COMPLETE STATE AND LOCAL FISCAL POLICY IMPACTS ON LOCAL ECONOMIC GROWTH

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ABSTRACT

What is the net effect of simultaneous changes in tax rates and government spending on economic growth? This question is both of theoretical interest to economists as well as practical interest to public decision makers. Our contribution to the question is two-fold. First, we advance the theoretical content by developing a two-sector endogenous growth model and showing the effects on economic growth of five types of taxes and three categories of public spending. Second, we empirically apply the model and calculate net growth impacts of alternative combinations of tax rate and public spending changes. Our results show the net impacts on growth importantly depend on the tax and spending combination considered. Increasing corporate income tax rates, regardless of how the revenues are spent, retard economic growth. Upwardly shifting marginal individual income tax rates with the added funds spent on higher education raises economic growth, while spending the funds on K-12 public education lowers growth. Finally, simultaneously increasing gas tax rates and spending on roads raises economic growth.

INTRODUCTION

What is the simultaneous effect of various combinations of taxes and government spending on economic growth? Since the use of state and local fiscal policy as an important device for economic growth is often central to this discussion, the question is both of theoretical interest to economists as well as practical interest to public decision makers. Unfortunately, existing theoretical and empirical literatures remain very sparse in terms of analyzing *simultaneous* effects of taxing and spending decisions on economic growth.

In the existing empirical growth literature, it is largely supported that fiscal policy (taxation and government spending) affects economic growth in opposite directions: taxes affect economic growth inversely whereas government expenditures enhance economic growth. For example, by taking full account of the wide variety of government expenditures and taxes in a regression for a panel of 22 OECD countries, Kneller, Bleaney and Gemmell (1999) show that an increase in productive expenditures significantly enhances growth, and an increase in distortionary taxation significantly reduces growth. Kocherlakota and Yi (1997) find that taxes have significant negative effects on economic growth only if public capital expenditures are included. The study by Helms (1985) extensively looks at the relationship between economic growth and fiscal policy at the state and local level. He finds the influence of state and local taxes on economic growth crucially depends on the way in which government expenditures are financed. Helms (1985) argues that state and local taxes have a negative effect if revenues are allocated to transfer payment programs, but increases in government expenditures in areas such as health, education, and highways have a positive effect on economic growth.

In this study, a generalized version of a two-sector endogenous growth model along the lines of Barro and Sala-I-Martin (1995, chp5), Mendoza, Milesi-Ferretti and Asea (1997) and Milesi-Ferretti and Roubini (1999) is used to analyze the effects of productive capital, consumer durable capital and various fiscal policies on economic growth. Including consumer durable capital allows examination of the effect of property taxes on growth, which has been ignored in the theoretical growth literature. In contrast to the existing theoretical literature, since this study includes both various taxes and government expenditures in the theoretical model, it provides a more complete examination of the simultaneous effects of government fiscal policies on growth, which is a crucial issue for policy makers.

On the other hand, this paper's empirical analysis aims to move the existing literature forward by formulating a way to estimate the net effect of the opposite forces of taxes and spending on economic growth. First, the developed theoretical model is empirically analyzed using county-level panel data for North Carolina covering the period 1980-1995. Second, the parameter estimates from the full model are used to forecast the growth effects of realistic fiscal policy changes, such as an increase in expenditures financed by a concomitant increase in taxes. Using a model estimated for one state (North Carolina), we show: (1) state economic growth is dependent not only upon state and local taxes, but also upon the types of expenditures the taxes finance, and (2) it is important for policy makers to know the simultaneous *net* effect of various combinations of taxes and government spending on economic growth. When policy makers are contemplating the effects of a fiscal policy change on economic growth, they must consider the net effects of the specific tax rate changed and the specific spending category changed together. As an example, we find an upward shift in individual marginal income tax rates combined with greater higher education spending increases economic growth, whereas an increase in the corporate income tax rate spent on K-12 education lowers economic growth.

The organization of the paper is as follows. Section 2 develops and presents the theoretical model and its implications along with the analysis of the effects of different taxes and expenditures on economic growth. Section 3 discusses the data and the empirical analysis. Simultaneous net effects of various combinations of taxes and government expenditures are calculated and presented in section 4. The concluding section summarizes the findings and makes recommendation for further study.

AN ENDOGENOUS GROWTH MODEL WITH TAXES AND GOVERNMENT SPENDING

This section examines how different taxes and various government expenditures affect economic growth in a human-capital driven growth model. We first extend an existing two-sector endogenous growth model by including property taxes and different types of government spending. We then use the model to examine how combinations of tax rate and spending changes impact economic growth. Then we examine how these fiscal polices affect economic growth.

The Two-Sector Endogenous Growth Model

Consider two sectors in which production takes place. The first sector produces final goods (physical private output). The second sector produces human capital through schooling (education).

Physical output is produced with a constant return to scale (CRS) technology that uses human capital H and private physical capital K. Physical output Y can be used for consumption, investment in physical capital, and investment in durable goods. The technology for a representative firm is assumed to take a Cobb-Douglas form:

$$Y_t = A\left(\frac{\mathrm{K}_{\mathrm{G,t}}^{\mathrm{R}}}{\mathrm{N}}\right)(v_t K_t)^{\alpha}(u_t H_t)^{1-\alpha} \qquad (1)$$
$$A' > 0; \mathrm{A}'' < 0,$$

where total factor productivity (parameter A) is a function of productive government capital K_G^R per person, and N denotes population. Therefore, K_G^R enters into the production of physical output as an input enhancing the productivity in the economy, that is, by raising total factor productivity. Parameters v and u are the fractions of physical private and human capital devoted to the production of physical goods, respectively, and α represents the physical capital share in the physical output sector. Further, K_G^R is specified as government owned capital stock in roads.

The technology for human capital production exhibits constant returns to scale and also uses human and physical capital as inputs. New human capital can only be obtained by allocating more time to schooling. Human capital of a representative household is produced as follows:

$$\dot{H} = B\left(\frac{G_{E,t}}{n}\right)\left[(1-v_t)K_t\right]^{\beta}(z_t H_t)^{1-\beta} - \delta_H H_t \qquad (2)$$

$$B' > 0;\ B'' < 0,$$

where (1-v) and z are the fractions of physical and human capital, respectively, used in the accumulation of human capital through schooling [1]. As agents devote part of their non-leisure time (z) attending school, the accumulation of human capital will increase. G_E is current government spending on operating schools and includes teachers' salaries, heating of school buildings, etc. G_E can be thought of as publicly provided quality of education, where n and β represent the numbers of students attending school and share of capital in human capital accumulation, respectively. Hence, (1-v)K is considered as public school buildings and equipment [2]. Finally, human capital depreciates at the rate δ_H.

The accumulation equation for physical capital is:

$$\dot{K} = Y_t - C_t - I_{D,t} - G_t - \delta_K K_t \qquad (3)$$

where G is the total government expenditure and δ_K is the depreciation rate of physical capital.

Firms operate in a perfectly competitive environment. They rent physical capital from households at the rate of return R^K and hire labor at the wage rate R^H to the point where the value of the marginal products equal their rental rates (factor prices):

$$R_t^K = A\left(\frac{K_{G,t}^R}{N}\right)\alpha\left[\frac{vK_t}{uH_t}\right]^{\alpha-1} \qquad (4)$$

$$R_t^H = A\left(\frac{K_{G,t}^R}{N}\right)(1-\alpha)\left[\frac{vK_t}{uH_t}\right]^{\alpha} \qquad (5)$$

Given the rate of return to physical capital R^K, and the competitive wage rate per efficiency unit of labor R^H, firms employ the optimal amount of physical capital (K) and human capital (H) in order to maximize their profits.

The economy is inhabited by identical, infinite horizon households. Households rent human and physical capital to firms and operate the human capital accumulation technology described in equation 2. The household's lifetime utility is shown as:

$$U_t = \int_0^{\infty} e^{-\rho t} u(C_t, \ell_t, D_t)\,dt \qquad (6)$$

where ρ is the rate of time preference, C is private consumption, ℓ denotes the proportion of time devoted to leisure and D is the stock of durable goods [3].

The instantaneous utility function takes the form of Constant Intertemporal Elasticity of Substitution (CIES) [4]:

$$u(C_t, \ell_t, D_t) = \frac{(C_t \ell_t^{\eta} D_t^{\varsigma})^{1-\theta} - 1}{1-\theta} \qquad \theta > 0 \qquad (7)$$

where θ is the inverse elasticity of intertemporal substitution, and both η and ς are positive. For simplicity, each individual's time endowment is normalized to one and is written as $u+z+\ell=1$.

The accumulation equation for household durable goods is:

$$\dot{D} = I_{D,t} - \delta_D D_t \tag{8}$$

where I_D represents the flow of durable goods and δ_D is the depreciation rate of durable goods. Throughout the analysis it is assumed that human capital depreciates at the same rate as durable goods and physical capital: $\delta=\delta_H=\delta_K=\delta_D$.

Consumers maximize utility subject to the equations for accumulation of human capital and durable goods given by equations 2 and 8 and subject to the budget constraint:

$$\begin{aligned} & R_t^K(1-\tau_t^K)vK_t + R_t^H(1-\tau_t^H)uH_t + S_t - C_t(1+\tau_t^C) - \tau_t^D D_t - \tau_t^D K_t \\ & - I_{D,t}(1+\tau_t^C) - \dot{K}_t - \delta K_t \geq 0 \end{aligned} \tag{9}$$

where τ^K is the tax on physical capital, τ^H is the tax on labor income, τ^C is the consumption tax and τ^D is the property tax on household durable goods and durable goods owned by the firm and S is a lump-sum transfer.

The government finances the various types of public expenditures by imposing taxes. It is assumed that government does not issue bonds. With the government budget balanced, the instantaneous budget constraint of the government is:

$$\begin{aligned} T_t &= G_t + S_t \\ &= G_t(IR) + G_t(IE) + G_{E,t} + G_t(OTHER) + S_t \end{aligned} \tag{10}$$

where G is the total government expenditure, T is total tax revenue and equal to $\tau^K R^K vK + \tau^H R^H uH + \tau^C(C+I_D) + \tau^D(D+K)$, G(IR) and G(IE) are government investment in roads (K_G^R) and schools ((1-v)K), respectively, G_E is current government spending for operating the schools, and G(OTHER) represents all other current government expenditure.

This paper looks at the long-run, balanced growth path (or steady state) in which the paths of {C, H, K, D} grow at a constant common rate (γ) rate and u, v and z remain constant. Then, the following is the steady-state growth rate (γ) (derivations of equation 11 and all other equations cited are available on request):

$$\gamma = \frac{1}{\theta}\left\{\left[F(1-\tau^K)^{\alpha}(1-\tau^H)^{(1-\alpha)}(u+z)^{\frac{1-\alpha}{\beta}} - \frac{\tau^D}{(\gamma\theta+\rho+\delta)^{\frac{\alpha-1}{\beta}}}\right]^{\frac{\beta}{1-\alpha+\beta}} - \rho - \delta\right\} \tag{11}$$

$$u+z=\frac{1}{1+\left[\eta\frac{(1+\tau^{C})}{(1-\tau^{H})}\frac{(1-\xi)}{(1-\alpha)}\right]\left[\frac{(\gamma\theta+\rho+\delta)+\tau^{D}}{(\gamma\theta+\rho+\delta)+\tau^{D}+\xi(\gamma+\delta)}\right]}\times$$

$$\frac{1}{\left[1\text{ - g - }\frac{(\gamma+\delta)}{(\gamma\theta+\rho+\delta+\tau^{D})(1\text{ - }\beta)(1-\xi)}\left((1-\xi)\alpha(1-\beta)(1-\tau^{K})+\xi(1-\alpha)\beta(1-\tau^{H})\right)\right]} \qquad (12)$$

where $F=A\left(\frac{K_G^R}{N}\right)\alpha\left[B\left(\frac{G_E}{n}\right)(1-\beta)\right]^{\frac{1-\alpha}{\beta}}\left[\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right]^{1-\alpha}$

$$\xi=(1-\beta)\left(\frac{\gamma+\delta}{\theta\gamma+\delta+\rho}\right)$$

$g=G/Y$

Equation 11 shows that the growth rate is a function of all exogenous fiscal variables (τ^K,τ^H,τ^C,τ^D G_E, K_G^R) and is also of the fraction of time spent in non-leisure activities (u+z), which is endogenous to the model. By inserting equation 12 into equation 11, we could eliminate u+z and obtain a very complicated non-closed form expression for γ that would be a function of all exogenous fiscal variables. However the resulting expression is not very informative. Instead both equations 11 and 12 are used simultaneously to determine the effects of fiscal policy variables on economic growth (i.e. the sign of the derivative of γ with respect to the fiscal policy in question). The results of these experiments are shown in Table 1.

Table 1 shows the effects of fiscal policy variables on growth resulting from the developed theoretical model. All taxes (τ^K,τ^H,τ^C,τ^D) affect long-run growth negatively, whereas all government expenditures (K_G^R/N and G_E/n) have positive effects. These overall effects are perhaps unsurprising, but it nonetheless is informative to identify all the channels through which each fiscal policy variable affects long-run growth. Details of these channels are available upon request.

Theoretically, the net growth effect of simultaneous tax and spending changes is ambiguous depending upon the relative magnitudes of the parameters given in equation 11. However, this ambiguity can be overcome by empirical investigation of the theoretical model. The next section provides empirical analysis of the simultaneous impacts of changes in government expenditures and taxes on growth in a cross-county growth framework.

DATA AND EMPIRICAL METHODOLOGY

The model is estimated with county-level annual data from North Carolina. The data cover 99 (out of 100) counties in North Carolina for the years 1981-1995 [5]. Since the data set is annual, an important econometric issue in such a panel data set concerns the presence of endogenous explanatory variables. As discussed by Kneller *et. al* (1999), Folster and Henrekson (1999), Easterly and Rebelo (1993), the sources of the problems are business cyclical and structural factors. In order to eliminate these cyclical and structural-induced correlations and reveal the real effects of fiscal policies on the economic growth, some conditioning variables are included.

The cyclical component of U.S. real GDP per capita (GDPPER) is included to control the national business cycle phenomena [6]. During the study period in North Carolina, the textile/apparel and tobacco industries experienced major restructuring. The portion of a county's total industry earnings in the tobacco, textile and apparel industries combined (TEXAPPTOB) is included to control for this structural change at the county level. It is expected there are positive relationships between these variables and economic growth.

To capture any structural differences in student socioeconomic status, the percentage of households receiving foods stamps (STAMP) is included. Presumably, students from a lower level socioeconomic background (high food stamp rate) have more difficulty learning than those coming from households with a higher socioeconomic background. A higher (lower) food stamp household rate in a county thus has fewer (more) quality skilled labor, which results in lower (higher) labor productivity. Therefore, a negative relationship between the percentage of households receiving foods stamps and economic growth is expected.

During the study period of this paper, individual marginal income tax rates in North Carolina were legislatively changed in 1989 and 1992. Hence, a dummy variable (RATECHG) is set equal to 0.53 for 1989 and 0.40 for 1992 and 0 for the other years. Both 0.53 and 0.40 are the weighted average (by the proportion of households in each tax bracket) percentage point increase in the income tax rate across the tax brackets for each year. Since legislated marginal income tax rates increased in these years, it is expected that a negative relationship between RATECHG and economic growth exists. Also, as is standard in the empirical growth literature, initial real non-transfer personal income per capita (INITIAL) is included as a right-hand-side variable. The means, standard deviations, and ranges for each variable in the empirical model are reported in Table 2.

The data used in this study are obtained from public county and state sources in North Carolina. Much of the data are taken from the LINC (Log into North Carolina) data bank (North Carolina State Data Center, Office of State Planning). A detailed source and definition for each variable are listed in Table 3 [7].

The regression equation follows the linear approximation form of equation 11 and can be described as following:

$$\begin{aligned} GROWTH_{i,t} = \; & \pi_0 + \pi_1 INITIAL_{i,t-1} + \pi_2 TAXINC_{i,t} + \pi_3 TAXCOR_{i,t} + \pi_4 TAXGAS_{i,t} + \\ & \pi_5 TAXSAL_{i,t} + \pi_6 TAXPRO_{i,t} + \pi_7 ROAD_{i,t} + \pi_8 EXPK12_{i,t} + \pi_9 EXPHIGH_{i,t} + \\ & \pi_{10} GDPPER + \pi_{11} TEXAPPTOB_{i,t} + \pi_{12} STAMP_{i,t} + \pi_{13} RATECHG_t + \varepsilon_{it} \end{aligned} \qquad (13)$$

where i represents county and t is time period (with t=1…T); *GROWTH* (γ) is the average growth rate in real non-transfer personal income per capita; INITIAL is the initial real-non transfer personal income per capita; TAXINC (τ^K) is the state average weighted marginal individual income tax rate, which varies over time; TAXCOR (τ^K) is the state corporate income tax rate, which varies over time; TAXGAS (τ^C) is the state real gas tax rate in \$ per mile driven, which varies over time; TAXSAL (τ^C) is the effective sales tax rate, which varies over time; TAXPRO (τ^D) is the effective property tax rate in \$ per \$100 of market valuation, which varies over time and across counties; ROAD (K^R_G / N) is the real stock value of roads per square mile of land area, which varies over time and across county; EXPK12 (G_E/n) is the real government operating school expenditures for grades K-12 per pupil, which varies over time and across counties; EXPHIGH(G_E/n) is real government operating expenditures for higher education per pupil, which varies over time; GDPPER is the cyclical component of U.S. real GDP per capita, which varies over time; TEXAPPTOB is the portion of a country's total industry earnings in the tobacco, textile and apparel industries combined, which varies over time and across counties; STAMP is the percentage of households receiving foods stamp, which varies over time and across counties; RATECHG is a dummy variable taking the value 0.53 for year 1989, 0.40 for year 1992 and 0 for other years; and ε_{it} is the error term [8].

ESTIMATION RESULTS

In order to forecast the growth effects of fiscal policy changes, such as an increase in public spending financed by a concomitant increase in taxes, a two step of estimation process is applied. Each step is discussed in turn with endogeneity issues.

Step One: The first step involves the empirical estimation of equation 13. An OLS procedure with fixed effects for each county is applied to the panel data [9]. Any outlier observations, defined as an observation deviating more than two standard errors of a full-sample regression, are excluded. Because of a high correlation between TAXCOR and TAXGAS (0.95), equation 13 is estimated by first omitting TAXCOR and then omitting TAXGAS.

The empirical results are given in Table 4. Since the results using TAXCOR or TAXGAS are very similar, using either regression gives the same interpretation of the empirical model. Initial income (INITIAL) is negative and significant at the five percent level, suggesting conditional convergence of growth rates over the year. Government spending variables have the expected signs and are consistent with the predictions of the theoretical model. The government capital stock of roads per square mile of land (ROAD), current government expenditures on operating public schools per pupil (EXPK12), and government spending on higher education per pupil (EXPHIGH) are positive and statistically significant. Their estimates suggest that, holding everything constant, a unit increase in ROAD, EXPK12 and EXPHIGH increases the growth rate by 0.0016, 0.00001 and 0.0001 percentage points, respectively. Once again this supports the standard hypothesis. Also, the results for the education variables are consistent with the findings of Devarajan *et al*. (1996).

In contrast, mixed results are found for the effects of taxes on economic growth. The gasoline tax (TAXGAS) and corporate income tax (TAXCOR) are statically negative at the five percent level, but the effective property tax (TAXPRO) is positive in regression 1 and negative in regression 2, although statistically insignificant in both regressions. Both the average-marginal income tax (TAXINC) and effective sales tax (TAXSAL) are statistically significant and positively correlated with the growth rate, contrary to expectations.

The parameter estimates for control variables, GDPPER, TEXAPPTOB and STAMP have the expected signs and are statistically significant. Finally, fixed effects are tested to see if there is a "county specific effect". The result is tabulated in Table 4 and suggests that at the five percent significance level, the hypothesis that the coefficients on county specific effect are jointly equal to zero is rejected by the data.

Explanations for the unexpected signs on TAXINC and TAXSAL are needed and important in this study. One possible and likely explanation for a positive coefficient is that the average income tax (TAXINC) is progressive in nature and positively related to the level of income. As the growth rate increases (decreases), a higher (lower) average income level results, and a rising (decreasing) income level pushes households into higher (lower) average income tax brackets. So there may be a spurious positive correlation between the growth rate and TAXINC. As a result, RATECHG, the dummy variable, is included to capture the effect of marginal income tax rates on economic growth. The parameter estimate on RATECHG has the expected negative sign and is statistically significant at the five percent level. However, this endogeneity issue still needs special attention.

The same line of thought may apply to the explanation of the positive sign of TAXSAL. An increase in the growth rate results into a higher average income level. As income increases, consumer spending shifts to services. Since consumer spending on services is largely untaxed by the retail sales tax in North Carolina, there will be pressure to increase the retail sales tax rate during years when and in counties where faster economic growth occurs. Therefore, this inconsistent sign on TAXSAL may be due to an endogeneity problem (spurious correlation between the dependent variable and TAXSAL). This possibility would be consistent with the arguments by Caselli *et al.* (1996) that endogeneity of the explanatory variables is the source of inconsistency of results in existing cross-country empirical studies.

Endogeneity Issues: Theoretically, it is plausible, and also very likely, that both the tax and government expenditure variables increase with higher growth rates. During periods of rapid growth, the government may commit itself to new spending programs and also to new taxes to finance them. The study by Slemrod (1995, p. 401) underlined this simultaneity problem, concluding that "there is no persuasive evidence that the extent of government has either a positive or a negative impact on either the level or the growth rate of income, largely because the fundamental problems of identification have not yet been adequately addressed".

However, as mentioned before, the greatest sources of this simultaneity in the regression are "business cycle effects" and "structural factors". Therefore, controlling for business cyclical and structural factors, as suggested, may not be enough to handle the endogeneity problem (Kneller *et al*., 1999 and Fölster and Henrekson, 1999).

So, there are many reasons to suspect an endogeneity problem in our study. To solve the problem of endogeneity, the method of instrumental variables (IV) is used. However, there is an important cost of performing IV estimation: when independent endogenous variable (x) and unobservable error term (u) are uncorrelated, the asymptotic variance of the IV estimator is always larger than the asymptotic variance of the OLS estimator (Wooldridge 2003, p.490). However, this loss of efficiency is worth accepting if the OLS estimator is indeed biased and inconsistent in the presence of the endogenous explanatory variable. Therefore, a test of the necessity to resort to IV would be useful. We perform "Granger causality" tests to evaluate the nature of the relationship between the dependent variable (GROWTH) and average income tax rate (TAXINC) and effective sales tax rate (TAXSAL).

A necessary condition for Y to Grange- cause X is to regress X on its own lags and a set of lagged Y's, and the coefficients on lagged Y's are statistically significant to the explanation of X (Maddala, 1992, p.393). The results in Table 5 suggest that there is a bi-directional relationship between GROWTH and TAXINC and between GROWTH and TAXSAL (GROWTH Granger-causes TAXINC (or TAXSAL), and TAXINC (or TAXSAL) Granger-causes GROWTH). This result suggests that both average income tax (TAXINC) and effective sales tax rates (TAXSAL) are not exogenous to the model (see Maddala 1992, p. 394 for the detail discussion).

Performing Instrumental Variables Technique (IV): To address the concern about endogeneity require constructing a set of instrumental variables (IV) for both taxes and government expenditures. Although there is no ideal instrument, the most common choice is followed. As instruments, we use fixed county effects, the lagged levels of all fiscal variables, the level and first difference of initial income (INITIAL), the percentage of households receiving foods stamp (STAMP) and the cyclical component of U.S. real GDP per capita (GDPPER). The regression results using this technique are tabulated in regressions 3 and 4 in Table 4.

Comparing the IV results with those regressions 1 and 2 in Table 4, the major difference is that the effective sales tax (TAXSAL) is positive but statistically insignificant. It is obvious that the effect of effective sales tax on economic growth identified earlier was simply the result of endogeneity. However, the interpretation of all other fiscal variables on growth is mainly unaffected.

Step Two: The second step in the estimation procedure uses the parameter estimates reported in regression 1 and 2 in Table 4 to estimate the net growth effects of the opposing government policy variables. The results allow five "tax and spend" combinations to be estimated, in which the increase in the tax rate reduces economic growth but the resulting increase in government spending increases growth. Changes in the corporate income tax rate and in the individual income tax dummy variable are each paired first with a change in higher education spending and then with a change in K-12 education spending. A change in the gas tax rate is matched with a change in road spending. The combinations and their empirical results are given in Table 6.

As an example, one of the "tax and spending" combinations increases the corporate income tax (TAXCOR) by one percentage point and spends the additional revenue on higher education (EXPHIGH). To see how the net effect was found, the following steps were followed. The one percentage unit (0.01) increase multiplied by the average real corporate income base over the study period (1981-1995) yields the additional revenue collected. This additional revenue is then allocated to spending on higher education. The additional spending per pupil is $140.24. Multiplying 0.0001 (the parameter estimate on EXPHIGH) by $140.24 yields a 0.0140 unit increase in the growth rate. To find the opposite effect of a one-percentage point increase in the corporate income tax rate on growth, -1.565, the parameter estimate, is multiplied by 0.01, which lowers the growth rate by –0.01565. Adding the two effects gives the net effect on the growth rate, which is approximately –0.002. As a result, a one-percentage point increase in the average corporate income tax, which is spent on higher education, lowers the growth rate by 0.002 percentage points.

The results suggest an increase in the corporate income tax, regardless of how the added revenues are spent, causes a reduction in economic growth, while an increase in the gas tax rate along with more road spending spurs faster growth. An upward shift in all marginal individual income tax rates with the funds spent on higher education increases economic growth, while the same tax change together with greater spending on K-12 public education lowers economic growth.

One drawback of our method is to ignore any transitional effect created through the change in tax rates. It is thought that increases in the tax rate leads to decreases in the tax base**,** since higher tax rates create disincentives for working, spending, and investing, and higher tax rates leads to a reallocation of economic activities to other areas with comparable lower tax rates. For example, an increase in the marginal income tax will motivate people to change their spending patterns, such as investing in tax-free activities, charitable gifts, etc., or reduce market work. In this sense, it is very difficult to capture individuals' decisions on how much to work or how much to invest in alternative actives in response to marginal tax rate changes [10].

Our method estimates the direct effect of taxes on economic growth and ignores any indirect effects of fiscal policies through changes in the tax base. However, since ignoring these indirect effects will result in an underestimated fiscal policy effect on economic growth, the net effects of different government policies on economic growth, listed in Table 6, should be more negative or much smaller.

CONCLUDING REMARKS

This paper has addressed the question of "what is the simultaneous effect of various combinations of taxes and government spending on economic growth?" in a theoretical and empirical framework, using county-level data for North Carolina. A two-sector endogenous growth model is developed, and the effects of five taxes and three types of public spending on economic growth are estimated. The empirical results are used to estimate the total effect of five different tax rate and public spending combinations on economic growth.

The empirical results have several important policy implications. The study has demonstrated the importance of analyzing both components of fiscal policy – taxes and spending – simultaneously. Thus, when policy makers are contemplating the effects of a fiscal policy change on the economic growth, they must consider the effects of the specific tax rate changed and the specific spending category altered together. Furthermore, the total impact may vary with the tax/spending category combination chosen. As an example, we found an increase in the income tax dummy with added funds spent on higher education leads to higher economic growth, whereas an increase in the corporate income tax rate combined with any added educational spending lowers economic growth.

Future work would refine and extent the public spending categories and extend the theoretical model to include "feedback" effects on the economic base. Application of the model to other governmental levels would also be beneficial.

ENDNOTES

1. Throughout the paper, a variable with a dot (.) over it represents the time derivative.

2. (1-v)K is the total physical capital used in human capital accumulation, comprising the sum of private and government capital. Educational capital is school buildings and equipment. It seems reasonable to suppose that publicly provided schools and equipment are perfectly substitutable with privately provided alternatives. The two quantities thus can be added. Since there are few private schools in North Carolina, to which the theoretical model is applied, defining (1-v)K as public schools and equipment is not at all unreasonable. For example, in 1989 only 4.3 % of elementary and secondary students in North Carolina were in private schools (U.S. Department of Education; *Digest of Education Statistics,* 1993, Table 43 and 62).

3. It is assumed that the flow from durable goods (d) is proportional to the stock of durable goods: d=QD, where Q is a constant. In the analysis, Q is taken as equal to unity for simplicity.

4. This CIES form has been shown by King, Plosser and Rebelo (1988) to be necessary for the existence of a balanced growth path in an endogenous growth model.

5. Dare County is omitted from the analysis. Dare County is a coastal county with unique natural features. It has experienced an economic boom based on tourism. Its growth rates are so different than the other countries that its economy is judged to be fundamentally different that the economies of the other counties.

6. Real U.S. GDP cyclical component (GDPPER) is obtained by a de-trending method. Approaches by Beveridge and Nelson (1981) and the Hodrick and Prescott (1997) are also used to separate real U.S. GDP from growth component. The results are also used for empirical estimation. However three approaches produce almost the same empirical results.

7. For more detailed information about the calculation of data used in this study, see the unpublished dissertation by Denaux (2001).

8. Even though this study is limited to a single state, North Carolina, it does make sense to include state taxes that do not vary cross county. The reason is that state taxes can vary over time. Since the empirical estimation uses panel data, we are not only comparing different counties at a point in time but are also comparing the same county over time. So we needed to control for the state taxes that can vary in different years.

9. Originally three different forms of panel data estimation methods were considered: pooled OLS, one-way (county dummies) fixed (by OLS) and random (by GLS) effects models. Since the Hausman test rejects the null hypothesis of no correlation amongst the county-specific effects and the error term, the results obtained by one-way fixed effect model are reported.

10. This is the issue of *static* versus *dynamic* tax analysis. Our work is in the spirit of static analysis, and future models could attempt to consider the feedback effects on the tax base. See the study by Walden (2003) for a recent empirical estimation of dynamic tax effects.

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Table 1. Effect of Each Fiscal Policy Variable on Growth

Fiscal Policies	Model Prediction
Tax on Physical Capital (τ^K)	(-)
Tax on Human Capital (τ^H)	(-)
Tax on Consumption (τ^C)	(-)
Tax on Property (τ^D)	(-)
Stock of Roads per capita (K_G^R / N)	(+)
Current Government Spending on School (G_E/n)	(+)

Table 2. Descriptive Summary Statistics of Data

Variable	Mean	Standard Deviation	Min	Max
γ (GROWTH)	0.02	0.04	-0.13	0.34
τ^H (TAXINC)	0.06	0.003	0.05	0.07
τ^K (TAXCOR)	0.07	0.007	0.06	0.08
τ^C (TAXSAL)	3.57	0.740	1.79	5.97
τ^C (TAXGAS)	0.74	0.156	0.54	0.94
τ^D (TAXPRO)	0.75	0.20	0.24	1.81
K_G^R / N (ROAD)	11.5	8.69	1.65	51.9
G_E/n (EXPK12)	4671	942.95	2929	8897
G_E/n (EXPHIGH)	1464	223.34	1082	1720
GDPPER	-0.00029	0.0246	-0.483	0.0039
TEXAPPTOB	0.1050	0.11	0	0.505
STAMP	27.59	15.01	4.63	114.86
RATECHG	0.06	0.159	0	0.53
INITIAL (thousands)	12.46	3.09	5.87	24.97

Table 3. Description of Data

Variables [a]	Definition	Source
γ (GROWTH)	average growth rate in real non-transfer personal income per capita,	LINC Data
τ^H (TAXINC)	state average weighted individual marginal income tax rate	U.S Census Bureau, LINC Data,
τ^K(TAXCOR)	state corporate income tax rate	N.C Dept. of Revenue
τ^C (TAXSAL) [b]	effective sales tax rate	LINC Data, N.C Dept. Of Revenue
τ^C (TAXGAS) [b]	state gas tax rate in $ per mile driven	N.C Dept of Revenue, National Highway Trans. Safety Adm.
τ^D (TAXPRO)	effective property tax rate in $ per $100 of market valuation	LINC Data, N.C. Association of County Commissions,
K_G^R / N (ROAD)	stock value of roads per square mile of land area	N.C. Dep. of Transportation
G_E/n (EXPK12) [c]	government operating school expenditures for grades K-12 per pupil	N.C. Dep. of Public Instruction
G_E/n (EXPHIGH) [c]	government operating expenditures for higher education per pupil	N.C. Office of State Planning
GDPPER	Cyclical component of U.S. real GDP	LINC Data
TEXAPPTOB	portion of a country's total industry earnings in the tobacco, textile and apparel industries combined	LINC Data
STAMP	percentage of households receiving foods stamp	LINC Data
RATECHG	Dummy variable for shift in individual marginal income tax rates	N.C. Dept. of Revenue
INITIAL	real non-transfer personal income per capita	LINC Data

Note: a) All variables are expressed in 1995 dollars; b) Since a variety of consumption tax rates are applied to different goods and services, the effects of consumption tax (τ^C) are sub-divided into two categories: the effective sales tax rate, TAXSAL and state gas tax rate in $ per mile driven, TAXGAS; c) Government current spending on operating schools per pupil (G_E/n) is also divided into two for empirical purposes: government operating school expenditures for grades K-12 per pupil (EXPK12) and government operating expenditures for higher education per pupil (EXPHIGH).

Table 4. How Do Taxes and Government Expenditure Affect Growth? Panel Regression for 99 North Caroline Counties (Fixed Effect Approach)

Dependent Variable: Per Capita Income Growth				
Regressions	(1)	(2)	(3)	(4)
INITIAL	-0.018*	-0.018*	-0.015*	-0.014*
	(-13.66)	(-13.20)	(-10.43)	(-9.51)
TAXINC	2.937*	2.197*	2.69*	2.105*
	(8.36)	(5.51)	(6.78)	(4.88)
TAXCOR	-1.565*	--------	-1.957*	---------
	(-4.08)		(-3.91)	
TAXGAS	--------	-0.078*	--------	-0.04**
		(-4.48)		(1.63)
TAXSAL	0.021*	0.02*	0.003	0.0016
	(5.06)	(4.88)	(0.56)	(0.31)
TAXPRO	-0.0007	-0.001	-0.02	-0.02
	(0.07)	(-0.10)	(-1.28)	(-1.25)
ROAD	0.002**	0.002*	0.03	0.028*
	(1.67)	(2.08)	(5.43)	(5.04)
EXPK12	0.00001*	0.00001*	0.00001**	0.00001**
	(2.01)	(2.56)	(1.79)	(1.79)
EXPHIGH	0.0001*	0.0001*	0.0001*	0.0001*
	(5.31)	(5.00)	(4.66)	(4.09)
GDPPER	0.18*	0.21*	0.678	-0.23**
	(2.58)	(3.31)	(10.46)	(-1.76)
TEXAPPTOB	0.035**	0.033**	0.035**	0.039*
	(1.78)	(1.67)	(1.85)	(2.02)
STAMP	-0.0004**	-0.0004**	-0.0012*	-0.0012
	(-1.89)	(-1.89)	(-5.27)	(-5.27)
RATECHG	-0.02*	-0.02*	-0.012**	-0.012*
	(-2.76)	(-3.78)	(-1.91)	(2.62)
R^2	**0.46**	**0.46**	**0.55**	**0.55**
No. of Obs.	**1386**	**1386**	**1287**	**1287**
Fixed Effects				
F value	2.83	2.65	2.25	2.41
P value	0.0001	0.0001	0.0001	0.0001

Note: a) t-statistics calculated using White's heteroscedasticity robust standard error, are reported in parentheses. b) * and ** denote significance at the 5% and 10 % levels. c) Ho: No Fixed Effects vs Ha: Fixed Effects. d) County dummies are included in the regressions.

Table 5: Granger Causality Tests:

H_1: GROWTH $\Rightarrow$ TAXINC Wald test: 4.64**	**H_1:** TAXINC $\Rightarrow$ GROWTH Wald test: 43.12*
H_1: GROWTH $\Rightarrow$ TAXSAL Wald test: 19.12*	**H_1:** TAXSAL $\Rightarrow$ GROWTH Wald test: 5.44**

Note: * and ** denote significance at the 1% and 5 % levels. The symbol '$\Rightarrow$' indicates direction of Granger causality.

Table 6: Net Effect of Different Government Policies on Economic Growth

Experiments	Change in Growth
1. Increase corporate income tax rate by 1% and spend on higher education spending	decrease growth rate by 0.002
2. Increase corporate income tax rate by 1% and spend on K-12 spending	decrease growth rate by 0.0152
3. Increase gas tax rate by 1% and spend on road spending	increase growth rate by 0.0012
4. Increase income tax dummy by 1% and spend on higher education spending [a]	increase growth rate by 0.002
5. Increase income tax dummy by 1% and spend on K-12 spending [a]	decrease growth rate by 0.00006

Note: a) Using either the panel growth regression 1 or regression 2 in Table 5 produces identical results.

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