ENDOGENOUS GROWTH, TAXES AND GOVERNMENT SPENDING: THEORY AND EVIDENCE

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Abstract:

This paper provides a theoretical and empirical investigation of the simultaneous effects of taxes and government spending on long-run economic growth in an endogenous growth framework. It is argued that including both taxes and government spending in the model eliminates the omitted variables bias associated with the government budget constraint. A two-sector model is considered: one sector produces physical output and the other produces human capital. Government expenditure is broken into several categories, and several types of taxes are included. One kind of government capital (roads) enters in the physical output sector and another kind (schools) enters in the human capital accumulation sector. In addition, government operating expenditures for schools enters in the human capital accumulation sector. Personal income, corporate income, property, sales and gasoline taxes are included. The property tax is especially interesting because it is a major source of revenue for local government. The theoretical model is estimated using annual panel data of North Carolina counties. This study finds that state-level fiscal policies affect economic growth but county-level fiscal policies do not.

Keywords: **endogenous growth, taxation, government spending, public finance**

*JEL classification***:** O4, E62, H7

INTRODUCTION

This study focuses on the effects of government fiscal policy on long-run economic growth. Although a number of studies have investigated these effects, growth literature has been limited in two important ways. First, attention has been restricted to either taxes (Mendoza *et al.* 1997) or expenditures (Barro, 1990). However, the government budget constraint causes correlation among taxes and expenditures, leading to omitted variable bias if only taxes or expenditures are included in the growth analysis**.** Kneller, Bleaney and Gemmell's (1999) cross-county study extensively focuses on the systematic biases associated with the omission of the government budget constraint in empirical specifications relating growth to fiscal variables. This point is also demonstrated by Helms (1985), Modifi and Stone (1990). Second, with few exceptions (Kneller *et al.* 1999, Mendoza *et al.* 1997), most studies do not decompose taxes and government spending, or if they do, the decomposition is very limited. In particular, because of the difficulty in constructing comparable and consistent measures of tax rates and government expenditure for a sufficiently large number of countries, empirical studies use very aggregated measures (e.g., Easterly and Rebelo, 1993a, b, and Engen and Skinner, 1992). Therefore, the effects of different types of government expenditure and different taxes on growth are ignored in the existing empirical growth literature.

In contrast to the existing literature, this study includes both alternative taxes and government expenditures in the theoretical model and its estimation, taking full account of the restriction imposed by the government budget constraint. Expenditures are divided into several categories, and several types of taxes are included. One kind of government capital expenditure (roads) enters in the physical output sector. Another kind (schools) enters in the human capital accumulation sector. In addition, government operating expenditures for schools - such as teacher salaries, heating school buildings, etc. - enter in the human capital accumulation sector. The model includes several taxes: personal income, corporate income, property, sales and gasoline taxes. The property tax is especially interesting because it is a major source of revenue for local government and has generally been ignored in the growth literature. The model, then, allows a more complete examination of the simultaneous effects of government fiscal policies on growth, which is a crucial issue for policy makers.

The theoretical model developed in this study is empirically analyzed using county level data for North Carolina. North Carolina is a good case study for use of the theoretical endogenous growth model for three reasons. First, the state has experienced substantial economic growth in recent years. For example, from 1980 to 1995, the state's real Gross State Product increased 174%. Second, although the entire state has grown economically, growth rates among North Carolina's counties show significant variation. As an example, in 1995, 25 of 100 North Carolina counties had real per capita personal income growth rates above 5%, while 13 counties had growth rates under 1.5%. Other years show similar variation. Third, fiscal policy in North Carolina has been dynamic in recent years. There have been several changes, both up and down, to various tax rates, and government spending as a fraction of gross state product has been increasing on trend[1].

A few studies look at evidence of how state and local fiscal policies effect state economic growth. Modifi and Stone (1990) find that state and local taxes have a negative effect if revenues are allocated to transfer payment programs, and increases in government expenditures such as education, highways, etc, have a positive effect on economic growth. Helms (1995), in a study of the effect of taxes on state economic growth, argues that there is a significant and negative effect on economic growth after controlling all source and use funds. In this study, the question of how local and state fiscal polices affect the *county* economic growth is answered.

Several interesting results emerge from the analysis. The theory yields predictions for the growth effects of both taxes and spending. The estimation shows that: (i) state-level fiscal policies affect economic growth but county-level fiscal policies do not. One possible explanation of this result is that a county is a small economy that cannot affect its own growth, which is consistent with general findings in the growth literature. The fact that state-wide fiscal polices have an effect on the county's economic growth rate also raises an interesting question about whether broader government associations, such as the European Union, could institute fiscal policy that would affect their members countries economic growth; (ii) mis-specification of government budget constraints leads to very different parameters estimates than those estimated by taking full account of the restriction imposed by the government budget constraint. Since existing studies consider only taxes alone or government spending alone, resulting omitted variable bias leads to serious specification errors; (iii) the results reported are robust to several changes in data specification and regression specification; (iv) the parameter estimates from the full model can be used to forecast the growth effects of realistic fiscal policy changes, such as an increase in expenditure financed by a concomitant increase in taxes. As an example, an increase in education spending financed by an increase in the corporate income tax is evaluated. For this example, the tax effect dominates the spending effect, leading to a reduction in economic growth.

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[1] For example, from fiscal year 1991-92 to fiscal year 1995-96, there was a 39.8% increase in real per capita state and local government spending in North Carolina (North Carolina Association of County Commissioners, *Fiscal Summary of North Carolina Counties*, Fiscal Years 1991-92 to 1995-96*)*

The organization of the paper is as follows. Section 2 develops and presents the model and its implications. Section 3 analyzes the growth effects of different taxes and expenditures. Section 4 discuses the data and the empirical analysis. Section 5 concludes.

2. The Endogenous Growth Model with Taxes and Government Spending

A generalized version of a two-sector endogenous growth model along the lines of Sala-I-Martin and Barro (1995, Chap5), 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. Production takes place in two sectors. The first sector produces final goods (physical private output). The second sector produces human capital through schooling (education). There are two factors of production: physical capital and human capital, which are reproducible. Both factors are necessary for production in each sector, and they are capable of growing without bound.

2.1 Technology

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:

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

where total factor productivity, A is a function of productive government capital per person K_G^R / N, population N is exogenous to the model[2]; v and u are the fractions of the physical private capital and human capital devoted to the production of physical goods, respectively; α is the physical capital share used in the output sector. In this specification, government capital K_G^R enters into the production of physical output as an input, which enhances

[2] In this analysis, population is taken as exogenous to the model. Treating population as endogenous would be a worthwhile extension of this model. As an example, modeling migration among locations would be an important extension of this model in terms of analyzing how migration affect the long-run effects. However, this study is unable to show theoretically the effect of the migration on economic growth which is the shortcoming of this study.

productivity in the economy. Government capital is exogenous and is subject to congestion[3]. As suggested by Fernald (1999), government owned capital stock in roads is used as a proxy for productive government capital stock K_G^R.

The technology for human capital production exhibits constant returns to scale and also uses human and physical capital as inputs. Human capital of a representative household is then produced as follows:

$$\dot{H} = B\left(\frac{G_{E,t}}{n}\right)[(1-v_t)K_t]^{\beta}(z_t H_t)^{1-\beta} - \delta_H H_t \qquad (2)$$
$$B' > 0;\ B'' < 0,$$

where (1-v) and z are the fractions of physical (K) and human capital (H), respectively, used in the accumulation of human capital through schooling; G_E is current government spending on operating schools and includes teacher's salaries, heating of school buildings, etc., and can be thought of as publicly provided quality of education[4]; n and β represent number of students attending school and physical capital share used in human capital accumulation. Hence, (1-v)K is considered as public school buildings and equipment. Along the same line of thought as Mendoza *et al.* (1997), the human capital sector is a non-market, tax-free activity, which depreciates at the rate δ_H. Finally, current government spending on education is subject to congestion.

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 C is private consumption, I_D is flow of durable goods, G is the total government expenditure and δ_K is the depreciation rate of physical capital.

2.3. Households

The economy is assumed to be inhabited by identical, infinite horizon households. We therefore can use the representative agent framework. The representative households' lifetime utility is[5]:

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[3] Dividing K by N is a simple way to capture the idea that K is subject to congestion. For different ways to proxy congestion, see Barro and Sala-I-Martin (1992) and Turnovsky (1995).

[4] The assumption is that the higher the salaries the government pays to teachers, the more qualified and productive are the teachers. Several studies show that teacher quality has a strong effect on student achievement. See Lee and Barro (1997).

[5] It is assumed that service flow from durable goods services, d, is proportional to the stock of durable goods: d=QD, where Q is a constant and D is the stock of durable goods. In the analysis, Q is taken as equal to unity for simplicity, so the service flow d from durable goods services is equal to the stock D of durable goods.

$$U_t = \int_0^{\infty} e^{-\rho t} u(C_t, \ell_t, D_t) dt \qquad (4)$$

where ρ is the rate of time preference, ℓ denotes proportion of time devoted to leisure and D is the stock of durable goods.

Inclusion of the stock of the durable goods in the utility function has two important implications. First, introducing the stock of durable goods is a natural way of modifying the consumer's lifetime utility function since the household gets utility not only from nondurable goods, C, but also from consumer durable goods, D. Mankiw (1987) has shown that including durables can have interesting effects on model dynamics. Secondly, inclusion of D in the consumer utility function allows incorporation of the property tax, which is the main revenue source of local government. Previous studies in the growth literature have not included the stock of durable goods in the utility function and have not examined the effect of the property tax on economic behavior.

The instantaneous utility function takes the form of Constant Intertemporal Elasticity of Substitution (CIES)[6]:

$$u(C_t, \ell_t, D_t) = \frac{(C_t^{1-\varsigma} \ell_t^{\eta} D_t^{\varsigma})^{1-\theta} - 1}{1-\theta} \qquad \theta > 0 \qquad (5)$$

where θ is the inverse of the intertemporal elasticity of substitution, and both η and ς are positive. It is non-separable preference between nondurable goods and durable goods. For simplicity, each individual's time endowment is normalized to one and is written as $u+z+\ell=1$. Leisure, ℓ, is defined as the fraction of time not spent working and studying and is independent of one's human capital.

The accumulation equation for household durable goods is:

$$\dot{D} = I_D - \delta_D D, \qquad (6)$$

where δ_D is the depreciation rate of durable goods. Throughout the analysis it is assumed that human capital, durable goods, and physical capital all depreciate at the same rate: $\delta=\delta_H=\delta_K=\delta_D$.

Consumers maximize utility subject to their budget constraint and to the equations for accumulation of human capital and durable goods. The budget constraint is:

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[6] 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.

$$R_t^K(1-\tau_t^K)vK_t + R_t^H(1-\tau_t^H)uH_t + S - C_t(1+\tau_t^C) - \tau_t^D D_t - \tau_t^D K_t$$
$$- I_{t,D}(1+\tau_t^C) - \dot{K}_t - \delta K_t \geq 0 \qquad (7)$$

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

2.3. Firms

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):

$$R_t^K = A\left(\frac{K_{G,t}^R}{N}\right)\alpha\left[\frac{vK_t}{uH_t}\right]^{\alpha-1} \qquad (8)$$

$$R_t^H = A\left(\frac{K_{G,t}^R}{N}\right)(1-\alpha)\left[\frac{vK_t}{uH_t}\right]^{\alpha} \qquad (9)$$

Given R^K and R^H, firms employ the optimal amount of physical capital (K) and human capital (H) in order to maximize their profits.

2.4. Government

The government finances the various types of public expenditures by imposing taxes. It is assumed that Ricardian equivalence holds, at least as close approximation. With the government budget balanced, the instantaneous budget constraint of the government is[7]:

$$T = G + S$$
$$= G(IR) + G(IE) + G_E + G(OTHER) + S \qquad (10)$$

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 purchases and S is the lump-sum transfer to the representative household.

This paper looks at the long-run, balanced growth path (or steady state) –hereafter denoted BGP- in which

[7] This assumes that each county is a closed- small economy which will be disused in the empirical section of this

the paths of {C, H, K, D} grow at a constant common rate (γ) and u, v and z remain constant for given initial conditions, K(0)= K_o>0, H(0)= H_o>0 and D(0)=D_o>0. Define the net, after tax rate of return on physical capital as $r = R^K(1-\tau^K) - \tau^D - \delta$. The following equation system-obtained by maximizing equation 4 subject to equations 1, 2,3, 6 and 7- characterizes the BGP in this two-sector economy (the author can provide derivations of all these equations as well as all equations cited in the paper upon request):

$$\gamma = \frac{1}{\theta}(r-\rho) \tag{11}$$

$$r = (1-\tau^K)\alpha A\left(\frac{K_G^R}{N}\right)\left[\frac{vK}{uH}\right]^{\alpha-1} - \tau^D - \delta \tag{12}$$

$$r = (1-\beta)B\left(\frac{G_E}{n}\right)\left[\frac{(1-v)K}{zH}\right]^{\beta}(u+z) - \delta \tag{13}$$

$$r = \frac{\varsigma}{1-\varsigma}\frac{C}{D} - \frac{\tau^D}{1+\tau^C} - \delta \tag{14}$$

$$\frac{v}{u} = \frac{\alpha}{1-\alpha}\frac{1-\beta}{\beta}\frac{1-\tau^K}{1-\tau^H}\frac{1-v}{z} \tag{15}$$

$$\frac{\eta}{(1-\varsigma)(1-u-z)}\frac{C}{H} = \frac{R^H(1-\tau^H)}{1+\tau^C} \tag{16}$$

$$\gamma = B\left(\frac{G_E}{n}\right)z\left[\frac{(1-v)K}{zH}\right]^{\beta} - \delta \tag{17}$$

$$\frac{C}{Y} + \frac{I_D}{Y} + \frac{K}{Y}(\gamma+\delta) = 1 - \frac{G}{Y} \tag{18}$$

Equation 11 is the well-known Ramsey condition for the optimal intertemporal allocation of consumption and sets the links between the growth rate and the net rate of return on physical capital and between the growth rate and the elasticity of intertemporal substitution. Equation 12 repeats the definition of r with the expression from equation 8 substituted for R^K. Equation 13 is the equilibrium requirement that the two kinds of productive capital (K and H) have the same net rate of return between the sectors that produce goods and that produce human capital. This equation assures that market efficiency between the two sectors is satisfied. Equation 14 represents the link between the net rate of return on physical capital and the accumulation of durable goods: it assures that the rate of return on

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productive capital durable goods equals the rate of return on consumer durable goods. Equation 15 shows that for an optimal allocation of physical capital and hours devoted to each sector, after-tax marginal rates of substitution between factors must be equalized across the two sectors. That is, equation 15 guarantees the equality of shadow prices of human capital across two sectors. Equation 16 reflects the trade-off between consumption and leisure. The left-hand side of equation 16 is the marginal rate of substitution between consumption and leisure, and the right-hand side is the real wage rate (price of leisure in terms of goods), adjusted for consumption and labor income taxes. Equation 17 verifies one of the properties of BGP: long-run human capital grows at the same rate as consumption, physical capital and durable goods. The last equation is the resource constraint for the economy, with all variables expressed as a fraction of Y.

We can use equations (11)-(18) to obtain the following two simultaneous equations in the two unknown γ and u+z:

$$\gamma = \frac{1}{\theta}\left\{\left[F(1-\tau^K)^{\alpha}(1-\tau^H)^{(1-\alpha)}(u+z)^{\frac{1-\alpha}{\beta}} - \frac{\tau^D}{(\gamma\theta+\rho+\delta)^{\frac{\alpha-1}{\beta}}}\right]^{\frac{\beta}{1-\alpha+\beta}} - \rho - \delta\right\} \qquad (19)$$

$$u+z = \frac{1}{1+\left[\eta\frac{(1+\tau^C)}{(1-\tau^H)}\frac{(1-\xi)}{(1-\alpha)}\right]\left[\frac{(\gamma\theta+\rho+\delta)+\tau^D}{(1-\varsigma)(\gamma\theta+\rho+\delta)+\tau^D+\varsigma(\gamma+\delta)}\right]}\times \frac{1}{\left[1\text{ - g - }\frac{(\gamma+\delta)}{(\gamma\theta+\rho+\delta+\tau^{D})(1\text{ - }\beta)(1-\xi)}\left((1-\xi)\alpha(1-\beta)(1-\tau^K)+\xi(1-\alpha)\beta(1-\tau^H)\right)\right]} \qquad (20)$$

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 19 shows that the growth rate is a function of all exogenous variables (τ^K,τ^H,τ^C,τ^D G_E, K_G^R) that are exogenous and is also of the fraction of time spent in non-leisure activities (u+z), which is endogenous to the model. Inspection of the system of equations 11-17 also reveals that both u and z are functions of τ^C and τ^K as well as both τ^D and τ^H. Finally, g is the share of government expenditure in output.

Equation 20 describes a very complicated non-linear relationship between (u+z) and γ. Since ξ is a function of γ, the relationship between (u+z) and γ depends on the sign of $\xi'(\gamma)$ which is positive for sufficiently large θ. By inserting equation 20 into equation 19, (u+z) can be eliminated and obtain a very complicated non-closed form expression for γ that is a function of all exogenous fiscal variables. However, the resulting expression is not very informative. Instead, both equations 19 and 20 are used simultaneously to determine the unique values of γ and (u+z)[8].

3. Analyzing the Effect of Different Taxes and Government Expenditure on Long-Run Growth

Government spending and taxes affect the economy's growth rate through several channels. The spending channels are fairly straightforward, whereas the tax channels are quite complex. The following two examples illustrate this.

3.1 Stock of Roads (K_G^R / N):

An increase in the ratio of the stock of roads to population K_G^R/N, directly increases the marginal product R^K of physical capital in the physical production sector through technology parameter A. As a result, for a given value of vK/uH, increasing R^K increases the net after tax-rate of return r and so leads to higher levels of the growth rate. This channel of K_G^R/N affecting long-run growth can be shown by equations 11 and 12. Additionally, examination of equation 19 shows the direct positive effect of (K_G^R/N) on the long-run growth rate through the technology parameter A. Since (K_G^R/N) has no effect on (u+z) decision, the net effect of (K_G^R/N) on growth is positive

Keeping K_G^R unchanged, an increase in N produces a lower growth rate through the same channel as K_G^R/N. This negative effect originates from the fact that the government capital stock of roads is subject to congestion. In contrast to these straightforward effects, the tax channels are quite complex.

3.2 Taxes on Physical Capital (τ^K):

i) An increase in τ^K reduces the net, after-tax rate of return r for a given capital/labor ratio in production (vK/uH). This directly reduces growth. Equations 11 and 12 show this channel of tax effect on growth.

ii) An increase in τ^K reduces the capital/labor ratio in production (vK/uH) for a given time allocation between work (u+z) and leisure (ℓ). Decreasing the capital/labor ratio induces an increase in the gross tax return on capital. This produces a positive effect on growth[9].

ii) This channel of tax on physical capital has an indirect effect on growth through (u+z). This is implicitly described by equation 20. An increase in τ^K affects the work-leisure decision, which affects the capital labor ratio in production. The sign of this channel's effect on growth depends on the magnitude of the parameters given by equation 20.

However, based on equation 19, it can be concluded that the negative effect (i) dominates the positive effect (ii) but the effect through (ii) is ambiguous. Nonetheless, the overall net effect of τ^K on growth is negative (appendix available upon request).

The net effects of fiscal policies on the economy's growth rate clearly can be quite complex, but for each policy, it is possible to derive the sign of the total effect (i.e. the sign of the derivative of γ with respect to the policy in question[10]). The results are summarized in Table 1.

Table 1 **Net Effects of Fiscal Policy Variables 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)	(+)

All taxes ($\tau^K,\tau^H,\tau^C,\tau^D$) affect long-run growth negatively, whereas all government expenditures (K_G^R/N and G_E/n)

[8] It is known from the study by Ladrón-de-Guevara *et. al*., 1997, that this type of specification may generate multiple equilibriums. As the line of Milesi-Ferretti and Roubini (1998), it is assumed that there is a unique equilibrium for growth rate.

[9] This can be shown by using equations 14, 15 and 16.
[10] The method proposed by Devereux and Love (1994) is used.

have positive effects.

3.3 *Simultaneous Effect of Alternative Taxes and Social Overhead Capital on Growth:*

So far, we have developed the growth effects of spending and tax policies taken individually. This analysis allows us to consider the more important policy question of the net effect of a simultaneous change in taxation and expenditures. Answering this question is very important because, on the one hand, both expenditures and taxes affect economic growth, and on the other hand, expenditures and taxes are likely to be highly correlated through the government budget constraint. As an example, an increase in the stock of roads in the output sector for a given level of uK/vH improves the marginal utility of physical capital in the output sector relative to that in the education sector, which in turn induces a higher level of the net after-tax rate of return, r. This directly increases the growth rate. However, the way in which the stock of roads is financed also has an impact on the growth rate. For example, if the corporate capital income tax rate τ^k is used as the method of financing, the cost of physical capital rises. Therefore, for a given level of vK/uH, r falls, which has a negative effect on the long-run growth rate. In general, if the government increases taxes, any additional revenue collected must be allocated to some type of government expenditure; conversely, a change in government expenditure must be financed by a tax. Studying the growth effect of either taxes alone or expenditures alone is likely to be misleading because of omitted variable biases. Therefore, this study includes both alternative taxes and government expenditures in the theoretical model and the estimation, taking full account of the restriction associated with the government budget constraint.

Theoretically, the net growth effect of simultaneous tax and spending changes is ambiguous depending upon the relative magnitudes of the parameters given in equation 19. However, this ambiguity will be overcome by empirical investigation of the theoretical model. The next section provides more empirical analysis of government expenditure and taxes on growth in cross-county growth framework.

4. Empirical Methodology and Results:

4.1. The Data:

The model is estimated with county-level annual data from the state of North Carolina. The data used for estimation covers 99 (out of 100) counties in North Carolina for the period 1980-1995. Because data availability is limited at the county level, the period of this study is 1980-1995 to ensure the most comprehensive coverage of both state and county statistics. Some public sector decision variables (tax rates, public-spending levels) are set at the state level and some are set at the county level, so the findings have implications for both state-level and county-level decision-makers.

The data used 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). The detailed source and definition for each variable is listed in Table 2. The data are annual. The standard practice of taking 5-year averages is followed to remove the effects of business cycles. A panel econometric technique is applied following the usual practice in the empirical growth literature. Table 3 presents some descriptive statistics for the data set used for the empirical estimation.

Table 2: Full Description and Sources of the Data

Variable[a] (Symbol used in Estimation)	Full Name and Unit	Source
GROWTH (γ)	Growth rate in Real Non-Transfer Personal Income per capita	LINC
TAXINC (τ^K)	Average Weighted Marginal Income Tax Rate	U.S Census Bureau, LINC,
TAXCOR (τ^K)	Corporate Income Tax Rate	N.C Dept. of Revenue
TAXSAL (τ^C)	Effective Sales Tax Rate	LINC, N.C Dept. Of Revenue
TAXGAS (τ^C)	Real Gas Tax Rate in $ per mile driven	N.C Dept of Revenue, National Highway Trans. Safety Adm.,
TAXPRO (τ^D)	Effective Property Tax Rate in $ per $100 of market valuation U.S. Bureau of the Census	LINC, N.C Association of County Commissions,
ROAD (K_G^R / N)	Real Stock Value of Roads per square mile of land area	N.C. Dep. of Transportation
EXPK-12 (G_E/n)	Real Government Operating School Expenditures for Grades K-12 per pupil	N.C. Dep. Of Public Instruction
EXPHIGH(G_E/n)	Real Government Operating Expenditures for Higher Education per pupil	N.C. Office of State Planning
INITIAL[b]	Initial Income	LINC
TEXAPPTOB[c]	(Textile +Apparel + Tobacco Earnings) / Total Private Industry Earnings	LINC
INFANT[c]	Infant mortality rate per 1,000 residents live births	LINC

a) Variables are expressed in 1995 dollars. b) Initial income variable, INITIAL is included as a conditioning variable that can be found in the usual Barro-type regression. c) TEXAPPTOB and INFANT are included to capture the structural and socio-economic differences among the counties in North Carolina. The details of these variables will be discussed in later.

Table 3
Overall Descriptive Statistics

Variable	Mean	Std.	Min	Max
GROWTH	2.325	4.322	-13.677	34.724

TAXINC	6.466	0.372	5.067	7.000
TAXCOR	6.796	0.756	6.000	7.750
TAXSAL	3.536	0.756	1.762	5.970
TAXGAS	0.726	0.164	0.482	0.939
TAXPRO	0.763	0.208	0.245	1.817
ROAD	11.664	8.819	1.654	55.077
EXPK-12	4593	966	2771	8960
EXPHIGH	8628	588	7628	9409
INITIAL (in thousand)	12.04	2.98	6.18	23.38
TEXAPPTOB	10.7	11.26	0	50.05
INFANT	11.68	6.52	0	57.69

4.2. The Empirical Estimation Methodology:

This paper follows the lead of Mendoza, *et al*. (1997) and postulates a linear approximation for the relation between growth and fiscal variables:

$$\gamma_{it} = \pi_0 + \pi_1 \tau_{it}^K + \pi_2 \tau_{it}^H + \pi_3 \tau_{it}^C + \pi_4 \tau_{it}^D + \pi_5 \frac{K_{G,it}^R}{N_{it}} + \pi_5 \frac{G_{E,it}}{n_{it}} + \varepsilon_{it} \qquad (21)$$

where i represents county and t is time period, $\gamma_t = ln\, y_t - ln\, y_{t-1}$ is the growth rate in non-transfer personal income, τ^K, τ^H, τ^C, and τ^D are the marginal tax rates on corporate income, personal income, consumption, and property, respectively, K_G^R/N and G_E/n are the stock of roads per square mile of land area and current government expenditures on operating schools per pupil, respectively.

Henceforth, the notation reported in Table 2 is followed: the corporate income tax rate (τ^K), average marginal individual weighted income tax rate (τ^H), and effective property tax rate (τ^D) are denoted as TAXCOR, TAXINC, and TAXPRO, respectively. Since a variety of consumption tax rates are applied to different goods and services, the effects of the consumption tax (τ^C) are sub-divided into two categories: the tax rate on gasoline per mile driven, denoted as TAXGAS, and the tax rate on effective sales reported as TAXSAL. The government capital stock of roads per square mile of land (K_G^R/N) is denoted as ROAD. Finally, government current spending on operating schools per pupil (G_E/n) is also sub-divided into two parts for empirical purposes: government spending on operating primary and secondary (K-12) schools, denoted as EXPK-12, and government current spending on higher education (universities and community colleges), denoted as EXPHIGH. Finally, the TAXCOR, TAXINC, TAXGAS, and EXPK-12 are determined at the state level. EXPK-12 and TAXPRO are determined at the county level. TAXSAL and ROAD are determined both locally and at the state level.

Consistent with other studies (Kneller et al. 1999, Modifi and Stone 1990, and Helms 19855), government transfer-payment (S) is ignored from the empirical estimation in order to eliminate government budget identity problem. The choice of transfer-payment expenditures (S), in fact, is adequate since theoretical model does support that transfer-payment has no effect on economic growth (see equation 19). The regressions are estimated using panel data techniques based on pooled ordinary least squares (OLS) with heteroskedastic-consistent standard errors.

4.3. Empirical Estimation Results:

First, the Pearson product-moment correlations among fiscal variables are calculated in Table 4. The correlation coefficient between TAXCOR and TAXGAS is 0.999. Because of this nearly perfect correlation between TAXCOR and TAXGAS, Equation 21 is estimated with TAXCOR excluded[11].

Table 4: Correlation Coefficient Matrix with 5-Year Averaged Data

VARIABLES	TAXINC	TAXCOR	TAXSAL	TAXGAS	TAXPRO	ROAD	EXPK-12	EXPHIGH
TAXINC	1							
TAXCOR	-0.183	1						
TAXSAL	-0.008	0.795	1					
TAXGAS	-0.177	0.999	0.795	1				
TAXPRO	-0.053	0.084	0.013	0.077	1			
ROAD	-0.213	-0.107	-0.124	-0.107	-0.448	1		
EXPK-12	-0.134	0.836	0.680	0.842	0.155	0.052	1	
EXPHIGH	0.082	0.337	0.306	0.377	-0.114	-0.043	0.414	1

Column 1 of Table 5 reports the results[12]. Initial income (INITIAL) is negative and significant at the five percent level, suggesting conditional convergence of growth rates over the year. Both the gasoline tax (TAXGAS) and government spending on higher education (EXPHIGH) are statistically significant and their signs are consistent with the predictions of the theoretical model. The effective sales tax (TAXSAL), effective property tax (TAXPRO),

[11] Equation 21 is estimated via Pooled OLS. Unfortunately, because there is virtually perfect multicollinearity among the fiscal variables, the model is not full rank and the estimates are not unique.

[12] Column 2 of Table 5 reports regression results using TAXCOR instead of TAXGAS. The findings are almost identical to those in column 1.

government capital stock of roads per square mile of land (ROAD) and current government expenditures on operating schools per pupil (EXPK-12) are statistically insignificant. The average-marginal income tax (TAXINC) is statistically significant and positive.

Findings reported in columns 1 and 2 suggest an interesting and very strong result – only fiscal policies set by state government have statistically significant effects on county economic growth. For example, government spending on higher education (EXPHIGH), which has a statistically significant effect on growth, is set by the state government and individual counties in North Carolina have no control over this spending. In contrast, property tax rates are entirely set by local governments. Although there is considerable variation in property tax rates across counties and over time, the property tax produces no statistically significant effect on growth.

One possible conclusion is that counties are too small to have power over their own growth rate. Counties can be considered as equivalent to small open economies in the world economy. Precisely, counties can be viewed as small open economies in North Carolina, where North Carolina can be viewed as the world economy. County policies have no effect on growth compared to the considerable impacts of the state government. If this interpretation is correct, then the assumption (see section 2, footnote 6) that each county is a small closed economy is not satisfactory. This assumption ignores interaction of counties with the rest of the "world". The possible implications for future research are discussed later.

Table 5: Results of Pooled OLS Panel Estimation

Dependent Variable: Per Capita Income Growth: five-year averages

Variables	1	2	3	4	5	6
INITIAL	-0.018*	-0.018*	-0.017*	-0.02*	-0.017*	-0.0029*
	(-3.06)	**(-3.06)**	**(-2.49)**	**(-4.26)**	**(-2.88)**	**(-5.20)**
TAXINC	1.396*	1.396*	1.873*	1.853*	1.462*	2.496*
	(3.84)	**(3.84)**	**(4.66)**	**(4.94)**	**(3.92)**	**(6.23)**
TAXCOR	----	-2.56*	----	-1.517*	-2.51*	-1.58*
		(-8.46)		**(-5.88)**	**(-8.14)**	**(-3.29)**
TAXSAL	0.0003	0.0003	-0.005*	0.0005	0.0006	0.007
	(0.16)	**(0.16)**	**(-3.13)**	**(0.27)**	**(0.36)**	**(3.38)**
TAXGAS	-0.141*	----	----	----	----	----
	(-8.46)					
TAXPRO	0.0027	0.0029	0.002	-0.003	0.002	0.0127**
	(0.58)	**(0.58)**	**(0.31)**	**(-0.67)**	**(0.40)**	**(2.04)**
ROAD	0.00001	0.00001	0.0001	-0.00015	0.00003	0.00008
	(0.09)	**(0.08)**	**(1.01)**	**(-1.24)**	**(0.29)**	**(0.54)**
EXPK-12	2.3E-6	2.3E-6	-2.5E-6	6E-6*	1.8E-6	1.4E-6
	(1.25)	**(1.25)**	**(-1.30)**	**(3.51)**	**(0.94)**	**(0.59)**
EXPHIGH	0.00006*	0.00006*	8.2E-6	----	0.00006*	0.0001*
	(6.40)	**(5.85)**	**(0.97)**		**(5.89)**	**(10.08)**
TEXAPPTOB	----	----	----	----	-0.002	----
					(-0.33)	
INFANT	----	----	----	----	0.0003	
					(1.24)	
Adjusted R^2	0.36	0.36	0.20	0.28	0.36	0.18
No. of Obs.	297	297	297	297	297	1485

Note: a) t-statistics calculated using White's Heteroscedasticity robust standard error, are reported in parentheses. b) Observations averaged over 5-year interval from 1981-1995. c) * and ** denote significance at the 1% and 5% levels, respectively. d) All regressions include an intercept term.

The positive coefficient on TAXINC is contrary to the prediction derived in Section 2. One possible explanation for a positive coefficient is that the state income tax (TAXINC) is progressive 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. This possibility would be consistent with the argument of Caselli *et al.* (1996) that endogeneity of the explanatory variables is the source of inconsistency of results in existing cross-county empirical research.

4.3.1 The importance of including both spending and taxes: A critical argument of this study is that specifying the government budget constraint fully is important for interpretation of fiscal parameters. Now, the empirical relevance of this argument is examined in two ways. First, to assess the importance of omitted variable bias on parameter estimates, statistically significant taxes or expenditures are excluded from the analysis to see how the remaining parameter estimates change (see Kneller *et al*. 1999). Comparing these results with those in column 1 and 2 (Table 5) reveals substantial changes in the parameter estimates. Second, this paper examines the growth effects of a realistic fiscal policy of increasing one type of expenditure and financing it with an increase in one type of tax. The joint effect on growth is substantially different from the effects of the spending and tax changes considered individually.

Column 3 presents the results of omitting the corporate income tax and gasoline tax. Remember that these two variables are nearly perfectly correlated, so both must be omitted to perform a valid experiment. These taxes were statistically significant in the regression (Col. 1 and 2). The coefficient on TAXSAL, which previously was statistically insignificant, now is statistically significant and negative. The magnitudes of this coefficient, and also that on TAXINC have increased substantially. The coefficient on EXPHIGH becomes statistically insignificant. The estimated impact of government expenditures and the remaining taxes are clearly biased by the omission of the corporate income and gasoline taxes. Similarly, when EXPHIGH is excluded (column 4), the coefficients on TAXPRO and ROAD have changed signs (although they remain insignificant). The coefficient on EXP-12 becomes statistically significant. Therefore the full model is necessary to identify and precisely estimate the individual effects of taxes and government spending on growth. These findings suggest that many previous studies (such as Deverajon, Swaroop and Zou (1996), Mendoza *et al*. (1997), i.e.) need to be re-evaluated because they ignore the biases associated with omitted variables in their regressions.

The estimated coefficients in Table 5 can be used to assess the growth impact of realistic government policies. For example, the point estimate of higher education spending suggests that an increase by one percentage point in EXPHIGH raises the growth rate by 0.00006 percentage points. A one-percentage point increase in the corporate income tax, on the other hand, reduces growth by 2.56 percentage points. Suppose the corporate income tax (TAXCOR) is increased by one percentage point and the additional revenue is spent on higher education spending (EXPHIGH). The net effect is a reduction in the growth rate by 0.0022 percentage points. Thus, although the spending increase rises the growth rate, that positive effect is more than offset by the negative growth impact of the higher tax used to finance the spending. Therefore, when policy makers are contemplating the effects of a fiscal policy change on the economic growth, they *must* consider the effects of both the specific tax rate and the specific spending to be changed together.

4.4. Robustness Testing

In this section, the robustness of the above Pooled OLS results to two changes in the specification of the data and regression equations are presented. First, two non-policy variables are included in the growth regression to investigate if these results are sensitive to structural and socioeconomic differences among counties. Second, the effects of using annual data rather than 5-year averaged data are explored.

4.4.1. Non-Policy Variable: North Carolina's economy has undergone major restructuring in recent decades. Tobacco, textile, and apparel industries no longer dominate the state economy like they did in years past. For example, as recently as 1979, tobacco, textile, and apparel industries accounted for almost 15 % of the state's gross domestic product whereas in 1996 these industries' direct contribution to the state economy was down to 6.6% (Walden, 1996). Therefore, in order to capture any variation resulting in this restructuring, the proportion of a county's total industry earnings in the textile/apparel and tobacco industries combined, TEXAPPTOB, is included as non-policy variable in the empirical analysis.

In addition to TEXAPPTOB, infant mortality rate, INFANT, is included to capture any socioeconomic differences among the counties. As numerous researchers have emphasized, low child mortality rate is an important factor for the human capital investment decisions of parents (Kalemli-Ozcan, Ryder and Weil, 2000). Lower mortality rate implies a higher rate of return to education which provides an important investment in the education of each child. So, higher investment in the human capital leads higher economic growth. On top of it, mortality rate fell directly because of higher income levels (which lead to better nutrition). Consequently, higher (lower) infant mortality rate in a county will have less (more) human capital investment, which will result in lower (more) economic growth.

Column (5) of Table 5 reports the coefficient estimates with these non-policy variables included. The parameter estimates on TEXAPPTOB and INFANT are statistically insignificant and the coefficient signs of all the fiscal variables are unchanged. The earlier results are *not* sensitive to the inclusion of these non-policy variables**.**

4.4.2. Annual Data Specification: Mendoza *et al.*, (1997) find that fiscal policy shows greater impacts on growth in a panel of annual data instead of 5-year averaged panel data. Hence, this study has explored the consequences of using an annual panel regression. The estimation results have the same character as those of Mendoza *et. al.,* that some of the county level fiscal policies are now statistically significant. Last column of Table 5 reports the coefficients. The source of the differences seems most likely to be the business cycle. During periods of rapid growth, the government may commit itself to new spending programs and also to new taxes to finance them. Government then would be associated with the business cycle of counties as well as the state. For example, due to high growth in Wake County, the state government allowed Wake County to impose new taxes on restaurant meals and hotel visits to finance an arena, children's museum, expanded convention center, and other public infrastructure. Under such circumstances, controlling for the state or county business cycle by using 5-year averaged data would eliminate this cycle-induced correlation and reveal the real effects of the consumption tax and property tax on growth. Thus, the empirical finding those state and county level fiscal policy variables may be statistically significant in annual growth regressions can be viewed as evidence of the importance of the business cycle.

5. Conclusions

This paper provides theoretical and empirical analysis to the issue of how fiscal policies affect economic growth. The effect of fiscal policies on long-run growth is presented in two steps. First, the effect of fiscal policies is qualitatively analyzed by extending the existing theoretical endogenous growth model driven by human capital accumulation. Second, this extended theoretical model is tested using county level panel data.

The theoretical two-sector endogenous growth model predicts that taxes on income, consumption, corporate income, and property affect growth negatively, and that government expenditures, such as spending on the stock of roads and spending on schools have a positive effect on long-run growth. This study analyzes the net effect of these opposing forces on long-run growth. Since the net effect depends upon the relative magnitudes of the parameters in the theoretical model, the simultaneous effect of taxes and different social overhead on long-run growth is theoretically ambiguous. However, the model with the net effect can be determined empirically.

This study estimates a panel data set for 99 North Carolina counties over the period 1980-1995, aggregating the data into 5-year averages to remove business-cycle fluctuations. An important feature of this empirical estimation is the inclusion of both taxes and government expenditures simultaneously in the growth regression to eliminate any omitted variables bias arising form the simultaneity in taxes and spending induced by the government budget constraint.

One of the main empirical findings of this study is that local fiscal policy variables have no effect on local economic growth whereas statewide fiscal policy variables do. The effective property tax (TAXPRO) and government current spending on operating schools per pupil (EXPK-12), which are set exclusively by local government, produce no effect on economic growth in the county. The fiscal policy variables set both locally and at the state level (Effective sales tax, TAXSAL, and government capital stock of roads, ROAD) also have no significant statistical effects on growth. In contrast, statewide fiscal policy variables such as the average marginal individual weighted-income tax (TAXINC), corporate income tax (TAXCOR), gasoline tax per mile driven (TAXGAS) and government expenditure on higher education (EXPHIGH) generate statistically significant effects on growth. Apparently, North Carolina's counties behave like small countries in a big world. Each county is such a small economic entity that it has little impact on its own growth rate whereas the state is large enough to affect county growth rates.

In this study, each county in North Carolina is being treated as a closed-economy. However, the evidence is consistent with being small-open economy with over-arching "world" government. Further analysis of this possibility would be interesting and require an appropriate theoretical development.

Another striking result of this study is that the full model is necessary to identify and precisely estimate the individual effects of taxes and government spending on growth. The estimating a model that includes only half the government budget-either taxes or spending-leads to biased estimates that often are inaccurate. Therefore, it is very easy to reach the wrong conclusion from a mis-specified regression equation.

The full model is also necessary when simulating the growth effects of realistic fiscal policy changes. Spending changes typically are accompanied by tax changes in the same direction, and vice versa. The theoretical analysis showed that taxes and spending affect growth in opposite directions. An accurate forecast of the growth effects of fiscal policy therefore requires estimating the net effect arising revenue policy. The parameter estimates obtained from the kind of model developed in this study permits a complete evaluation of changes in taxes and expenditures.

In conclusion, 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 economic growth, they must consider the effects of the specific tax rate changed and the specific spending category changed simultaneously.

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