Spending for Growth: An Empirical Evidence of Thailand

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Spending for Growth: An Empirical Evidence of Thailand

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Abstract This article analyzes the dynamic effects of proportional change in government spending on Thailand's economic growth. The analytical methods comprise: 1) stationarity test of time series data, 2) cointegration test between government spending and economic growth, and 3) error correction model estimation. The results show that the expenditure variables had long-run equilibrium relationships with the economic growth variable. The ECM estimation revealed that the financial instrument, i.e. expenditure budgeting should be further applied to drive Thailand's economic growth. However, the current expenditure scheme was considered unproductive. An increased expenditure proportion to enhance the quality of education was found ineffective. This study suggests that government spending focus more on research and development, to facilitate a direct improvement on human resources. Such spending regime could be expected to give a positive effect on long term growth and thus enhance the competitiveness of Thailand in the world's economy.

Keywords: government spending, economic growth, error correction model

JEL Classification: E62, H50, H52

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Introduction

Government spending can be classified into two types: 1) current expenditure (i.e. wage and salary, goods and services expenditure, interest payments and subsidies, and current transfers), and 2) capital expenditure (i.e. acquisition of fixed capital assets, capital transfers, and loan). The data from the Bank of Thailand show that during 1995-2004 the average proportion of national actual expenditure on the national product was 16.91% per quarter. The current expenditure proportion on total government spending increased from 69.70% in the first quarter of year 1995 to 76.83% in the third quarter of 2004. The government thus had to reduce capital expenditure from 30.30% to 23.17% for the respective time period. An increase of current expenditure can improve consumers' purchasing power. This would increase the aggregate demand and thus stimulate economic growth. On the other hand, capital investments would contribute to technological progress and raise the level of national production in the long run.

Government spending in terms of functional expenditure (i.e. general public service, defense, public order and safety, education, health, social security and welfare, housing and community amenities, recreation, culture and religion, and economic services) during 1995-2004 was largest on economic service and education.(24.77% and 24.02% of total expenditure) followed by defense at 9.80%. The key issue here is how the government spending on these three main items would affect economic growth.

In Thailand, the number of related literature is scarce. Three different methods used for analyzing the effects were found. Susangkarn and Tinnakorn (1999), Saebae (2002) and Chainakul (2002) for instance use the computable general equilibrium or CGE model. Some studies use econometric techniques to develop a structural model and even a more complex model of dynamic-impact analysis (see Warrarith, 2003). Meanwhile Chokbrandansuk (1987), Sittitham (1996), Charenkittayawut (2001), and Boonyarakyotin (2007) use a simpler static approach. A calibration method is also used in some literature. The general equilibrium neoclassical growth model was specified with various underlining assumptions. See Barro (1990) for example. More literature and the main findings from the cases in Thailand and other countries are summarized in Appendix Table 1 and 2.

The paper is structured as follows. The theoretical model is described. It explains the roles of government spending in terms of current and capital expenditures on the production function of the national product. Three steps of analysis, i.e. stationarity test of time series data, cointegration test and error correction model estimation are presented followed by the results, conclusion and policy recommendations.

Concept and Theory

The overall concept of this paper is presented in Figure 1. The government spending is represented by 6 variables of expenditure proportions. A dynamic relationship between each variable and economic growth is investigated using the estimation of error correction model.

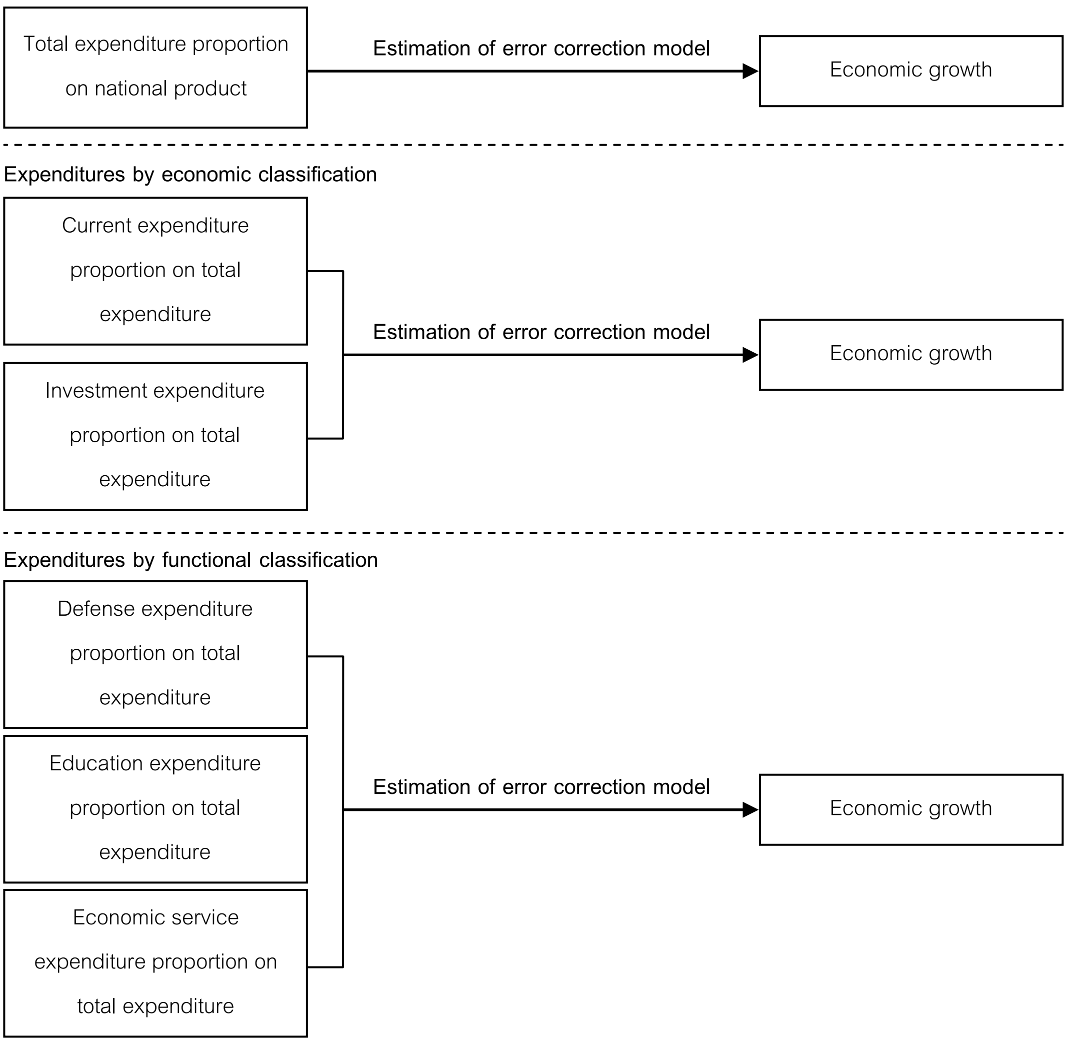

Figure 1 Conceptual framework

This study follows the theoretical concept suggested by Devarajan *et al.* (1996) to investigate the relationship between government spending and economic growth. A production function of national product (y) is determined by capital stock (k) and government expenditure (g). The latter is classified by the productive expenditure (g_2) and unproductive expenditure (g_1). The production function is in the form of constant elasticity of substitution (CES) as follows:

$$y = f(k, g_1, g_2) = \left[\alpha k^{-\zeta} + \beta g_1^{-\zeta} + \gamma g_2^{-\zeta}\right]^{-\frac{1}{\zeta}} \quad (1)$$

where the parameter is concordant with the hypothesis that $\alpha > 0, \beta \geq 0, \gamma \geq 0, \alpha + \beta + \gamma = 1, \zeta \geq -1$

A budget balance is indicated by Equation 2. It is stated that the government earns total revenue (τy) from consistently stationary income tax rates (τ).

$$\tau y = g = g_1 + g_2 \quad (2)$$

Government spending is determined by a national income shown in Equation 3 and 4. Φ refers to a current expenditure proportion on total expenditure $(0 \leq \Phi \leq 1)$. The model assumes that Φ and τ are determined by external factors.

$$g_1 = \Phi \tau y \quad (3)$$

$$g_2 = (1 - \Phi) \tau y \quad (4)$$

To attain the equilibrium, it is assumed that the representative agents will seek the most happiness situation in all of their everlasting life. This obtains a utility function U as follows:

$$U = \int_0^{\infty} u(c) e^{-\rho t} dt \quad (5)$$

where ρ refers to a discount rate and $U = \frac{c^{1-\sigma} - 1}{1 - \sigma}$. In addition, the capital accumulation is assumed to have a movement as shown in Equation 6.

$$\dot{k} = (1 - \tau) y - c \quad (6)$$

Thus, the optimization problem is shown below:

$$\text{Maximize} \int_0^{\infty} u(c) e^{-\rho t} dt$$

subject to $\dot{k} = (1-\tau)\left[\alpha k^{-\zeta} + \beta g_1^{-\zeta} + \gamma g_2^{-\zeta}\right]^{-\frac{1}{\zeta}} - c$

$\tau y = g_1 + g_2$

$g_1 = \Phi \tau y$

$g_2 = (1-\Phi)\tau y$

Set the Hamiltonian function and take the first-order derivative with c and then set the solution in the form of consumption growth rate. This gives the result in Equation 7.

$$\frac{\dot{c}}{c} = \frac{\alpha(1-\tau)\left(\alpha + \left(\frac{g}{k}\right)^{-\zeta}\left(\beta\Phi^{-\zeta} + \gamma(1-\Phi)^{-\zeta}\right)\right)^{\frac{-(1+\zeta)}{\zeta}} - \rho}{\sigma} \tag{7}$$

By the manipulation of Equation 1 to 4, $\frac{g}{k}$ can be expressed as follows:

$$\frac{g}{k} = \left(\frac{\tau^{\zeta} - \beta\Phi^{-\zeta} - \gamma(1-\Phi)^{-\zeta}}{\alpha}\right)^{\frac{1}{\zeta}} \tag{8}$$

Suppose in the steady-state growth path, the tax rate τ is constant. Thus $\frac{g}{y}$ in Equation 2 and $\frac{g}{k}$ in Equation 8 are constant. Apart from this, λ is defined as the steady-state growth rate of consumption. When substitute Equation 8 into Equation 7, λ can then be expressed as follows:

$$\lambda \equiv \frac{\dot{c}}{c} = \frac{\alpha(1-\tau)\left(\alpha + \left(\left(\frac{\tau^{\zeta} - \beta\Phi^{-\zeta} - \gamma(1-\Phi)^{-\zeta}}{\alpha}\right)^{\frac{1}{\zeta}}\right)^{-\zeta}\left(\beta\Phi^{-\zeta} + \gamma(1-\Phi)^{-\zeta}\right)\right)^{\frac{-(1+\zeta)}{\zeta}} - \rho}{\sigma}$$

$$= \frac{\alpha(1-\tau)\left(\frac{\alpha\tau^{\zeta}}{\tau^{\zeta} - \beta\Phi^{-\zeta} - \gamma(1-\Phi)^{-\zeta}}\right)^{\frac{-(1+\zeta)}{\zeta}} - \rho}{\sigma} \tag{9}$$

From Equation 9, the relationship between consumption growth rate and government spending proportion can be expressed as follows:

$$\frac{d\lambda}{d\Phi}=\frac{\alpha(1-\tau)(\alpha\tau\zeta)^{\frac{-(1+\zeta)}{\zeta}}(1+\zeta)\left(\beta\Phi^{-(1+\zeta)}-\gamma(1-\Phi)^{-(1+\zeta)}\right)}{\sigma\left(\tau\zeta-\beta\Phi^{-\zeta}-\gamma(1-\Phi)^{-\zeta}\right)^{\frac{-1}{\zeta}}} \tag{10}$$

Now, the productive expenditure is defined as a component of public spending. An increase of its share will give the steady-state growth rate of consumption.

$$\frac{\alpha(1-\tau)(\alpha\tau\zeta)^{\frac{-(1+\zeta)}{\zeta}}}{\sigma\left(\tau\zeta-\beta\Phi^{-\zeta}-\gamma(1-\Phi)^{-\zeta}\right)^{\frac{-1}{\zeta}}}>0,$$

If $d\lambda/d\Phi > 0$, it will indicate that the component g_1 is productive. Suppose that λ>0, the right-hand side of Equation 10 will be positive if $(1+\zeta)\left(\beta\Phi^{-(1+\zeta)}-\gamma(1-\Phi)^{-(1+\zeta)}\right)>0$. Since $\zeta \geq -1$, it implies that $d\lambda/d\Phi$ if

$$\frac{\Phi}{1-\Phi}<\left(\frac{\beta}{\gamma}\right)^{\theta},$$

where θ = 1/1+ζ is the elasticity of substitution. Devarajan *et al.* (1996) proposed that the above condition, for a shift in the composition to increase the growth rate, depends not only on the productivity (β and γ) of the two components but also on the initial shares. Therefore, a shift in favor of an objectively more productive type of expenditure (e.g., $\beta > \gamma$) may not raise the growth rate if its initial share (Φ) is too high. In other words, the conditions would depend not on the physical productivity of different components of public spending but also on the shares of government expenditure. Therefore, it can happen that the capital expenditures become unproductive because of improper allocation, i.e. too much or too little share of each.

The theoretical concept serves as a basis for the empirical test. The following section applies the concept using econometrics to show the effects of the proportional changes of government spending on Thailand's economic growth and the effectiveness of the spending on each component.

Methods and Data

IIn the optimization problem, the representative agent is assumed to seek the consumption path so as to maximize the intertemporal utility function subject to economic constraints. The optimization solution will indicate an unproductive capital spending if there is a negative effect of proportional change in government spending on economic growth. Using econometric model[1] "Error Correction Model" (ECM) can express the relationship in a long run and adjustment in the short run. It first requires testing of the equilibrium relationship in the long run, the so called "cointegration test" between the time series data of government spending and economic growth. The operation consists of 3 steps: 1) augmented Dicky-Fuller unit root test, 2) Johansen cointegration test, and 3) estimation of ECM. The data for all variables are in year 1995-2004. The variables are: the economic growth ($GRGDP_t$) and government spending. The data of economic growth variable are calculated based on the national product at stationary price of year 1988. The data were obtained from the Office of the National Economic and Social Development Board. The government spending comprises 6 variables. First, the total expenditure proportion on national product (TE_GDP_t) is calculated based on the actual expenditure data from the Bank of Thailand (BOT). The data are adjusted for the 1988 base year price with consumer price index. Other expenditure variables are: the current expenditure proportion on total expenditure (GC_TEt), capital expenditure proportion on total expenditure (GK_TE_t), defense expenditure proportion on total expenditure, (GD_TE_t) education expenditure proportion on total expenditure (GE_TE_t) and economic service expenditure proportion on total expenditure (GES_TE_t). The data are also from BOT and adjusted with CPI for 1988 base year price.

Augmented Dicky-Fuller Unit Root Test

The null hypothesis is that a series contains a unit root (i.e. it is non-stationary) against the alternative of stationarity. The test is based on the auto-regression of differences:

$$\Delta y_t = f(\text{constant}, \text{trend}, y_{t-1}, \Delta y_{t-1}, \ldots, \Delta y_{t-p+1}) \tag{11}$$

In this paper, the above equation is used to base the formulation of 7 equations for the 7 variables. The computer program will select an appropriate lag for the examination and calculate the MacKinnon (1996)[2] one-sided p-values. It is expected that the data of all variables become stationary when they are in the first difference form.

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[1] See details in Johnston and DiNardo (1996)

[2] MacKinnon (1996) derives a critical value from a large set of replications. The technique permits the calculation of Dickey-Fuller critical values for any sample size and for various specifications of regressions.

Johansen Cointegration Test

Here, the cointegration of 6 equations between the economic growth ($GRGDP_t$) and other variables are examined for a long-run equilibrium relationship. The first-order autoregressive model can be shown as follows.

$$y_t = \begin{bmatrix} GRGDP_t \\ TE\_GDP_t \end{bmatrix} = \begin{bmatrix} m_1 \\ m_2 \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} GRGDP_{t-1} \\ TE\_GDP_{t-1} \end{bmatrix} + \begin{bmatrix} u_{t1} \\ u_{2t} \end{bmatrix} \tag{12}$$

The behavior of y_t will depend on the properties of the Λ matrix. Let the eigenvalues and eigenvectors of the Λ matrix be:

$$\Lambda = \begin{bmatrix} \lambda_1 & 0 \\ 0 & \lambda_2 \end{bmatrix} = \begin{bmatrix} \vdots & \vdots \\ c_1 & c_2 \\ \vdots & \vdots \end{bmatrix} \tag{13}$$

Provided that the eigenvalues are distinct, the eigenvectors will be linearly independent and c will be nonsingular. Then, $c^{-1}ac = \Lambda$. Define a new vector of variables z_t as:

$$z_t = c^{-1}y_t \tag{14}$$

The process of premultiplying Equation 14 using c^{-1} will give:

$$z_t = m^* + \Lambda z_{t-1} + \eta_t \tag{15}$$

where $m^* = c^{-1}m$ and, which $\eta_t = c^{-1}u_t$ is a white noise vector. Thus,

$$z_{1t} = m_1^* + \lambda_1 z_{1,t-1} + \eta_{1,t} \tag{16}$$

$$z_{2t} = m_2^* + \lambda_2 z_{2,t-1} + \eta_{2,t} \tag{17}$$

Each z variable follows a separate AR(1) scheme and is eigenvalue. Each of them has modulus less than 1; is a random walk with drift, I(1), if the eigenvalue is 1; and is explosive if the eigenvalue exceeds 1 in numerical value.

Estimation of Error Correction Model

A proportion of the disequilibrium from one period is corrected in the next period. To illustrate this idea, let y_t follows a p-th order vector autoregressive process for the $N \times 1$ vector y_t of I(1) series. In this paper, N=2. The following is an example model of economic growth variable and current expenditure proportion on national product variable:

$$y_t = \begin{bmatrix} GRGDP_t \\ TE\_GDP_t \end{bmatrix} = \sum_{t=1}^{p} \Pi_i y_{t-i} + u_t \qquad (18)$$

where u_t is white noise. To express the regression in Equation 18 in an error correction model, rewrite it as:

$$\Delta y_t = \Pi y_{t-1} + \sum_{t=1}^{p-1} \Gamma_i \Delta y_{t-i} + u_t \qquad (19)$$

where Δ is the difference operator. According to Granger's representation theorem, the Π matrix will be of less than full rank if the vector is cointegrated. The rank of this matrix will equal to a number of cointegrating vectors. When the cointegrating restrictions are imposed, Equation 19 becomes:

$$\Delta y_t = \alpha\beta' y_t + \sum_{t=1}^{p-1} \Gamma_i \Delta y_{t-i} + u_t \qquad (20)$$

where the term $\beta' y_{t-1}$ defines the disequilibrium errors at time t-1 and measures the adjustment made at t. The coefficient estimation which expresses disequilibrium should give a negative sign.

The procedure starts with determining an appropriate lag of each variable. Then, use statistical values, i.e. t-statistic, adjusted R-square and LM test to find the most appropriate equation to investigate a dynamic relationship. In this paper, six ECM models are developed. The model that represents a dynamic effect of actual expenditure proportion of national product on economic growth is shown as follows:

$$\begin{bmatrix} \Delta GRGDP_t \\ \Delta TE\_GDP_t \end{bmatrix} = \alpha\beta' \begin{bmatrix} \Delta GRGDP_{t-1} \\ \Delta TE\_GDP_{t-1} \end{bmatrix} + \sum_{t=1}^{p-1} \Gamma_i \begin{bmatrix} \Delta GRGDP_{t-i} \\ \Delta TE\_GDP_{t-i} \end{bmatrix} + u_t \qquad (21)$$

Dynamic effects of economic expenditures and functional expenditures on economic growth can be expressed as follows:

$$\begin{bmatrix} \Delta GRGDP_t \\ \Delta GC\_TE_t \end{bmatrix} = \alpha\beta' \begin{bmatrix} \Delta GRGDP_{t-1} \\ \Delta GC\_TE_{t-1} \end{bmatrix} + \sum_{t=1}^{p-1} \Gamma_i \begin{bmatrix} \Delta GRGDP_{t\ \ i} \\ \Delta GC\_\ \ E_{t-i} \end{bmatrix} + u_t \qquad (22)$$

$$\begin{bmatrix} \Delta GRGDP_t \\ \Delta GK\_TE_t \end{bmatrix} = \alpha\beta' \begin{bmatrix} \Delta GRGDP_{t-1} \\ \Delta GK\_TE_{t-1} \end{bmatrix} + \sum_{t=1}^{p-1} \Gamma_i \begin{bmatrix} \Delta GRGDP_{t-i} \\ \Delta GK\_TE_{t-i} \end{bmatrix} + u_t \qquad (23)$$

$$\begin{bmatrix} \Delta GRGDP_t \\ \Delta GD\_TE_t \end{bmatrix} = \alpha\beta' \begin{bmatrix} \Delta GRGDP_{t-1} \\ \Delta GD\_TE_{t-1} \end{bmatrix} + \sum_{t=1}^{p-1} \Gamma_i \begin{bmatrix} \Delta GRGDP_{t-i} \\ \Delta GD\_TE_{t-i} \end{bmatrix} + u_t \quad (24)$$

$$\begin{bmatrix} \Delta GRGDP_t \\ \Delta GE\_TE_t \end{bmatrix} = \alpha\beta' \begin{bmatrix} \Delta GRGDP_{t-1} \\ \Delta GE\_TE_{t-1} \end{bmatrix} + \sum_{t=1}^{p-1} \Gamma_i \begin{bmatrix} \Delta GRGDP_{t-i} \\ \Delta GE\_TE_{t-i} \end{bmatrix} + u_t \quad (25)$$

$$\begin{bmatrix} \Delta GRGDP_t \\ \Delta GES\_TE_t \end{bmatrix} = \alpha\beta' \begin{bmatrix} \Delta GRGDP_{t-1} \\ \Delta GES\_TE_{t-1} \end{bmatrix} + \sum_{t=1}^{p-1} \Gamma_i \begin{bmatrix} \Delta GRGDP_{t-i} \\ \Delta GES\_TE_{t-i} \end{bmatrix} + u_t \quad (26)$$

In each model, an adjustment of ECM indicates that the change of Thailand's economic growth ($\Delta GRGDP_t$) would depend on a short-run change of government spending proportion. This reflects an "impact effect". Meanwhile others would depend on the size of equilibrium loss in a long run (EC term). This indicates a "feedback effect". When a change of government spending proportion causes a deviation of economic growth from a long-run equilibrium, a proportion of the disequilibrium from one period is corrected in the next period.

Results and Discussion

Table 1 shows the results of the stationarity test of time series data for all variables. It is found that that the Mackinnon p-values of all variables are more than 0.05; the null hypothesis $H_o : y_t \sim I(0)$ is accepted. It implies that the data are non-stationary.

Table 1 Results of augmented Dickey-Fuller test for unit root in level

Variable	Augmented Dickey-Fuller test equation	Null hypothesis: The variable has a unit root		Stationarity of data
		t-statistic	MacKinnon one-sided p-values	
$GRGDP_t$	$\Delta GRGDP_t = -0.021GRGDP_{t-1}+0.202\Delta GRGDP_{t-1}+0.337\Delta GRGDP_{t-2}-0.044\Delta GRGDP_{t-3}-0.345\Delta GRGDP_{t-4}$	-0.432	0.520	Non- stationary
TE_GDP_t	$\Delta TE\_GDP_t = 0.003TE\_GDP_{t-1}-0.605\Delta TE\_GDP_{t-1}-0.382\Delta TE\_GDP_{t-2}+0.432\Delta TE\_GDP_{t-3}$	0.173	0.730	non- stationary
GC_TE_t	$\Delta GC\_TE_t = 0.006GC\_TE_{t-1}-0.794\Delta GC\_TE_{t-1}$	0.579	0.837	non- stationary
GK_TE_t	$\Delta GK\_TE_t = -0.023GK\_TE_{t-1}-0.779\Delta GK\_TE_{t-1}$	-0.858	0.338	non- stationary
GD_TE_t	$\Delta GD\_TE_t = 0.069-0.0003TREND^1-0.774GD\_TE_{t-1}-$	-1.920	0.620	non- stationary

Table 1 (Continued)

Variable	Augmented Dickey-Fuller test equation	Null hypothesis: The variable has a unit root		Stationarity of data
		t-statistic	MacKinnon one-sided p-values	
	$0.443\Delta GD\_TE_{t-1}-0.443\Delta GD\_TE_{t-2}-0.565\Delta GD\_TE_{t-3}-0.448\Delta GD\_TE_{t-4}-0.529\Delta GD\_TE_{t-5}-0.626\Delta GD\_TE_{t-6}-0.514\Delta GD\_TE_{t-7}-0.181\Delta GD\_TE_{t-8}$			
GE_TE_t	$\Delta GE\_TE_t = -0.002GE\_TE_{t-1}-0.729\ \Delta GE\_TE_{t-1}$	-0.123	0.635	non- stationary
GES_TE_t	$\Delta GES\_TE_t = 0.034-0.150GES\_TE_{t-1}-0.736\Delta GES\_TE_{t-1}-0.289\Delta GES\_TE_{t-2}-0.317\Delta GES\_TE_{t-3}$	-0.875	0.784	non- stationary

Note: [1] The variable TREND refers to time trend defined as follows: 1st quarter of year 1995 = 1, 2nd quarter of 1995 = 2, 3rd quarter of 1995 = 3, 4th quarter of 1995 = 4,…, 3rd quarter of 2004 = 39.

Next, the data are adjusted in the 1st difference form and tested using the same method. It is found that the null hypothesis is rejected for all variables. It can be concluded that Δy_t is stationary or $y_t \sim I(1)$. The data for all variables have the range as I(1) (Table 2).

Table 2 Results of augmented Dickey-Fuller test for unit root in the 1st difference

1st Difference variable	Augmented Dickey-Fuller test equation	Null hypothesis: The variable has a unit root		The variable stationarity
		t-statistic	MacKinnon one-sided p-values	
$\Delta GRGDP_t$	$\Delta^2 GRGDP_t = -0.881\Delta GRGDP_{t-1}+0.081\Delta^2 GRGDP_{t-1}+0.415\Delta^2 GRGDP_{t-2}+0.358\Delta^2 GRGDP_{t-3}$	-5.192	0.000	stationary
ΔTE_GDP_t	$\Delta^2 TE\_GDP_t = -2.414\Delta TE\_GDP_{t-1}+0.811\Delta^2 TE\_GDP_{t-1}+0.431\Delta^2 TE\_\ GDP_{t-2}$	-6.485	0.000	Stationary
ΔGC_TE_t	$\Delta^2 GC\_TE_t = -1.787\Delta GC\_TE_{t-1}$	17.025	0.000	Stationary
ΔGK_TE_t	$\Delta^2 GK\_TE_t = -1.78\ \Delta GK\_TE_{t-1}$	17.025	0.000	Stationary
ΔGD_TE_t	$\Delta^2 GD\_TE_t = -0.018+0.0005\ TREND^1-3.272\Delta GD\_TE_{t-1}+1.355\Delta^2 GD\_TE_{t-1}+0.625\Delta^2 GD\_TE_{t-2}$	-10.972	0.000	Stationary

Table 2 (Continued)

1st Difference variable	Augmented Dickey-Fuller test equation	Null hypothesis: The variable has a unit root: t-statistic	MacKinnon one-sided p-values	The variable stationarity
ΔGE_TE_t	$\Delta^2 GE\_TE_t = -1.730\Delta GE\_TE_{t-1}$	-15.076	0.000	Stationary
ΔGES_TE_t	$\Delta^2 GES\_TE_t = -0.004-2.596\Delta GES\_TE_{t-1} +0.774\Delta^2 GE\_TE_{t-1}+0.368\Delta^2 GE\_TE_{t-2}$	-5.672	0.000	Stationary

Note: [1] The variable TREND refers to time trend defined as follows: 1st quarter of year 1995 = 1, 2nd quarter of 1995 = 2, 3rd quarter of 1995 = 3, 4th quarter of 1995 = 4,…, 3rd quarter of 2004 = 39.

Based on the Johansen cointegration test, it is revealed that all the types of government spending cointegrated with the economic growth variable with the level of statistical significance at 0.05 (Table 3).

Table 3 Results of Johansen cointegration test

Series	Assumption	Lags interval (in 1st differences)	Hypothesized no. of cointegrating equations: None**: Max-Eigen Statistic	None**: 5% critical value	At most 1*: Max-Eigen statistic	At most 1*: 5% critical value	Conclusion
$GRGDP_t$ and TE_GDP_t	Linear deterministic trend	1 to 4	46.106	14.07	5.284	3.76	2 cointegrating equations at the 5% level
$GRGDP_t$ and GC_TE_t	Linear deterministic trend	1 to 4	45.902	14.07	8.258	3.76	2 cointegrating equations at the 5% level
$GRGDP_t$ and GK_TE_t	Linear deterministic trend	1 to 4	45.902	14.07	8.258	3.76	2 cointegrating equations at the 5% level
$GRGDP_t$ and GD_TE_t	Linear deterministic trend	1 to 3	72.205	14.07	7.387	3.76	2 cointegrating equations at the 5% level
$GRGDP_t$ and GE_TE_t	Linear deterministic trend	1 to 3	41.590	14.07	4.941	3.76	2 cointegrating equations at the 5% level
$GRGDP_t$ and GES_TE_t	Linear deterministic trend	1 to 3	64.148	14.07	3.389	3.76	2 cointegrating equations at the 5% level

Note: * (**) denotes rejection of the hypothesis at the 5% (1%) level

The results of ECM estimation of 6 equations are shown in Table 4. The results show that all models can provide an appropriate economic interpretation for four reasons. First, the feedback effect (EC term) had a negative sign. It confirms that a proportion of the disequilibrium from one period is corrected in the next. Second, p-value of LM(1) test indicates no autocorrelation problem occurred in the estimation. Third, t-statistic values of most expenditure variables had statistical significance at the 0.05 level. Lastly, the values of adjusted R-squared were high.

Table 4 Results of dynamic relationship between government spending and economic growth

Estimated error correction model	No. of eq.	$\overline{R}^2$	S.E.	LM(1) test p-value
$\Delta GRGDP_t = 0.240 \quad -0.651\ EC\ term \quad -0.209\Delta GRGDP_{t-1} \quad +0.165\Delta GRGDP_{t-2}$				
$(1.303) \quad (-5.750)^{**} \quad (-1.932)^{*} \quad (1.681)$				
$+0.327\ \Delta GRGDP_{t-3} \quad -0.033\ \Delta GRGDP_{t-4} \quad +72.334\ \Delta TE\_GDP_{t-1}$				
$(3.055) \quad (-0.296) \quad (4.687)$				
$+49.146\ \Delta TE\_GDP_{t-2} \quad +34.140\ \Delta TE\_GDP_{t-3} \quad +13.785\ \Delta TE\_GDP_{t-4}$				
$(3.641)^{**} \quad (2.980)^{**} \quad (1.434)$	…(27)	0.737	0.993	0.234
$\Delta GRGDP_t = 0.315 \quad -0.862\ EC\ term \quad -0.115\Delta GRGDP_{t-1} \quad +0.189\Delta GRGDP_{t-2}$				
$(1.718)^{*} \quad (-6.666)^{**} \quad (-1.302) \quad (2.314)^{**}$				
$+0.416\ \Delta GRGDP_{t-3} \quad +0.008\ \Delta GRGDP_{t-4} \quad -11.046\ \Delta GC\_TE_{t-1}$				
$(3.716)^{**} \quad (0.082) \quad (-2.946)^{**}$				
$-10.050\ \Delta GC\_TE_{t-2} \quad -10.524\ \Delta GC\_TE_{t-3} \quad -3.570\ \Delta GC\_TE_{t-4}$				
$(-2.124)^{**} \quad (-2.305)^{**} \quad (-1.062)$	…(28)	0.799	0.870	0.193
$\Delta GRGDP_t = 0.315 \quad -0.862\ EC\ term \quad -0.115\Delta GRGDP_{t-1} \quad +0.189\Delta GRGDP_{t-2}$				
$(1.718)^{*} \quad (-6.667)^{**} \quad (-1.302) \quad (2.314)^{**}$				
$+0.416\ \Delta GRGDP_{t-3} \quad +0.008\ \Delta GRGDP_{t-4} \quad +11.046\ \Delta GK\_TE_{t-1}$				
$(3.716)^{**} \quad (0.082) \quad (-2.946)^{**}$				
$+10.050\ \Delta GK\_TE_{t-2} \quad +10.524\ \Delta GK\_TE_{t-3} \quad +3.570\ \Delta GK\_TE_{t-4}$				
$(2.124)^{**} \quad (2.305)^{**} \quad (1.062)$	…(29)	0.799	0.870	0.193
$GRGDP_t = 0.473 \quad - 0.801\ EC\ term \quad +0.110\ GRGDP_{t-1} \quad +0.373\ GRGDP_{t-2}$				
$(3.013)^{**} \quad (-12.216)^{**} \quad (1.447) \quad (4.584)^{**}$				
$+0.358\ \Delta GRGDP_{t-3} \quad +44.208\ \Delta GD\_TE_{t-1} \quad +48.154\ \Delta GD\_TE_{t-2}$				
$(4.342)^{**} \quad (3.865)^{**} \quad (3.623)^{**}$				
$+29.659\ \Delta GD\_TE_{t-3}$				
$(2.865)^{**}$	…(30)	0.846	0.859	0.751

Table 4 (Continued)

Estimated error correction model	No. of eq.	$\overline{R}^2$	S.E.	LM(1) test p-value
$GRGDP_t$ = 0.435 -0.495 EC term 0.021 $GRGDP_{t-1}$ +0.256 $GRGDP_{t-2}$ (2.032)** (-7.815)** (0.191) (2.554)** +0.129 $\Delta GRGDP_{t-3}$ -16.857 ΔGE_TE_{t-1} -14.598 ΔGE_TE_{t-2} (1.286) (-1.959)** (-1.307) -7.273 ΔGE_TE_{t-3} (0.878)	…(31)	0.697	1.207	0.779
$GRGDP_t$ = 0.493 -0.568 EC term +0.006 $GRGDP_{t-1}$ +0.287 $GRGDP_{t-2}$ (2.661)** (-9.767)** (0.068) (3.327)** +0.223 $\Delta GRGDP_{t-3}$ +22.417 ΔGES_TE_{t-1} +12.853 ΔGES_TE_{t-2} (2.440)** (4.736)** (2.117)** +4.467 ΔGES_TE_{t-3} (1.047)**	…(32)	0.790	1.004	0.119

Note: Values in parentheses are t-statistic. *(**) denotes rejection of the hypothesis at the 5% (1%) level.

The result of the model in Equation 27 reassures that an increase in government spending proportion on national product gives a positive effect on Thailand's economic growth. This is in accordance with the findings of Chokbrandansuk (1987) and Charenkittayawut (2001). On the other hand, Hsieh and Lai (1994) found no clear evidence in G7 countries as to whether government spending enhances the growth according to the VAR model. Unsurprisingly, the impact of the current expenditure proportion variable had a negative sign, which implies that the current expenditure of the Thai government is unproductive. For the investment expenditure, it was found that the impact had a positive value, that is, the change of investment proportion of the Thai government caused an increase in the economic growth. It suggests that the government could extend the capital expenditure proportion. This finding is in accordance with Easterly and Rebelo (1993). However, Devarajan *et al.* (1996) report that the relationship between capital component of public expenditure and growth per capita is negative in the case of developing countries, which implies that excessive production expenditures could become unproductive.

The result of the ECM model shows a dynamic impact of proportion change in government spending for defense, education and economic service (see Equation 30, 31 and 32 in Table 4).

It is found that the expenditure proportion change for defense and economic service gave a positive impact on Thailand's economic growth. However, the change of expenditure proportion for education gave a negative effect on growth. It implies that the government spending on education between 1995 and 2004 did not significantly produce an increase in productivity. This can be seen by persisting problems of educational quality which is deemed to be a main barrier to the development of human capital and thus economic growth. Fan *et al.* (2004) reported out that at the tertiary level, science and engineering programs were weak, and graduates failed to meet labor market standards. However, the report says that in the early 1990s, the Thai government began to address the issues of access and quality in secondary and higher education. With support from the World Bank, a number of programs were launched to improve the quality of science, mathematics and foreign language instruction in teacher education colleges and secondary schools.

Conclusion and Recommendation

The key issue here is to observe whether the Thai government spending on the three main development sectors, i.e. education, economic service and defense would affect the economic growth. The investigation draws conceptual guidance from the theoretical concept suggested by Devarajan *et al.* (1996). It is proposed that the productive and unproductive expenditure were production factors of the national product. The data are from 1995 to 2004, a period of increasing current expenditure proportion.

The error correction model is applied for the analysis. After adjusting the government spending variables and the economic growth variable to have a first difference form, all variables became stationary. In a long-run equilibrium, the proportion of government spending cointegrated with the economic growth. The increase the proportion of government spending to the national product significantly gave a positive effect on the change of economic growth. However, the increasing proportion of education expenditure did not contribute significantly to the accumulation of human capital. This study recommends that an increase of budget proportion on education in Thailand should also be allocated for improving the research and development. The findings of Jaroensathapornkul (2008), Fan and Pardey (1995), Fan and Rao (2003) and Fan *et al.* (2004) confirm that improving the R&D would be an important mechanism for enhancing economic growth in the long run. This would also support a proactive policy of Thailand's creative economy regime.

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References

Barro, R. J. 1990. **Government Spending in a Simple Model of Endogenous Growth Model** (Online). http://links.jstor.org/sici?sici=0022-3808%28199010%2998%3A5%3CS103%3AGSIASM%3E2.0.CO%3B2-T

Boonyarakyotin, N. 2007. **Structure of Government Expenditure and Economic Growth.** Master of Science Thesis in Economics, Kasetsart University. (in Thai)

Chainakul, A. 2002. **The Adjustment of Thai Economy Responds to Government Expenditure and Credit Allocation of Thai Commercial Bank: A Computable General Equilibrium Analysis.** Master of Art Thesis in Economics, Thammasat University. (in Thai)

Charenkittayawut, S. 2001. **The Impacts of Changes in Government Expenditure on Macroeconomic Variables in Thailand.** Master of Science Thesis in Economics, Kasetsart University. (in Thai)

Chokbrandansuk, W. 1987. **The Impact of Government Expenditure on Gross Domestic Product in Thailand.** Master of Science Thesis in Economics, Kasetsart University. (in Thai)

Devarajan, S., V. Swaroop, and H. Zou. 1996. "The Composition of Public Expenditure and Economic Growth." **Journal of Monetary Economics** 37 (2): 313-344.

Easterly, W. and S. Rebelo. 1993. **Fiscal Policy and Economic Growth: An Empirical Investigation** (Online). http://www.nber.org/papers/w4499.pdf, June 16, 2010.

Fan, S. and N. Rao. 2003. **Public Spending in Developing Countries: Trends, Determination, and Impact.** (Online). www.ifpri.org/divs/eptd/dp/papers/eptdp99.pdf, June 1, 2010.

Fan, S. and P. G. Pardey. 1995. **Government Spending on Asian Agriculture: Trends and Production Consequences.** In Agricultural Public Finance Policy in Asia, Asian Productivity Organization, Tokyo, 49-87.

Fan, S., S. Jitsuchon, and N. Methakunnavut. 2004. **The Importance of Public Investment for Reducing Rural Poverty in Middle-Income Countries: The Case of Thailand** (Online). www.ifpri.org/divs/dsgd/dp/papers/dsgdp07pdf, June 1, 2010.

Hsieh, E. and K. S. Lai. 1994. "Government Spending and Economic Growth: The G-7 Experience." **Applied Economics** 26 (5): 535-542.

Jaroensathapornkul, J. 2008. “Driving Force of Research toward Thailand’s Agricultural Growth.” **Srinakharinwirot Journal of Economics** 4 (4): 82-92. (in Thai)

Johnston, J. and J. DiNardo. 1996. **Econometric Methods.** 4th ed. New York: McGraw-Hill Irwin.

MacKinnon, J. G. 1996. "Numerical Distribution Functions for Unit Root and Cointegration Tests." **Journal of Applied Econometrics** 11 (6): 601-618.

Saebae, S. 2002. **Effects of Fiscal Policy on the Social Accounting Matrix.** Master of Art Thesis in Economics, Thammasat University. (in Thai)

Sittitham, S. 1996. **An Analysis of Government Expenditure on Economic Growth of Thailand.** Master of Science Thesis in Economics, Kasetsart University. (in Thai)

Susangkarn, S. and P. Tinnakorn. 1999. **Social Accounting Matrix and Analysis of the Impacts of Government Spending.** Bangkok: TDRI. (in Thai)

Warrarith, S. 2003. **An Analysis of Government Expenditure and Economic Growth in Thailand.** Master of Science Thesis in Economics, Kasetsart University. (in Thai)

Appendices

Appendix Table 1 Related literature in cases of Thailand

Authors	Data time period	Analytical methods	Findings
Chokbrandansuk (1987)	1970-1995	Single and multiple linear regression	Government spending had positive relationship with the gross product. The regional spending on education, public health and public service had positive effects on the GDP.
Sittitham (1996)	1977-1994	Multiple linear regression	An increasing rate of expenditure budget on economy, community and society administration gave a positive effect on growth. This is in contrast to the expenditure budget on general administration.
Charenkittayawut (2001)	1989-1998	Macro-econometric model	Government spending increased the aggregate demand and GDP.
Warrarith (2003)	1980-2002 1993-1997	Granger’s causality test	Budgets for buying goods and services, social service, economic service and goods and public service caused the changes of economic growth. The government could use expenditure budget as a tool to control over the economic system to attain an appropriate growth.
Boonyarakyotin (2007)		Multiple linear regression	A budget proportion on national product had a negative relationship with an economic growth. The relationship between current expenditure proportion on national product and population growth was not statistically significant.

Appendix Table 2 Related literature in cases of other countries

Authors	Case countries and data time period	Analytical methods	Findings
Easterly and Rebelo (1993)	28 countries; 1970-1988	Cross-section regressions	Capital expenditure on transportation and communication had relationship with economic growth.
Hsieh and Lai (1994)	G7 countries (Canada, France, Germany, Italy, Japan, England and America)	Vector autoregressive analysis	Economic growth and government spending had dynamic relationship. However, there was no clear evidence whether government spending enhances the growth.
Devarajan *et al*. (1996)	43 developing countries; 1970-1990	Multiple linear regression	Proportion of current expenditure on total expenditure positively affected the economic growth. This contrasts to the effect of capital expenditure. It indicates the over productive expenditure that could damage the economic system.
M'Amanja and Morrissey (2005)	Kenya; 1964-2002	Multivariate cointegration and vector error correction models	Government spending had a positive long-run effect on growth and per capita income.
Arpaia and Turrini (2008)	15 countries in EU; 1970-2003	Panel unit root test and cointegration analysis	The pooled mean group estimation shows a long-run and short-run relationship between government expenditure and potential output in EU countries.