ANNALS OF ECONOMICS AND FINANCE **3**, 379–406 (2002)

Effects of Growth and Volatility in Public Expenditures on Economic Growth: Theory and Evidence*

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This paper sets up a theoretical model linking the growth rate of the economy to the growth rate and volatility of different government expenditures. On a theoretical basis, it is found that volatility in government spending can be positively or negatively associated with economic growth depending on the intertemporal elasticity in consumption. On an empirical basis, it is rather surprising to find no association between growth in capital expenditure and output growth, whereas growth in current expenditure seems to stimulate output growth. In particular, growth in transportation and communication seems to have a negative effect on output growth. It is also very interesting to find that the rises in the volatility in the growth of general public services, transportation, and communication have a positive effect on output growth.

Key Words: Public expenditures; Volatility; Economic growth.
JEL Classification Numbers: E62, I00, H5, O4.

1. INTRODUCTION

The present paper explores growth and volatility in public expenditures and their effects on economic growth. At the theoretical level, we offer a stochastic model linking the growth and volatility in the composition

* Project Supported by the National Natural Science Fundation of China.

1529-7373/2002

of public expenditures to economic growth. At the empirical level, we use a data set covering more than 90 countries over the period of 1970-1994 in order to examine the effects on economic growth of (i) the growth and volatility in current and capital expenditures, and (ii) the growth and volatility in general public services, defense, education, human welfare services, economic services, and transportation and communication.

The effects of public expenditures on economic growth have been studied since the 1980s. Kormendi and Meguire (1985); Aschauer (1989); Barro (1990); and Fischer (1993), among many others, have studied aggregate government spending and its effects on growth and productivity. Those studies divide government spending into aggregate public consumption and aggregate public investment. At the same time, Easterly and Rebelo (1993); and Devarajan, Swaroop, and Zou (1996) have made a systematic examination of the relationship between the composition of public expenditures and economic growth. To our best knowledge, none of the existing studies has explicitly considered the effects of growth and volatility in various public expenditures on economic growth. There is also an enormous body of literature on the growth of government and public expenditures; see Peltzman (1980), North (1985), and Borcherding(1985). The growth of government and various public sectors are associated with per capita GDP and the rate of GDP growth. The issue here is the reverse relationship: how the growth and volatility of the public sector affect economic growth.

Our present study is in the spirit of Bertola and Drazen (1993); Gali (1994); and especially Ramey and Ramey (1995). The volatility of government spending on macroeconomic stabilization has been examined by Bertola and Drazen (1993); and Gali (1994). The effects of the volatility in aggregate government spending on investment and growth have been examined by Ramey and Ramey (1995), but they have not explicitly addressed the volatility in various components of government expenditures. Furthermore, they have not dealt with the potentially differentiated effects of growth and volatility in public expenditures on economic growth— a clear result from our theoretical model. Our approach can also be regarded as an extension of the study on political instability and economic growth by Alesina *et al* (1996). Political instability typically affects the sector allocation of public expenditures and leads to different degrees of volatility in different public sectors, say, education, infrastructure, and defense.

The paper is organized as follows. Section 2 sets up a stochastic growth model and discusses the effects of growth and volatility of multiple public expenditures on economic growth. The expected growth rate of output, asset, and consumption is derived explicitly from the stochastic differential equations describing the motion of asset accumulation and consumption. Section 3 is devoted to the empirical analysis of the effects of growth and volatility of government expenditures on economic growth for more than 90

countries over the time period 1970-94. Section 4 summarizes theoretical and empirical findings.

2. ANALYTICAL MODEL

Following Arrow and Kurz (1970); Barro (1990); Turnovsky (1995); Turnovsky and Fisher (1995); and Devarajan, Swaroop, and Zou (1996), we consider the representative-agent model with the utility function defined on private consumption, c, and various public services, $g_1, \ldots, g_n$, namely,

$$u\left(c, g_1, \ldots, g_n\right).$$

Suppose the representative agent derives positive but diminishing marginal utility from private consumption good and various public services, i.e.

$$u_c > 0, u_{cc} < 0, u_{g_i} > 0, u_{g_i g_i} < 0, \quad i = 1, \ldots, n.$$

Without loss of any generality, we take $n = 2$.

As in Eaton (1981); Gertler and Grinols (1982); Grinols and Turnovsky (1992, 1993); and Turnovsky (1993, 1995), output is produced by a stochastic technology,

$$dY = f\left(k\right) dt + h\left(k\right) dy, \quad f' > 0, \quad f'' \leq 0 \tag{1}$$

which asserts that the flow of output over the period $(t, t + dt)$, consists of two components. First, there is the deterministic component, described by the first term on the right side, with $f(k)$ representing the mean rate of output per unit of time. In addition, there is a stochastic component, reflecting the various random influences that impact on production.[1] The stochastic term dy can be explained as stochastic shock and assumed to be a temporally independent, normally distributed with mean zero and variance $\sigma_y^2 dt$:

$$E\left(dy\right) = 0, \; V\left(dy\right) = \sigma_y^2 dt.$$

Extending the model specifications in Bertola and Drazen (1993); and Turnovsky (1995), we suppose that the two kinds of government spending follow the stochastic processes

$$dg_i = g_i\left(t\right) dt + m_i\left(k\right) dz, \quad i = 1 \text{ and } 2, \tag{2}$$

where the stochastic component dz is an intertemporally independent, normally distributed, random variable with mean zero and variance $\sigma_z^2 dt$.

[1] In order to derive explicit solutions to asset accumulation and the growth rate, government spending is excluded from the production function.

There are two assets: capital stock, k, and government bonds, b, in our model. The returns on the two assets, k and b, are R_k and R_b, respectively. The stochastic processes of these two returns are given as follows:

$$dR_k = \frac{dY}{k} \equiv r_k dt + du_k,$$

$$dR_b = r_b dt,$$

where r_k is the mean return on capital and du_k is its stochastic component with mean zero; and r_b is the deterministic return on government bonds.

There is an income tax, τdY. The two kinds of government expenditures are financed by the income tax and new bond issues minus interest payments on government bonds:

$$dg_1 + dg_2 = \tau dY + db - bdR_b.$$

Given the income tax and the two assets in the economy, the budget constraint for the representative agent can be written as

$$dw = \left((1-\tau) r_k n_k w + r_b (1-n_k) w - c\right) dt + w dv \tag{3}$$

Where $w = k + b$, and it is the agent's total wealth. n_k and n_b are the holding shares of capital and bonds, respectively, which are defined as

$$n_k = \frac{k}{w}, n_b = \frac{b}{w}, \tag{4}$$

and dv is a stochastic process defined by

$$dv \equiv (1-\tau) n_k du_k \tag{5}$$

Now, the representative agent choose his consumption path, $c(t)$, and asset holding shares,n_k and n_b, to maximize his discounted utility

$$\max E_0 \int_0^\infty u(c, g_1, g_2) e^{-\rho t} dt$$

subject to budget constraint (3) and the portfolio constraint

$$n_k + n_b = 1.$$

In order to derive explicit solutions to consumption and asset holdings, we specify the technology, government expenditures, and the utility func-

tion as follows

$$dY = Ak\left(dt + dy\right), \tag{6}$$

$$dg_i = \mu_{g_i} g_i dt + \sigma_{g_i} g_i dz_i \quad (i = 1, 2), \tag{7}$$

$$u\left(c, g\right) = \frac{c^{1-\gamma}}{1-\gamma} g_1^{-\lambda_1} g_2^{-\lambda_2}, \tag{8}$$

where A, μ_{g_i} and σ_{g_i} $(i = 1\text{and}2)$ are constants, and λ_1, λ_2, and γ satisfy the following conditions: $-1 < \lambda_1, \lambda_2 > 0$, when $0 < \gamma < 1$; and $\lambda_1, \lambda_2 > 0$, when $\gamma > 1$. μ_{g_i} is the mean of the growth rate of the i-th item of public expenditure, and σ_{g_i} measures the volatility in the growth rate of the i-th item of public expenditure. These function forms are not new if taken individually. For example, the production technology in (6) is used by Eaton (1981) and Turnovsky (1995); the geometric Brownian motion describing government spending in (7) is very similar to the ones in Bertola and Drazen (1993); and Turnovsky (1995), among many others; and the utility function in (8) can be regarded as an extension of Barro (1990); Turnovsky and Fisher (1995); and Devarajan, Swaroop, and Zou (1996) with multiple public goods. But the combination of these conventional specifications of technology, government expenditures, and preferences allows us to obtain explicit stochastic differential equations of consumption and asset accumulation, and hence to obtain the expected growth rate of consumption and wealth accumulation.

Substituting equation (6) into the budget constraint (3), we can rewrite the budget constraint as

$$\frac{dw}{w} = \left[\left(1-\tau\right) An_k + r_b\left(1-n_k\right) - \frac{c}{w}\right] dt + dv. \tag{9}$$

To solve the problem, we introduce the value function

$$V\left(w, g_1, g_2, t\right),$$

and define

$$V\left(w, g_1, g_2, t\right) = X\left(w, g_1, g_2\right) e^{-\rho t}.$$

Now, we define the differential operator, $L\left(X\left(w, g_1, g_2, t\right) e^{-\rho t}\right)$, by

$$\begin{aligned}
& L\left(X\left(w, g_1, g_2, t\right) e^{-\rho t}\right) \\
= \; & \{-\rho X + X_w\left[\left(1-\tau\right) An_k w + r_b\left(1-n_k\right) w - c\right] + X_{g_1}\mu_{g_1} g_1 \\
+ \; & X_{g_2}\mu_{g_2} g_2 + \frac{1}{2} X_{ww} n_k^2 w^2 \sigma_y^2 + \frac{1}{2} X_{g_1 g_1} g_1^2 \sigma_{g_1}^2 + \frac{1}{2} X_{g_2 g_2} g_2^2 \sigma_{g_2}^2 \\
+ \; & \frac{1}{2} X_{wg_1} n_k w g_1 \sigma_{yg_1} + \frac{1}{2} X_{wg_2} g_2 n_k w \sigma_{yg_2} + \frac{1}{2} X_{g_1 g_2} g_1 g_2 \sigma_{g_1 g_2}\} e^{-\rho t}.
\end{aligned}$$

The problem is equivalent to maximizing the following Lagrangian expression with respect to $c(t)$ and n_k

$$\begin{aligned} & u(c, g_1, g_2) - \rho X + X_w \left[(1-\tau) A n_k w + r_b (1-n_k) w - c\right] + X_{g_1} \mu_{g_1} g_1 \\ + \; & X_{g_2} \mu_{g_2} g_2 + \frac{1}{2} X_{ww} n_k^2 w^2 \sigma_y^2 + \frac{1}{2} X_{g_1 g_1} g_1^2 \sigma_{g_1}^2 + \frac{1}{2} X_{g_2 g_2} g_2^2 \sigma_{g_2}^2 \\ + \; & \frac{1}{2} X_{w g_1} n_k w g_1 \sigma_{y g_1} + \frac{1}{2} X_{w g_2} g_2 n_k w \sigma_{y g_2} + \frac{1}{2} X_{g_1 g_2} g_1 g_2 \sigma_{g_1 g_2}. \end{aligned}$$

The first-order conditions are

$$u_c(c, g_1, g_2) = X_w, \tag{10}$$

$$X_w \left[(1-\tau) A w - r_b w\right] + X_{ww} n_k w^2 \sigma_y^2 + \frac{1}{2} X_{w g_1} w g_1 \sigma_{y g_1} + \frac{1}{2} X_{w g_2} g_2 w \sigma_{y g_2} = 0. \tag{11}$$

From equations (10) and (11), we can derive the optimal values of $c(t)$ and n_k as the functions of X, X_w, and X_{ww}. With the optimal values of $c(t)$ and n_k, the value function must satisfy the Bellman equation

$$\begin{aligned} & u(c, g_1, g_2) - \rho X + X_w \left[(1-\tau) A n_k w + r_b (1-n_k) w - c\right] + X_{g_1} \mu_{g_1} g_1 \\ + \; & X_{g_2} \mu_{g_2} g_2 + \frac{1}{2} X_{ww} n_k^2 w^2 \sigma_y^2 + \frac{1}{2} X_{g_1 g_1} g_1^2 \sigma_{g_1}^2 + \frac{1}{2} X_{g_2 g_2} g_2^2 \sigma_{g_2}^2 \\ + \; & \frac{1}{2} X_{w g_1} n_k w g_1 \sigma_{y g_1} + \frac{1}{2} X_{w g_2} g_2 n_k w \sigma_{y g_2} + \frac{1}{2} X_{g_1 g_2} g_1 g_2 \sigma_{g_1 g_2} = 0. \end{aligned} \tag{12}$$

For the special utility function in equation (8), we postulate the value function as

$$X(w, g_1, g_2) = \delta w^{1-\gamma} g_1^{-\lambda_1} g_2^{-\lambda_2},$$

where the coefficient, δ, is to be determined.

Taking partial differentiation, we have

$$\begin{aligned} X_w &= \delta (1-\gamma) w^{-\gamma} g_1^{-\lambda_1} g_2^{-\lambda_2 - 1}, \\ X_{g_1} &= -\delta \lambda_1 w^{1-\gamma} g_1^{-\lambda_1 - 1} g_2^{-\lambda_2}, \\ X_{g_2} &= -\delta \lambda_2 w^{1-\gamma} g_1^{-\lambda_1} g_2^{-\lambda_2 - 1}, \\ X_{w g_1} &= -\delta \lambda_1 (1-\gamma) w^{-\gamma} g_1^{-\lambda_1 - 1} g_2^{-\lambda_2}, \\ X_{ww} &= -\delta \gamma (1-\gamma) w^{-\gamma - 1} g_1^{-\lambda_1} g_2^{-\lambda_2}, \\ X_{g_1 g_1} &= \delta \lambda_1 (\lambda_1 + 1) w^{1-\gamma} g_2^{-\lambda_1 - 2} g_2^{-\lambda_2}, \end{aligned}$$

$$\begin{aligned} X_{g_2 g_2} &= \delta\lambda_2 (\lambda_2 + 1) w^{1-\gamma} g_1^{-\lambda_1} g_2^{-\lambda_2 - 2}, \\ X_{w g_2} &= -\delta\lambda_2 (1-\gamma) w^{-\gamma} g_1^{-\lambda_1} g_2^{-\lambda_2 - 1}, \\ X_{g_1 g_2} &= \delta\lambda_1\lambda_2 w^{1-\gamma} g_1^{-\lambda_1 - 1} g_2^{-\lambda_2 - 1}. \end{aligned}$$

Substituting the above expressions into the first-order conditions (10), (11), and the Bellman equation (12), we have

$$\frac{c}{w} = [\delta (1-\gamma)]^{-\frac{1}{\gamma}}, \tag{13}$$

$$n_k = \frac{[(1-\tau)A - r_b] - \frac{1}{2}\lambda_1\sigma_{yg_1} - \frac{1}{2}\lambda_2\sigma_{yg_1}}{\gamma\sigma_y^2}, \tag{14}$$

and

$$\begin{aligned} & [\delta(1-\gamma)]^{-\frac{1}{\gamma}} - \rho + (1-\gamma)\left[(1-\tau)An_k + r_b(1-n_k) - [\delta(1-\gamma)]^{-\frac{1}{\gamma}}\right] \\ - \ & \lambda_1\mu_{g_1} - \lambda_2\mu_{g_2} - \frac{1}{2}\gamma(1-\gamma)n_k^2\sigma_y^2 + \frac{1}{2}\lambda_1(\lambda_1+1)\sigma_{g_1}^2 + \frac{1}{2}\lambda_2(\lambda_2+1)\sigma_{g_2}^2 \\ - \ & \frac{1}{2}\lambda_1(1-\gamma)n_k\sigma_{yg_1} - \frac{1}{2}\lambda_2(1-\gamma)n_k\sigma_{yg_1} + \frac{1}{2}\lambda_1\lambda_2\sigma_{g_1g_2} = 0. \end{aligned} \tag{15}$$

Therefore, we have

$$\begin{aligned} \frac{c}{w} &= [\delta(1-\gamma)]^{-\frac{1}{\gamma}} \\ &= \frac{\rho - (1-\gamma)[(1-\tau)An_k + r_b(1-n_k)] + \lambda_1\mu_{g_1} + \lambda_2\mu_{g_2}}{\gamma} \\ &+ \frac{\frac{1}{2}\gamma(1-\gamma)n_k^2\sigma_y^2 - \frac{1}{2}\lambda_1(\lambda_1+1)\sigma_{g_1}^2 - \frac{1}{2}\lambda_2(\lambda_2+1)\sigma_{g_2}^2}{\gamma} \\ &+ \frac{\frac{1}{2}\lambda_1(1-\gamma)n_k\sigma_{yg_1} + \frac{1}{2}\lambda_2(1-\gamma)n_k\sigma_{yg_1} - \frac{1}{2}\lambda_1\lambda_2\sigma_{g_1g_2}}{\gamma}. \end{aligned} \tag{16}$$

With c/w given in (16) and n_k in (14), we have the explicit stochastic differential equation describing the motion of wealth accumulation from equation (9):

$$\frac{dw}{w} = \left[(1-\tau)An_k + r_b(1-n_k) - \frac{c}{w}\right]dt + dv.$$

Taking expectation in equation (13), we have the expected growth rate of consumption and capital accumulation:

$$\phi = E\frac{dw}{w} = \left[(1-\tau)An_k + r_b(1-n_k) - [\delta(1-\gamma)]^{-\frac{1}{\gamma}}\right], \qquad (17)$$

with n_k and $[\delta(1-\gamma)]^{-\frac{1}{\gamma}}$ given in (14) and (16), respectively. It is obvious that the expected growth rate, ϕ, is a very complicated function of various parameters in the model. Our main concern here is to see how the mean growth rates of various government expenditures and the volatility in the growth of government expenditures affect the growth rate of the economy.

First, to see how the volatility in various kinds of government spending affects long-run growth in equation (17), we differentiate the expected growth rate with respect to $\sigma^2_{g_i}(i = 1\text{and}2)$ in equation (17), and get

$$\frac{\partial\phi}{\partial\sigma^2_{g_i}} = \frac{\frac{1}{2}\lambda_i(\lambda_i+1)}{\gamma}.$$

From the expression above, we know that

$$\frac{\partial\phi}{\partial\sigma^2_{g_i}} > 0,$$

when $\gamma > 1$; and

$$\frac{\partial\phi}{\partial\sigma^2_{g_i}} < 0,$$

when $-1 < \lambda_i < 0, 0 < \gamma < 1$. That is to say, when the elasticity of intertemporal substitution in consumption, which is equal to the inverse of γ in our model, is relatively low, a rise in the volatility of government expenditures leads to more savings and investment and a higher growth rate. On the other hand, when the elasticity of intertemporal substitution in consumption is relatively high, a rise in the volatility of government expenditures reduces the long-run growth rate. This observation incorporates two trends of literature on the relationship between volatility and growth, as clearly observed by Ramey and Ramey (1995). For example, in very different theoretical contexts, if there are irreversibility in investment, higher volatility can lead to lower investment and growth; see Pindyck (1991). But in another theoretical framework, if there is a precautionary motive for savings, higher volatility should result in higher savings and growth rates (Ramey and Ramey, 1995). In addition, Obstfeld (1994) has also obtained an ambiguity on the relationship between volatility and growth in an optimal investment and portfolio-choice model. Our focus here is

rather different since we try to identify the effects of volatility of public expenditures on the growth rate of the economy.

Next we examine how the growth rate of capital accumulation is linked to the mean of the growth rates of public expenditures. In (17), we differentiate ϕ with respect to μ_{g_i}:

$$\frac{\partial \phi}{\partial \mu_{g_i}} = \frac{-\lambda_i}{\gamma}.$$

Hence,

$$\frac{\partial \phi}{\partial \mu_{g_i}} > 0$$

if $0 < \gamma < 1$; and

$$\frac{\partial \phi}{\partial \mu_{g_i}} < 0$$

if $\gamma > 1$. Therefore, the link between the mean in the growth rates of public expenditures and the growth rate of the economy is rather similar to the relationship between the volatility in public expenditures and economic growth. Theoretically it is possible that a higher growth in public expenditures gives rise to lower economic growth. In view of these theoretical ambiguities, it is important for us to confront the theory with empirical data.

3. EMPIRICAL EVIDENCE

To test the effects of the growth and volatility of government expenditures on the growth rate of the economy, we use data for more than 90 countries over a period from 1970-94. The data on various public expenditures by central governments are from the International Monetary Fund's Government Finance Statistics (GFS).[2] In the GFS, government expenditures are classified by two main approaches: economic type and function. Economic type of government expenditures are divided into (1) current expenditure (including purchase of goods and services, wages, salary, interest payments, and subsidies), and (2) capital expenditure (including investment in stocks, land, capital assets, and capital transfers). Government expenditures by function are divided into six categories: (1) general public service, (2) defense (including national defense and public order and safety), (3) education, (4) human welfare services (including health, social security, housing, community amenities, recreations, cultural, and religious

[2]GFS provides the most comprehensive data on spending by central governments and contains much less information on subnational or local governments.

affairs), (5) transportation (roads, water transport, rail transport, and air transport) and communication, and (6) economic affairs and services (including public spending on fuel and energy, agriculture, forestry, fishing, mining, manufacturing, and construction). The summary statistics of these different public expenditures for all the countries in our data set are provided in the summary statistics tables A and B. The mean growth rate and variance of the growth rates of current and capital expenditures over the period from 1970-94 are in Table A. The mean growth and variance of the growth in the six categories of public expenditures by function during 1970-94 are provided in Table B.

Our theoretical analysis relates the growth rate of the economy to the growth and volatility of various public expenditures:

$$\phi = \phi\left(\mu_{g_1}, \mu_{g_2}, \ldots, \mu_{g_n}, \sigma^2_{g_1}, \sigma^2_{g_2}, \ldots, \sigma^2_{g_n}, Z\right)$$

where μ_{g_i} $(i = 1, \ldots, n)$ and $\sigma^2_{g_i}$ $(i = 1, \ldots, n)$ are the mean growth rate and variance of the growth rate of the i-th item of public spending by economic type or by function as given in Tables A and B. Z denotes a vector of other variables affecting growth: (i) initial GDP defined as per capita real GDP in year 1970 from the Summers-Heston data base; (ii) openness measured by the sum of exports and imports over GDP from the International Monetary Fund's *International Financial Statistics* (IFS); (iii) population growth rate from IFS; (iv) human capital measured by the secondary school enrollment from *World Development Indicators* (WDI) published by the World Bank; (v) population growth from WDI; (vi) democracy index or civil liberty index from *Freedom in the World* by R. Gastil (various issues); and (vi) the average tax rate from the GFS. These control variables are widely used in many empirical studies on economics growth; see Levine and Renelt (1992) for an example.

3.1. Effects of government expenditures by economic type

Our first group of cross-section regression analysis is presented in Table 1. In the baseline regression, Eq (1), the average output growth rate from 1970 to 1994 is positively and significantly associated with the mean growth of current expenditure; whereas it has no statistically significant relationship with the mean growth of capital expenditure. This finding is surprising because we would expecte capital expenditure and its growth to have a more significant, positive effect on economic growth. This intuitive argument is not validated by our empirical results. Please also note that this finding is consistent with our theoretical model, which admits both positive and negative effects of public expenditure growth on output growth.

Compared to other empirical studies, Barro (1990) found that from a cross-country regression the ratio of public consumption over GDP, which is closely related to current expenditure, is associated with lower per capita

output growth. Devarajan, Swaroop, and Zou (1996) found a positive association between the share of current expenditure in total government spending and economic growth and a negative association between the share of capital expenditure in total government spending and economic growth for a sample of 43 developing countries. Our results here are different. Growth in both public consumption or current expenditure and public investment or capital expenditure is associated with higher output growth. The former association is statistically significant, whereas the latter is not. Of course, the comparison has its limitation here because we are looking at the growth rate and volatility in different public expenditures, and not at their shares in GDP or in total government spending. Our empirical approach is more in line with the stochastic growth model, which differentiates the effects of mean growth from the effects of volatility.

Turning to the uncertainty or volatility in current and capital expenditure growth, Eq (1) in Table 1 presents very strong evidence of a negative effect of government expenditure volatility on output growth. The variances of both current and capital expenditure growth are negatively and significantly associated with output growth. This finding supports the argument that instability and uncertainty in macroeconomic policies tend to reduce the rate of private investment and output growth (Pindyck and Solimano, 1993; and Ramey and Ramey, 1995). This more detailed examination of volatility in both current and capital expenditure extends the result that aggregate government spending-induced volatility is negatively associated with output growth in Ramey and Ramey (1995). Please also note that in Ramey and Ramey's (1995) analysis the difference between growth and volatility in government expenditures are not explicitly examined.

For other control variables in Eq (1) in Table 1, we find that the estimated coefficient for initial GDP is negative, but not significant. The coefficient for the inflation rate is positive and significant, supporting the Mundell-Tobin portfolio-shift effect. Openness has a positive, significant estimated coefficient, whereas population growth has a negative, significant coefficient. Except for the strong, positive effect of inflation on output growth, all other estimated coefficients in Eq (1) are broadly consistent with the results in many recent growth empirics.

To examine the robustness of our results in Eq (1), we gradually introduce a few other control variables into our regressions. Eq (2) presents the regression result when the average tax rate is added as another explanatory variable. The tax rate has no significant relationship with output growth. But at the same time, all other variables still retain qualitatively the same estimates as in Eq (1). When the variable of democracy is introduced into Eq (3), it has no significance on economic growth as it does in Alesina and Rodrik (1994). The only major change as a result of the inclusion of

TABLE 1. Cross-Section Estimations (t-statistics are in brackets)

	Dependent Variable: per-capita GDP growth rate			
Explanatory variables	Eq (1)	Eq (2)	Eq (3)	Eq (4)
constant	0.009	0.008	0.002	−0.011
	[0.821]	[0.572]	[0.140]	[−0.554]
mean of current	0.409	0.409	0.374	0.370
expenditure growth	[3.808]	[3.695]	[3.243]	[3.415]
mean of capital	0.020	0.020	0.015	0.028
expenditure growth	[0.473]	[0.474]	[0.364]	[0.735]
variance of current	−0.086	−0.086	−0.075	−0.074
expenditure growth	[−2.668]	[−2.722]	[−2.187]	[−2.284]
variance of capital	−0.005	−0.005	−0.005	−0.005
expenditure growth	[−2.585]	[−2.646]	[−2.539]	[−2.534]
initial GDP	−1.31E-06	−1.33E-06	−1.94E-06	−3.66E-06
	[−1.441]	[−1.458]	[−2.097]	[−3.127]
inflation rate	0.005	0.005	0.005	0.005
	[2.299]	[2.301]	[2.172]	[2.272]
openness	0.018	0.018	0.018	0.013
	[3.315]	[3.055]	[2.763]	[1.620]
population growth rate	−1.143	−1.138	−0.973	−0.658
	[−3.674]	[−3.155]	[−1.991]	[−1.182]
tax rate		0.001	0.001	0.001
		[0.047]	[0.055]	[0.038]
democracy			0.012	0.004
			[0.914]	[0.359]
human capital				0.0004
				[2.570]
R-squared	0.447	0.447	0.418	0.435
Adjusted R-squared	0.396	0.389	0.344	0.353
Observations	96	96	90	88
Durbin-Watson stat	1.934	1.934	1.695	1.685

variable of democracy in the regression is that the estimated coefficient for initial GDP is now becoming negative and significant. Finally, in Eq (4) of Table 1 the variable of human capital in included in the regression. Now human capital has a very significant, positive estimate, suggesting that human capital formation has a positive effect on output growth. At the same time, the estimated coefficient for initial GDP becomes even more significant, and the one for openness becomes less significant. The coefficient for the inflation rate is still positive and significant. Across Eq (2) to Eq (4), the mean growth rate in current expenditure is always positively and significantly associated with output growth; the mean growth rate of

capital expenditure is positively, but highly insignificantly, associated with output growth; and the volatility in the growth of both current and capital expenditures is negatively and significantly associated with output growth.

3.2. Effects of government expenditures by function

In Table 2, we offer another perspective on the effects of the growth and volatility in various public expenditures by function on output growth. Across Eq (1) to Eq (4), the mean growth rate in general public services is negatively, but not significantly, associated with output growth, whereas the variance of its growth rate is positively and significantly associated with output growth. Unlike the case of public expenditure by economic type, we find here that volatility in certain public spending can even promote economic growth—a result consistent with our theoretical model and with other theoretical studies.[3] While the estimated coefficients for the growth rates in defense spending, education spending, human welfare spending, and economic services spending are all positive, only the coefficient for economic services spending is statistically significant. It is rather surprising to find that spending growth in the most important public infrastructure—transportation and communication— is negatively, but almost not significantly, associated with output growth. Furthermore the coefficient for the variance of the growth in transportation and communication is positive and weakly significant. The volatility in defense spending has a significant, negative effect on output growth, whereas the estimated coefficients for the volatility in education spending and economic services are negative and weakly significant. Throughout these regressions, the volatility in human welfare spending has no association with output growth.

The negative association between growth in transportation and communication expenditure and output growth stands in contrast to the positive association between the share of transportation and communication spending in GDP and output growth in Easterly and Rebelo (1993). Our result is more in line with Devarajan, Swaroop, and Zou (196) who found a negative, statistically significant association between the share of transportation and communication spending in total government spending and GDP growth for a sample of 43 developing countries. But again the comparison is of limited value because our explanatory variable is the growth rate in transportation and communication spending. From these empirical exercises, we shall pay particular attention to the relationship between transportation and communication expenditure and output growth. We need to make sure that their spending share in GDP, their spending share in total government spending, and their growth rate can give rise to very different effects on output growth.

[3]See Ramey and Ramey (1995) for a survey on the positive impact of uncertainty on investment and output growth.

TABLE 2. Cross-Section Estimations (t-statistics are in brackets)

	Dependent Variable: per-capita GDP growth rate			
Explanatory variables	Eq (1)	Eq (2)	Eq (3)	Eq (4)
constant	0.025	0.031	0.029	0.011
	[2.582]	[2.169]	[1.266]	[0.508]
mean of general public	−0.0004	−0.0004	−0.0004	−0.0005
service growth	[−0.239]	[−0.269]	[−0.242]	[−0.304]
mean of defense	0.087	0.079	0.086	0.091
expenditure growth	[1.277]	[1.146]	[1.158]	[1.220]
mean of education	0.084	0.092	0.072	0.056
expenditure growth	[1.201]	[1.287]	[0.951]	[0.774]
mean of human welfare	0.069	0.070	0.092	0.078
expenditure growth	[1.105]	[1.113]	[1.447]	[1.285]
mean of economic service	0.155	0.157	0.153	0.154
expenditure growth	[3.227]	[3.261]	[2.871]	[2.976]
mean of transporation and	−0.035	−0.040	−0.046	−0.032
communication expenditure growth	[−1.512]	[−1.664]	[−1.618]	[−1.094]
variance of general public	0.001	0.001	0.001	0.001
service growth	[3.224]	[2.974]	[2.828]	[2.971]
variance of defense	−0.028	−0.028	−0.029	−0.030
expenditure growth	[−2.257]	[−2.220]	[−2.298]	[−2.416]
variance of education	−0.059	−0.063	−0.061	−0.030
expenditure growth	[−1.120]	[−1.216]	[−1.070]	[−0.534]
variance of human welfare	0.010	0.009	0.009	0.012
expenditure growth	[0.521]	[0.463]	[0.470]	[0.689]
variance of economic service	−0.020	−0.020	−0.021	−0.021
expenditure growth	[−1.435]	[−1.491]	[−1.477]	[−1.532]
variance of transporation and	0.001	0.002	0.002	0.001
communication expenditure growth	[1.511]	[1.642]	[1.566]	[1.171]
initial GDP	−1.87E-06	−1.71E-06	−1.79E-06	−3.17E-06
	[−2.045]	[−1.843]	[−1.948]	[−2.930]
inflation rate	0.005	0.005	0.005	0.005
	[4.762]	[4.701]	[4.602]	[4.392]
openness	0.018	0.020	0.020	0.016
	[2.925]	[3.067]	[3.020]	[2.347]
population growth rate	−1.571	−1.701	−1.587	−1.222
	[−4.904]	[−4.166]	[−2.867]	[−2.234]
tax rate		−0.024	−0.025	−0.017
		[−0.749]	[−0.751]	[−0.542]
democracy			0.002	−0.0004
			[0.131]	[−0.022]
human capital				0.0003
				[2.390]
R-squared	0.535	0.539	0.537	0.560
Adjusted R-squared	0.429	0.425	0.409	0.430
Observations	87	87	84	84
Durbin-Watson stat	1.830	1.85	1.506	1.47

TABLE 3. Cross-Section Estimations (t-statistics are in brackets)

	Dependent Variable: per-capita GDP growth rate			
Explanatory variables	Eq (1)	Eq (2)	Eq (3)	Eq (4)
constant	0.013	0.008	0.001	−0.006
	[1.419]	[0.581]	[0.068]	[−0.314]
mean of current	0.192	0.223	0.210	0.209
expenditure growth	[3.834]	[4.145]	[3.588]	[3.504]
mean of capital	0.109	0.115	0.115	0.118
expenditure growth	[2.901]	[2.703]	[2.550]	[2.523]
variance of current	−0.037	−0.013	−0.008	−0.004
expenditure growth	[−1.387]	[−0.352]	[−0.210]	[−0.131]
variance of capital	−0.015	−0.015	−0.015	−0.016
expenditure growth	[−3.369]	[−3.200]	[−3.050]	[−3.009]
initial GDP	−4.68E-07	−5.27E-07	−7.17E-07	−1.59E-06
	[−0.703]	[−0.840]	[−1.003]	[−1.856]
inflation rate	0.002	0.003	0.002	0.002
	[0.709]	[0.728]	[0.703]	[0.696]
openness	0.008	0.007	0.006	0.004
	[1.444]	[1.327]	[1.161]	[0.733]
population growth rate	−0.682	−0.652	−0.428	−0.286
	[−3.064]	[−2.247]	[−1.315]	[−0.814]
tax rate		0.012	0.014	0.011
		[0.346]	[0.426]	[0.349]
democracy			0.008	0.004
			[0.675]	[0.374]
human capital				0.0002
				[1.746]
R-squared	0.188	0.204	0.188	0.188
Adjusted R-squared	0.170	0.183	0.162	0.159
Observations	363	343	326	323

TABLE 4. Cross-Section Estimations (t-statistics are in brackets)

	Dependent Variable: per-capita GDP growth rate			
Explanatory variables	Eq (1)	Eq (2)	Eq (3)	Eq (4)
constant	0.011	0.001	−0.004	−0.006
	[1.075]	[0.043]	[−0.212]	[−0.355]
mean of general public	−0.003	0.008	0.008	0.009
service growth	[−0.109]	[0.252]	[0.270]	[0.281]
mean of defense	−0.056	−0.050	−0.049	−0.048
expenditure growth	[−0.677]	[−0.593]	[−0.534]	[−0.513]
mean of education	0.209	0.201	0.197	0.195
expenditure growth	[2.151]	[2.056]	[1.901]	[1.852]
mean of human welfare	0.170	0.223	0.260	0.259
expenditure growth	[2.899]	[2.889]	[3.063]	[3.031]
mean of economic service	0.027	0.039	0.026	0.028
expenditure growth	[1.218]	[1.096]	[0.692]	[0.717]
mean of transporation and	−0.005	−0.010	−0.014	−0.014
communication expenditure growth	[−0.502]	[−0.881]	[−1.205]	[−1.169]
variance of general	6.60E-05	−0.001	−0.001	−0.001
public service growth	[0.031]	[−0.264]	[−0.247]	[−0.262]
variance of defense	0.018	0.017	0.018	0.017
expenditure growth	[0.819]	[0.716]	[0.684]	[0.663]
variance of education	−0.163	−0.155	0.169	−0.167
expenditure growth	[−1.409]	[−1.231]	[−1.210]	[−1.177]
variance of human welfare	−0.036	−0.047	−0.052	−0.052
expenditure growth	[−2.238]	[−2.407]	[−2.626]	[−2.611]
variance of economic service	−0.003	−0.007	−0.003	−0.004
expenditure growth	[−0.591]	[−0.486]	[−0.229]	[−0.251]
variance of transporation and	0.0002	0.0004	0.001	0.001
communication expenditure growth	[0.249]	[0.514]	[0.730]	[0.727]
initial GDP	−1.20E-06	−1.45E-06	−1.43E-06	−1.74E-06
	[−1.568]	[−1.713]	[−1.486]	[−1.691]
inflation rate	0.005	0.006	0.006	0.006
	[1.140]	[1.246]	[1.254]	[1.247]
openness	0.009	0.009	0.008	0.008
	[1.352]	[1.303]	[1.184]	[1.024]
population growth rate	−0.577	−0.510	−0.326	−0.281
	[−2.352]	[−1.681]	[−1.119]	[−0.987]
tax rate		0.026	0.033	0.032
		[0.754]	[1.038]	[0.977]
democracy			−0.0002	−0.001
			[−0.012]	[−0.132]
human capital				8.68E-05
				[0.522]
R-squared	0.204	0.232	0.231	0.231
Adjusted R-squared	0.157	0.181	0.175	0.172
Observations	288	276	265	265

The positive association between the volatility in the growth rates of general public services and transportation and communication spending and output growth confirms the positive impact of uncertainty and volatility on economic growth predicted by many theoretical models. While our results from the analysis of the volatility in current and capital expenditures are consistent with the finding from aggregate government spending by Ramey and Ramey (1995), our results from government spending by various functions show the possibility of a positive association between the volatility in some components of government spending and economic growth. This suggests that there is some value added in offering a more micro-oriented examination of the relationship between the volatility in the various components of government expenditures and economic growth. Instead of an aggregate, negative association between volatility in government spending and output growth, we can say something more: uncertainty in infrastructure and general public services is likely to promote output growth, whereas uncertainty in other government expenditures may retard output growth.

As for other control variables in Table 2, their estimates are consistent with the ones in Table 1. For example, the estimated coefficients for initial GDP is negative and significant; the inflation rate is positively and significantly associated with output growth; openness and human capital formation have highly significant and positive effects on output growth; population growth is negatively and statistically significantly associated with output growth; and the tax rate and democracy have no association with output growth.

4. CONCLUSIONS

This paper sets up a theoretical model linking the growth rate of the economy to the growth rates and volatility in various government expenditures. On a theoretical basis, it is found that volatility in government spending can be positively or negatively associated with economic growth depending on the intertemporal elasticity of consumption. Empirically, we have found the following:

(1) When public expenditures are classified by economic type, the mean growth rate in current expenditure is positively and significantly associated with output growth, whereas, surprisingly, the mean growth in capital expenditure has no relationship with output growth. At the same time, the volatility in the growth of current and capital expenditures have a significant, negative effedt on output growth.

(2) When public expenditures are classified by function, the mean growth rate in general public services is negatively, but not significantly, associated with output growth, whereas the variance of its growth rate is positively and significantly associated with output growth. While the esti-

mated coefficients for the growth rates in spending for defense, education, human welfare, and economic services are all positive, only the coefficient for economic services spending is statistically significant. On the other hand, growth in transportation and communication is negatively, and almost not significantly, associated with output growth. Furthermore the variance of the growth in transportation and communication is positively, weakly significantly, associated with output growth.

A few important points should be emphasized here. First, unlike many existing studies on the relationship between public expenditure and economic growth, our paper has differentiated the effects of growth and volatility in public spending on economic growth. This approach is more in line with recent theoretical advances examining the economic effects of government spending in stochastic environments. Second, our approach has offered new empirical insights on the relationship between output growth and public spending growth. For example, it is rather surprising to find that growth in capital expenditure has no association with output growth, whereas growth in current expenditure seems to stimulate output growth. In particular, growth in transportation and communication seems to have a negative impact on output growth. These findings indicate that rapid and excessive investment in infrastructure may be harmful for economic growth if spending on administration, education, and basic economic services are neglected. Third, it is very interesting to find that the positive association between the volatility in public spending and output growth can be empirically validated. In fact, the volatility in the growth of general public services as well as transportation and communication has been shown to have a positive effect on output growth.

Appendix A: Summery Statistics of variables

IMF's Country Code	per-capita GDP growth rate	initial GDP	inflation rate	population growth rate	openness	mean of current expenditure growth	mean of capital expenditure growth	variance of current expenditure growth	variance of capital expenditure growth
USA	0.013	12963	0.058	0.010	0.176	0.030	0.028	0.001	0.040
GBR	0.020	8537	0.090	0.002	0.516	0.034	0.028	0.001	0.026
AUT	0.028	7510	0.047	0.003	0.714	0.045	0.047	0.001	0.023
BEL	0.023	8331	0.054	0.002	1.229	0.039	0.004	0.002	0.010
DNK	0.018	9670	0.069	0.002	0.642	0.036	0.013	0.001	0.028
FRA	0.022	9200	0.070	0.006	0.415	0.037	0.028	0.000	0.020
DEU	0.021	9425	0.039	0.013	0.514	0.048	0.018	0.002	0.024
ITA	0.035	7568	0.105	0.003	0.393	0.064	−0.005	0.003	0.093
LUX	0.045	9782	0.051	0.007	1.810	0.060	0.061	0.001	0.017
NLD	0.021	9199	0.045	0.007	1.009	0.030	0.007	0.001	0.017
NOR	0.028	8034	0.072	0.005	0.786	0.038	0.024	0.001	0.006
SWE	0.015	10766	0.078	0.004	0.597	0.048	−0.004	0.001	0.054
CHE	0.015	12942	0.041	0.005	0.686	0.048	−0.010	0.002	0.005
JPN	0.027	7307	0.051	0.008	0.223	0.061	0.030	0.003	0.010
FIN	0.025	8108	0.077	0.004	0.557	0.057	−0.007	0.002	0.010
GRC	0.029	4224	0.160	0.007	0.439	0.056	0.007	0.011	0.017
ISL	0.035	6772	0.288	0.012	0.728	0.048	0.037	0.007	0.051
IRL	0.033	5015	0.094	0.008	1.066	0.052	0.039	0.003	0.011
MLT	0.055	2424	0.043	0.007	1.697	0.068	0.117	0.004	0.097
PRT	0.035	3306	0.157	0.004	0.612	0.064	0.085	0.006	0.051
ESP	0.024	5861	0.110	0.006	0.357	0.067	0.019	0.002	0.015
TUR	0.005	2202	0.446	0.023	0.342	0.085	0.038	0.012	0.051
AUS	0.018	10756	0.079	0.015	0.328	0.051	0.029	0.002	0.025
NZL	0.011	9392	0.098	0.009	0.565	0.053	−0.004	0.003	0.016
ZAF	0.007	3254	0.122	0.025	0.521	0.055	0.033	0.002	0.055

Appendix A: Summery Statistics of variables (continued)

IMF's Country Code	per-capita GDP growth rate	initial GDP	inflation rate	population growth rate	openness	mean of current expenditure growth	mean of capital expenditure growth	variance of current expenditure growth	variance of capital expenditure growth
ARG	0.005	5637	3.805	0.015	0.167	0.008	0.010	0.032	0.302
BOL	0.018	1813.92	5.408	0.019	0.451	0.085	0.173	0.007	7.278
BRA	0.015	2434	9.400	0.022	0.170	0.104	0.003	0.055	0.198
CHL	0.054	3605	0.819	0.017	0.636	0.038	0.051	0.008	0.064
COL	0.028	2140	0.224	0.022	0.298	0.086	0.036	0.009	0.218
CRI	0.036	2904	0.185	0.024	0.716	0.083	0.082	0.016	0.102
DOM	0.013	1536	0.166	0.027	0.514	0.032	0.083	0.018	0.110
ECU	0.028	1789	0.273	0.027	0.507	0.025	0.224	0.004	0.151
SLV	−0.014	1810	0.143	0.021	0.569	0.016	0.105	0.009	0.151
GTM	0.007	2028	0.127	0.029	0.407	0.015	0.071	0.005	0.128
HTI	−0.014	834	0.114	0.021	0.542	0.038	0.205	0.018	0.643
MEX	0.022	3987	0.368	0.026	0.254	0.073	0.044	0.032	0.038
NIC	0.012	2359	12.516	0.037	0.620	0.046	0.436	0.055	1.180
PAN	0.024	2584	0.039	0.025	1.335	0.054	0.112	0.011	0.317
PRY	0.030	1394	0.173	0.030	0.473	0.059	0.160	0.010	0.225
PER	−0.016	2736	5.246	0.023	0.323	0.004	0.070	0.026	0.118
URY	0.004	4121	0.620	0.006	0.384	0.034	0.092	0.010	0.111
VEN	0.012	7753	0.201	0.031	0.525	0.046	0.124	0.012	0.238
BHS	0.002	7742	0.061	0.021	1.310	0.032	0.108	0.003	0.501
BRB	0.016	4638	0.090	0.004	1.197	0.032	0.016	0.009	0.038
GUY	0.013	1816	0.128	0.007	1.390	0.023	0.134	0.013	0.542
BLZ	0.015	3943	0.036	0.024	1.213	0.071	0.071	0.005	0.157
KNA	0.080	3070	0.043	0.003	1.429	0.093	0.119	0.010	0.385

Appendix A: Summery Statistics of variables (continued)

IMF's Country Code	per-capita GDP growth rate	initial GDP	inflation rate	population growth rate	openness	mean of current expenditure growth	mean of capital expenditure growth	variance of current expenditure growth	variance of capital expenditure growth
LCA	0.063	2211	0.085	0.013	1.827	0.060	0.086	0.016	0.069
VCT	0.057	2411	0.062	0.001	1.459	0.071	0.177	0.010	0.369
SUR	−0.020	2970	0.328	0.003	0.993	0.039	0.393	0.004	0.280
TTO	0.010	6795	0.110	0.008	0.788	0.105	0.050	0.015	0.032
BHR	−0.003	10151	0.061	0.041	2.072	0.072	0.032	0.005	0.058
CYP	0.054	3753	0.061	0.008	1.030	0.089	0.089	0.004	0.053
IRN	0.034	4796	0.165	0.031	0.375	0.085	0.088	0.115	0.115
ISR	0.029	6004	0.677	0.026	0.927	0.057	0.097	0.031	0.089
JOR	0.006	1422	0.085	0.036	1.105	0.047	0.042	0.015	0.058
SYR	0.006	2294	0.155	0.034	0.502	0.071	0.115	0.042	0.105
EGY	0.025	1163	0.129	0.024	0.515	0.028	0.112	0.014	0.244
BGD	0.029	1280	0.133	0.022	0.213	0.245	0.245	0.704	0.704
LKA	0.045	1243	0.105	0.015	0.659	0.075	0.082	0.029	0.097
IND	0.023	802	0.087	0.022	0.143	0.081	0.068	0.004	0.007
IDN	0.066	718.346	0.123	0.021	0.459	0.078	0.110	0.013	0.033
KOR	0.089	1680	0.109	0.014	0.629	0.114	0.112	0.004	0.066
MYS	0.045	2154	0.044	0.028	1.170	0.080	0.254	0.006	0.147
PAK	0.053	1029	0.097	0.011	0.312	0.089	0.077	0.006	0.065
PHL	0.001	1403	0.142	0.026	0.494	0.052	0.098	0.028	0.114
BWA	0.065	823	0.115	0.038	1.121	0.128	0.072	0.009	0.025
CMR	−0.002	804	0.091	0.027	0.460	0.038	−0.026	0.021	0.149
ZAR	0.015	686	13.239	0.029	0.560	−0.116	−0.069	0.057	0.219
ETH	−0.027	296	0.085	0.035	0.256	0.019	0.076	0.019	0.161
GMB	0.005	722	0.124	0.036	0.973	0.113	0.274	0.011	0.412
GHA	−0.017	1059	0.394	0.028	0.339	0.041	0.051	0.058	0.143

Appendix A: Summery Statistics of variables (continued)

IMF's Country Code	per-capita GDP growth rate	initial GDP	inflation rate	population growth rate	openness	mean of current expenditure growth	mean of capital expenditure growth	variance of current expenditure growth	variance of capital expenditure growth
KEN	−0.025	586	0.147	0.041	0.594	0.025	−0.003	0.009	0.083
LSO	0.014	419	0.138	0.027	1.305	0.070	0.211	0.014	0.132
LBR	−0.036	982	0.074	0.030	1.079	0.019	0.084	0.017	0.221
MDG	−0.007	1146	0.139	0.032	0.392	0.069	−0.050	0.008	0.044
MWI	−0.021	440	0.180	0.032	0.587	0.030	−0.078	0.026	0.036
MUS	0.061	2398	0.106	0.012	1.148	0.077	0.098	0.012	0.071
MAR	0.017	1342	0.074	0.024	0.485	0.060	0.082	0.012	0.084
NER	0.000	805	0.064	0.033	0.479	0.068	0.301	0.018	0.010
ZWE	0.011	1082	0.133	0.032	0.567	0.066	0.095	0.016	0.159
RWA	−0.034	647	0.091	0.032	0.285	0.047	0.218	0.013	0.171
SEN	−0.006	1146	0.079	0.028	0.698	0.023	0.435	0.011	0.214
SLE	−0.034	1435	0.425	0.021	0.504	0.075	0.098	0.123	0.258
SOM	−0.019	921	0.268	0.052	0.325	0.119	0.186	0.057	0.135
NAM	−0.001	2642	0.128	0.024	1.233	0.014	0.012	0.011	0.066
SDN	−0.001	817	0.277	0.030	0.220	0.017	0.120	0.017	0.184
SWZ	0.026	2531	0.122	0.031	1.575	0.048	0.164	0.009	0.285
TUN	0.028	1442	0.068	0.031	0.755	0.026	−0.021	0.002	0.007
UGA	0.034	647	0.807	0.031	0.281	0.154	0.276	0.336	0.211
BFA	0.025	374	0.063	0.027	0.477	0.075	0.088	0.022	0.193
ZMB	−0.052	1117	0.987	0.033	0.748	−0.029	0.347	0.108	2.157
FJI	0.020	2592	0.082	0.017	1.000	0.045	0.028	0.007	0.037
PNG	0.010	1896	0.072	0.021	0.870	0.037	0.013	0.003	0.091
HUN	0.007	3358	0.113	−0.0003	0.504	0.006	−0.119	0.004	0.030
total	0.022		0.581	0.021	0.739	0.060	0.100	0.031	0.272

Appendix B: Summery Statistics of Variables

IMF's Country Code	mean of general public services growth	mean of defense expenditure growth	mean of edu expenditure growth	mean of human welfare growth	mean of economic service growth	mean of transportation and communication growth	variance of general public services growth	variance of defense expenditure growth	variance of edu expenditure growth	variance of human welfare growth	variance of economic service growth	variance of transportation and communication growth
USA	0.070	0.004	0.008	0.036	0.030	0.009	0.015	0.003	0.006	0.002	0.046	0.004
GBR	0.003	0.003	0.065	0.043	0.020	−0.012	0.011	0.002	0.011	0.001	0.043	0.027
AUT	0.051	0.023	0.045	0.044	0.061	0.027	0.007	0.003	0.001	0.001	0.091	0.010
BEL	0.008	0.018	0.030	0.046	0.037	0.004	0.018	0.002	0.003	0.002	0.059	0.009
DNK	0.033	0.006	0.016	0.031	0.041	−0.007	0.011	0.002	0.005	0.002	0.054	0.007
FRA	0.037	0.018	0.017	0.039	0.090	−0.020	0.010	0.004	0.001	0.001	0.158	0.015
DEU	0.098	0.012	0.054	0.045	0.071	0.022	0.063	0.001	0.030	0.002	0.061	0.008
ITA	−0.016	0.056	0.039	0.085	0.153	0.155	0.028	0.004	0.002	0.006	0.231	0.075
LUX	0.082	0.048	0.065	0.065	0.038	0.056	0.020	0.028	0.011	0.002	0.055	0.011
NLD	0.051	0.002	0.008	0.033	0.008	0.017	0.016	0.001	0.001	0.001	0.020	0.003
NOR	0.056	0.023	0.056	0.045	0.026	0.036	0.003	0.002	0.002	0.001	0.012	0.006
SWE	−0.003	0.007	0.001	0.053	0.086	0.038	0.022	0.001	0.009	0.002	0.058	0.034
CHE	0.023	0.004	0.027	0.059	0.019	0.024	0.002	0.003	0.004	0.006	0.004	0.008
CAN	0.026	0.019	0.025	0.035	0.001	0.004	0.006	0.003	0.009	0.002	0.022	0.030
JPN	0.041	0.003	0.036	0.118	0.072	0.065	0.000	0.000	0.000	0.000	0.002	0.010
FIN	0.019	0.035	0.034	0.063	0.053	−0.006	0.015	0.007	0.002	0.002	0.018	0.005
GRC	0.090	0.026	0.066	0.062	0.033	0.015	0.046	0.025	0.015	0.005	0.059	0.021
IRL	0.034	0.008	0.032	0.026	0.008	0.035	0.007	0.003	0.002	0.002	0.036	0.012
MLT	0.076	0.109	0.069	0.084	0.102	0.085	0.052	0.055	0.008	0.009	0.105	0.064
ESP	0.054	0.025	0.036	0.065	0.007	0.083	0.038	0.020	0.006	0.005	0.025	0.069
TUR	0.126	0.056	0.106	0.153	0.050	0.053	0.079	0.012	0.046	0.101	0.086	0.044

Appendix B: Summery Statistics of Variables (continued)

IMF's Country Code	mean of general public services growth	mean of defense expenditure growth	mean of edu expenditure growth	mean of human welfare growth	mean of economic service growth	mean of transportation and communication growth	variance of general public services growth	variance of defense expenditure growth	variance of edu expenditure growth	variance of human welfare growth	variance of economic service growth	variance of transportation and communication growth
AUS	0.046	0.014	0.091	0.076	0.037	0.010	0.003	0.002	0.037	0.009	0.021	0.011
NZL	0.069	0.021	0.035	0.056	0.032	0.022	0.031	0.006	0.005	0.002	0.041	0.022
ARG	0.048	−0.074	−0.023	0.040	0.010	−0.017	0.247	0.031	0.040	0.026	0.138	0.115
BOL	0.251	0.033	0.105	0.089	0.110	0.241	0.357	0.021	0.013	0.030	0.489	0.119
BRA	0.071	0.046	0.066	0.045	−0.065	0.256	0.043	0.071	0.077	0.011	0.113	1.005
CHL	−0.023	0.040	0.029	0.044	0.033	0.039	0.031	0.039	0.026	0.021	0.176	0.068
COL	0.093	0.105	0.103	0.078	0.039	0.039	0.046	0.027	0.009	0.012	0.682	0.070
CRI	0.260	0.002	0.061	0.111	0.210	0.040	1.008	0.033	0.026	0.043	0.320	0.088
DOM	0.000	0.015	0.036	0.062	0.039	0.072	0.067	0.024	0.031	0.035	0.059	0.052
ECU	0.063	0.064	0.055	0.145	0.094	0.023	0.058	0.033	0.052	0.058	0.151	0.083
SLV	0.012	0.049	−0.004	0.064	0.082	0.074	0.050	0.045	0.014	0.064	0.118	0.109
GTM	0.029	0.056	0.068	0.053	0.077	0.025	0.071	0.023	0.224	0.070	0.339	0.064
HND	0.269	0.098	0.071	0.084	0.264	0.098	0.703	0.017	0.006	0.032	0.307	0.157
MEX	0.640	0.060	0.086	0.061	0.048	0.035	10.016	0.016	0.020	0.019	0.059	0.051
NIC	0.456	−0.031	0.027	0.083	0.578	0.149	1.919	0.106	0.050	0.071	1.936	0.342
PAN	0.039	−0.002	0.035	0.071	−0.007	0.070	0.090	0.022	0.007	0.008	0.083	0.111
PRY	12.111	0.036	0.098	0.107	0.131	0.673	0.061	0.018	0.027	0.048	0.266	8.227
URY	12.008	0.066	0.020	0.048	0.111	0.127	0.040	0.065	0.019	0.022	0.260	0.282
BRB	0.016	0.204	0.029	0.054	0.021	0.123	0.097	1.270	0.013	0.014	0.032	0.137
GUY	−0.044	0.194	−0.042	−0.005	0.112	0.049	0.004	0.425	0.015	0.074	0.188	0.293
BLZ	0.076	0.085	0.087	0.180	0.035	0.054	0.077	0.010	0.013	0.078	0.106	0.206
TTO	0.267	0.111	0.034	0.130	−0.029	0.183	0.201	0.059	0.006	0.036	0.089	0.232

Appendix B: Summery Statistics of Variables (continued)

IMF's Country Code	mean of general public services growth	mean of defense expenditure growth	mean of edu expenditure growth	mean of human welfare growth	mean of economic service growth	mean of transportation and communication growth	variance of general public services growth	variance of defense expenditure growth	variance of edu expenditure growth	variance of human welfare growth	variance of economic service growth	variance of transportation and communication growth
BHR	0.155	0.152	0.075	0.075	0.021	0.112	0.453	0.127	0.018	0.112	0.056	0.179
CYP	0.046	0.071	0.080	0.106	0.074	0.083	0.015	0.050	0.003	0.005	0.037	0.050
IRN	0.036	0.068	0.091	0.109	0.099	0.068	0.067	0.145	0.039	0.059	0.121	0.124
ISR	0.019	0.032	0.093	0.162	0.180	0.074	0.059	0.066	0.040	0.124	0.555	0.134
JOR	0.012	0.032	0.097	0.103	−0.007	0.159	0.049	0.047	0.027	0.104	0.060	0.491
SYR	0.194	0.064	0.068	0.223	0.121	0.109	0.459	0.063	0.098	0.480	0.092	0.141
EGY	−0.007	−0.021	0.058	0.040	−0.035	0.120	0.051	0.015	0.011	0.015	0.039	0.049
BGD	0.147	0.170	0.060	0.096	0.090	0.299	0.049	0.088	0.027	0.125	0.068	0.709
LKA	0.059	0.244	0.063	0.068	0.137	0.104	0.100	0.349	0.020	0.029	0.428	0.138
IND	0.087	0.050	0.076	0.063	0.052	0.052	0.013	0.005	0.018	0.017	0.010	0.024
IDN	0.191	0.039	0.104	0.350	0.094	0.137	0.366	0.013	0.019	1.052	0.025	0.152
KOR	0.079	0.100	0.119	0.145	0.157	0.275	0.021	0.012	0.013	0.028	0.128	1.055
MYS	0.150	0.124	0.091	0.149	0.197	0.185	0.201	0.023	0.011	0.042	0.167	0.055
PHL	0.087	0.048	0.044	0.043	0.126	0.076	0.089	0.057	0.016	0.031	0.174	0.057
BWA	0.099	0.193	0.126	0.132	0.073	0.082	0.025	0.110	0.013	0.050	0.031	0.089
BDI	0.159	0.086	0.088	0.074	0.062	0.414	0.166	0.014	0.117	0.028	0.043	1.414
CMR	−0.006	−0.037	−0.023	−0.010	0.136	−0.032	0.106	0.024	0.027	0.075	0.886	0.287
ZAR	−0.131	−0.036	−0.118	−0.090	0.003	0.250	0.077	0.290	0.097	0.078	0.223	1.627
ETH	−0.034	0.051	0.022	0.039	0.087	−0.017	0.035	0.083	0.021	0.025	0.072	0.044
GHA	0.027	0.044	0.043	0.045	0.039	0.094	0.116	0.133	0.072	0.082	0.100	0.176
KEN	0.030	0.014	0.011	−0.014	0.025	−0.028	0.049	0.064	0.011	0.020	0.079	0.063

Appendix B: Summery Statistics of Variables (continued)

IMF's Country Code	mean of general public services growth	mean of defense expenditure growth	mean of edu expenditure growth	mean of human welfare growth	mean of economic service growth	mean of transportation and communication growth	variance of general public services growth	variance of defense expenditure growth	variance of edu expenditure growth	variance of human welfare growth	variance of economic service growth	variance of transportation and communication growth
LSO	0.023	0.042	0.142	0.211	0.105	0.209	0.033	0.049	0.105	0.125	0.110	0.435
LBR	0.009	0.105	0.013	−0.016	0.134	0.074	0.034	0.144	0.062	0.052	0.277	0.337
MDG	−0.078	−0.007	0.118	0.156	−0.034	2.634	0.057	0.028	0.102	0.140	0.112	54.962
MWI	−0.020	−0.109	0.022	−0.038	0.013	−0.050	0.049	0.041	0.017	0.025	0.046	0.057
MUS	0.044	0.165	0.091	0.092	0.091	0.265	0.028	0.228	0.024	0.036	0.088	0.411
MAR	0.069	0.080	0.063	0.037	0.104	0.035	0.135	0.026	0.010	0.012	0.136	0.075
NER	0.102	0.107	0.204	0.231	0.082	0.299	0.025	0.014	0.009	0.061	0.112	0.313
NGA	−0.093	−0.141	−0.127	0.111	0.365	0.053	0.081	0.022	0.153	0.184	0.437	0.087
ZWE	0.008	0.077	0.107	0.057	0.113	0.040	0.022	0.045	0.043	0.016	0.081	0.057
SEN	−0.090	−0.091	−0.041	0.053	0.216	0.398	0.036	0.008	0.008	0.011	0.080	0.963
SLE	0.022	−0.045	−0.056	0.018	−0.058	0.053	0.137	0.034	0.035	0.113	0.103	0.259
SOM	0.082	0.248	0.258	0.067	0.100	0.028	0.059	0.289	0.046	0.047	0.098	0.091
SDN	0.378	−0.033	0.054	0.069	0.380	0.261	1.406	0.047	0.066	0.823	1.994	0.913
SWZ	0.026	0.038	0.081	0.084	0.023	0.190	0.055	0.032	0.034	0.075	0.031	0.593
TUN	0.038	−0.043	0.033	0.057	0.007	−0.060	0.046	0.016	0.003	0.017	0.057	0.022
UGA	0.218	0.113	0.165	0.034	0.186	0.065	0.618	0.056	0.278	0.112	0.123	0.254
BFA	0.150	0.048	0.083	0.116	0.126	1.862	0.283	0.032	0.025	0.028	0.139	27.186
FJI	0.085	0.153	0.046	0.057	0.023	0.034	0.039	0.054	0.009	0.017	0.059	0.119
PNG	−0.025	0.103	0.032	0.029	0.045	0.020	0.034	0.162	0.009	0.012	0.019	0.020
HUN	−0.022	−0.001	0.077	0.052	−0.070	−0.057	0.039	0.065	0.036	0.003	0.019	0.070
total	0.189	0.053	0.063	0.080	0.101	0.171	0.235	0.115	0.041	0.076	0.246	1.108

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