Is the Thai Government Revenue-Spending Nexus Asymmetric?

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Abstract

This paper examines the relationship between government revenue and spending in Thailand using both linear and nonlinear cointegration techniques. A residual-based cointegration test with an unknown structural break is used to detect the linear long-run relationship between government revenue and spending. For nonlinear cointegration tests, both TAR and MTAR models are estimated. The empirical results from the estimate of the redidual-based test for cointegration suggest that there is the positive long-run relationship between government revenue and spending when revenue is dependent variable. However, the results from the estimates of the TAR and MTAR models show the absence of asymmetric adjustments towards the long-run equilibrium. Based upon the results of linear cointegration test, short-run dynamics indicate that any deviation from budgetary disequilibrium will be corrected. In causality sense, there is a short-run unidirectional causality running from government spending to revenue. The evidence appears to support the fiscal spend-and-tax hypothesis. This finding implies that policymakers should be careful in exercising expansionary fiscal policy measures because fiscal deficits will occur when revenue falls short of spending.

Keywords: Government revenue and expenditures, cointegration, causality
JEL *Classification*: C32, E62

1. Introduction

It is well-recognized in the literature that budget deficits can be sustainable in the long-run for some countries, especially the US. Even though budget deficits can be expansionary, they are related to political support by the public. According to Ghate and Zak (2002), politicians choose government spending to maximize support by their constituents. When government spending is large enough, the policies chosen by politicians are Pareto suboptimal and cause endogenous cycles in output. Most previous empirical studies focusing on the relationship between revenue and spending intend to test three main hypotheses: tax-and-spend, spend-and-tax or fiscal synchronization. The tax-and-spend hypothesis proposed by Friedman (1978) posits that tax revenue causes government spending, i. e., an increase in tax revenue leads to higher spending by the government and vice versa. The spend-and-tax hypothesis of Peacock and Wiseman (1979) and Roberts (1978) states that government spending causes tax revenue. Decisions on government spending are made prior to tax collection. The spend-and-tax hypothesis is opposite to the tax-and-spend hypothesis. In Granger causality sense, there exists unidirectional causality between the two variables. The fiscal synchronization hypothesis proposed by Musgrave (1966) and Meltzer and Richard (1981) posits that spending and revenue are interdependent. Therefore, there should be bidirectional causality between the two variables. Koren and Stiassny (1998) investigate the relationship between government spending and taxation decisions in nine industrialized countries. They find that the spend-and-tax hypothesis is supported in Italy, Austria and France while the tax-and-spend hypothesis is supported in the UK, Netherlands, Germany and the US. Neither hypothesis is supported in Switzerland and Sweden. Chang et al. (2002) use annual data during 1951 and 1996 to examine the relationship between government revenue and spending in 10 countries. They find evidence from only two countries (New Zealand and Thailand) that does not support tax-and-spend, spend-and-tax or fiscal synchronization hypothesis. Many previous studies employ linear cointegration and causality tests to investigate the relationship between government revenue and expenditures (e.g. Hakkio and Rush, 1991, and Quintos, 1995). Afonso and Rault (2009) employ bootstrap panel analysis that allows for cross-country correlation to examine the causal relationship between government spending and revenue for the EU in the period 1960P-2006. They find evidence supporting both tax-and-spend and spend-and-tax hypothesis.

However, the government budget deficit can be sustainable in the long run and policymakers will try to reduce the deficit when it reaches a certain threshold level (Arestis et al. 2004: Cipolini et al. 2009, among others). Payne and Saunoris (2010) estimate an asymmetric error correction model for the UK and find asymmetric adjustment toward long-run equilibrium. Their finding lends support for the spend-and-tax hypothesis. Paleologou (2013) examines the revenue-expenditure nexus in Sweden, Germany and Greece and finds that asymmetric adjustment towards the long-run equilibrium is found for Greece only. Athanesenas et al. (2014) re-examines the revenue-expenditure relationship for Greece. They find evidence of asymmetric interactions between the two variables in both the long- and short-run time horizon. Their evidence supports the synchronization hypothesis while the evidence found by Paleologou (2013) supports the spend-and-tax hypothesis for Greece. Tiwari and Mutascu (2016) examine the relationship between government revenue and spending in Romania using threshold regression. They find the existence of nonlinear and asymmetric adjustment toward the long-run equilibrium. Their results also support the spend-and-tax hypothesis. Saunoris (2015) examines the dynamics of the intertemporal budget constraint in the US states. The overall results lend support to the tax-and-spend hypothesis even though the dynamics differ in some states.

Thailand has been confronted with larger sizes of budgetary disequilibria as a result of the global financial crisis beginning in 2008. Figure 1 shows fluctuations in the Thai government budgets measured by surpluses and deficits as percentage of GDP.

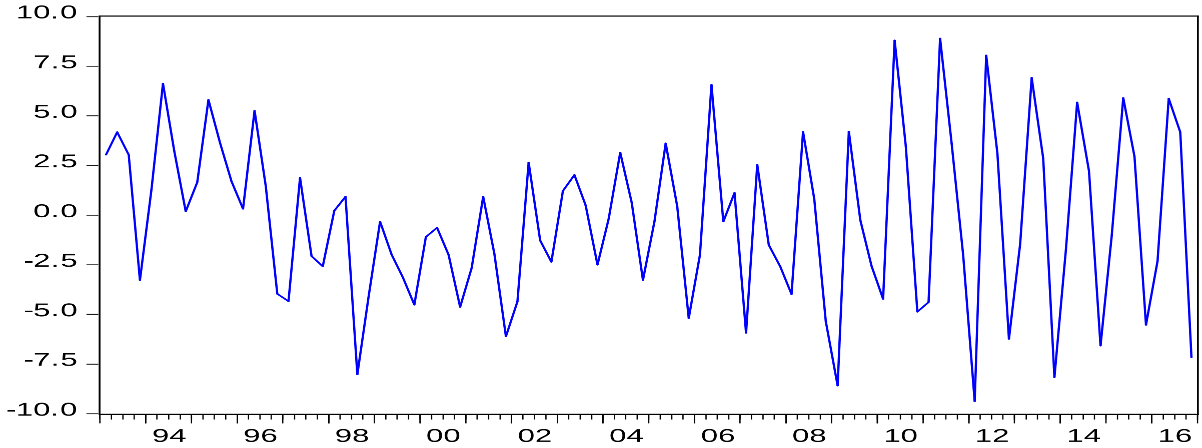

Figure 1. Budgetary Disequilibrium in Thailand, 1993-2016.

The smoother period of fluctuations in the government budgets seems to be few years after the Asian financial crisis in 1997 until the last quarter of 2005. However, this period seems to contain mostly budget deficits. For the whole sample, the mean of the government budget is the deficit of 0.24% of GDP. The largest budget deficit is 9.37% of GDP in the first quarter of 2012 while the largest budget surplus is 8.91% in the second quarter of GDP.

The main purpose of this study is to investigate the relationship between government revenue and spending by employing nonlinear cointegration tests using quarterly data during 1993 and 2016. Two types of cointegration tests are used. Johansen's cointegration test is used to determine whether the long-run relationship between government revenue and spending is linear. For nonlinear cointegration and asymmetric adjustment toward the long-run equilibrium, the threshold autoregressive (TAR) and momentum threshold autoregressive (MTAR) models are used. The paper contributes to the literature by focusing on an emerging market economy that experiences more frequent budget deficits than budget surpluses. The results show that both TAR and MTAR models do not capture the nonlinear relationship and threshold adjustments as documented by some recent studies. However, the results from Gregory and Hansen's (1996) cointegration test capture the linear relationship and symmetric adjustments towards long-run equilibrium. This paper is organized as follows. Section 2 describes the data and estimation techniques used in the analysis. Section 3 presents empirical results and the last section concludes.

2. Data and Estimation Techniques

2.1 Data

Quarterly data on general government revenue (R_t), and spending (G_t) are retrieved from the website of the Bank of Thailand. Nominal GDP are obtained from the Office of National Economic and Social Development Board. All series are measured in millions of baht (Thai currency). The government budget as a percentage of GDP is computed as the difference between revenue and spending divided by GDP. The time series data cover the period from 1993 to 2016. The revenue and expenditure series are seasonally adjusted and transformed to the logarithmic series. The time series property is obtained by performing unit root tests.

The Augmented Dickey-Fuller (ADF) tests with optimal lag length determined by Akaike Information Criterion (AIC) are performed to determine the property of time series data used in the analysis. The results of unit root tests are reported in Table 1.

Table 1
Results of Unit Root Tests.

Variable	ADF Statistic (constant)	ADF statistic (constant+trend)
R	-0.617	-3.115
ΔR	-9.528***	-9.477***
G	-1.046	-2.810
ΔG	-3.536***	-3.637**

Note: ***and ** indicate significance at the 1% and 5% level, respectively.

The results in Table 1 indicate that the revenue and expenditure series are non-stationary in level, but they are stationary in first differences. Therefore, both series are integrated of order one, i.e., they are I(1) series. This time series property is suitable for testing cointegration between revenue and expenditures in both linear and non-linear cointegration frameworks.

2.2 Estimation Techniques

The starting point on the adjustment of revenue and spending toward the long-run equilibrium can be drawn from the studies by Hakkio and Rush (1991) and Cunado et al. (2004). Testing for cointegration between government and expenditure time series can reveal evidence that support the intertemporal budget constraint of the government. An empirical model for a long-run relationship between government revenue and spending using the power functional form is expressed as:

$$GR_t = AGS_t^{\beta}\varepsilon_t \qquad (1)$$

where GR_t denotes government revenue, GS_t denotes government spending, ε_t is the error term, A is a constant, and β is the coefficient. By using log transformation of Eq. (1), the linear equation can be expressed as:

$$R_t = \alpha + \beta G_t + e_t \qquad (2)$$

where R_t is the log of government revenue, G_t is the log of government spending, α is the log of A, and e_t is the log of ε_t. By allowing for a shift in the intercept, the long-run equation can be rewritten as:

$$R_t = \alpha + \delta D_t + \beta G_t + e_t \qquad (3)$$

where D_t is the dummy variable that captures the impact of an unknown structural break. In this respect, it can be claimed that the break will affect the decision of fiscal policymakers. This dummy variable takes the value of 1 at the time the break point occurred and and 0 otherwise. In the same token, if government revenue determines government spending, the equation can be expressed as:

$$G_t = \alpha + \delta D_t + \beta R_t + e_t \tag{4}$$

Since the long-run relationship between government revenue and spending can be either linear, nonlinear or both, two types of tests for cointegration used are: (1) Gregory-Hansen cointegration test proposed by Gregory and Hansen (1996), and (2) threshold cointegration tests, both TAR and MTAR models, proposed by Enders and Granger (1998) and Enders and Siklos (2001).

The first step of Gregory-Hansen cointegration test is to estimate Eq. (2). The second step is the test for unit root in the estimated residual (e_t) by the following equation:

$$\Delta e_t = \rho e_{t-1} + \sum_{i=1}^{k} \beta_i \Delta e_{t-i} + u_t \tag{5}$$

where k is the optimal lag order. Eq. (4) is the Augmented Dickey-Fuller test. By taking into account the level shift as specified in Eq. (3), the t-statistic of the coefficient the lagged residual term is compared with the critical value provided by Gregory and Hansen (1996).[1] If the t-statistic is larger than the critical value statistic, the null hypothesis of no cointegration is rejected. On the contrary of the t-statistic is smaller than the critical value statistic, the null hypothesis is accepted. It should be noted that this residual-based test for cointegration takes into account possible an unknown breakpoint. The Gregory-Hansen cointegration test implicitly assumes a linear adjustment mechanism. However, this test is misspecified when the adjustment is asymmetric. The Gregory-Hansen cointegration test is also applied to Eq. (4).

The symmetric adjustment under short-run dynamics using an error correction mechanism (ECM) for Eq. (3) is expressed as:

$$\Delta R_t = c_1 + \delta_1 D_t + \sum_{i=1}^{p} \alpha_{1i} \Delta R_{t-i} + \sum_{i=1}^{p} \beta_{1j} \Delta G_{t-i} + \lambda_1 \hat{e}_{t-1} + \varpi_{1t} \tag{6}$$

and the ECM for Eq. (4) is expressed as:

$$\Delta G_t = c_2 + \delta_2 D_t + \sum_{i=1}^{p} \alpha_{2i} \Delta R_{t-i} + \sum_{i=1}^{p} \beta_{2i} \Delta G_{t-i} + \lambda_2 \hat{e}_{t-1} + \varpi_{2t} \tag{7}$$

Where p is the optimal lag that can be determined by AIC and λ_i is the speed of adjustment towards long-run equilibrium. The error correction term (ECT) is the lagged residual series ($\hat{e}_{t-1}$). If the coefficient of the ECT is significantly negative and has the

[1] The t-statistic is the augmented Dickey-Fuller (ADF*) statistic, which is different from the ADF statistic of Engle and Granger (1987). In addition, Phillips' (1987) procedure is also calculated as the Z^*_t statistic.

absolute value of less than one, any deviation from the long-run equilibrium will be corrected.

In case of the absence of linear cointegration between revenue and spending, it is possible that the long-run relationship is nonlinear and asymmetric. Therefore, the threshold autoregressive (TAR) and momentum threshold autoregressive (MTAR) models are utilized. The two models are residual-based tests developed by Enders and Granger (1998) and Enders and Siklos (2001). The residuals from the estimates of Eqs. (3) and (4) are decomposed, and the test equation is expressed as:

$$\Delta\hat{e}_t = I_t\rho_1\hat{e}_{t-1} + (1-I_t)\rho_2\hat{e}_{t-1} + \sum_{i=1}^{k}\beta_i\Delta\hat{e}_{t-i} + v_t \qquad (8)$$

where $v_t \sim$ iid.$(0,\sigma^2)$ and the lagged augmented term $(\Delta\hat{e}_{t-i})$ can be added to yield uncorrelated residuals of the estimates of Eq. (8). The Heaviside indicator function for TAR is specified in Eq. (9) while this function for MTAR is specified in equation (10), which are:

$$I_t = \begin{cases} 1\_if\_\hat{e}_{t-1} \geq \tau \\ 0\_if\_\hat{e}_{t-1} < \tau \end{cases} \qquad (9)$$

and

$$I_t = \begin{cases} 1\_if\_\Delta\hat{e}_{t-1} \geq \tau \\ 0\_if\_\Delta\hat{e}_{t-1} < \tau \end{cases} \qquad (10)$$

where the threshold value τ can be endogenously determined by the data. If the evidence indicates the existence of linear cointegration between revenue and spending, the time series dynamics of the relationship between the two variables can be explored by a bivariate vector error correction mechanism (VECM). The bivariate VECM can be expressed as:

$$\Delta R_t = \alpha_0 + \sum_{i=1}^{k}\alpha_i\Delta R_{t-i} + \sum_{i=1}^{k}\beta_i\Delta G_t + \lambda_1\hat{e}_{t-1} + v_{1t} \qquad (11)$$

and

$$\Delta G_t = \tilde{\alpha}_0 + \sum_{i=1}^{k}\tilde{\alpha}_i\Delta R_{t-i} + \sum_{i=1}^{k}\tilde{\beta}_i\Delta G_t + \lambda_2\hat{e}_{t-1} + v_{2t} \qquad (12)$$

where k is the lag order, λ_1 and λ_2 are the coefficients showing the speeds of adjustment.[2] The short-run dynamics allow for testing the alternative hypotheses pertaining to the revenue-spending nexus. The coefficients of the lagged differences for government revenue and spending show the short-run dynamics while the coefficients of the asymmetric errors correction terms are the speeds of adjustment toward the long-run equilibrium. Eqs. (11) and (12) can also be used to test for short-run causality between revenue and spending.

[2] The speed of adjustment is $\lambda_1 = I_t\hat{\rho}_1$ in the first regime and $\lambda_2 = (1-I_t)\hat{\rho}_2$ in the second regime while I_t is expressed in equation (8) for the TAR model and in equation (9) for the MTAR model.

3. Empirical Results

Since the revenue and expenditure series are integrated of order one, the ordinary least squares (OLS) method is estimated without taking into account of structural breaks. The Quandt (1960) and Andrews (1993) unknown breakpoint tests and Bai and Perron (1998) sequentially determined multiple breakpoint tests are used to determine the breakpoints in the estimated equation. The results are shown in Table 2.

Table 2
Tests for Structural Breaks.
Dependent Variable is R

Testing Method	Suggested Breaks	Dummy Type	Test Statistic
Quandt and Andrews Test	1998Q2	Shift	44.480***
Bai and Perron Test	(1) 1998Q2	Shift	44.480**
	(2) 2002Q4	Shift	25.364**

Note: *** and ** denote significance at the 1% and 5% level, respectively. In Quandt and Andrews tests, the p-values are calculated by Hansen (1997) method. For Bai and Perron tests, the 5% critical value is provided by Bai and Perron (2003).

The result from the Quandt and Andrews test indicates the presence of one break point in the second quarter of 1998 for the estimated revenue equation. However, the Bai and Perron test indicates two break points: 1998Q2 and 2002Q4 for revenue equation. However, the most significant break point at the second quarter of 1998 shows that the impact of a structural break occurred around the 1997 Asian financial crisis should affect the government discipline and transparency in fiscal policy management.

The results of Gregory and Hansen cointegration test for Eq. (3) are reported in Table 3. This cointegration test comprises two procedures: ADF procedure and Phillips procedure.

Table 3
Gregory-Hansen Cointegration Test.

Model 2: Level Shift	
ADF Procedure:	Phillips' (1987) Procedure:
ADF* Statistic = -5.259	Z^*_t Statistic = -5.538
Lag = 0	Break Date = 1997Q4
Break Date = 1997Q2	

Note: The 1% critical value provided by Gregory and Hansen (1996) is -5.13.

The results in Table 3 show that the null hypothesis of no cointegration is rejected at the 1% level of significance because both ADF* and Z^*_t are larger than the critical value.

The long-run relationship between government revenue and spending is shown in Table 4.

Table 4
Long-run Relationship
Dependent Variable: R_t

Variable	Coefficient	Std.Error	t-statistic	p-value
G_t	0.724***	0.024	30.597	0.000
D_t	0.035	0.038	0.917	0.362
Intercept	3..538***	0.291	12.304	0.000
Adj. R^2 = 0.942, F = 769.643				

Note: *** indicates significance at the 1% level.

The results in Table 4 show that the possible long-run relationship between government revenue and spending is significantly positive. A 1% increase in government spending causes revenue to increase by 0.72%. Furthermore, the impact of a structural break around the 1997 financial crisis seems to strengthen this long-run relationship, but this impact is not significant. The results of linear cointegration test for Eq. (4) are shown in Table 5.

Table 5
Gregory-Hansen Cointegration Test.

Model 2: Level Shift	
ADF Procedure:	Phillips' (1987) Procedure:
ADF* Statistic = -5.260	Z^*_t Statistic = -5.566
Lag = 0	Break Date = 1997Q3
Break Date = 1997Q2	

Note: The 1% critical value provided by Gregory and Hansen (1996) is -5.13.

The results in Table 5 show that the null hypothesis of no cointegration is rejected at the 1% level of significance because both ADF* and Z^*_t are larger than the critical value. Therefore, government spending and revenue are cointegrated.

The long-run relationship between government spending and revenue is shown in Table 6.

Table 6
Long-run Relationship
Dependent Variable: G_t

Variable	Coefficient	Std.Error	t-statistic	p-value
R_t	1.265***	0.041	30.597	0.000
D_t	0.045	0.050	0.886	0.362
Intercept	-3..930***	0.513	-6.613	0.000
Adj. R^2 = 0.942, F = 769.643				

Note: *** indicates significance at the 1% level.

The results in Table 6 show that the possible long-run relationship between government spending and revenue is significantly positive. A 1% increase in government revenue causes spending to increase by 1.27%. Furthermore, the impact of a structural break around the 1997 financial crisis seems to strengthen this long-run relationship, but this impact is not significant.

The results of short-run dynamics are reported in Table 7. Table 7 shows the estimated ECMs for Eqs. (3) and (4).

Table 7
Short-Run Dynamics with Bivariate ECMs

Panel A: Dependent Vaiable is ΔR_t				
Variable	Coefficient	Std. Error	t-Statistic	p-Value
$\hat{e}_{t-1}$	-0.156**	0.070	-2.226	0.029
ΔR_{t-1}	-0.261**	0.110	-2.365	0.020
ΔR_{t-2}	-0.151	0.106	-1.421	0.157
ΔG_{t-1}	0.087	0.182	1.576	0.119
ΔG_{t-2}	0.137	0.182	0.753	0.453
D_t	-0.039*	0.020	-1.942	0.055
Intercept	0.045**	0.021	2.184	0.032
Adj. R^2 = 0.176, F = 4.273				
Diagnostics				
Serial Correlation: $\chi^2_{(2)}$ = 3.711 (0.210)				
Heteroskedasticity: $\chi^2_{(1)}$ = 0.297 (0.894)				
Normality: JB = 134.27 (0.000)				
Functional Form: F = 0.061 (0.805)				
Panel B: Dependent Vaiable is ΔG_t				
Variable	Coefficient	Std. Error	t-Statistic	p-Value
$\hat{e}_{t-1}$	-0.033	0.036	-0.916	0.306
ΔR_{t-1}	-0.102	0.065	-1.562	0.122
ΔR_{t-2}	0.008	0.062	0.135	0.893
ΔG_{t-1}	-0.525***	0.109	-4.820	0.000
ΔG_{t-2}	-0.192*	0.108	-1.783	0.078
D_t	-0.017	0.012	-1.422	0.159
Intercept	0.049***	0.137	3.623	0.000
Adj. R^2 = 0.234, F = 5.693				
Diagnostics				
Serial Correlation: $\chi^2_{(2)}$ = 4.658 (0.097)				
Heteroskedasticity: $\chi^2_{(1)}$ = 2.264 (0.104)				
Normality: JB = 0.770 (0.641)				
Functional Form: F = 3.225 (0.075)				

Note: ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively, the number in parenthesis is p-value.

The results in Table 7 reveal that the ECMs for both long-run equations pass all important diagnostic tests, except for the results in Panel A that exhibit non-normal distribution of the residuals. However, non-normality is not as serious as the other three diagnostic tests.

Panel A of Table 7 reports the short-run dynamics when government revenue is assumed to be dependent on government spending. The coefficient of the error correction term is -0.156 and significant at the 5% level. This coefficient has a correct sign with the absolute value of less than one, which indicates that any deviation from the long-run equilibrium relationship will be corrected. Even though the 1997 financial crisis dummy does not affect the long-run relationship, this dummy negatively affect the short-run relationship at the 10% level of significance. However, lagged changes in spending do not affect a change in revenue. The short-run dynamics for Eq. (4) are shown in Panel B of Table 6. The estimated coefficient of the error correction term has a correct sign with the absolute value of less than one. However, this coefficient is not statistically significant, which indicates that any deviation from the long-run equilibrium will not be corrected. In other words, the long-run relationship is not stable when government spending is dependent variable. Similarly, lagged changes in revenue do not affect a change in spending. Therefore, it can be conclude that the estimated Eq. (3) is more reliable than the estimated Eq. (4).

The residual-based tests of cointegration between the two series assume that the cointegrating equation is time invariant. However, the long-run relationship can be nonlinear with asymmetric adjustments toward long-run equilibrium as documented by the recent literature. To test for asymmetric adjustment, the TAR and MTAR models for Eq. (3) are estimated. The results are shown in Table 8.

Table 8
Estimates of the Budgetary Disequilibrium: TAR and MTAR Models.

Parameters	Models	
	TAR	MTAR
ρ_1	-0.415	-0.331
ρ_2	-0.299	-0.548
Threshold Value	-0.063	-0.049
Φ	5.846 [7.464]	6.195 [8.450]
t-Max	-2.083 [-1.962]	-2.630 [-1.880]
F-equal	0.456 [6.881]	1.073 [8.531]
κ	3	3

Note: The number in bracket is the simulated 5% critical value by 1,000 numbers of simulations, and κ is the number of lag determined by AIC.

The lag of augmented term is 3 (κ =3) for the estimated TAR and MTAR models. The threshold values are determined by the data. The threshold value for the TAR model is --0.063 while the threshold value for the MTAR model is -0.049. These threshold values are used to determine I_t in Eqs. (9) and (10). The estimates of TAR and MTAR models show that the null hypothesis of no threshold cointegration can be rejected at the 5% level of significance. The estimated threshold parameters in the TAR model are -0.415 for improving budgets and -0.299 for worsening budget deficits while these parameters in the MTAR model are -0.331 for improving budgets and -0.548 for worsening budgets. The F-statistics for testing nonlinear cointegration (Φ) are compared with the critical values to determine the existence of cointegration. Evidence of threshold cointegration in terms of TAR and MTAR is not found since the F-statistic of the TAR model for testing the null hypothesis that $\rho_1=\rho_2=0$ is 5.846 is smaller than the critical value of 7.464 at the 5% level of significance while the Φ-statistic for the MTAR model is 6.195 is also smaller than the critical value of 8.450 at the 1% level of significance.[3] Also, evidence of asymmetry is found by testing the null hypothesis that $\rho_1=\rho_2$ because this hypothesis is rejected by the standard F-equal statistic at the 5% level of significance for both TAR and MTAR models.[4] The tests for asymmetric adjustment of Eq. (4) are reported in Table 9.

Table 9

Estimates of the Budgetary Disequilibrium: TAR and MTAR Models.

Parameters	Models	
	TAR	MTAR
ρ_1	0.024	-0.585
ρ_2	-0.061	-0.326
Threshold Value	0.242	0.066
Φ	1.459 [5.770]	6.574 [8.158]
t-Max	0.068 [-1.565]	-2.825 [-1.825]
F-equal	2.461 [7.732]	1.607 [8.352]
κ	4	3

Note: The number in bracket is the simulated 5% critical value., κ is the number of lag determined by AIC.

The optimal lag for the TAR model is 4 while the optimal lag for the MTAR model is 3 determined by AIC. The convergence condition is met for the MTAR model, but not for the TAR model. In a similar manner, the null hypotheses of no threshold cointegration and of no asymmetric adjustments are accepted for both models.

The absence of nonlinear and asymmetric long-run relationship does not allow for the analysis of short-run dynamics. Therefore, the analysis of asymmetric VECM expressed in equations (11) and (12) is not necessary.

The standard causality tests are performed on first differences of the two series. The results are reported in Table 10.

Table 10

Results of Granger Causality tests.

Null Hypothesis	F-Statistic	Prob.
ΔG_t does not cause ΔR_t.	2.589**	0.021
ΔR_t does not cause ΔG_t.	1.210	0.303

Note: *** and ** indicate significance at the 1% and 5% level, respectively. The optimal lag of 2 is determined by AIC.

[3] According to Hansen and Seo (2002), the F-test for TAR and MTAR models has a non-standard distribution due to the presence of nuisance parameters that are only identified by the alternative hypothesis. Therefore, the test critical values must be computed.

[4] The results also indicate that convergence condition is met, i. e., $\rho_1 < 0$. $\rho_2 < 0$ and $(1+\rho_1)(1+\rho_2) < 1$. According to Pettrucelli and Woolford (1984), this convergence condition is the condition for the stationarity of the residual series. Even though the t-Max statistic leads to an rejection of the null hypothesis of no threshold cointegration, the Φ statistic leads to an acceptance of the null hypothesis of no threshold cointegration. The t-Max statistic has lower power than the Φ-statistic.

The results in Table 10 reveal that the null hypotheses that ΔG_t does not cause ΔR_t can be rejected at the 5% level of significance while the null hypothesis that ΔR_t does not cause ΔG_t is rejected. Therefore, the results confirm the existence of unidirectional causality between revenue and spending. Therefore, it can be concluded that there exists unidirectional causality running from government spending to government revenue. This finding seems to support the spend-and-tax hypothesis of Roberts (1978) and Peacock and Wiseman (199). The results do not support the fiscal synchronization hypothesis proposed by Meltzer and Richard (1981) and Musgrave (1966), which postulates that the voters' choice determines the concurrent adjustment in both tax revenue and spending. This finding is not in line with the finding by Tiwari and Mutascu (2016) in the case of Romania and Athanasenas et al. (2014) in the case of Greece. By contrast, the tax-and-spend hypothesis proposed by friedman (1978) is not supported because only government spending causes government revenue.

4. Conclusion

This study examines the nexus between government revenue and spending in the case of Thailand during 1993 and 2016. To detect the possibility of asymmetric adjustment toward long-run equilibrium, the TAR and MTAR models are used. The results show that both models do not capture nonlinear cointegration between government revenue and spending because the null hypothesis of no threshold cointegration cannot be rejected. Therefore, both TAR and MTAR models are not suitable and do not lend support for the presence of asymmetric adjustment process toward the long-run equilibrium. By finding the evidence in favor of linear cointegration between revenue and spending, i.e., government spending positively causes revenue in the long run. The time series dynamics of the relationship between the two variables are explored in an ECM framework. It is found that government revenue is a dependent variable, the stable long-run relationship is established. The results from the standard causality test show that government spending causes revenue, but not the other way around. The results seem to support the spend-and-tax hypothesis.

By knowing the relationship between government revenue and spending, policymakers should be able to identify the cause of fiscal imbalances. The finding in this paper gives some policy implications. Even though budget deficits can be expansionary to the economy, there is an upper limit for policymakers to allow too large budget deficits because when revenue falls short of spending, public debts can be prevalent.

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