1.77)	----	-0.3633 (-2.83)
Female	***D***	-2.7097 (-1.97)	-3.4947 (-2.92)	-3.4630 (-2.92)
	L	0.3608 (0.46)	----	----
Population	***L***	2.8954 (1.50)	4.0213 (3.19)	----
Population Density	***D***	0.0300 (0.74)	----	----
	L	0.0217 (1.64)	----	0.0269 (2.39)
Urban	***D***	-0.1486 (-1.32)	----	----
	L	-0.0674 (-0.94)	----	----

[18] Summary statistics for each of the variables is reported in the Appendix.

Variable Name[18]	***D/L***	***Equation (12)*** ***All Variables***	***Equation (13)*** ***Best SIC Specification***	***Equation (14)*** ***Best AICc Specification***
Agriculture	***D***	0.5333 (4.19)	0.5365 (5.82)	0.5272 (5.08)
	L	0.3413 (3.03)	0.3881 (5.54)	0.4084 (6.03)
Manufacturing	***D***	-0.0218 (-0.13)	----	----
	L	-0.0304 (-0.25)	----	----
Service	***D***	0.0397 (0.16)	----	----
	L	-0.3083 (-1.90)	----	-0.2956 (-2.57)
Mining	***D***	-0.6314 (-2.72)	-0.5724 (-2.95)	-0.5032 (-2.50)
	L	-0.3006 (-1.58)	----	----
Union	***D***	0.1240 (1.86)	0.1143 (2.10)	0.1251 (2.37)
	L	0.0182 (0.27)	----	----
Diversity	***D***	0.2591 (1.00)	----	0.3241 (1.57)
	L	-0.2144 (-1.02)	-0.3495 (-2.26)	----
LNY_1		-41.857 (-8.37)	-39.783 (-9.72)	-44.085 (-9.96)
Number of observations		288	288	288
R^2		0.938	0.933	0.935
SIC		624.70	572.52	573.91
AICc		675.36	647.78	645.00

NOTE: The regression equation follows the general specification of Equation (6) in the text. "D" and "L" stand for differenced and level forms of the variables. In addition to the variables listed above, the model includes the variables DLNK, DLNL, DLNN, and state and time fixed effects. t-statistics are listed in parenthesis below each estimated coefficient.

TABLE 4
Robustness Check Using Alternative Estimation Procedures

Procedure	***TaxBurden(D)***	***TaxBurden(L)***
OLS	***-0.5470***	***-0.6905***
with robust VCE for individual heteroscedasticity	(-3.59)	(-3.20)
with panel-corrected standard errors	(-2.88)	(-3.35)
with robust VCE for cross-sectional correlation	(-5.43)	(-6.57)
FGLS (weighted on groupwise heteroscedasticity)	***-0.5086***	***-0.6494***
with robust VCE for individual heteroscedasticity	(-3.83)	(-3.89)
with panel-corrected standard errors	(-3.52)	(-4.43)
with robust VCE for cross-sectional correlation	(-3.54)	(-8.00)
DPD	***-0.9168***	***-1.1887***
Arellano-Bond two-step procedure	(-3.65)	(-3.90)

NOTE: Coefficient estimates are boldface and italicized; t-statistics are reported in parentheses. Each estimation procedure estimates the same variable specification as Equation (13) in TABLE 3. The first set of OLS results repeats those results for comparison's sake. The respective estimation procedures are described in greater detail in Section IV.

TABLE 5
Robustness Check Using Alternative Cuts of the Data

Variable Name	***D/L***	***5-YEAR DATA*** ***1970-1974, 1975-1979, …, 1995-1999***	***5-YEAR DATA*** ***1970-1975, 1975-1980, …, 1995-2000***	***5-YEAR DATA*** ***1971-1975, 1976-1980, …, 1996-2000***
Tax Burden	***D***	-0.5086 (-3.54)	-0.5616 (-3.91)	-0.4545 (-3.47)
	L	-0.6494 (-8.00)	-0.4179 (-3.00)	-0.3096 (-2.01)
Education	***D***	1.6935 (4.81)	1.4690 (5.33)	1.7034 (6.12)
	L	1.0819 (5.69)	1.3104 (5.94)	1.0290 (5.03)
Working Population	***D***	1.7580 (4.90)	0.8836 (4.06)	0.5753 (1.97)
	L	1.2660 (13.50)	1.3152 (13.92)	1.0980 (10.50)
Nonwhite	***D***	1.3004 (4.84)	0.9542 (4.08)	0.5168 (3.06)
Female	***D***	-3.2024 (-4.38)	-1.1457 (-1.51)	-0.8878 (-2.12)
Population	***L***	4.1887 (6.63)	5.5797 (3.75)	4.6138 (2.88)
Agriculture	***D***	0.5061 (5.66)	0.5657 (5.44)	0.3047 (2.24)
	L	0.3592 (5.79)	0.4739 (6.47)	0.5536 (6.00)
Mining	***D***	-0.4663 (-2.48)	0.0357 (0.23)	0.0780 (0.57)

Variable Name	***D/L***	***<u>5-YEAR DATA</u>*** ***1970-1974, 1975-1979, …, 1995-1999***	***<u>5-YEAR DATA</u>*** ***1970-1975, 1975-1980, …, 1995-2000***	***<u>5-YEAR DATA</u>*** ***1971-1975, 1976-1980, …, 1996-2000***
Union	***D***	0.1045 (3.07)	0.0776 (1.73)	0.0843 (4.96)
Diversity	***L***	-0.2312 (-1.86)	-0.2516 (-1.81)	0.0764 (0.94)
LNY_1		-39.042 (-12.67)	-43.288 (-12.85)	-34.17 (-11.61)
Number of observations		288	288	288

<u>NOTE</u>: Each of the three sets of regression results employs FGLS (weighting on groupwise heteroscedasticity) with robust VCE for cross-sectional correlation. t-statistics are reported in parentheses below the respective coefficient estimates. The first column reproduces previous results for comparison's sake (cf. the next to last row in TABLE 4). The next two columns show the effects of using different cuts of the data.

TABLE 6
Robustness Check Across Time Periods

Time Period	*TIME-SPECIFIC COEFFICIENTS*			
	TaxBurden(D)		*TaxBurden(L)*	
	Coefficient	***t-statistic***	***Coefficient***	***t-statistic***
1970-1974	-1.1551	*-9.83*	-0.3062	*-5.18*
1975-1979	-0.7518	*-4.58*	-0.6710	*-7.32*
1980-1984	-0.0615	*-0.24*	-0.6455	*-7.18*
1985-1989	-0.1642	*-0.71*	-0.9044	*-6.61*
1990-1994	-0.6450	*-2.97*	-1.0086	*-8.20*
1995-1999	-1.1014	*-5.17*	-0.5286	*-4.98*
Test of Significance for Time Interaction Terms:	χ^2 = 14.214 (p-value = 0.014)		χ^2 = 13.427 (p-value = 0.020)	

NOTE: Estimation results are generated by estimating the core variable specification of Equation (13), supplemented with the respective time-interaction dummy variables (cf. the text for further details). The estimation procedure is FGLS (weighting on groupwise heteroscedasticity) with robust VCE for cross-sectional correlation. t-statistics are generated using the delta method.

TABLE 7
Robustness Check Across States

	STATE-SPECIFIC COEFFICIENTS	
	TaxBurden(D)	***TaxBurden(L)***
Total Number of Coefficients / Number Negative *(Percent Negative)*	48 / 35 *(72.9)*	48 / 31 *(64.5)*
Total Number of Significant Coefficients / Number Negative *(Percent Negative)*	14 / 12 *(85.7)*	10 / 7 *(70.0)*
Test of Significance for State Interaction Terms:	χ^2 = 106.396 (p-value = 0.000)	χ^2 = 94.653 (p-value = 0.000)

NOTE: This table uses the same estimation procedure as TABLE 6, except that state-specific interaction terms are used. Given their large number, individual state results are not reported.

TABLE 8
Estimation of the Relationship Between
Tax Burden and Economic Growth Using Annual Data

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
TaxBurden	0.0016 (3.06)	0.0017 (1.11)	0.0174 (8.77)	0.0040 (1.16)	0.0064 (6.27)
TaxBurden(-1)	----	----	----	----	-0.0025 (-1.96)
TaxBurden(-2)	----	----	----	----	-0.0020 (-1.62)
TaxBurden(-3)	----	----	----	----	-0.0001 (-0.11)
TaxBurden(-4)	----	----	----	----	-0.0025 (-2.63)
LNK	0.0754 (8.84)	----	----	----	0.0936 (9.97)
LNL	0.1073 (8.19)	----	----	----	0.1330 (9.79)
LNN	0.0064 (5.91)	----	----	----	0.0034 (3.29)
LNY_1	0.7466 (65.25)	----	----	----	0.7180 (55.54)
Education	0.0034 (10.38)	0.0174 (20.17)	----	----	0.0038 (10.62)
Working Population	0.0056 (11.85)	0.0288 (25.28)	----	----	0.0055 (11.19)
Nonwhite	-0.0004 (-2.84)	-0.0008 (-2.38)	----	----	-0.0001 (-1.09)
Female	0.0112 (8.33)	-0.0014 (-0.37)	----	----	0.0127 (8.95)
Agriculture	0.0028 (12.11)	0.0057 (11.53)	----	----	0.0015 (5.11)
Mining	-0.0005 (-1.16)	0.0029 (4.80)	----	----	-0.0011 (-2.74)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Union	0.0008 (5.31)	0.0049 (15.24)	----	----	0.0013 (8.45)
Diversity	0.0032 (7.06)	0.0039 (3.17)	----	----	0.0017 (3.10)
Other variables	state fixed effects, year fixed effects	state fixed effects, year fixed effects	state fixed effects, year fixed effects	----	state fixed effects, year fixed effects
Number of observations	1440	1440	1440	1440	1248
R^2	0.994	0.944	0.843	0.448	0.993

NOTE: The dependent variable is the log of real Per Capita Personal Income (1984 dollars). All equations are estimated using OLS. t-statistics are reported in parenthesis.

APPENDIX
Statistical Summary of Data

Variable		*Mean*	*Std. Deviation*	*Minimum*	*Maximum*
DLNY[1]		8.23	5.20	-9.38	40.45
DLNK[2]		7.42	7.81	-26.92	55.43
DLNL[3]		4.66	3.99	-7.22	14.97
DLNN[4]		4.63	4.48	-8.63	21.45
Tax Burden[5]	D	0.13	0.88	-5.52	5.91
	L	10.87	1.37	7.92	19.27
Education[6]	D	1.77	0.55	0.34	3.21
	L	16.41	4.92	6.66	30.21
Working Population[6]	D	0.97	0.93	-1.22	2.93
	L	55.84	3.18	47.54	62.26
Nonwhite[6]	D	0.56	0.51	-0.98	2.42
	L	11.75	8.76	0.36	37.35
Female[6]	D	-0.02	0.15	-0.57	0.75
	L	51.23	0.77	48.77	52.76
Population[6]	L	14.93	1.00	12.72	17.27
Population Density[6]	D	4.93	6.68	-8.44	37.26
	L	162.25	230.78	3.44	1089.83
Urban[6]	D	0.75	1.13	-1.97	3.96
	L	67.18	14.43	32.16	93.54
Agriculture[6]	D	-0.06	2.46	-16.72	18.85
	L	3.28	3.98	-8.92	29.06
Manufacturing[6]	D	-0.81	1.68	-6.09	3.37
	L	20.93	8.42	3.73	40.49
Service[6]	D	1.47	1.25	-3.22	6.40
	L	19.51	5.65	10.93	41.55
Mining[6]	D	-0.19	0.76	-3.29	4.27
	L	2.15	3.53	0.02	24.98

Variable		***Mean***	***Std. Deviation***	***Minimum***	***Maximum***
Union[6]	D	-1.47	2.36	-10.6	5.0
	L	18.48	8.12	3.3	41.7
Diversity[6]	D	-0.06	0.77	-5.42	4.66
	L	17.36	2.05	13.84	23.56
LNY_1[7]		2.53	0.20	1.96	3.06

Variable Descriptions

[1] *DLNY is the percent change in real Per Capita Personal Income (1984 dollars).*
[2] *DLNK is the percent change in net private Capital Stock created through 1-digit SIC industries (measured in millions of chained 1996 dollars). These data were provided by Steve Yamarik (cf. Garofalo and Yamarik[2002]).*
[3] *DLNL is the percent change in total employment (source: BEA).*
[4] *DLNN is the percent change in total population (source: Census).*
[5] *Tax Burden is the ratio of total state and local tax revenues over total state personal income.*
[6] *These variables are described in TABLE 2. "D" denotes the five-year difference in the variable over the period (t-4,t). "L" denotes the value of the variable at the beginning of the five-year period.*
[7] *LNY_1 is the value of the log of real Per Capita Personal Income (1984 dollars) at the beginning of the five-year period.*