Abstract - Barro–style models of endogenous growth imply that economic growth will initially rise with an increase in taxes directed toward economically “productive” expenditures (e.g., education, highways, public safety), but will subsequently decline—consistent with a “growth hill”—as the rising tax share depresses the net return to private capital. Previous tests focus on whether the linear incremental effect of taxes is positive, negative, or zero, with substantial evidence for all three conclusions. This study incorporates potentially non–monotonic effects for fiscal policy. Based on estimates for U.S. states, the incremental effect of taxes directed toward publicly provided productive inputs is initially positive, but eventually turns negative, consistent with a growth hill.

INTRODUCTION

Do taxes and government expenditures enhance or impede economic growth? This question lies at the heart of public finance and taxation policy, both at the national and sub–national levels. In an extensive summary of empirical studies of the effects of taxes on economic growth, Poot (2000) finds that most estimates are either insignificant or negative, though a small number are positive. Similarly, estimates of the effects of government investment expenditures on economic growth also tend to be insignificant, though some studies find positive effects, particularly for expenditures on physical infrastructure and education (e.g., Cohen and Paul (2004) and Pereira (2000)).


While the studies surveyed by Poot (2000) and the recent Bleaney et al. (2001) study are based primarily on cross–
country data, there are also a number of cross-state (or cross-county) studies for the United States, including, for example, Helms (1985), Mofidi and Stone (1990) and, more recently, Mark, McGuire, and Papke (2000) and Holcombe and Lacombe (2004). Helms (1985) and Mofidi and Stone (1990) find that taxes spent on publicly provided productive inputs tend to enhance growth, while Holcombe and Lacombe (2004) and Mark et al. (2000) find that increases in taxes tend to impede growth. Which conclusion is correct?

Ironically, the Barro-style models of endogenous growth suggest that all could be right, depending on the level of taxes, the composition of expenditures, and other factors. In Barro-style models, increases in taxes can enhance, have no effect on, or impede growth depending, in particular, on the initial level of taxes—as well as on how the tax revenues are spent. For example, an incremental dollar of tax revenue spent on productive government services has a much more positive effect on growth in the Barro model when taxes are initially low than when they are already high, when the effect may even be negative. This kind of “growth hill” arises because a rising tax share invested in productive public services initially increases but ultimately decreases the net (i.e., after-tax) return to private capital, crowding out private capital investment (as in Barro and Sala-i-Martin (1992)).

Surprisingly, no study, at least to our knowledge, has attempted to estimate the growth hills arising from Barro-style models.¹ This is the task we set out for ourselves in this paper. Based on data for 49 of the 50 U.S. states (Alaska is excluded), our results provide insights not only for some of the conflicting findings of positive, insignificant, or negative effects in other studies, but also for the extent to which U.S. states have tax and expenditure structures conducive to economic growth.

A well-specified examination of the long-term effects of state and local taxes and expenditures on the growth in state per-capita income requires, at a minimum, that: i) the potential for growth hills inherent in Barro-style models of endogenous growth be incorporated into empirical specifications; ii) the government budget constraint be fully specified, i.e., all revenues, expenditures and deficits/surpluses be specified, explicitly or implicitly, since the effect of an additional dollar of tax revenue presumably will vary depending on what it is used for (Helms, 1985; Mofidi and Stone, 1990); iii) unobserved differences across states, which are likely to be correlated with both the dependent and independent variables, be accounted for (Mofidi and Stone, 1990; Mark et al., 2000); and iv) the period of analysis be sufficiently long and the dynamics adequately specified to ensure that steady-state effects are identified separately from shorter-term, cyclical effects (Mofidi and Stone, 1990; Bleaney et al., 2001; and Gray and Stone, 2006).

Our findings suggest, consistent with Barro-style models, that increases in taxes spent on publicly provided productive inputs initially increase the growth rate of state real personal income per capita, but do so at a declining rate sufficient to induce a growth hill. Hence, the impact of taxes depends both on the initial level of taxes, as well as on how they are spent. We also provide empirical assessments of the extent to which state and local taxes and corresponding public investments are optimal, too low, or too high in terms of growth in state real personal income per capita, though we urge caution in interpreting our particular point estimates.

¹ Aschauer (1997) and Kalaitzidakis and Kalyvitis (2005) incorporate nonlinear effects for public capital, but not taxes. In addition, several papers, including Haughwout, Inman, Craig, and Luce (2004), do estimate “revenue hills”—so-called “Laffer curves.”
In the next section, we set out the theoretical context for our empirical specifications, and describe the data and estimation strategies in the third section. In the fourth section, we present the empirical estimates, along with a number of robustness tests. In the fifth section, we assess the implications of the non-monotonic tax effects—growth hills—for whether or not tax and expenditure structures are conducive to economic growth. In a final section, we summarize our findings and offer some suggestions for future directions.

THEORETICAL BACKGROUND

Unlike the neoclassical growth model, where fiscal effects alter the level of the long-run output path, the endogenous growth model permits fiscal effects to alter the slope of the long-run output path, as illustrated, for example, in Barro (1990). Here, we employ an adaptation of the Bleaney et al. (2001) presentation of the Barro and Sala-i-Martin (1992, 1995) model of endogenous growth. There are \( n \) producers, each producing output \( y \) according to the production function

\[
y = Ak^{(1-a)}g^a,
\]

where \( A \) is a positive constant, \( k \) is private capital, \( g \) is a publicly provided input, and \( a \) is a parameter between zero and one.\(^2\)

The government funds its budget with a proportional tax on output at the rate \( r \).\(^3\)

\[
g + C = rny,
\]

where \( C \) is government-provided consumption (or “non-productive”) goods.\(^4\) Bleaney et al. (2001) note that with an isoelastic utility function, the long-run growth rate \( V \) in this variant of the Barro and Sala-i-Martin (1992) model can be expressed as

\[
V = w(1-r)(1-a)A^{1/(1-a)}(g/y)^{a/(1-a)} - u,
\]

where \( w \) and \( u \) are constants reflecting parameters in the utility function. Note that private capital is endogenously determined in the model and, hence, does not appear in equation [3]. Thus, output growth in the steady state depends only on structural parameters for production and utility \( (w, u, a, \text{ and } A) \), the tax rate \( r \), and the ratio of productive government expenditures to output \( (g/y) \).\(^5\)

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\(^2\) Publicly provided inputs \( g \) are assumed in this model to be rival (i.e., publicly provided “private” services) and excludable (from other firms). If \( g \) is assumed instead to be either non-rival or non-excludable (or both, a pure public good), then the effect on growth of public provision is greater than otherwise (Barro and Sala-i-Martin, 1992).

\(^3\) Bleaney et al. (2001) distinguish between distortionary and non-distortionary taxes, whereas here, for simplicity, we treat all state and local taxes as distortionary. Kneller, Bleaney, and Gemmell (1999) find that results tend not to be sensitive to distinctions in the definitions of distortionary versus non-distortionary taxes. If productive government expenditures are for productive goods subject to congestion, then distortionary taxes can be more efficient by serving (either directly or indirectly) as a user fee to mitigate the externality associated with congestion (Barro and Sala-i-Martin, 1992).

\(^4\) Alternatively, one could also incorporate a deficit (or surplus) in the steady state, which would require the introduction of interest payments on the debt, as well as steady-state conditions that the ratio of the deficit to income and of debt to income be constant. Doing so appears to offer little gain in the context of U.S. states. For U.S. states, deficits and surpluses are typically small, averaging only about 0.3 percent of personal income, so for simplicity we abstract from the steady state effects of a deficit or surplus. We include the deficit/surplus as one of several auxiliary control variables, and results are not sensitive to whether or not it is included.

\(^5\) In estimation, one is concerned about initial heterogeneities across states, including the level of the private capital stock. For this reason, our empirical specification includes fixed effects for each state (and period).
Equations [2] and [3] together are typically used to motivate a static or dynamic linear regression equation, despite the nonlinearity of equation [3]. Here, however, we are concerned with the intrinsic nonlinearities, in particular the potential for Barro–style growth hills for tax–financed expenditures on productive government services. Using equation [2] to substitute for productive government expenditures (g) in equation [3], one obtains a nonlinear equation in the production and utility parameters (w, u, a, and A), the tax rate (r) and government consumption expenditures (as a fraction of output, C/ny):

\[ V = \omega_0 + \omega_1 r + \omega_2 r^2 + \omega_3 (C/ny) + \omega_4 (C/ny)^2 + \omega_5 r (C/ny) + \omega_6 z + e, \]

where the \( \omega \)’s represent fixed coefficients, \( z \) represents an auxiliary control variable (or set of variables), and \( e \) represents a stochastic error. Coefficients on the fiscal policy variables (\( r \) and \( C/ny \)) in equation [6] are interpreted as the net effect of simultaneous unit changes in the relevant variable and in the omitted variable (in this case, \( g \), productive government expenditures), all else the same.

Our model for growth in equation [4] can be approximated for estimation by a second–order expansion, which is linear in parameters, but nonlinear in the variables:

\[ V = w(1 – r)(1 – a)A^{1/(1 – a)} \]

\[ (r – C/ny)^{a/(1 – a)} – u. \]

The incremental effect of taxes (\( r \)) is initially positive in equation [4], as taxes are implicitly spent on productive government services. However, the effect eventually turns negative, as private capital is increasingly crowded out by the depressing effect of the rising tax share on the net return to private capital. If \( C/ny \) is zero, the growth peak occurs where the rate of taxation equals the productivity parameter for publicly provided inputs in equation [1], i.e., where \( r = a \) (Barro and Sala–i–Martin, 1992). If \( C/ny \) is non–zero, the typical case, then the growth peak occurs where

\[ r – a = (1 – a)(C/ny). \]

Hence, as public spending shifts away from publicly provided productive inputs toward publicly provided consumption goods, the tax rate consistent with maximum growth rises relative to \( a \), but proportionately less than the increase in \( C/ny \). The effect of an increment in \( C/ny \) is negative in equation [4], all else the same, as it reflects a shift of expenditures from productive to nonproductive government expenditures.

**DATA AND EMPIRICAL METHODOLOGY**

Our measure of \( V \), the dependent variable, is GROWTH, the (log) growth in real personal income per capita in each state. The key fiscal variables are TAX, the ratio of all state and local taxes, fees, and inter–governmental revenues to state personal income; H&W, the ratio of health, welfare, and other transfer payment expenditures in the state to state personal income; and PROD, the corresponding ratio of productive government expenditures to state personal income. PROD includes expenditures on highways, education, and other publicly provided inputs.

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6 The budget constraint [2] implies that this will be the case as long as \( g \) is strictly positive.

7 Bleaney et al. (2001) typically exclude nonproductive, rather than productive, expenditures, so the expected coefficient on taxes in their linear specifications is negative, rather than positive. The two specifications (one omitting nonproductive expenditures, the other, productive expenditures) are equivalent and can be mapped one to the other.
In addition, we employ a number of state–level time–varying controls (z’s, in equation [6]): the unemployment rate, the proportion of the population age 18 to 64, the proportion of union members in the labor force, the annual budget surplus (or deficit) relative to state personal income, and unemployment insurance expenditures relative to state personal income. Also, we find, as in Bleaney et al. (2001), that two–way fixed effects for both country (in our case, state) and period are important, so all final specifications include two–way fixed effects.

Our data for state fiscal variables are from the Census of Governments at five–year intervals from 1962 through 1997. Related economic, demographic and other data for corresponding years are obtained from the Current Population Reports for age composition of state population, from the Bureau of Labor Statistics for the state unemployment rate, from Hirsch, McPherson, and Vroman (2001) for the proportion of nonagricultural wage and salary employees in the state who are union members, and from the Department of Commerce for state real personal income per capita. We exclude Alaska, since the variance in its state fiscal variables is extreme relative to the other 49 states, due in large part to the Alaska pipeline.

Thus, we have data for 49 states at five–year intervals from 1962 to 1997, a total of 392 cross–section, time–series observations. Only 343 observations are available for use in the regression estimations, since the calculation of lags requires an initial year of data. Annual data are available consistently at the state level only beginning in the 1970s, so we focus on the longer sample period, based on five–year intervals, to better identify long–run effects.

Table 1 presents summary statistics for our key dependent and explanatory variables: GROWTH, TAX, TAXSQ, H&W, and PROD. H&W and PROD are the measures of nonproductive and productive government expenditures, respectively. In the steady state, PROD equals the difference between TAX, on the one hand, and H&W, on the other, aside from a surplus or deficit. The average value for GROWTH for the five–year data interval is approximately 13 percent, roughly 2.5 percent per annum. The average value for TAX is about 17.4 percent, with average values of 3.3 percent for H&W and 13.8 percent for PROD.

We take the following approach in specifying the dynamics for the growth equation, eq. [6]. First, we assume a priori that the current five–year growth rate is unaffected by contemporaneous fiscal variables, but is a function of the fiscal variables from the previous five–year period. Thus, for example, real personal income growth per capita between 1962 and 1967 may be influenced by the values of the fiscal variables (i.e., TAX, H&W, and their second–order terms) in 1962, but is unaffected by the values of these variables in 1967. Mofidi and Stone (1990) successfully employ this recursive approach for five–year data for states. Eberts and Stone (1992) and Mark et al. (2000) employ a

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8 Consistent with other studies (e.g., Helms (1985) and Mofidi and Stone (1990)), we treat unemployment insurance (UI) expenditures as outside the regular fiscal structure, in part because UI is largely driven federally, with separate accounting. A surplus (or deficit) variable is included as an auxiliary control, as noted above in footnote 4.

9 The first of the U.S. Census of Governments surveys in our sample is actually for 1963, but our other data are aligned with 1962 to be consistent throughout with the subsequent five–year intervals for the Census of Governments.

10 Use of personal income enables us to extend our sample period as far back as 1962, when state fiscal variables are also available, but at time of submission, we do not yet have fully complete data more recent than 1997. Union density estimates by state were “backcast” for 1962 based upon proximate data by state and national data for union density.
similar recursive strategy using longer lags with annual data—the former for major U.S. metropolitan areas, and the latter for jurisdictions in the District of Columbia metropolitan area. Bleaney et al. (2001) find evidence of slightly longer adjustment for OECD countries, about eight years, so we test for the significance of effects of additional lags of the fiscal variables.

In addition, we explore the sensitivity of our results to the explicit inclusion of a lagged dependent variable and instrumental–variable methods. Dynamic fixed–effects models can generate biased and/or inefficient parameter estimates arising from the (explicit or implicit) presence of the lagged dependent variable. In our case, the number of periods is well below the number of states included, so the Arellano and Bond (1991) and Arellano and Bover (1995) style generalized method of moment (GMM) estimators are appropriate. These GMM estimators use (first–differenced or orthogonalized) lagged values of the dependent variable and the exogenous (or predetermined) regressors as instruments.

### REGRESSION & GMM RESULTS

Table 2 presents various regression and GMM instrumental variable estimates for eq. [6], our equation for $GROWTH$, which again is the log–change in state real personal income per capita (times 100). For all estimates, the fiscal variable omitted from the estimated equation is $PROD$, the ratio of state and local expenditures on highways, education, and other related items to personal income (times 100).

### Results for Linear Specifications

Column (1) of Table 2 begins with a linear, baseline specification with lagged $TAX$, $H&W$, and two–way fixed effects for period and state, but without the inclusion of the nonlinear effect of $TAXSQ$. We also include auxiliary controls at the state level to control for potentially confounding effects, especially short–term cyclical influences. Again, the auxiliary variables added are the unemployment rate, the percentage of the working–age (18–64) population, the percentage of union membership in the labor force, the

### TABLE 1

**SUMMARY STATISTICS**  
(U.S. States, 1962–1997)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean</th>
<th>Std. dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>$GROWTH$</td>
<td>log change in state real personal income per capita (times 100)</td>
<td>13.036</td>
<td>6.126</td>
<td>8.554</td>
<td>29.081</td>
</tr>
<tr>
<td>$TAX$</td>
<td>ratio of state &amp; local taxes, fees, inter–gov’t revenues to state personal income (times 100)</td>
<td>17.422</td>
<td>2.987</td>
<td>10.792</td>
<td>36.110</td>
</tr>
<tr>
<td>$TAXSQ$</td>
<td>$TAX$ squared</td>
<td>322.048</td>
<td>120.789</td>
<td>116.459</td>
<td>1303.932</td>
</tr>
<tr>
<td>$H&amp;W$</td>
<td>ratio of state &amp; local expenditures on health, welfare, and other transfers to state personal income (times 100)</td>
<td>3.278</td>
<td>1.028</td>
<td>1.365</td>
<td>6.850</td>
</tr>
<tr>
<td>$PROD$</td>
<td>ratio of state &amp; local expenditures on high–ways, education, and other related areas to state personal income (times 100)</td>
<td>13.834</td>
<td>2.351</td>
<td>9.104</td>
<td>26.346</td>
</tr>
</tbody>
</table>

Notes: Data are for 49 of the 50 states in the U.S. (Alaska is excluded) from 1962 to 1997 in five–year intervals. See text for sources and further details.
Growth, Taxes, and Government Expenditures: Growth Hills for U.S. States

The coefficient on \( \text{TAX}(-1) \) (0.848) is significantly positive at the five–percent level, and the coefficient on \( \text{H&W}(-1) \) (–1.345) is significantly negative. Overall, the fit of the equation (R–squared of 0.741) is relatively good for a growth equation with no lagged dependent variable. Taken at face value, these estimates suggest that increases in taxes spent on productive government services will increase growth in state real personal income per capita, regardless of the initial level of taxes.

We should note at this point that negative, insignificant, or positive effects of taxes are easily induced in alternative specifications of column (1), depending on which expenditure category is omitted.

\[ \begin{array}{l}
\text{Constant} & 0.101 & -10.441 \\
& (17.104) & (17.370) \\
\text{TAX}(-1) & 0.848^{**} & 1.851^{**} \\
& (0.241) & (0.535) & 1.966^{**} \\
& & (0.613) \\
\text{TAXSQ}(-1) & -0.023^{**} & -0.034^{**} \\
& (0.011) & (0.013) \\
\text{H&W}(-1) & -1.345^{**} & -1.500^{**} \\
& (0.573) & (0.571) & -0.780 \\
& & (0.605) \\
\text{GROWTH}(-1) & & -0.150^{**} \\
& & (0.057) \\
\text{Fixed period effects} & yes & yes & yes \\
\text{Fixed state effects} & yes & yes & yes \\
\text{Auxiliary controls} & yes & yes & yes \\
\text{R–squared} & 0.741 & 0.745 & 0.707 \\
\text{J–statistic} & & 14.979 \\
\text{# observations} & 343 & 343 & 245
\end{array} \]

** significant at the five percent level.

Notes: Dependent variable is \( \text{GROWTH} \) (see Table 1). Data are for 49 of the 50 states in the U.S. (Alaska is excluded) from 1962 to 1997 in five–year intervals. See text for sources and further details. Robust (panel–corrected, period SUR) standard errors are in parentheses, which correct for heteroskedasticity, autocorrelation, and contemporaneous correlation. The J–statistic is a test of the validity of the over–identifying restrictions in the GMM instrumental variables estimates in column (3).

and on whether period and state fixed effects are incorporated into the specifications. If one omits the state and period fixed effects, for example, the coefficient on taxes (–0.462), is significantly negative, rather than positive, suggesting that taxes spent on productive government services reduce growth. If one omits both the fixed effects and the government consumption expenditures (H&W(–1))—a common specification in prior studies—the coefficient on taxes (–0.474) is slightly more negative and, again, significantly so.

Alternatively, if one includes state fixed effects but omits period fixed effects, the coefficient on taxes (0.261) is positive, but insignificant. If in addition one also omits H&W(–1), the coefficient on taxes (–0.461) turns significantly negative. All else the same, if one replaces TAX with PROD, the omitted productive public expenditures, results identical to those in column (1) are obtained, since the specifications are fully equivalent.

**Nonlinearity and Growth Hills**

Returning to our main story, though, we now turn to estimating the growth equation, eq. [6], which is nonlinear in the fiscal variables, but not in the coefficients. First, we estimate eq. [6], incorporating all higher order terms for TAX(–1) and H&W(–1). Next, we retain any higher–order terms with coefficients in excess of the corresponding standard error. The resulting equation includes only one higher–order term, TAXESQ(–1). Of course, higher–order terms other than TAXSQ(–1) might still be potentially important. If so, the variation in our sample data is insufficient to allow them to be estimated precisely.

We present least–squares results including TAXSQ(–1) in column (2), which again include fixed effects for both states and periods and the auxiliary control variables. The coefficient on TAX(–1) is even larger than in column (1) at 1.851, but this linear effect is mitigated by a significantly negative coefficient (–0.023) for TAXSQ(–1). Jointly, the linear and quadratic coefficients indicate a growth peak, consistent with a growth hill. The coefficient on H&W(–1) (–1.500) is slightly more negative than in column (1) and again significant. This effect indicates a significant difference in the effect of increasing spending on this category at the expense of productive government services. Of course, the objectives for expenditures for H&W are broader than simply economic growth, but the negative coefficient in column (2) highlights a potential tradeoff in terms of growth.

In column (3) of Table 2, we add the lagged value of the dependent variable (i.e., GROWTH(–1)) and present estimates based upon the GMM instrumental–variables estimator. This estimator uses appropriately lagged values of the dependent variable (in our case to lag 3, or 15 years) and other exogenous or predetermined regressors as instruments. While the coefficient on the lagged dependent variable is significantly negative, as expected, it is relatively small (–0.150). Not surprisingly, then, the TAX(–1) and TAXSQ(–1) coefficients change only modestly and, again, remain significantly positive (1.966) and negative (–0.034), respectively—and consistent with a growth hill. Near the bottom of the table, the J–statistic (14.979) for the validity of the over–identifying restrictions fails to reject them at the five–percent level. The coefficient on H&W(–1) is again negative in column (3), but no longer significantly so.

In other results (not presented here), we explore two robustness tests of our

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12 We apply this strategy based on our preferred GMM specification, column (3) of Table 2.
13 GMM estimates are obtained using E–Views 5.1, with fixed period effects, an orthogonal transformation for cross–section effects, and robust Period SUR standard errors.
results. First, we add second–period lags of all variables to specifications in column (2), and the second–period lags of the fiscal variables (i.e., for TAX(–2), TAXSQ(–2), and H&W(–2)) do not enter significantly at the five–percent level. In column (3), only the coefficient for TAX(–2) enters significantly, but the sum of the one– and two–period lag coefficients is only modestly larger than the one–period lag coefficient in column (3). Hence, if the dynamics extend much beyond five years, they are weak by ten years. Next, we explore the sensitivity of the results in columns (2) and (3) to the definitional relationship between the lagged personal income variable implicit in GROWTH and in the denominator of the lagged fiscal variables. To do this, we omit the first period lags for TAX, TAXSQ, and H&W, and add second–period lags for all variables. The second–period lags for TAX, TAXSQ and H&W now enter significantly, in the absence of the first–period lags, and their coefficients are only marginally smaller in absolute value than those for the first–period lags. Hence, spurious definitional correlations between the measures of GROWTH and the lagged fiscal variables appear trivial.

ASSESSING “GROWTH HILLS”

Our key result is that the incremental effect of taxes directed toward productive government activities and investments is initially positive, but eventually turns negative as the tax share rises. This conclusion is consistent with Barro–style growth hills. As Barro (1990, pp. S123–4) explains, if governments increase taxes close to the level of maximal growth, then growth rates and tax (implicitly, productive public expenditure) shares would evidence little or no correlation, but would show a positive (or negative) correlation if governments choose too little (or too much) of productive public services, relative to the maximum growth rate. In the Barro (1990) model, the maximum growth rate also corresponds to the relevant welfare maximum along a balanced growth path, but Barro and others have noted factors that can disrupt this correspondence (e.g., Greiner and Hanusch (1998)).

The level of tax and productive public expenditure shares relative to the maximum growth rate can provide a useful benchmark, if interpreted with caution. We can examine this question in the context of our results by noting that the peak for the growth hill in our estimates of eq. [6], where the incremental effect of taxes spent on productive government activities is zero, occurs where

$$r = - \left( \omega_1 / 2 \omega_2 \right)$$

if other terms involving $r$ in eq. [6] are zero. If taken literally, the incremental effect of taxes spent on productive public services is positive (or negative) if, relative to maximum growth, taxes directed toward productive public services are too low (or too high), but is zero if consistent with maximum growth.

The point estimate for the peak of the growth hill in the column (3) specification is about 28.9. However, the five–percent confidence interval for this peak indicates that values of $r$ between 21.1 and 54.5 are consistent with maximum growth, so the estimate for the peak is relatively imprecise. Still, the incremental effect of taxes at the sample mean for $r$ of 17.4 is modestly positive (0.77) and significant (p value = 0.007), so that many states appear to have been below the growth peak during this period. However, the incremental effect at two standard deviations above the mean (i.e., at 23.4) lies within the confidence interval for the peak. At the maximum value for $r$ in the sample of 36.1, the incremental effect turns negative at –0.51 (p value = 0.271), but not significantly so. By 2004 the mean tax ratio rose by nearly 20 percent to 20.7, still outside the confidence interval for the growth peak,
but only barely so. For many reasons, as discussed below, we are cautious in placing too much emphasis on the particular point estimate for the growth peak.

The magnitude of the budget share for H&W at roughly a fifth suggests one possible explanation for the apparent underspending on productive government services by a number of states during the period. If, in order to spend incremental tax revenues on productive services, at least a portion of the increase is also typically spent on health and welfare—whether for political reasons, equity concerns, or other considerations—the average state may appear to underspend relative to maximum growth. Since governments have many competing political objectives, the option to direct incremental expenditures solely to economically productive services is not feasible.

CONCLUSION

Surprisingly, studies have neglected to test directly the prediction from Barro–style models of endogenous growth that economic growth will initially rise with increases in taxes directed toward productive government activities, but will subsequently decline. Other studies, including Barro (1989, 1990), typically focus on whether the linear incremental effect of taxes spent on productive government activities is positive, negative, or zero, with substantial evidence for all three conclusions.

In this study, we explore nonlinearities in state fiscal policies, in particular both linear and quadratic effects for taxes spent on productive government activities. Results for U.S. states provide support for the “growth hill” predicted by the Barro–style models: the incremental effect of tax financed expenditures on productive government activities is non–monotonic—initially positive (a positive linear effect), but eventually negative (a sufficiently negative quadratic effect).

The decline arises primarily from the crowding out of private capital as the rising (distortionary) tax share reduces the net return to private capital.

These results stand in contrast to other studies based on linear models that find positive linear effects of taxes spent on productive inputs. In those studies, the positive effect, if taken literally, implies that government can raise the tax rate to 100 percent as long as the revenues are spent on productive public services, while implausibly continuing to increase economic growth. Similarly, the results stand in sharp contrast to many studies based on linear models that find either negative or insignificant effects of taxes. The negative (or insignificant) effect in those studies, if taken literally, implies that publicly provided inputs (schools, highways, streets) never contribute to economic growth. Of course, some studies, notably those by Barro, interpret coefficients from linear specifications correctly, i.e., as the slope at a particular point on a potentially non–monotonic growth hill.

Overall in our sample, the average state appears to be underinvesting tax revenues in productive government services, relative to the maximum growth rate. However, by 2004 many more states were within the confidence interval for the growth peak. Still, for many reasons, we are hesitant to place too much emphasis on our particular point estimates. The confidence interval for the peak of the growth hill is large. Our categories for state–local budgets are broadly defined, so that one cannot distinguish, for example, highways from schools or water systems from airports. Similarly, the revenue side is also broadly defined, so that one cannot distinguish among taxes, fees, or inter–governmental revenues. Also, apparent underspending on productive activities may arise because state political preferences preclude major increments in tax revenues devoted exclusively to economically productive public services,
with no increments to health, welfare or related support programs.

All of these distinctions and considerations with regard to the precise magnitude of the growth–hill peak are potentially important, and no doubt worthy of more precise examination. Nevertheless, our results provide novel evidence for growth hills for U.S. states, confirming that the effect of taxes depends both on their initial level and on how they are spent.

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