PUBLIC SPENDING AND ECONOMIC GROWTH: EMPIRICAL INVESTIGATION OF SUB-SAHARAN AFRICA

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ABSTRACT

Existing studies on the relationship between government spending and economic growth provide inconclusive empirical evidence. This paper re-examines the effect of government spending on economic growth using panel data set from Sub-Saharan Africa. The model is derived from an aggregate production function in which government spending, foreign assistance for development and trade-openness are explicitly specified as input factors. Fixed-effects and random-effects estimation techniques were applied to the model. The results from both estimation techniques indicate that government spending, trade-openness, and private investment spending all have positive and significant effect on economic growth. Foreign development assistance and the growth rate in population are statistically insignificant. A test of a restricted version of the model indicates that the contributions of foreign development assistance and the growth rate in population on economic growth are statistically zero.

INTRODUCTION

The effect of government spending on economic growth is still an unresolved issue theoretically as well as empirically. Although the theoretical positions on the subject are quite diverse, the conventional wisdom is that a large government spending is a source of economic instability or stagnation. Empirical research, however, does not conclusively support the conventional wisdom. A few studies report positive and significant relation between government spending and economic growth while several others find significantly negative or no relation between an increase in government spending and growth in real output. An extensive review of literature, presented in the next section, clearly indicates that empirical evidence on the effect of government spending on economic growth is at best mixed.

The purpose of this study is to empirically re-examine the effect of government spending on the growth rates of real domestic products of some Sub-Saharan African countries. Though the goal of the study is similar to those of previous studies in this area of research, the method of analysis is different at least in two ways. First, the study examines the effects of two types of public spending: domestic government spending on capital formation and foreign receipts for development assistance. The main interest of the study is to investigate the effect of each type of public spending separately. Second, the model uses panel data, rather than simple cross-section data, and has been estimated by fixed-effects and random-effects estimation techniques, which are fairly new and advanced estimation methods of panel data. Another difference between this study and the previous ones is that the countries included in this study are similar in economic structure, background, stage of development, and have similar institutional arrangements and culture.[1] These

similar characteristics of the sample countries are expected to make the inferences derived from the empirical results more valid. At a minimum, the study will contribute to the methodology of cross-section analysis as it is applied to the economies of developing countries in this area of research.

REVIEW OF EMPIRICAL LITERATURE

Numerous studies have been conducted to investigate the relation between government spending and economic growth. This section provides a brief review of the various empirical models, specifications, and conclusions of existing studies on the topic.

Using an endogenous growth model of the U.S. economy in which government purchases directly affect both the utility of consumers and the productivity of firms, Knoop [15] finds that reducing the size of government reduces economic growth and welfare. Devarajan, et al. [7] examine the relation between the share of total government expenditure in GDP and the growth in per capita real GDP and find negative and significant relationship between the two. Ghura [9] tests the relation between government consumption as a percent of GDP and economic growth using data from developing countries. He finds significantly negative relation between government consumption and the growth in per capita real GDP. Nelson and Singh [19] examine the effect of overall government size, measured by the central government revenue as a percent of GDP, on the average growth rate of GDP. They find no relation between growth in government spending and the growth rate in GDP. Lindauer and Velenchik [18] conclude that there is no significant direct relation between government expenditure and economic growth. However, they argue that government spending may positively affect economic growth indirectly through its influence on the efficiency of the private sector allocation of inputs. Khan and Reinhart [14] develop a growth model that examines separately the effects of public sector and private sector investments. Using cross-section data from a sample of 24 developing countries, they find that public investment has no direct effect on economic growth. Barro [3] defines the government's productive expenditure alternatively as a ratio of gross domestic product and as a ratio of the sum of private and public investments. He finds insignificant relation in both specifications. In another similar study, Barro [4] regresses the average annual growth rate in real per capita GDP on the ratio of real government consumption to real GDP. In this study, he finds significantly negative relation between economic growth and government consumption. Aschauer [1] reports positive and significant relation between government spending and the level of output.

In a similar study, Aschauer [2] specifies real output as a function of employment, stock of capital, productivity, and government expenditure. He concludes that the additions to nonmilitary structures increase the overall economic productivity. Grier and Tullock [10] define the government variable as a growth rate in the share of government consumption in GDP and test the model using 30-year data from 24 OECD countries and 20-year data from developing countries. They report negative and significant relation between the share of government consumption in GDP and the growth in GDP in both samples. Conte and Darrat [6] examine the effect of government spending on output using one-sided Granger-causality analysis. Their findings are mixed but indicate no significant relation between government spending and growth in output for most of the countries.

Ram [20,21] derives the empirical model from a production function that explicitly includes both private and public sectors. He reports that public investment is more productive than private investment in both studies. Saunders [22] tests the effect of government expenditure on the economy by regressing the percentage change in real GDP on the share of the total government spending in GDP. Using data from OECD countries, he finds negative relation between average economic growth and average share of total government expenditure in GDP. Landau [16] reports a negative relation between growth in government spending and the growth rate in real per capita GDP. In another paper [17], he defines government consumption as a ratio of GDP and the real output as an average rate of growth in real per capita GDP, and tests the model using cross-section data from developed and developing countries for several sub-periods. His results show that an increase in government consumption significantly reduces the growth rate in real per capita GDP.

In summary, the empirical evidence regarding the effect of government spending on economic growth is clearly mixed. Furthermore, the literature review indicates that the empirical results are specification-dependent. In other words, the results seem to depend on how the government spending is specified in the empirical model. Based on the empirical review, it can be concluded that the relationship between government spending and economic growth is generally negative if the government spending is expressed as percent of GDP and is generally positive if it is expressed as an annual percentage change in the estimating equation.

THE EMPIRICAL MODEL

The neoclassical production function is used as the basis for specifying the empirical model for this study. Ignoring the level of technology (A), the standard aggregate production function is written as:

$$Y = F(K, L) \tag{1}$$

where, Y is the level of output, K is the stock of domestic physical capital, and L is the labor force. As in Feder [8], Ram [21], and Grossman [11], the standard aggregate production function can be modified to include the total government expenditure for capital formation (G) as an independent input and rewritten as:

$$Y = f(K, L, G) \tag{2}$$

For analytical purpose, the government expenditure on capital formation is divided into domestic component (G^D) and foreign component (G^F), which represents the official inflow for development assistance. Disaggregating the government expenditure into its domestic and foreign components as in Khan and Reinhart [14] and introducing a measure of openness (Z), the aggregate production function used in this analysis is specified as:

$$Y = g(K, L, G^D, G^F, Z) \tag{3}$$

Taking total derivatives of equation (3) and normalizing the results by the gross domestic product (Y), except the labor force, yields to:

$$dY/Y = (\partial Y/\partial K)dK/Y + (\partial Y/\partial L)dL/L + (\partial Y/\partial G^D)dG^D/Y + (\partial Y/\partial G^F) dG^F/Y + (\partial Y/\partial Z)dZ/Y \quad (4)$$

where, $\partial Y/\partial K$ is the marginal product of capital, $\partial Y/\partial L$ is the marginal product labor. Similarly, $\partial Y/\partial G^{D,F}$ and $\partial Y/\partial Z$ can be defined as the marginal products of government expenditure for capital formation and trade openness, respectively. The signs of all partial derivatives with respect to output are assumed to be positive. This means that private investment, the labor force, government spending for capital formation (regardless of the source of financing), and trade-openness are all expected to have positive and significant effect on economic growth. Trade-openness is expected to have a positive and significant effect on economic growth because open economies can have more access to foreign resources and markets. Thus, a more open economy is expected to have a higher growth rate than a closed economy.

For empirical analysis, $\partial Y/\partial K = \alpha_1$, $\partial Y/\partial L = \alpha_2$, $\partial Y/\partial G^D = \alpha_3$, $\partial Y/\partial G^F = \alpha_4$, and $\partial Y/\partial Z = \alpha_5$.

The variables are also expressed in more explicit notation as:

dY/Y = GDPGR = annual growth rate in real gross domestic product,
dK/Y = I/Y = PI = private investment as percent of gross domestic product,
dL/L = PGR = annual percentage change in population, a proxy for the labor force,[2]
$dG^D/Y = G^D/Y$ = GI = government expenditure for capital formation as percent of GDP,
$dG^F/Y = G^F/Y$ = ODA = net official development assistance from all donors as percent of recipient GDP,[3]
dZ/Y = TOP = annual percentage change in the ratio of the sum of exports and imports to GDP, a proxy for trade-openness. [4]

After making these adjustments in definitions and notations, the estimating equation is written as:

$$GDPGR_{it} = \alpha_0 + \alpha_1 PI_{it} + \alpha_2 PGR_{it} + \alpha_3 GI_{it} + \alpha_4 ODA_{it} + \alpha_5 TOP + e_{it}, \quad (5)$$

where, i =1. …., 26,
t =1……., 10,
α_0 = the constant term,
e_{it} = the error term.

The model specified in equation (5) examines the independent effects of private investment and public investment on economic growth. The main focus of the study

though is an investigation of the effects of government spending and foreign official development on economic growth. The other variables in the model serve as control variables.[5]

The study uses panel data from 26 Sub-Saharan African countries, which were selected mainly based on the availability of continuous data for the period under consideration.[6] The data cover 1987-97 period for the variables expressed in annual changes for a total of 260 observations on each variable. The data in level form were reported in U.S. dollars for all countries. All data were transformed to three-year moving averages. The moving average process was applied to correct any autocorrelation problem and to make the data stationary. The data were also formally tested for heteroscedasticity, the most commonly expected problem in panel and cross-section data, using the White Test. The test results indicate no heteroscedasticity problem.[7] Furthermore, the correlation matrix of the explanatory variables indicate no significant pairwise correlation. The variance inflation factor (VIF), reported on the last column of Table 1, also indicates no evidence of multicollenearity problem among the regressors.[8]

EMPIRICAL RESULTS

The model was estimated using two alternative estimation methods: fixed-effects and random-effects methods.[9] The fixed-effects method is expected to remove the effects of any time-invariant unobserved attribute of each country, which may be correlated with one or more of the explanatory variables. In the fixed-effects model, the intercept term is eliminated during data transformation. Therefore, there is no constant term in the fixed-effects model. In the random-effects model, however, it is assumed that the unobserved attribute of each country is uncorrelated with each explanatory variable at all times. Thus, the constant term remains intact in the random-effects model. Both methods were estimated by the current version of the RATS software. The results from both estimation methods are shown in Table 1. Both estimation techniques have produced comparable results but the results obtained from the random-effects estimation are slightly more robust. The slight edge in robustness of the results from the random-effects estimation might be indicating that there are no individual differences statistically among the countries in the sample.[10]

The results from both estimation techniques show that the government spending on capital formation has the expected positive effect on economic growth and is statistically significant at 1 percent significance level. This result is consistent with some of the previous studies, such as Aschauer [1,2] and Ram [20,21]. The trade-openness also has the expected sign and is significant close to 1 percent significance level. Private investment spending is statistically significant at 5% percent level in the random-effects and at 10 percent level in the fixed-effects. This implies that the random-effects model is a better fit for the private investment spending. The official development assistance and the labor force are both statistically insignificant in both models. With the exception of Billet [5], who reports mixed results on the effect of official development assistance on economic growth of some developing countries, there are no other empirical studies on this relationship to which the results of this paper can be directly compared. As in all previous similar studies, the population variable is insignificant. However, this could be due to the fact that the labor force has been proxied by the growth rate in population rather than by the actual growth rate in labor force.

Table 1
Regression Results
Dependent Variable: Gdpgr

FIXED-EFFECTS MODEL (t-ratios in parenthesis)	**RANDOM-EFFECTS Model (t-ratios in parenthesis)**	**Variance Inflation factor**
Variable	**Coefficient**	**Coefficient**	**VIF**
Constant	-----	1.756** (2.78)	----
PI	0.066*** (1.80)	0.071** (2.33)	1.1
PGR	-0.008 (-0.19)	0.004 (0.10)	1.0
GI	0.156* (3.27)	0.137* (3.32)	1.5
ODA	-0.033 (-1.41)	-0.029 (-1.57)	1.5
TOP	0.009** (2.48)	0.008** (2.50)	1.0
Adj. R^2 = 0.300 F-ratio = 4.65 NT = 260	Adj. R^2 = 0.350 SEE = 2.171 NT = 260	

* Significant at 1% level, ** Significant at least at 5% level, *** Significant at 10% level.

Table 2
Regression Resluts: Restricted Model Dependent Variable: GDPGR

FIXED-EFFECTS MODEL (t-ratios in parenthesis)	**RANDOM-EFFECTS Model (t-ratios in parenthesis)**
Variable	**Coefficient**	**Coefficient**
Constant	------	1.505** (2.52)
PI	0.060 (1.62)	0.068** (2.21)
GI	0.140* (3.01)	0.111* (2.93)
TOP	0.009** (2.42)	0.008** (2.48)
Adj.R^2 = 0.299 F-ratio = 4.913 NT = 260	Adj. R^2 = 0.353 SEE = 2.172 NT = 260

* Significant at 1% level, ** Significant at least at 5% level.

Estimation of a restricted model, which assumes that the population growth rate and the official development assistance both have zero effect on economic

growth (i.e., $\alpha_2 = \alpha_4 = 0$), produced the results in Table 2. Comparison of the results in Tables 1 and 2 illustrates that the t-ratios of government spending (GI) and trade-openness (TOP) are slightly lower than in the full model but they are still significant at the same significance level. Private investment (PI) becomes less significant in the fixed-effects model but remains significant in the random-effects model. The adjusted R^2s also remain virtually unchanged. This means that the hypothesis $\alpha_2 = \alpha_4 = 0$ cannot be rejected.[11]

CONCLUSIONS

This paper has examined the effects of government spending, official development assistance, trade-openness, private investment spending, and population growth rate on economic growth using panel data from Sub-Saharan African countries for the 1987-97 period. The model was estimated in its full and restricted versions by fixed-effects and random-effects techniques. The results from both estimation techniques indicate that the government spending on capital formation, trade-openness, and the private investment spending all have positive and significant effect on economic growth. The official development assistance and the growth rate in population are statistically insignificant. Hence, the results obtained from the restricted model do not significantly change the conclusions from the full model.

These results seem to imply that these countries have to increase government spending on capital formation and create favorable economic environment for sufficient private investment spending. The results also point out that the economies of these countries are positively impacted by open trade sectors. The official development assistance, which was expected to have positive and significant effect, turned out to be insignificant. This unexpected result between official development assistance and economic growth suggests the need for a further research for more conclusive evidence. Although the results of this study may have only limited policy implications, they are useful in the sense that they encourage a further extended research on the topic.

ENDNOTES

1. This attempts to address a major criticism on cross-section studies in which countries of different history, size, and economic structure are pooled for a study. Some economists argue that for a cross-section analysis to be valid, the countries in a cross-sectional study should be made as homogeneous as possible by grouping the countries by geography, size, or economic structure.
2. As in several other studies, such as Islam [12] and Ram [21], the labor force has been proxied by the growth rate in population for which data are readily available. As in for most developing countries, there are no continuous time series data on the labor force for the countries selected for this study. The literacy rate was initially considered as an alternative proxy for the labor force but it was dropped for lack of consistent data for the period under study.
3. Following some previous studies, both the domestic government spending for capital formation and the official development assistance have been expressed as percentages of domestic GDP rather than annual percentage changes.
4. Some studies, such as Ram [20] and Khan and Reinhart [14], use the rate growth in real exports, or the rate of growth in real imports as a proxy for trade-openness. But the sum of exports and imports as a ratio of domestic GDP is a more accepted measure of trade-openness.
5. Some studies use "start-of-period GDP" and education attainment of the labor force as additional control variables. Since the countries are in the same stage of economic development, it was not necessary to include "start-of-period GDP" in this study, and education attainment of the labor force was dropped due to lack of data.
6. Initially, all politically stable Sub-Saharan African countries were considered. As the study progressed, several countries were dropped due to lack of availability of complete data for the period under consideration. The countries in the sample are Benin, Burkina Faso, Burundi, Cape Verde, Central African Republic, Comoros, Cote d'Ivoire, Republic of Congo, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Niger, Senegal, Swaziland, Togo, Uganda, and Zimbabwe. The two main sources of data are the *African Development Indicators 1998/99,* and various yearbooks of the *International Financial Statistics.* The former i*s* published by the World Bank and the later by the International Monetary Fund.
7. The squares of the regression residuals were regressed on the original regressors and their squares and cross products. The chi-square distribution of this test with 20 degrees of freedom is 22.63. The critical chi-square distribution with 20 degrees of freedom at 5 percent significance level is 31.41. Thus, the hypothesis of homoscedasticity is not rejected.
8. A variance inflation factor (VIF) less than 10 is generally viewed as evidence of absence of problematic multicollinearity.

9. In panel data, the dependent variable is influenced by two types of unobserved factors. One of the factors is assumed constant over time (fixed-effects) and the other is assumed to vary over time (random-effects) (See Wooldridge [23], and Johnston and DiNardo [13]).
10. Individual-effects test at 5% significance level reveals that there is no statistical difference in the individual characteristics of the countries.
11. The restricted model assumes that the population and the official development assistance coefficients are both zero. This is formally stated as: Ho: $\alpha_2 = \alpha_4 = 0$ Ha: not Ho.

The F-statistic of this test is 1.02. The critical F value with 2 degrees of freedom in the numerator and 227 degrees of freedom in the denominator at 5% significance level is 3.0. Thus, the hypothesis that the population and the official development assistance coefficients are zero cannot be rejected. This means that population growth and official development assistance have no effect on economic growth in this model.

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