Fiscal Structures and Economic Growth:

International Evidence

by

Stephen M. Miller

and

Frank S. Russek *

July 1993

ABSTRACT

A large and growing literature searches for the determinants of economic growth, using cross-country regressions. Within this literature, one branch considers the effect of various fiscal policy variables on the growth process. Our paper continues this research effort by systematically examining the effects, if any, of fiscal structure on economic growth. We impose the government budget constraint on the regression equations so that the precise change in fiscal policy can be identified (e.g., the effect of a corporate income tax financed increase in health expenditure). In addition, our analysis employs a pooled cross-section, time-series sample that allows us to use the fixed- and random-effect model methodology. We find that debt-financed increases in government expenditure retard economic growth while tax-financed increases lead to higher or lower growth depending on the expenditure category.

* Professor and Head of Economics, University of Connecticut, Storrs, CT, and Principal Analyst, Congressional Budget Office, Washington, DC. This paper has been prepared for the 1993 Western Economic Association meetings in Lake Tahoe. We acknowledge the helpful comments of Mark Wohar, the discussant at the Western meetings. The views expressed are the authors', and do not necessarily reflect those of the Congressional Budget Office or its staff.

1. Introduction

A large and growing literature searches for the determinants of economic growth, employing cross-country regression analysis (e.g., Landau 1983, 1985, 1986, Kormendi and Meguire 1985, Ram 1986, Grier and Tullock 1989, Barro 1990, 1991, 1992, Romer 1990, and Levine and Renelt 1992).[1] The cross-country regression approach implicitly assumes that the growth process possesses similar structural properties across the countries in the sample. Structural differences, be they political, economic, social, or other, between countries, therefore, do not condition the growth process. Or if they do, then the effects are randomly distributed with zero mean.

If structural differences between countries do matter significantly and non-randomly in the growth process, then the existing cross-country research is potentially flawed. Attempts are sometimes made to control for such differences by including dummy variables for different regions of the world (e.g., dummy variables for African, Latin American, and other groups of countries). Another, more-drastic solution to this problem is to examine the growth process within individual countries over time. For example, in addition to his cross-country results, Ram (1986) provides time-series findings for each country. That is, time-series data on a given country are examined to determine those factors that contribute to the growth process. Such a solution, however, seems unduly restrictive, since it assumes that nothing can be gained from examining the growth process across countries.

Within this broader literature on the determinants of economic growth, a smaller group of papers (e.g., Landau 1983, 1985, 1986, Ram 1986, Romer 1989, Barro 1990, 1991, Levine 1991, and Levine and Renelt 1992) consider the effects, if any, of government expenditure and revenue on economic growth. These studies as a rule, however, do not examine the effects of fiscal variables in any systematic way. Studies frequently include the share of GDP spent on government consumption expenditure. Such an approach overlooks how an increase in government consumption expenditure is financed. Is it with higher taxes, and which taxes? Or is it with lower spending, and which spending? Finally, is it with a higher deficit? The answer to these questions may lead to different implications about the effect of an increase in government consumption expenditure on economic growth.

Borrowing from some work on the effect of fiscal structure on national economic growth within the United States (i.e., Helms 1985, Mofidi and Stone 1990, and Miller and Russek 1993), we introduce the government budget constraint into the regression equations examining the determinants of economic growth. As a result, we are able to directly address the three questions raised in the previous paragraph.

We consider the growth process using pooled times-series cross-section data and employing the fixed- and random-effects econometric techniques.[2] These techniques attempt to accommodate across-country and across-time structural differences. We also compare the performance of the more-standard ordinary least squares regression approach with that of the fixed- and random-effects models.

2. A Review of the Empirical Literature

Most empirical studies of the effect of government spending and its financing on national economic growth over the past decade produce little evidence of a positive relationship.[3] This continues to be the case for relative recent research based on endogenous theories of growth. For the most part, various measures of the size of government exhibit either a negative effect on economic growth, or no significant effect. When a positive relationship occurs, it usually involves the growth, rather than the size, of government.

Landau (1985) examines pooled time-series cross-section data for 16 OECD countries, and finds a negative effect of government consumption and investment (relative to GDP) on economic growth. In part, these negative effects seem to operate through private investment. Government transfer payments have a positive, but insignificant, effect on growth. These findings continue to hold when the growth of total output was replaced by the growth of private output as the dependent variable.

Landau (1986) uses a wide range of economic and non-economic variables to explain real per capita growth with pooled data for less developed countries. His regressors include several measures of government spending and revenue for all government levels. He considers five types of government spending: consumption other than education or defense, education, defense, transfer, and capital expenditures. The revenue sources include current revenue, the deficit, and official transfers from abroad -- a partial measure of foreign aid. All fiscal variables are expressed relative to GDP, and are averaged over the three preceding periods to prevent contemporaneous correlation with the disturbances.

Government consumption is the only fiscal variable to have a significant effect on economic growth. This spending reduces growth, in part, because of the need to finance it. Landau (1986) attributes the lack of significance for education spending to inefficient use of funds and the lack of significance for government investment to the long gestation period for infrastructure expenditure to affect economic growth, possibly longer than is allowed for in the regressions.

Kormendi and McGuire (1985) examine the relationship between government spending and economic growth with a sample of 47 countries for the post-World War II period. Their measure of government spending excludes government investment and transfer payments, but includes spending on defense and education. They discover no significant relationship between economic growth and either the growth or the level of the consumption share of government in output.

In one of the few studies to find a positive link between government spending and economic growth, Ram (1986) employs both cross-section and time-series data for 115 countries. Generally, the regression results indicate that higher real government consumption -- the variable that Ram argues is the most appropriate measure -- contributes to economic growth. His two-sector model allows for differences between the government and the private sectors, and for externality effects of government spending. Government output is viewed as an input to private consumption.

Grier and Tullock (1989) examine pooled cross-section time-series sample for 115 countries, where data are averaged over 5-year intervals. They find a negative relation between government consumption and economic growth, especially for the OECD countries.

Barth and Bradley (1988) find that the ratio of government spending to GDP adversely affects economic growth during 1971 to 1983, based on data for 16 OECD countries. Holding the private investment share of GDP constant, they uncover a positive, but insignificant, effect of government investment on growth.

Barro (1991) investigates data on 98 countries for 1970 to 1985 with a measure of government consumption that excludes defense and education expenditure. He finds that government consumption reduces economic growth, while government investment has no significant effect.

Koester and Kormendi (1989) estimate the effects of average and marginal tax rates on the growth and level of economic activity for 63 countries during 1970 to 1979. They conclude that tax rates do not significantly affect growth, when measures are taken to control for the potential endogeneity of average tax rates to per capita income and for the relationship between growth and per capita income. High marginal tax rates, however, do depress the level of economic activity, when average tax rates are controlled for. This finding implies that reducing the progressivity of taxes (holding average tax rates constant) can increase revenues -- a modified supply-side result.

Levine and Renelt (1992) consider the sensitivity of cross-country growth regressions with the aid of error-bounds analysis. They specifically examine the relationship between long-run average growth rates and economic policy, as well as political and institutional factors. In separate regressions, they include: (i) the government consumption share of GDP, (ii) the growth rate of government consumption, (iii) total government expenditure with and without defense and military spending, (iv) government investment share of GDP, and (v) similar shares for government spending on education and defense. They also consider the central government deficit, the ratio of export (import) taxes to exports (imports), as well as the ratios of corporate, individual, and social insurance taxes to GDP. Although specifications that include the investment share of GDP yield some significant effects of fiscal variables on economic growth, the fiscal variables are not significant in explaining the investment ratio. They conclude that the effect does not run through capital formation. More generally, however, they conclude that the effects of the fiscal variables are not robust.

Engen and Skinner (1992) examine the effects of government spending and taxation on economic growth in a model that allows for transitional growth as well as production functions with increasing returns. In their model, Engen and Skinner have government spending affecting the productivity of inputs, while taxes affect the allocation of factors between the taxed and untaxed sectors, which in turn affects sectoral (and aggregate) productivity. They focus on the issue of allocative efficiency, and include both the level and growth measures of fiscal policy. Their regressions allow for correlated random coefficients across countries and country-specific data quality. They use the White 2SIV estimating procedure to address the issue of endogeneity.

Based on cross-section regressions for 107 countries covering 1970 to 1985, they find that both government spending and taxes have a negative effect on growth, both in the short-run and in the long-run. Spending exerts more of a long-run negative effect. Controlling for endogeneity, they conclude that the results of Ram -- that growth in government spending has a positive effect on growth -- are not supported.

Finally, Miller (1993) controls for structural differences across countries and over time with pooled cross-section time-series data and fixed- and random-effects econometric techniques. Although his primary focus is on the convergence hypothesis, he concludes that increases in the government's share contributes to slower economic growth, but that the absolute share does not.

3. Data and an Overview of International Fiscal Structures

Our data come from two sources. First, we use information on real and nominal gross domestic product, population, imports and exports of goods and non-financial services, gross domestic investment, and the base year PPP convergence factor from 1975 to 1984, which come from the World Bank data tape. Second, we use information on central government revenue and spending from 1975 to 1984, which was compiled by the International Monetary Fund and distributed in the Government Financial Statistics data tape. Revenue categories include total revenue and grants; income, profit, and capital gains tax revenue broken out by corporate and individual classes; social-security tax revenue; domestic taxes on goods and service revenue; international trade tax revenue; and total tax revenue. From these items, we construct as residuals other tax and non-tax revenue. Expenditure categories include total expenditure; defense expenditure; education expenditure; health expenditure; social-security and welfare expenditure; economic affairs and services expenditure; and transportation and communication expenditure. We construct as a residual other expenditure.

Preliminary examination of the Government Financial Statistics data suggested that only 44 countries had the detailed information identified in the previous paragraph. Moreover, this data for these countries had to be restricted to 1975 to 1984. After downloading the data, we discovered that Cyprus, the Solomon Islands, and Uganda were missing one of the needed data series for at least part of the sample period. These countries were deleted from the sample. Finally, after examining the summary statistics reported in Tables 1, 2, and 3, we discovered two additional countries with problems in the other tax and other expenditure variables. Mexico collects taxes on behalf of state governments. This money is rebated to state governments. Thus, our constructed other tax revenue variable turned out to be negative for Mexico. In the Philippines, the data are adjusted to a cash basis between the reporting of expenditure sub-categories and total expenditure. Thus, the other expenditure category in the Philippines was negative. We deleted both Mexico and the Philippines from our final sample.

We begin by considering a number of general questions about the fiscal structures of the countries in our sample. What are some of the most salient features of the fiscal structures in the different countries? Is there substantial variation in the size of deficits or surpluses and in the composition of revenue and expenditure? Finally, and most importantly, are there any obvious differences between the fiscal structures of high-growth and low-growth countries?

First, consider growth itself along with some other broad economic aggregates (Table 1). For the sample as a whole, real per capita GDP growth averaged 1.3 percent per year during 1975 to 1984, with a coefficient of variation of 3.52. The five highest average annual growth-rates were in Botswana (6.72), Indonesia (4.19), Korea (6.32), Sri Lanka (3.20), and Thailand (4.31). Together, these countries experienced an average growth of 4.9 percent. The five lowest average growth rates were in El Salvador (-1.74), Iran (-2.16), Liberia (-2.78), Venezuela (-2.21), and Zambia (-3.33). Together, these countries experienced an average negative growth of 2.4 percent. Eighteen countries had larger growth than the U.S., which was tied with France at a rate of 1.45 percent.

How do these relatively fast-growth and slow-growth countries rank in terms of some other important economic variables? All of the fastest-growing as well as all of the slowest-growing countries had above-average population growth. Two of the fastest growing countries (Botswana and Korea) were among the top five in terms of investment shares of GDP, while one of the slowest growing countries (Venezuela) was also in this group. Botswana was the only country in the fastest-growing group that ranked in the top five in terms of openness -- the ratio of exports plus imports to GDP. None of the slowest-growing countries were in this group. Finally, with one exception, none of the fastest-growing or slowest-growing countries were among the bottom five in terms of openness or among the five countries with the most or least inflation. The exception, Liberia, was among the bottom five in inflation.

In summary, based on these crude considerations, we do not see any clear linkage between the growth rate of real GDP per capita and these broad economic aggregates. Whenever high-growth countries exhibited a particular relationship with these economic aggregates, other low-growth countries exhibited a similar relationship. Our regression analysis that follows allows for a more careful and systematic investigation of these issues.

Now, consider some broad fiscal aggregates. Relative to GDP, the average fiscal position of the countries in our sample was a deficit of 2.71 percent, with a coefficient of variation of 1.72. This average was slightly less than the 2.78 percent average deficit experienced by the United

States. The five largest average deficits (relative to GDP) were in Belgium (7.95), Israel (11.27), Morocco (10.71), Sri Lanka (9.52), and Zambia (9.78). Sri Lanka and Zambia were among the five fastest-growing and the five slowest-growing countries, respectively. Nine countries had surpluses instead of deficits, with the largest five surpluses relative to GDP appearing in Botswana (5.56), Brazil (3.16), Luxembourg (1.61), Swaziland (2.19), and Venezuela (3.05). This group also contained one member (Botswana) from the fastest-growth group and one (Venezuela) from the slowest-growth group.

Aggregate central government revenues averaged 28.3 percent of GDP, with a coefficient of variation of 0.39. The highest five revenue-GDP ratios were in Belgium (43.74), Botswana (44.64), Israel (59.81), Luxembourg (48.92), and the Netherlands (53.15). Botswana and Luxembourg were among the five countries with the largest surpluses while Israel was among the five countries with the largest deficits. Eight countries had revenue-GDP ratios below 20.0 percent. The five lowest were in Costa Rica (18.69), El Salvador (13.26), Korea (17.26), Paraguay (11.08), and Thailand (14.18). None of these were among the five countries with the largest or smallest deficits. The United States (19.53) ranked thirty-third out of thirty-nine in terms of its revenue-GDP ratio.

Finally, aggregate central government spending averaged 31.01 percent of GDP, with a coefficient of variation of 0.39. The five highest spending-GDP ratios were in Belgium (51.69), France (39.89), Israel (71.08), Luxembourg (47.31), and the Netherlands (53.15). All but France were in the five highest revenue-GDP ratios; Botswana replaced France in the revenue to GDP top five. Belgium and Israel were in the group of five countries having the largest deficits while Botswana was in the group of five countries with the largest surpluses. The five lowest spending-GDP ratios were in Brazil (19.93), El Salvador (16.12), Korea (16.58), Paraguay (10.94), and Thailand (17.80). These were the only countries with spending less than 20 percent of GDP. Of these, Brazil was the only country having one of the five largest fiscal surpluses. Also, all but Brazil were in the five lowest revenue to GDP ratios; Costa Rica replaced Brazil in the revenue to GDP bottom five. The U.S. ranked twenty-ninth in terms of its spending-GDP ratio.

As in the case of the economic aggregates, we do not find any obvious relationship between economic growth and the fiscal aggregates. Does this apparent lack of correlation also apply to the composition of taxes and spending?

Table 2 shows that, on average, the largest share of total revenue (24.55 percent) was collected in the form of revenue from domestic taxes on goods and services. In descending order of quantitative importance, the other six sources of revenue are individual income tax revenue (16.48), non-tax revenue (15.34), social security tax revenue (14.57), international trade tax revenue (13.24), corporate income tax revenue (11.17), and all other tax revenue (4.65). Of these, the ones with the largest and smallest coefficients of variation, respectively, were corporate income tax revenue (1.15) and revenue from domestic taxes on goods and services (0.52).

Four of the five fastest-growing countries had below-average revenue-GDP ratios. Three of the fastest growing countries had a below-average reliance on corporate income tax revenue. All were below average in terms of both individual income tax revenue and social security tax revenue; four countries reported no social security tax revenue at all. Two countries were below-average in terms of revenue from domestic taxes on goods and services, while only one country had below-average reliance on trade tax revenue. Finally, four countries were below-average for other taxes, and three were below average for non-tax revenue.

Turning to the slowest-growing countries, one had a higher-than-average revenue GDP ratio. Three had above-average reliance on corporate income tax revenue. One country had above average individual income tax revenue share of GDP while no country had above average social security tax revenue share of GDP. Two were above average with regard to revenue from domestic taxes on goods and services, and international trade tax revenue. Only one country had an above-average reliance on other tax revenue, and only two had above average reliance on non-tax revenue.

Table 3 shows that, on average, the largest share of total spending (23.61 percent) was allocated to social security and welfare. In descending order of quantitative importance, the other six categories of spending are other expenditure (20.32), economic affairs and services expenditure (19.12), education expenditure (12.10), defense expenditure (9.32), health expenditure (7.86), and transportation and communication expenditure (7.67). Of these, the ones with the largest and smallest coefficients of variation, respectively, were defense expenditure (0.88), and education (0.50) and economic affairs and services (0.50) expenditures. Two of the fastest-growing countries, Botswana and Sri Lanka, had an above-average spending-GDP ratio. Three had above-average defense spending (relative to GDP). Three had above-average spending on education. None had above-average spending on health or social security and welfare. Four were above-average in terms of spending on economic affairs and services, and transportation and communication, Korea was below average in both categories. In addition, three had above-average other expenditure.

Finally, two of the five slowest-growing countries, Iran and Zambia, had above-average spending-GDP ratios. Two had above-average defense spending, while all five had above-average spending on education (relative to total spending). Three were above average in terms of health spending, while none were above average in terms of social security spending. All had above-average spending on economic affairs and services. Two were above average in terms of spending on transportation and communication, and all five were above-average in terms of other spending.

4. The Model and Econometric Methodology

Our modeling of national economic growth borrows from some work on state and local economic growth in the United States (i.e., Helms 1985, Mofidi and Stone 1990, and Miller and

Russek 1993). We begin by defining the growth rate of gross domestic product per capita (g) as follows:

$$g_{ct} = \ln y_{ct} - \ln y_{ct-1}, \quad (1)$$

where y is real gross domestic product per capita, ln is the natural logarithm operator, and c and t indicate the country and time period. Let $X_{ct} = (x^1_{ct}, x^2_{ct}, \ldots x^n_{ct})$ represent those observable factors (e.g., investment, tax and spending patterns, and so on) that can influence national economic growth. Thus, we model national economic growth as follows:

$$g_{ct} = \alpha + \sum_{i=1}^{n} \beta_i x^i_{ct} + v_{ct}. \quad (2)$$

where v_{ct} is the error term.

The error term v_{ct} incorporates the influences of the omitted variables. Classical regression analysis assumes that the omitted variables are independent of the included x_{ct} and are independently identically distributed. When using pooled cross-section time-series data, however, the omitted variables can be further classified into three groups -- country-varying time-invariant, time-varying country-invariant, and country- and time-varying variables.[4] The country-varying time-invariant variables differ across countries but are constant within a given country over time (i.e., C_c give essentially constant country-specific information). Time-varying country-invariant variables differ over time but are constant at a point in time across countries (i.e., T_t give essentially constant time-specific information). Examples of the former variables include geography and climate, while examples of the latter include world economic conditions such as Euro interest rates. Finally, the country- and time-varying variables differ across both country and time. Thus, the error term v_{ct} can be written as follows:

$$v_{ct} = \delta C_c + \mu T_t + \varepsilon_{ct}, \quad (3)$$

where δ and μ measure the effects of C_c and T_t on v_{ct}.

Substituting equation (3) into (2) gives the following:

$$g_{ct} = \alpha + \sum_{i=1}^{n} \beta_i x^i_{ct} + \delta C_c + \mu T_t + \varepsilon_{ct}. \quad (4)$$

Estimation of equation (4) without consideration of possible country-specific or time-specific effects can seriously mislead ordinary least squares regressions. Hsiao (1986, p. 7) provides illustrations of misleading results. Problems emerge when either the unobservable country-specific or time-specific variables correlate with the included variables x_{ct}. Two alternative, but related, approaches exist for addressing these problems -- fixed- and random-effect models.

Fixed-Effect Models:

Suppose the problem is omitted country-specific variables that are correlated with the included x_{ct}. A solution to this problem is to adjust the dependent and independent variables by subtracting the mean of each variable over time.[5] Since the unobserved country-specific variables and the intercept do not change over time, the subtraction of their respective means over time drops these variables out of the regression equation. If this is the only problem in the estimation of equation (4), then the regression adjusted for the means across time provides unbiased and consistent estimates of β_i. Without this adjustment, the ordinary least squares estimates are biased and inconsistent.

Similarly, if the problem is the time-specific variables that are correlated with the included x_{ct}, then a similar solution adjusts the dependent and independent variables by subtracting the mean of each variable over countries. Since each country faces the same time-specific effect, subtracting the mean over countries drops the intercept and the time-specific effects out of the revised regression equation. Once again, the revised regression provides unbiased and consistent estimates of β_i.

Of course, it is possible that both country- and time-specific effects are correlated with the included x_{ct}. In this case, we can adjust for the means over countries and time.

Random-Effect Models:

The fixed-effect model assumes that the differences across units -- either countries or time -- are due to parametric shifts in the regression function. Such a view becomes more appropriate when the problem at hand uses the whole population rather than a sample from the population. If the problem at hand examines only a sample from a larger population, then the fixed-effect model can be properly interpreted as applying to the differences within that sample only. The specific problem at hand considers a sample of countries. Therefore, the random-effect model needs to be considered.

Random-effect models treat the country-specific (e_c) and time-specific (e_t) effects as random variables. Thus, the error term v_{ct} is viewed as having three random components -- e_c, e_t, and ε_{ct}. These error terms have the following properties:

$$E\, e_c = E\, e_t = E\, \varepsilon_{ct} = 0;\;\; E\, e_c e_t = E\, e_c \varepsilon_{ct} = E\, e_t \varepsilon_{ct} = 0;$$
$$E\, e_c e_i = \sigma^2_C, \text{ if } c = i; \text{ 0 otherwise;}$$
$$E\, e_t e_j = \sigma^2_T, \text{ if } t = j; \text{ 0 otherwise;}$$
$$E\, \varepsilon_{ct} \varepsilon_{ij} = \sigma^2_\varepsilon, \text{ if } c = i \text{ and } t = j; \text{ 0 otherwise; and}$$
$$e_c, e_t, \text{ and } \varepsilon_{ct} \text{ are each uncorrelated with } x_{ct}. \tag{5}$$

The variance of the growth rate of real gross domestic product per capita conditional on the explanatory variables x_{ct} is given from equation (4) as follows:

$$\sigma^2_G = \sigma^2_C + \sigma^2_T + \sigma^2_\varepsilon, \tag{6}$$

where σ^2_G is the variance of the growth rate of gross domestic product per capita left unexplained by the explanatory variables x_{ct}. As a consequence, such a formulation -- the random-effect model -- is frequently referred to as a variance-components (error-components) model.

If the variance components are known, then the estimation of the random-effect model using generalized least squares (GLS) merely requires the transformation of the dependent and independent variables using the variance components in the appropriate way. Absent knowledge of the variance components, then we must first provide estimates of these components and apply a feasible GLS procedure to estimate the equation.

As discussed above, our methodology borrows from the literature on state and local economic growth in the United States. The previous empirical research into the effect of state and local government taxes and spending on state and local economic growth provides a mixed picture; no consensus exists even on the sign of the effect. Helms (1985) provides a rationale for the divergent results -- "... it is not meaningful to evaluate the effects of tax or expenditure changes in isolation: both the sources and uses of funds must be considered." In other words, the regression equations need to be designed carefully so that when considering the coefficient of total taxes, for example, it is clear what an increase in taxes finances.

We provide a taxonomy of results by excluding, in turn, different revenue and expenditure categories from the surplus constrained regression equations that follows the method of Miller and Russek (1993) on state and local economic growth. This more thorough analysis deals explicitly with the overall fiscal structure and may lead to findings not revealed by the more limited approach of including fiscal variables on a more ad hoc basis, as has been the norm in the determinants of national growth literature to date.

5. Regression Equations and Hypotheses

Our regression equations fall into two distinct categories -- equations where we do not disaggregate total revenue and expenditure and equations where we do. Each of these two sets of regressions includes a set of conditioning variables that have been found to be important in other cross-country growth regressions, including lagged real GDP per capita, the rate of growth of population, the investment share of GDP, the import plus export share of GDP, and the GDP implicit price deflator inflation rate. These two types of regression equations are given as follows:

$$g_{ct} = a1 + a2\, y_{ct-1} + a3\, n_{ct} + a4\, inv_{ct} + a5\, opn_{ct} + a6\, p_{ct} + a7\, rev_{ct} + a8\, exp_{ct} + a9\, sur_{ct} + v_{ct}, \text{ and} \quad (7)$$

$$g_{ct} = b1 + b2\, y_{ct-1} + b3\, n_{ct} + b4\, inv_{ct} + b5\, opn_{ct} + b6\, p_{ct} + b7\, rci_{ct} + b8\, rii_{ct} + b9\, rss_{ct} + b10\, rdgs_{ct} + b11\, rtrd_{ct} + b12\, rot_{ct} + b13\, rnt_{ct} + b14\, edfs_{ct} + b15\, eed_{ct} + b16\, ehlh_{ct} + b17\, ess_{ct} + b18\, eeas_{ct} + b19\, etc_{ct} + b20\, eoe_{ct} + b21\, sur_{ct} + v_{ct}, \quad (8)$$

where g is the growth rate of real GDP per capita, y is real GDP per capita, n is the rate of growth of population, inv is the investment share of GDP, opn is the import plus export share of GDP, p is the GDP implicit price deflator rate of inflation, rev is total revenue to GDP, exp is total expenditure to GDP, sur is the government surplus to GDP (i.e., rev - exp), rci is corporate income tax revenue to GDP, rii is individual income tax revenue to GDP, rss is social-security tax revenue to GDP, rdgs is domestic goods and services tax revenue to GDP, rtrd is international trade tax revenue to GDP, rot is other tax revenue to GDP, rnt is non-tax revenue to GDP, edfs is defense expenditure to GDP, eed is education expenditure to GDP, ehlh is health expenditure to GDP, ess is social-security and welfare expenditure to GDP, eeas is economic affairs and service expenditure to GDP, etc is transportation and communication expenditure to GDP, and eoe is other expenditure to GDP. Three regression results for equation (7) are calculated for the cases where rev, exp, and sur are deleted in turn. Fifteen regression results for equation (8) are calculated for the cases where individual revenue items, individual expenditure items, and sur are deleted in turn. In fact, only two independent regression equations exist -- one for equation (7) and one for equation (8); but, we report all the regressions results to make interpretation of results easier.

How do we interpret the coefficients in these two equations? First, the coefficients of y_{t-1}, n, inv, opn, and p remain unchanged as different revenue items, expenditure items, or the surplus are excluded in equations (7) and (8) These coefficients do vary across equations (7) and (8), but do not differ within each equation as we alter the fiscal variable excluded.

Second, let us examine equation (7) and assume that rev is excluded. The coefficient a_8 measures the effect on national economic growth of a revenue share of GDP financed increase in the expenditure share of GDP, since the government surplus share of GDP is held constant. Similarly, a_9 measures a revenue share of GDP financed increase in the government surplus share of GDP. The exclusion of total expenditure or the government surplus lead to similar interpretations of coefficients.

Third, let us examine equation (8) and assume that rci is excluded. The coefficient b_8 measures the effect on national economic growth of a (reduced) corporate income tax revenue share of GDP financed increase in the individual income tax revenue share of GDP, since the government surplus share of GDP and all other fiscal variables are constant. Similarly, b_{14} and b_{21} measure the corporate income tax revenue share financed increase in the defense expenditure share of GDP and the government surplus share of GDP, respectively. The exclusion of other revenue sources, expenditure categories, or the surplus lead to similar interpretations of coefficients.

6. Empirical Results

We first estimate each equation using ordinary least squares, and fixed- and random-effect models, where the latter regressions are both over countries, and over countries and time.[6] We next perform three tests that compare the alternative specifications. An F-test compares the fixed-effect model and the OLS model (Greene 1990, p. 484). A Lagrange-Multiplier test due to Bruesch and Pagan (1980) compares the random-effect model with the OLS model (Greene 1990, p. 491-92). And a Wald criterion due to Hausman (1978) compares the random-effect model with the fixed-effect model (Greene 1990, p. 495).

Before proceeding with the estimates of equations (7) and (8), we first do some preliminary analysis to link our results to the existing literature on convergence. Most studies to date use averaged data for each country and test convergence hypotheses across the cross-section of countries. Thus, we first estimate equation (7) using averaged data across the 39 countries under two scenarios -- including only the initial lagged real GDP per capita (i.e., the 1974 value of real GDP per capita) to test the unconditional convergence hypothesis and including all other non-fiscal variables to test for conditional convergence. Results appear in Table 4. We find evidence of conditional, but not unconditional, convergence.

We next estimate these two restricted versions of equation (7) using OLS, and fixed- and random-effect models for the pooled sample of 390 observations. The tests of the alternative models tell a different story for the two equations. The random-effect model dominates the OLS and fixed-effect models for the test of unconditional convergence. The fixed-effect model dominates the OLS and random-effect models for the test of conditional convergence. Since the results for the models across countries and across countries and time are similar, we report only the latter results to conserve on space. These results also appear in Table 4.

The typical test of unconditional and conditional convergence, which we also follow in our cross-section estimates using averaged data, includes the initial level of real gross domestic product per capita. This typical approach is necessary, since the growth rates used in the cross-country growth regressions are usually the averages across the whole time-series sample. Friedman (1992) criticizes the standard cross-country test of the convergence hypothesis as committing the regression fallacy.[7] The test offered in this paper is less subject to this criticism, because the initial level of real gross domestic product per capita is up-dated each year.[8] That is, convergence is tested each year against the position of the country last year and not against the country's position at the beginning of the sample period.

Both the averaged and pooled data produce evidence of conditional convergence. This is the standard result in the literature (e.g., Barro 1991, and Levine and Renelt 1992). Researchers find evidence to support unconditional convergence when the sample includes only developed countries (e.g., Mankiw, Romer, and Weil 1992, and Miller 1993). Our sample includes both developed and developing countries.

Both approaches also uncover a positive link between the investment share of GDP and the rate of growth of real GDP per capita. On the other hand, the signs of the coefficients of the import-export share of GDP and the inflation rate flip for the averaged and the pooled data and are significantly different from zero in three of the four cases. The results from the pooled data are generally consistent with the existing literature.

We now turn to estimating equations (7) and (8), which incorporate the fiscal variables. The tests of alternative specifications convey a generally consistent story, at least for the fixed- and random-effect models over countries and time. In all cases, the fixed-effect model dominates the OLS model; the random-effect model does not. In addition, the fixed-effect model also dominates the random-effect model over countries and time. The one anomaly is that the random-effect model appears to dominate the fixed-effect model over countries alone. This inconsistency in the three tests may suggest that the fixed-effect model over countries is mis-specified. Thus, we report in Tables 5 and 6 only the fixed-effect models over countries and time.

Several items stand out from the overall results reported in Tables 5 and 6. The non-fiscal (conditioning) variables tell a consistent story across the two Tables, and a story that is also reasonably consistent with the existing literature. First, lagged real GDP per capita is incorporated to test again the conditional convergence hypothesis. As discussed above, this test differs from the standard approach in the cross-country growth literature. The coefficient of lagged real gross domestic product per capita is significantly negative in both sets of regressions, again supporting the conditional convergence hypothesis.

Second, the investment share of GDP is significantly positive in both sets of regressions. Levine and Renelt (1992) report this result as one of their "robust" findings. It is the one result that appears consistently across the empirical studies of the determinants of economic growth.

Third, the inflation rate has a significant negative effect in both sets of regressions. While Levine and Renelt (1992) find the inflation rate effect to be fragile; they do find it to be consistently negative. Other authors (e.g., Kormendi and Meguire 1985, and Grier and Tullock 1989) report some evidence of a negative effect of inflation on economic growth. Grier and Tullock's strongest evidence is for the African countries, a few of which are in our sample. As noted above, the use of averaged data for the 39 countries in our sample produces a significantly positive effect.

Finally, the population growth and openness (imports plus exports to GDP) variables have coefficients that are negative and positive, respectively, but insignificant. A negative sign for the coefficient of population implies that real output growth adjusts at less than one-to-one with population growth. Levine and Renelt (1992) report a robust positive effect of a country's openness on the investment share of GDP; the effect of openness on real per capita growth was fragile, but positive. Once again, using averaged data in our sample produces a significantly negative effect for the openness variable.

Focusing on the effects of aggregate fiscal variables in Table 5, several observations can be made. First, none of the fiscal variables are significant in the regressions based on averaged data. This finding is consistent with most previous findings based on averaged cross-section data.

Second, in the pooled-data regressions, the effect that government expenditure has on the growth rate of real GDP per capita depends crucially on the method of financing. Tax-financed increases in government expenditure stimulate economic growth, while debt-financed increases in government expenditure retard economic growth.

Second, reducing the government deficit stimulates economic growth. Reducing expenditure while holding revenue constant (i.e., a lower government deficit) or increasing revenue while holding expenditure constant (i.e., also a lower government deficit) both stimulate economic growth. Moreover, the tax-financed reduction in the government deficit has a larger magnitude than the expenditure-financed reduction.

Table 6 confirms these findings of Table 5, and provides additional insights. Focusing on the last column of Table 6 where the government surplus as a fraction of GDP is excluded, we see that debt-financed increases in government expenditure retard economic growth; tax-financed increases in the surplus stimulate economic growth. These effects, however, are not always significant for all types of spending and taxes.

Table 6 provides some interesting commentary on the differential effect of fiscal variables on economic growth. Some tax financed reductions in the government deficit -- such as increases in corporate income tax, other tax, and non-tax revenues -- stimulate economic growth; other taxes -- such as individual income tax, social security tax, domestic goods and services tax, and international trade tax revenues -- do not. Such findings may suggest that individual income tax, social security tax, domestic goods and services tax, and international trade tax revenues are too heavily used in many countries as sources of revenue and may exceed the levels consistent with strong economic growth. Similarly, some expenditure financed reductions in the government deficit -- such as defense, education, health, and social security and welfare expenditures -- stimulate economic growth; other expenditures -- such as economic affairs and services, transportation and communication, or other expenditures -- do not. These findings may suggest that defense, education, health, and social security and welfare expenditures are too large a share of the government budget, at least as far as economic growth considerations are concerned.

Table 6 also furnishes information on the effects of specific revenue and expenditure categories. In general, the composition of taxes for a given level of revenue does not seem to matter. That is, the coefficients of specific taxes are not significant, regardless of which revenue variable is excluded from the regression. The only exceptions occur when either domestic taxes on goods and services or trade-related taxes are substituted for non-tax revenue. Such substitutions reduce economic growth.

These revenue coefficients also become significant when certain spending categories are omitted. In particular, domestic taxes on goods and services as well as trade-related taxes have a negative effect on economic growth when they finance expenditure on defense, education, health, or social security and welfare. but not when they finance other spending categories.

In contrast, the composition of a given level of government expenditure matters more than the composition of revenue. Higher spending on defense, education, health, and social security and welfare at the expense of any of the other expenditure categories significantly reduces economic growth. But, within this sub-expenditure category, substituting one expenditure for another does not have a significant effect on economic growth.

For the most part, the significance of the coefficients for expenditure on defense, education, health, and social security and welfare also depend on how these expenditures are financed. Generally, increases in these expenditure categories do not have a significant effect on economic growth unless they are financed by increased domestic taxes on goods and services and trade-related taxes. Expenditure on economic affairs and services significantly raises economic growth when financed by non-tax revenue, but not otherwise. Finally, increasing the residual expenditure category positively affects economic growth when financed by non-tax revenue, corporate income tax revenue, or the residual tax revenue category.

Health expenditure deserves special comment because of the strong and unexpected results. An increase in health expenditure, no matter how it is financed, significantly decreases the growth rate of real per capita GDP. In other words, whether higher health expenditure is financed with tax increases, with other spending cuts, or with an increase in the government deficit, the growth rate of real per capita GDP generally decreases.

7. Issues of Endogeneity

One criticism of our method, and of most of the existing literature, is that we are discovering correlations and not necessarily causality. The independent variables in equations (7) and (8) may not be independent. Our fiscal variables address this issue in a limited way, since they reflect fiscal, and not calendar, years. That is, the 1980 expenditure and revenue data generally represent July 1979 through June 1980 data. In this sense, our fiscal variables have a six-month lag on the dependent variable. These fiscal variables, however, are deflated by nominal GDP. Thus the endogeneity issues cannot be ignored.

As one attempt to address this issue, we estimate equations (7) and (8) using the once lagged values of all fiscal variables. Results appear in Tables 7 and 8. Table 7 redoes the analysis contained in Table 5 while Table 8 replicates the analysis in Table 6. Generally the results are similar.

Comparing Table 5 and 7, all coefficients have the same signs. With one exception, the coefficients also are significant at the same level. The exception, the coefficient of the fiscal surplus in the equation omitting fiscal expenditure and the coefficient of expenditure in the equation omitting the surplus, is now only significant at the 10-, rather than the 1-, percent level.

Table 8 presents a picture similar to that portrayed in Table 6. The major changes reflect the effects of education and health expenditure. While health expenditure still exhibits a consistent negative effect on economic growth, the significance of this effect is generally diminished and frequently disappears. At the same time, education expenditure now exhibits a strong positive effect on economic growth no matter the source of financing.

8. Conclusion

We examine the effects of national fiscal structures on national economic growth, using an international sample of developed and developing countries and alternative econometric techniques. We adopt the methodology of Miller and Russek (1993), who considered the determinants of state and local economic growth in the United States. The approach incorporates the government budget constraint into the growth rate regressions so that we can clearly identify how a particular change in fiscal policy is financed (e.g., the effect of a tax-financed increase in defense spending).

We can succinctly state our findings concerning the effect of fiscal structure on economic growth. First, the method of financing government expenditure plays an important role in determining the effect of that expenditure on economic growth. Debt-financed increases in expenditure retard growth; tax-financed increases in government expenditure lead to either higher or lower economic growth depending on the expenditure category. Education expenditure is the only category that possesses evidence of a positive effect on economic growth.

Finally, increasing the government surplus generally raises growth, especially if the deficit is reduced by raising taxes.

Footnotes

1. Typically, the data for each country are averaged over the time-series sample (e.g., the growth rate of real gross domestic product per capita).

2. Grier and Tullock (1989) and Barro (1992) come the closest to our methodology. Both divide their samples into 5-year sub-periods and calculate average growth rates over these sub-periods. Thus, they have a pooled cross-section time-series data base. Moreover, for their OECD findings, Grier and Tullock include dummy variables for each time period, save one, producing fixed-effect results across time. For their non-OECD findings, Grier and Tullock include dummy variables for time periods as well as for some geographic regions (i.e., Africa and the Americas), approximating fixed-effect results across time and regions (but not across countries). Barro, on the other hand, includes geographic dummy variables (i.e., sub-Saharan Africa and Latin America), approximating fixed-effect results across regions.

3. Barth, Keleher, and Russek (1990) provide a comprehensive review of the research conducted in the early part of this period.

4. Since our study uses pooled cross-section time-series data, we shall be referring to the methodology associated with pooled estimation. Our discussion draws on Hsiao (1986) and Greene (1990).

5. An alternative procedure is to estimate the first-differenced regression. By lagging equation (4) one period and subtracting the lagged equation from equation (4) causes the intercept and the state-specific terms to drop out.

6. The transformations for the various fixed- and random-effects models are documented in Judge et al (1985, pp. 521, 524, 532, and 535).

7. Friedman (1992) does suggest that the data are consistent with the convergence hypothesis, even though the test may be inappropriate.

8. Romer (1991), when considering this issue, includes the average level of output over the sample rather than its initial value. Miller (1993) introduces the approach we use in this paper.

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Table 1: Country-by-Country Averages of Data: General Macroeconomic Variables Including Central Government Revenue, Expenditure, and Surplus as a Share of GDP

	g	n	inv	opn	p	rev	exp	sur
AVERAGE	1.34	1.51	24.00	69.81	15.09	28.30	31.01	-2.71
(CV)	(3.54)	(0.78)	(0.25)	(0.51)	(1.26)	(0.39)	(0.39)	(-1.72)
Australia	1.57	1.25	24.52	32.16(L)	9.25	22.48	23.70	
Austria	2.02	-0.02(L)	25.73	71.48	5.25(L)	34.07	37.48	-3.41
Barbados	1.80	0.33	22.38	126.44(H)	9.80	28.04	30.92	
Belgium	1.56	0.09(L)	19.83	127.27(H)	6.03	43.74(H)	51.69(H)	-7.95(L)
Botswana	6.72(H)	3.53(H)	38.15(H)	119.56(H)	9.09	44.64(H)	39.08	
Brazil	1.23	2.29	21.77	17.89(L)	59.42(H)	23.09	19.93(L)	
Canada	2.00	1.11	23.00	50.36	7.62	18.98	22.03	-3.05
Chile	0.21	1.57	15.43(L)	46.43	51.49(H)	31.92	31.30	0.62
Costa Rica	0.46	2.37	24.55	71.11	22.30	18.69(L)	21.74	-3.06
Denmark	1.91	0.13	19.52	65.78	8.68	35.58	38.38	-2.79
El Salvador	-1.74(L)	1.66	17.18(L)	65.48	10.92	13.26(L)	16.12(L)	-2.86
Finland	2.28	0.40	26.57	58.89	9.63	28.77	28.85	-0.08
France	1.45	0.46	22.70	42.77	10.17	38.95	39.89(H)	-0.94
Germany	1.95	-0.14(L)	21.10	52.23	3.95(L)	28.42	30.29	-1.87
Iceland	2.79	1.06	25.45	74.56	37.38(H)	27.12	27.20	-0.09
Indonesia	4.19(H)	2.12	25.80	47.90	14.43	19.84	20.80	-0.96
Iran	-2.16(L)	3.31(H)	25.16	40.84	14.76	29.29	35.34	-6.05
Israel	1.21	2.11	23.33	84.71	68.68(H)	59.81(H)	71.08(H)	-11.27(L)
Korea	6.32(H)	1.55	29.50(H)	68.82	14.67	17.26(L)	16.58(L)	0.68
Liberia	-2.78(L)	3.08	23.81	104.49	5.41(L)	21.80	26.45	-4.65
Luxembourg	1.17	0.24	23.91	178.05(H)	5.85	48.92(H)	47.31(H)	1.61(H)
Malawi	0.50	3.12	25.28	61.33	9.46	20.90	28.44	-7.54
Mauritius	2.00	1.53	25.37	102.88	9.84	20.75	26.89	-6.14
Morocco	2.38	2.39	26.53	52.30	7.30	24.82	35.54	-10.71(L)
Netherlands	0.89	0.63	20.15	103.69	5.43(L)	49.81(H)	53.15(H)	-3.34
New Zealand	0.53	0.75	25.08	61.25	12.46	34.15	37.98	-3.83
Paraguay	3.05	3.16(H)	26.47	36.03(L)	12.31	11.08(L)	10.94(L)	
Spain	0.51	0.87	23.59	34.46(L)	14.50	23.68	26.00	
Sri Lanka	3.20(H)	1.61	23.78	70.64	13.80	22.03	31.55	-9.52(L)
Swaziland	-1.18	3.15	32.85(H)	159.35(H)	11.21	31.88	28.69	

Sweden	1.38	0.21	19.31(L)	61.06	9.66	36.55	38.76	-2.20
Switzerland	0.41	-0.00(L)	23.47	70.31	3.72(L)	20.34	20.28	0.06
Thailand	4.31(H)	2.31	25.97	47.98	5.87	14.18(L)	17.80(L)	-3.63
Tunisia	2.72	2.54	30.44(H)	77.72	8.67	31.94	34.01	-2.07
United Kingdom	1.63	0.04(L)	17.97(L)	54.54	11.87	35.68	38.84	-3.15
United States	1.45	1.03	19.01(L)	18.05(L)		6.90	19.53	22.31
Uruguay	0.17	0.57	19.98	39.90	40.25(H)	22.34	24.79	-2.46
Venezuela	-2.21(L)	3.21(H)	29.73(H)	47.85	10.83	24.32	21.27	
3.05(H)								
Zambia	-3.33(L)	3.25(H)	21.48	76.17	9.68	25.11	34.89	-
9.78(L)								

NOTE: AVERAGE is the average value across countries and time; SD is the standard deviation of AVERAGE. The variables are defined as follows: g = the growth rate of real per capita GDP; n = the growth rate of population; inv = the gross domestic investment share of GDP; opn = exports plus imports share of GDP; p = the rate of growth of the GDP implicit price deflator; rev = central government revenue share of GDP; exp = central government expenditure share of GDP; and sur = rev - exp. In each column, (H) and (L) refer to the 5-highest and 5-lowest countries.

Table 2: Country-by-Country Averages of Data: Central Government Revenue Shares

	rev	rci	rii	rss	rdgs	rtrd	rot	rnt	AVERAGE
(CV)	(0.39)	(1.15)	(0.83)	(1.10)	(0.52)	(1.08)	(0.89)	(0.80)	
Australia	22.48	11.84	49.42(H)		0.00(L)	21.60	5.37	1.35(L)	
Austria	34.07	3.24	17.12	34.22	26.27	1.83	9.38(H)	7.94	
Barbados	28.04	16.14	18.30	9.93	19.07	19.69	8.05(H)	8.83	
Belgium	43.74(H)		5.70	32.07	31.27	24.17	0.01(L)	2.59	
Botswana(H)	44.64(H)		17.93(H)		5.66	0.00(L)	1.14(L)		
28.96(H)	2.69	43.63(H)							
Brazil	23.09	2.51(L)	0.25(L)	29.80	22.11	3.91	9.50(H)		
31.92(H)									
Canada	18.98	13.07	36.56(H)		11.47	17.78	6.57	1.41	
Chile	31.92	5.58	8.06	11.18	36.15	6.25	7.09	25.68	
Costa Rica	18.69(L)	0.47(L)	14.90	23.79	29.45	22.38	1.39(L)	7.62	
Denmark	35.58	3.52	32.59(H)		2.65	44.53(H)		0.20	
El Salvador(L)	13.26(L)	8.14	8.26	0.00(L)	32.06	35.87(H)			
9.38(H)	6.29(L)								
Finland	28.77	2.63(L)	27.17	9.35	45.38(H)		1.72	4.58	
France	38.95	5.29	12.18	41.08(H)		30.90	0.04(L)	2.97	
Germany	28.42	3.85	14.85	52.78(H)		23.06	0.02(L)	0.29(L)	

Iceland	27.12	2.22(L)	7.80	3.82	46.53(H)		19.19	
8.05(H)	12.38							
Indonesia(H)	19.84	63.94(H)		2.37(L)	0.00(L)	10.96	7.61	5.86
Iran(L)	29.29	7.79	0.68(L)	5.61	3.35(L)	8.60	3.88	
70.09(H)								
Israel	59.81(H)		7.96	22.40	7.88	21.30	5.23	7.68
Korea(H)	17.26(L)	10.88	12.38	1.03	44.21(H)		15.21	4.61
Liberia(L)	21.80	14.53	17.55	0.00(L)	21.21	28.67	3.05	15.00
Luxembourg	48.92(H)		11.30	25.24	26.71	19.49	0.04(L)	5.57
Malawi	20.90	19.36(H)		11.31	0.00(L)	25.20	16.61	0.44(L)
Mauritius	20.75	9.67	11.84	0.92	17.00	45.16(H)		4.11
Morocco	24.82	11.18	7.38	4.94	33.19	18.80	7.56	16.95
Netherlands	49.81(H)		5.98	22.64	37.28(H)		20.24	0.01(L)
New Zealand	34.15	8.68	56.38(H)		0.00(L)	18.84	3.62	1.94
Paraguay	11.08(L)	11.60	0.17(L)	12.94	20.08	20.97	21.79(H)	
Spain	23.68	6.20	14.69	45.99(H)		14.51	6.80	1.88
Sri Lanka(H)	22.03	9.38	3.76	0.00(L)	28.75	37.74(H)		1.48
Swaziland	31.88	13.84	11.47	0.00(L)	2.28(L)	59.17(H)		2.31
Sweden	36.55	2.54(L)	15.80	31.56	28.72	1.11	6.34	13.94
Switzerland	20.34	2.63(L)	11.64	46.48(H)		18.14	9.12	2.18
Thailand(H)	14.18(L)	9.66	8.08	0.00(L)	45.46(H)		23.77	1.86
Tunisia	31.94	6.40	6.50	9.08	23.67	25.81	6.24	22.32
United Kingdom	35.68	8.48	31.56	16.70	26.28	0.21	3.89	12.88
United States	19.53	11.24	43.45(H)		29.01	5.06(L)	1.52	1.28(L)
Uruguay	22.34	5.61	1.77(L)	26.71	42.41	10.81	6.52	6.17(L)
Venezuela(L)	24.32	57.90(H)		3.10	4.07	4.52(L)	9.19	2.27
Zambia(H)	25.11	16.89(H)		15.28	0.00(L)	42.43	8.39	4.54

NOTE: See Table 1. The variables are defined as follows: rev = central government revenue share of GDP; rci = corporate income tax revenue share of central government revenue (R); rii = individual income tax revenue share of R; rss = social security revenue share of R; rdgs = domestic taxes on goods and services revenue share of R; rtrd = taxes on international trade revenue share of R; rot = other tax revenue share of R; and non-tax revenue share of R. The (H) and (L) indications following selected countries identifies the 5-highest and 5-lowest growth rate countries in real GDP per capita.

Table 3: Country-by-Country Averages of Data: Central Government Expenditure Shares

	exp	edfs	eed	ehlh	ess	eeas	etc	eoe	AVERAGE
(CV)	(0.39)	(0.88)	(0.50)	(0.70)	(0.76)	(0.50)	(0.63)	(0.55)	
Australia	23.70	9.42	8.73	9.45	27.24	8.30(L)	3.65		

33.20(H)								
Austria	37.48	3.10	9.89	12.73	45.87	11.80	7.68	8.92
Barbados	30.92	1.95(L)	20.37(H)		11.01	14.81	22.17	8.25
Belgium	51.69(H)		5.58	14.62	1.77(L)	42.20	14.95	9.40
Botswana(H)	39.08	6.41	19.76(H)		5.69	1.27(L)	29.94(H)	
Brazil	19.93(L)	2.06(L)	1.35(L)	6.16	36.88	12.63	1.29(L)	
39.63(H)								
Canada	22.03	7.83	3.74	6.89	33.99	17.51	5.77	24.27
Chile	31.30	12.36	13.97	6.70	32.96	12.25	3.55	18.20
Costa Rica	21.74	3.05	24.62(H)		20.15(H)		14.81	18.33
Denmark	38.38	6.37	10.52	1.89(L)	41.83	7.36(L)	3.58	28.45
El Salvador(L)	16.12(L)	10.51	19.30	8.58	3.61	23.05	9.26	25.71
Finland	28.85	5.05	14.75	10.81	27.98	26.82	10.55	4.04(L)
France	39.89(H)		7.18	8.85	15.17(H)		42.64	7.74(L)
Germany	30.29	9.57	0.90(L)	19.18(H)		49.60(H)		8.01(L)
Iceland	27.20	0.00(L)	12.80	20.44(H)		15.04	29.01	9.83
Indonesia(H)	20.80	14.85	8.98	2.32	0.00(L)	38.24(H)		
15.48(H)	20.13							
Iran(L)	35.34	17.96(H)		13.33	4.73	7.02	24.85	5.72
Israel	71.08(H)		35.75(H)		8.25	4.12	15.55	12.27
Korea(H)	16.58(L)	32.99(H)		17.16	1.35(L)	5.78	17.44	4.62
Liberia(L)	26.45	6.63	14.20	7.22	1.32(L)	31.40(H)		
14.24(H)	24.99							
Luxembourg	47.31(H)		2.13	8.65	2.19(L)	49.06(H)		17.97
Malawi	28.44	8.74	11.27	5.87	1.51(L)	38.61(H)		
19.19(H)	14.76							
Mauritius	26.89	0.88(L)	15.34	7.86	19.01	14.30	3.42	
39.19(H)								
Morocco	35.54	15.90	16.30	3.19	5.00	26.25	9.92	23.44
Netherlands	53.15(H)		5.76	13.16	11.65	37.02	10.02	3.61
New Zealand	37.98	4.94	13.98	14.32(H)		28.50	16.11	5.10
Paraguay	10.94(L)	12.16	12.54	3.67	21.74	19.96	13.88(H)	
Spain	26.00	4.67	7.57	1.95(L)	56.31(H)		12.16	3.68
Sri Lanka(H)	31.55	2.20	8.61	4.94	16.75	27.01	9.12	31.37
Swaziland	28.69	5.91	20.19(H)		6.47	0.00(L)	31.99(H)	
Sweden	38.76	8.08	10.71	2.30	46.06	11.69	3.90	17.27
Switzerland	20.28	10.43	3.54(L)	11.71	48.61(H)		13.89	8.03
Thailand(H)	17.80(L)	20.18(H)		20.48(H)		4.52	3.21	23.88
Tunisia	34.01	8.41	17.78	6.80	9.85	29.13	6.60	21.44
United Kingdom	38.84	13.59	2.36(L)	13.06	26.83	8.37(L)	2.34(L)	
33.44(H)								
United States	22.31	22.61(H)		2.68(L)	10.34	34.28	9.49	3.36(L)
Uruguay	24.79	11.85	8.78	4.03	47.92(H)		10.34	5.80

Venezuela(L)	21.27	6.52	17.08	8.41	6.71	25.23	8.16	27.88
Zambia(L)	34.89	0.00(L)	14.72	6.89	2.12	23.14	5.78	47.35(H)

NOTE: See Tables 1 and 2. The variables are defined as follows: e = central government expenditure share of GDP; edfs = defense expenditure share of central government expenditure (E); eed = education expenditure share of E; ehlh = health expenditure share of E; ess = social security and welfare expenditure share of E; eeas = economic affairs and service expenditure share of E; etc = transportation and communication expenditure share of E; and other expenditure share of E.

Table 4: Comparison of Cross-Section and Pooled Cross-Section, Time-Series Estimates of Unconditional and Conditional Convergence Tests

	Averaged Data		Random-Effect	Fixed-Effect
				CONSTANT
	(0.97)	(0.60)	(0.95)	
yt-1	-0.0006	-0.0084*	-0.0005	
	(-0.27)	(-2.99)	(-0.22)	(-5.37)
n		-1.9991*		
		(-4.91)		
inv		0.4173*		
		(5.31)		
opn		-0.0162**		
		(-2.06)		
p		0.0253		
		(1.39)		
DF	37	33	388	336
SEE	0.0215	0.0159	0.0425	0.0397

NOTE: See Table 1 for definitions of variables. In addition, y_{t-1} is the lagged value of real per capita GDP adjusted by the World Bank's base year PPP conversion factor for each county to make cross-country comparisons meaningful. Each regression has the same coefficient estimates for the first five variables. DF is the degrees of freedom and SEE is the standard error of the regression.

* means the coefficient is significantly different form zero (two-tailed test) at the 1-percent level.

** means the coefficient is significantly different form zero (two-tailed test) at the 5-percent level.

Ø means the coefficient is significantly different form zero (two-tailed test) at the 10-percent level.

Table 5: Fixed Effect Models Across Countries and Time with Central Government Revenue, Expenditure, and Surplus as a Share of GDP

Variable	Averaged Data			Pooled Data		
Omitted	rev	exp	sur	rev	exp	rev
CONSTANT		0.0351				
		(0.98)				
yt-1		-0.1037*				-0.2120*
		(-3.12)				(-7.30)
n		-2.0259*				-1.1017
		(-4.89)				(-1.25)
inv		0.3959*				0.2652*
		(4.48)				(4.68)
opn		-0.0235**				0.0407
		(-2.28)				(1.43)
p		0.0139				-0.0704*
		(0.66)				(-4.16)

rev	--	0.0433	0.0804	--	0.2395*	0.5727*
		(1.14)	(0.82)		(2.74)	(5.82)
exp	0.0433	--	-0.0371	0.2395*	--	-0.3332*
	(1.14)		(-0.46)	(2.74)		(-4.01)
sur	0.0804	0.0371	--	0.5727*	0.3332*	--
	(0.82)	(0.46)		(5.82)	(4.01)	

NOTE: See Table 1 for definitions of variables. In addition, y_{t-1} is the lagged value of real per capita GDP adjusted by the World Bank's base year PPP conversion factor for each county to make cross-country comparisons meaningful. Each regression has the same coefficient estimates for the first five variables. Degrees of freedom are 31 for the regressions using averaged data and 334 for those using the pooled data. The standard error of the regression is 0.0160 for those regressions using the averaged data and 0.0379 for those using the pooled data.

* means the coefficient is significantly different form zero (two-tailed test) at the 1-percent level.
** means the coefficient is significantly different form zero (two-tailed test) at the 5-percent level.
Ø means the coefficient is significantly different form zero (two-tailed test) at the 10-percent level.

Table 6: Fixed Effect Models Across Countries and Time with the Components of Central Government Revenue and Expenditure as Shares of GDP, and the Central Government Surplus as a Share of GDP

Variable Omitted	rci	rii	rss	rdgs	rtrd	rot	rnt	y_{t-1}
					(-7.50)			

n				-0.5581			
				(-0.70)			
inv				0.2087*			
				(3.47)			
opn				0.0452			
				(1.57)			
p				-0.1084*			
				(-5.73)			

rci	--	0.0771	0.1431	0.3367	0.3920	-0.4636	-0.3312
		(0.23)	(0.35)	(0.90)	(1.36)	(-0.81)	(-1.18)
rii	-0.0771	--	0.0659	0.2596	0.3149	-0.5407	-0.4084
	(-0.23)		(0.16)	(0.62)	(0.97)	(-1.03)	(-1.24)
rss	-0.1431	-0.0659	--	0.1936	0.2489	-0.6066	-0.4743
	(-0.35)	(-0.16)		(0.45)	(0.66)	(-1.07)	(-1.20)
rdgs	-0.3367	-0.2596	-0.1936	--	0.0553	-0.8003	-0.6679Ø
	(-0.90)	(-0.62)	(-0.45)		(0.16)	(-1.24)	(-1.85)
rtrd	-0.3920	-0.3149	-0.2489	-0.0553	--	-0.8556	-0.7232*
	(-1.36)	(-0.97)	(-0.66)	(-0.16)		(-1.57)	(-3.04)
rot	0.4636	0.5407	0.6066	0.8003	0.8556	--	0.1324
	(0.81)	(1.03)	(1.07)	(1.24)	(1.57)		(0.26)
rnt	0.3312	0.4084	0.4743	0.6679Ø	0.7232*	-0.1323	--
	(1.18)	(1.24)	(1.20)	(1.85)	(3.04)	(-0.26)	
edfs	-0.3401	-0.4172	-0.4832	-0.6768Ø	-0.7321*	0.1235	-0.0089
	(-0.99)	(-1.07)	(-1.08)	(-1.68)	(-2.59)	(0.23)	(-0.04)
eed	-0.4758	-0.5529	-0.6188	-0.8125	-0.8678Ø	-0.0122	-0.1445
	(-0.93)	(-1.22)	(-1.12)	(-1.54)	(-1.85)	(-0.02)	(-0.30)
ehlh	-0.8301Ø	-0.9072**	-0.9732**	-1.1668**	-1.2221*	-0.3665	-0.4989
	(-1.85)	(-2.07)	(-2.10)	(-2.31)	(-2.82)	(-0.64)	(-1.13)
ess	-0.4138	-0.4909	-0.5569	-0.7505**	-0.8058*	0.0498	-0.0826
	(-1.31)	(-1.49)	(-1.55)	(-2.00)	(-2.71)	(0.10)	(-0.31)
eeas	0.3727	0.2956	0.2296	0.0360	-0.0193	0.8363	0.7039*
	(1.26)	(1.00)	(0.62)	(0.10)	(-0.07)	(1.59)	(3.21)
etc	0.3261	0.2490	0.1830	-0.0107	-0.0659	0.7897	0.4001
	(0.73)	(0.52)	(0.34)	(-0.02)	(-0.16)	(1.25)	(1.64)
eoe	0.4684Ø	0.3913	0.3254	0.1317	0.0764	0.9320Ø	0.7997*
	(1.87)	(1.34)	(0.92)	(0.42)	(0.37)	(1.74)	(4.92)
sur	0.2266**	0.4341	0.3681	0.1745	0.1192	0.9748**	

0.8424*							
	(2.26)	(1.62)	(1.05)	(0.55)	(0.62)	(1.96)	(5.18)

NOTE: See Tables 1, 2, 3, and 4 for definitions of variables. In these regressions, the revenue and expenditure components are all shares of GDP rather than shares of total revenue and expenditure as is the case in Tables 2 and 3. Each regression has the same coefficient estimates for the first five variables. Each equation has 322 degrees of freedom. The standard error of the regression in each case is 0.0363.

Table 6: (continued)

Variable Omitted	edfs	eed	ehlh	ess	eeas	etc	eoe	sur	y_{t-1}
				(-7.50)					
n				-0.5581					
				(-0.70)					
inv				0.2087*					
				(3.47)					
opn				0.0452					
				(1.57)					
p				-0.1084*					
				(-5.73)					
rci	-0.3401	-0.4758	-0.8301Ø	-0.4138	0.3727	0.3261	0.4684Ø	0.5112**	
	(-0.99)	(-0.93)	(-1.85)	(-1.31)	(1.26)	(0.73)	(1.87)	(2.26)	
rii	-0.4172	-0.5529	-0.9072**	-0.4909	0.2956	0.2490	0.3913	0.4341	
	(-1.07)	(-1.22)	(-2.07)	(-1.49)	(1.00)	(0.52)	(1.34)	(1.62)	
rss	-0.4832	-0.6188	-0.9732**	-0.5569	0.2296	0.1830	0.3254	0.3681	
	(-1.08)	(-1.12)	(-2.10)	(-1.55)	(0.62)	(0.34)	(0.92)	(1.05)	
rdgs	-0.6768Ø	-0.8125	-1.1668**	-0.7505**	0.0360	-0.0107	0.1317	0.1745	
	(-1.68)	(-1.54)	(-2.31)	(-2.00)	(0.10)	(-0.02)	(0.42)	(0.55)	
rtrd	-0.7321*	-0.8678Ø	-1.2221*	-0.8058*	-0.0193	-0.0659	0.0764	0.1192	
	(-2.59)	(-1.85)	(-2.82)	(-2.71)	(-0.07)	(-0.16)	(0.37)	(0.62)	
rot	0.1235	-0.0122	-0.3665	0.0498	0.8363	0.7897	0.9320Ø	0.9748**	
	(0.23)	(-0.02)	(-0.64)	(0.10)	(1.59)	(1.25)	(1.74)	(1.96)	
rnt	-0.0089	-0.1445	-0.4989	-0.0826	0.7039*	0.6573	0.7997*	0.8424*	

	(-0.04)	(-0.30)	(-1.14)	(-0.31)	(3.22)	(1.64)	(4.92)	(5.18)
edfs	--	0.1357	0.4900	0.0737	-0.7128**	-0.6662	-0.8085*	-0.8513*
		(0.26)	(1.03)	(0.23)	(-2.31)	(-1.47)	(-3.24)	(-3.39)
eed	-0.1357	--	0.3543	-0.0620	-0.8485Ø	-0.8019	-0.9442**	-0.9870**
	(-0.26)		(0.61)	(-0.13)	(-1.84)	(-1.28)	(-2.03)	(-2.29)
ehlh	-0.4900	-0.3544	--	-0.4163	-1.2028*	-1.1562**	-1.2985*	-1.3413*
	(-1.03)	(-0.61)		(-1.05)	(-2.90)	(-1.97)	(-3.10)	(-3.40)
ess	-0.0737	0.0620	0.4163	--	-0.7865*	-0.7399	-0.8822*	-0.9250*
	(-0.23)	(0.13)	(1.05)		(-3.18)	(-1.51)	(-3.42)	(-4.08)
eeas	0.7128**	0.8485Ø	1.2028*	0.7865*	--	0.0466	-0.0957	-0.1385
	(2.31)	(1.84)	(2.90)	(3.18)		(0.09)	(-0.44)	(-0.71)
etc	0.6662	0.8019	1.1562**	0.7399	-0.0466	--	-0.1423	-0.1851
	(1.47)	(1.28)	(1.97)	(1.51)	(-0.09)		(-0.38)	(-0.49)
eoe	0.8085*	0.9442**	1.2985*	0.8822*	0.0957	0.1423	--	-0.0428
	(3.24)	(2.03)	(3.10)	(3.42)	(0.44)	(0.38)		(-0.34)
sur	0.8513*	0.9870**	1.3413*	0.9250*	0.1385	0.1851	0.0428	--
	(3.39)	(2.29)	(3.40)	(4.08)	(0.71)	(0.49)	(0.34)	

NOTE:(Continued)

* means the coefficient is significantly different form zero (two-tailed test) at the 1-percent level.

** means the coefficient is significantly different form zero (two-tailed test) at the 5-percent level.

Ø means the coefficient is significantly different form zero (two-tailed test) at the 10-percent level.

Table 7: Fixed Effect Models Across Countries and Time with Lagged Central Government Revenue, Expenditure, and Surplus as a Share of GDP

Variable Omitted	rev	exp	sur	yt-1
		(-7.67)		
n		-0.7704		
		(-0.84)		

inv		0.3422*	
		(5.48)	
opn		0.0404	
		(1.31)	
p		-0.0559*	
		(-2.78)	
rev_{t-1}	--	0.3656*	0.5264*
		(3.66)	(4.77)
exp_{t-1}	0.3656*	--	-0.1608Ø
	(3.66)		(-1.78)
sur_{t-1}	0.5264*	0.1608Ø	--
	(4.77)	(1.78)	

NOTE: See Table 4. Each equation has 296 degrees of freedom. The standard error of the regression in each case is 0.0378.

* means the coefficient is significantly different form zero (two-tailed test) at the 1-percent level.

** means the coefficient is significantly different form zero (two-tailed test) at the 5-percent level.

Ø means the coefficient is significantly different form zero (two-tailed test) at the 10-percent level.

Table 8: Fixed Effect Models Across Countries and Time with the Lagged Components of Central Government Revenue and Expenditure as Shares of GDP, and the Central Government Surplus as a Share of GDP

Variable Omitted	rci	rii	rss	rdgs	rtrd	rot	rnt	y_{t-1}
				(-7.56)				
n				-0.3627				
				(-0.39)				
inv				0.3191*				
				(5.53)				
opn				0.0636Ø				
				(1.93)				
p				-0.0895*				
				(-3.76)				
rci_{t-1}	--	-0.3599	-0.1512	0.2436	0.0640	-1.1183Ø	-0.5687Ø	
		(-0.98)	(-0.30)	(0.56)	(0.20)	(-1.76)	(-1.86)	
rii_{t-1}	0.3599	--	0.2086	0.6035	0.4239	-0.7584	-0.2088	
	(0.98)		(0.46)	(1.33)	(1.21)	(-1.26)	(-0.58)	
rss_{t-1}	0.1512	-0.2086	--	0.3948	0.2152	-0.9671	-0.4175	
	(0.32)	(-0.46)		(0.82)	(0.51)	(-1.48)	(-0.92)	
$rdgs_{t-1}$	-0.2436	-0.6035	-0.3948	--	-0.1796	-1.3619Ø	-0.8123**	
	(-0.56)	(-1.33)	(-0.82)		(-0.46)	(-1.83)	(-1.99)	
$rtrd_{t-1}$	-0.0640	-0.4239	-0.2152	0.1796	--	-1.1823Ø	-0.6327**	
	(-0.20)	(-1.21)	(-0.52)	(0.46)		(-1.89)	(-2.52)	
rot_{t-1}	1.1183Ø	0.7584	0.9671	1.3619Ø	1.1823Ø	--	0.5496	
	(1.76)	(1.26)	(1.48)	(1.83)	(1.89)		(0.94)	
rnt_{t-1}	0.5687Ø	0.2088	0.4175	0.8123**	0.6327**	-0.5496	--	
	(1.86)	(0.58)	(0.92)	(1.99)	(2.32)	(-0.94)		
$edfs_{t-1}$	-0.3610	-0.0012	-0.2048	-0.6046	-0.4250	0.7573	0.2077	
	(-0.97)	(-0.00)	(-0.41)	(-1.34)	(-1.36)	(1.23)	(0.87)	
eed_{t-1}	1.0974**	1.4572*	1.2486**	0.8538	1.0334**	2.2157*	1.6661*	

	(1.97)	(2.96)	(2.09)	(1.52)	(2.07)	(3.02)	(3.12)
$ehlh_{t-1}$	-0.8417	-0.4819	-0.6905	-1.0853Ø	-0.9058Ø	0.2766	-0.2730
	(-1.62)	(-0.93)	(-1.26)	(-1.83)	(-1.80)	(0.41)	(-0.53)
ess_{t-1}	-0.2804	0.0759	-0.1292	-0.5240	-0.3444	0.8379	0.2883
	(-0.83)	(0.22)	(-0.36)	(-1.27)	(-1.07)	(1.44)	(0.98)
$eeas_{t-1}$	0.0607	0.4205	0.2119	-0.1829	-0.0034	1.1790**	0.6294**
	(0.19)	(1.32)	(0.50)	(-0.47)	(-0.01)	(1.96)	(2.49)
etc_{t-1}	0.1957	0.5556	0.3470	-0.0478	0.1317	1.3140Ø	0.7645Ø
	(0.42)	(1.12)	(0.61)	(-0.09)	(0.33)	(1.86)	(1.85)
eoe_{t-1}	0.3628	0.7227**	0.5140	0.1192	0.2988	1.4811**	0.9315*
	(1.29)	(2.29)	(1.28)	(0.33)	(1.37)	(2.39)	(4.71)
sur_{t-1}	0.3454	0.7053**	0.4966	0.1018	0.2814	1.4937**	0.9141*
	(1.34)	(2.43)	(1.25)	(0.29)	(1.36)	(2.57)	(4.69)

NOTE: See Table 5. In these regressions, the revenue and expenditure components are all shares of GDP are lagged on period. Each regression has the same coefficient estimates for the first five variables. Each equation has 284 degrees of freedom. The standard error of the regression in each case is 0.0363.

Table 8: (continued)

Variable Omitted	edfs	eed	ehlh	ess	eeas	etc	eoe	sur	y_{t-1}
				(-7.56)					
n				-0.3627					
				(-0.39)					
inv				0.3591*					
				(5.53)					
opn				0.0636Ø					
				(1.93)					
p				-0.0895*					
				(-3.76)					
rci_{t-1}	-0.3610	1.0974**	-0.8148	-0.2804	0.0606	0.1957	0.3628	0.3454	
	(-0.97)	(1.97)	(-1.62)	(-0.83)	(0.19)	(0.42)	(1.29)	(1.34)	
rii_{t-1}	-0.0012	1.4572*	-0.4819	0.0795	0.4205	0.5556	0.7227**	0.7053**	
	(-0.03)	(2.96)	(-0.93)	(0.22)	(1.32)	(1.12)	(2.29)	(2.43)	

rss_{t-1}	-0.2098	1.2486**	-0.6905	-0.1292	0.2119	0.3470	0.5140	0.4966
	(-0.41)	(2.09)	(-1.26)	(-0.32)	(0.50)	(0.61)	(1.28)	(1.25)
$rdgs_{t-1}$	-0.6046	0.8538	-1.0853Ø	-0.5240	-0.1829	-0.0479	0.1192	0.1018
	(-1.34)	(1.52)	(-1.83)	(-1.27)	(-0.47)	(-0.09)	(0.33)	(0.29)
$rtrd_{t-1}$	-0.4250	1.0334**	-0.9058Ø	-0.3444	-0.0034	0.1317	0.2988	0.2814
	(-1.35)	(2.07)	(-1.80)	(-1.07)	(-0.01)	(0.33)	(1.37)	(1.36)
rot_{t-1}	0.7573	2.2157*	0.2766	0.8379	1.1790**	1.3140Ø	1.4811**	1.4637**
	(1.23)	(3.02)	(0.41)	(1.44)	(1.96)	(1.86)	(2.39)	(2.57)
rnt_{t-1}	0.2077	1.6661*	-0.2730	0.2883	0.6294**	0.7644Ø	0.9315*	0.9141*
	(0.87)	(3.12)	(-0.53)	(0.98)	(2.49)	(1.85)	(4.71)	(4.69)
$edfs_{t-1}$	--	-1.4584**	0.4807	-0.0806	-0.4217	-0.5568	-0.7238**	-0.7064**
		(-2.53)	(0.86)	(-0.23)	(-1.21)	(-1.21)	(-2.58)	(-2.52)
eed_{t-1}	1.4584**	--	1.9391*	1.3778*	1.0367**	0.9016	0.7346	0.7520
	(2.53)		(2.94)	(2.62)	(2.09)	(1.39)	(1.49)	(1.63)
$ehlh_{t-1}$	-0.4807	-1.9391*	--	-0.5613	-0.9024Ø	-1.0375	-1.2045**	-1.1871**
	(-0.86)	(-2.94)		(-1.23)	(-1.86)	(-1.63)	(-2.46)	(-2.55)
ess_{t-1}	0.0806	-1.3778*	0.5613	--	-0.3411	-0.4761	-0.6432**	-0.6258**
	(0.23)	(-2.62)	(1.23)		(-1.25)	(-0.96)	(-2.31)	(-2.55)
$eeas_{t-1}$	0.4257	-1.0367**	0.9024Ø	0.3411	--	-0.1351	-0.3021	-0.2847
	(1.21)	(-2.09)	(1.86)	(1.25)		(-0.26)	(-1.34)	(-1.36)
etc_{t-1}	0.5568	-0.9016	1.0375	0.4761	0.1351	--	-0.1671	-0.1997
	(1.21)	(-1.39)	(1.63)	(0.96)	(0.26)		(-0.45)	(-0.40)
eoe_{t-1}	0.7238*	-0.7346	1.2045**	0.6432**	0.3021	0.1671	--	0.0174
	(2.58)	(-1.49)	(2.46)	(2.31)	(1.34)	(0.45)		(0.13)
sur_{t-1}	0.7064**	-0.7520	1.1871**	0.6258**	0.2847	0.1497	-0.0174	--
	(2.52)	(-1.63)	(2.55)	(2.55)	(1.36)	(0.40)	(-0.13)	

NOTE:(Continued)

* means the coefficient is significantly different form zero (two-tailed test) at the 1-percent level.

** means the coefficient is significantly different form zero (two-tailed test) at the 5-percent level.

Ø means the coefficient is significantly different form zero (two-tailed test) at the 10-percent level.