Southeast Asian Journal of Economics 2(1), June 2014: 183-218

Fiscal Policy in Response to Climate Variability in Thailand

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Abstract

This study employed the regression-based measure of discretionary changes in fiscal policy to examine fiscal spending in response to economic cycles and non-economic shocks in Thailand, particularly in climate variability. In response to economic cycles, the discretionary component of fiscal policy within the Thai government has generally been pro-cyclical. However, the overall effects of fiscal responses in terms of discretionary and non-discretionary government budgetary expenditures show a neutral stance. At the disaggregated ministry-level, five out of six ministries selected in the study illustrate a neutral fiscal spending behaviour. The effects of climate variability are mostly silent on the use of fiscal policy discretion and on total government budget expenditures, but have some impacts on budget formulation at the line-ministry level. However, the associations are often not indicative, and may even oppose expectations, of the government allocating higher budget appropriation in cases of increasing climate variability.

Keywords: Climate Variability, Discretionary Fiscal Policy, Budget Formulation

1. Introduction

In recent years, fiscal deficits and public debt in Thailand's public sector have been increasing. Looking ahead, expanding social welfare spending and the implementation of the so-called "populist policies" may lead to further increase in public expenditures in the coming years. Indeed, Laksanasud *et al*. (2010) conclude that public debt to Gross Domestic Product (GDP) over the next 20 years is projected to increase from the present level of 40 percent towards 60-70 percent under the normal economic trend. However, the study illustrates that slowing global economic growth and economic shocks could worsen public finance, resulting in an even higher public debt to GDP level of 80-90 percent over the same time frame.

In addition to economic fluctuations, fiscal policy in the coming years could also be affected by non-economic shocks. More specifically, global climate change and volatile weather patterns could have significant implica-tions on fiscal policy in Thailand. In late 2011, the devastating flood crisis (primarily caused by heavy rainfall and the poor water management of dams) in the northern and central regions of Thailand resulted in an estimated 1.3 trillion Baht (representing over 12 percent of GDP) in damages and losses. Official estimates indicate that over 793 billion Baht (representing 7.6 percent of GDP) would be needed, in total, for recovery and rehabilitation from the flooding. According to this official assessment, the public sector may have to spend over 180 billion Baht (representing 1.6 percent of GDP or 5 percent of government revenue) in relation to the 2011 flooding issues.

In its regular annual budget, the Thai government normally sets aside nominal contingency budget for these unexpected events. However, as is evident from the aftermath of the recent 2011 flood crisis, existing fiscal

resources are not sufficient to cover the necessary spending for flood recovery and rehabilitation. The Thai government had to issue the emergency decree authorizing the government to borrow 350 billion Baht for flood prevention and water management projects during 2011-2013. Moreover, it also recently announced its intention to invest additional 2.27 trillion Baht spending (around 19.6 percent of GDP) in public investment programs over the next 7 years. As a result, Thailand currently uses greater fiscal discretion in response to natural disasters and adverse external economic environments hitting the economy.

Consequently, climate variability and the subsequent government policies used to deal with it certainly represent significant additional fiscal risks for Thailand in the future. The government should take climate variability and its consequences, such as floods, droughts, and severe heat, into consideration when formulating the governments' budgetary policy. Policy-makers indeed have to recognize fiscal risks arising from these natural calamities and formulate appropriate measures, such as maintaining adequate fiscal spaces and/or setting aside reserve funds for potential unexpected natural disaster shocks.

Given these uncertain domestic and external factors, the sustainability of fiscal policy has always been at the forefront of the public focus. In Thailand, there are existing legislated fiscal rules under the Budget Procedure Act B.E. 2502 (1959) and Public Debt Management Act B.E. 2548 (2005) as well as guidelines under the Fiscal Sustainability Framework. However, the major shortcoming in Thailand's fiscal rules is that the government can bypass these legislated fiscal rules by issuing emergency decrees or special laws authorizing the government to undertake additional the so-called extra-budgetary borrowings outside the purview of existing fiscal rules governing regular budgetary borrowings, particularly the aforementioned special borrowing legislations.

Box 1: Fiscal Rules in Thailand

Under the Public Debt Management Act B.E. 2548 (2005), there are fiscal legislations and rules governing issues related to public debt management in both direct borrowing and guarantees. The Ministry of Finance can raise loans only for the following purposes: (1) Financing the budget in the case of a deficit or where the expenditure exceeds the revenue; (2) Economic and social development; (3) Restructuring public debt; and (4) On-lending to another government agency.

For government domestic borrowing (in Thai Baht), borrowing can only be done by the Ministry of Finance for financing the budget deficit in which the aggregate amount of the loan shall not exceed: (1) Twenty percent of the existing annual budgetary appropriation and the additional budgetary appropriation and (2) Eighty percent of the budgetary appropriation as set out for the repayment of principal. Government foreign borrowing (in foreign-denominated currencies) can only be done for the purpose of economic and social development if the expenditures are needed to be in foreign currencies to be spent apart from the annual budgetary appropriation or if there is a necessity to raise a loan to strengthen the national financial security. In this case, the Ministry of Finance shall raise a loan in a foreign currency. The aggregate amount of the loan shall not exceed ten percent of the annual budgetary appropriation. Moreover, the Ministry of Finance is authorized to guarantee loans raised by State agencies, State enterprises or State financial institutions, not exceeding twenty percent of the existing annual budgetary appropriation and the additional budgetary appropriation in each fiscal year.

In addition to the fiscal rules in the legislature, Thailand also has its non-legal binding fiscal sustainability rules. Since 2002, the Thai government has endorsed the Fiscal Sustainability Framework stipulating that public debt to GDP should not exceed 60 percent of GDP; debt service to the budget not more than 15 percent and capital expenditures to the total budget expenditure ratio not less than 25 percent. Thus far, the government has been able to achieve the first two targets, while the third target on the capital expenditure ratio remains to be achieved. Moreover, the balanced budget goal in which the Thai government has been postponing over the successive years and now set its latest target by Fiscal Year 2016, remains to be achieved.

Thailand has fiscal rules to achieve various objectives, as shown in Table 1. One obvious goal is to achieve debt sustainability; thereby one of the most common fiscal rules is to limit fiscal discretion in terms of deficit per year and/or a public debt ceiling. In addition, the fiscal rules often seek to limit the size of the government, thereby capping the fiscal deficit and public debt level relative to the economic size of the country. However, what seems to be missing in Thailand's fiscal rules is how to effectively deal with economic cycles and non-economic shocks in the event of national calamity, as well as, the subsequent fiscal needs to address the problem.

As can be seen from the severe flood crisis in late-2011, the government dealt with the crisis in an ad hoc manner that included significant fiscal discretion with unclear policy agendas on how to bring fiscal discipline back to the country over the long run. Moreover, the existing fiscal rules implemented in Thailand have some weaknesses. They do not provide any guidance on government budget adjustments in response to economic cycles, as well as non-economic shocks, such as natural disasters caused by climate variability. These types of fiscal rules, such as a cyclically adjusted balance rule and/or balanced budget over the cycle, are not adopted in Thailand at present, despite their usefulness as a mechanism to control output fluctuations in a less discretionary manner. Ineffective and inadequate fiscal rules result in excessive fiscal discretion, which further leads to an unsustainable fiscal path. The emergence of non-economic shocks would only aggravate the problem, creating potential for further fiscal imbalances in the future.

An automatic correction mechanism (under fiscal rules) and medium-term fiscal consolidation and discipline are crucial to ensure public financial soundness and sustained economic growth in Thailand. Therefore, fiscal policy operated under the pretext of existing budget and public debt laws may need to be thoroughly reviewed and reconsidered for their relevancy and appropriateness going forward. The fiscal policy framework in Thailand may benefit from the revision of fiscal rules that put debt on a more sustainable path and possess adequate flexibility to respond to output and natural shocks. However, before one can make any appropriate policy adjustment, it is important to understand the current behavior of Thailand's fiscal policy.

Table 1 Summary of fiscal regulations in Thailand and their objectives.

	Legislation/ Guideline	Debt Sustainability	Economic Stabilization	Non-economic shock	Government Size
Fiscal rules					
1. Domestic borrowing ceiling	Legislation	√√	-	-	√
2. Foreign borrowing ceiling	Legislation	√√	-	-	√
3. Gov. Guarantee ceiling	Legislation	√√	-	-	√
4. Public debt to GDP ceiling	Guideline	√	√	-	√
5. Debt service to budget	Guideline	√	-	-	-
6. Capital expenditure minimum	Guideline	-	-	-	√√
7. Budget balance target	Guideline	√√	-	-	-
Non-fiscal rules					
8. Special Emergency decree	Legislation	-	√√	√√	-

Note: (√√) indicates strong property; (√) indicates weak property; (-) indicates no or neutral property.

Source: Compiled by authors.

Therefore, this study primarily aims to explain current fiscal policy behavior by focusing on the use of discretionary fiscal policy and its response to economic cycles and non-economic shocks, particularly in climate variability in terms of temperature and rainfall fluctuations. Discretionary fiscal policy normally refers to the changes in fiscal policy that do not reflect the current economic conditions. A regression-based measure of discretionary fiscal policy is adopted to address the following questions:

- What is the trend, or the pattern, in the use of discretionary fiscal policy in Thailand?
- What are the factors influencing the magnitude of fiscal policy discretion?
- How does fiscal policy discretion respond to economic cycles and non-economic shocks, particularly climate variability?

In addition, the effects of economic cycles and non-economic shocks on the annual government budgetary expenditures are investigated. Since the economic cycles and non-economic shocks could have different impacts on the disaggregated components of the fiscal policy variables, especially government budget expenditures, the total government expenditure is disaggregated by the administrative classification of the Thai ministries. This approach will address several important issues, such as: How does the Thai government respond to economic cycles and non-economic shocks in terms of budget formulation? Which components of government budget expenditures at the line-ministry level would be affected by these fluctuations? Research findings on these important questions will shed greater insights on fiscal policy behavior and provide valuable information for policy-makers to design improved fiscal policy frameworks that could be adopted to promote Thailand fiscal sustainability and prudential sovereign debt management in the future.

Previous studies on fiscal policy responses to economic cycles have indicated that it has often resulted in pro-cyclicality, rather than the desired counter-cyclical fiscal policy stance. Magud (2007) examined counter-cyclical fiscal policy and found that its effectiveness largely depended on the initial state of the fiscal position. In his study, he concluded that governments with high indebtedness tend to illustrate lower or even non-existent impacts of counter-cyclical fiscal policy.

Alesina and Perotti (2008) concluded that people make rational decisions in voting, such that as they observe economic booms, they demand more government spending in the form of public goods and lower taxes in order to reduce political rents. Voter behavior results in a pro-cyclical fiscal policy stance. Taylor (2000) assessed discretionary fiscal policy and concluded that the government should allow fiscal policy to have its main counter-cyclical impact through the use of automatic stabilizers. Hebous (2011) also found that fiscal discretionary often does not result in a stimulative effect on the economy.

Dixit and Lambertini (2003) stated that when monetary and fiscal policies are discretionary, the economic equilibrium records lower output growth and higher prices than optimal. The study also found that fiscal discretion often undermines the effectiveness of the monetary policy commitment. Niemann and Pichler (2010) developed a stochastic model of optimal fiscal and monetary policies in an economy facing rare disasters, as defined by the large exogenous drops in total factor productivity, and illustrated that, under discretion, a lack of commitment seriously limits the government's ability to use debt as a shock absorber. Any increase in debt can raise inflation expectations, leading to higher inflation and nominal interest rates. Thus, the welfare costs of disasters are higher under discretion, as compared with if the government can commit to its policy plans. In addition, the study by the IMF (2008) indicated that discretionary fiscal policy only has a modest effect on stimulating output. Moreover, the fiscal impact is even weaker for emerging economies, when compared to advanced economies. Hence, a country should rely more on an automatic correction mechanism to ensure fiscal sustainability.

While there are numerous studies that focused on fiscal policy responses to economic shocks, it is difficult to find studies that directly examine overall fiscal policy in response to non-economic shocks, in particular, climate related risks. Hence, empirically examining the overall fiscal response to climate variability in terms of discretionary and non-discretionary fiscal policies is one of the important contributions of this study to the literature.

The remainder of this paper is organized as follows. The next section presents the analysis of discretionary fiscal policy in Thailand and its determinants. It begins with the construction of discretionary fiscal policy measures

and proceeds with an econometric model of the determinants of a discretionary fiscal policy response. The variables of interest include economic cycles and non-economic shocks, particularly climate variability. Four climate indicators are constructed. In the third section, the determinants of the Thai government's budget expenditures are explored. Finally, the conclusion provides policy suggestions.

2. Discretionary Fiscal Policy and Its Determinants

As stated previously, one of the objectives of this study is to better understand the fiscal policy behavior in Thailand by focusing on the use of discretionary fiscal policy and its response to economic cycles and non-economic shocks, particularly in climate variability. In doing so, this study must first be able distinguish between the change in fiscal position that results from the effects of an economic cycle and the change at the discretion of governments in order to construct the measure of discretionary fiscal policy. For the methodology, this study employs the measure of fiscal policy discretion drawn from the existing frameworks.

2.1 A measure o discretionary fiscal policy

Following the influential works of Blanchard (1990) and Alesina and Perotti (1995), the measure of discretionary changes in fiscal policy is the regression-based fiscal impulse that is adjusted for built-in stabilizers, such as unemployment compensation[3]. It is what the government's primary deficit would be in a given year had the unemployment rate remained at the same value as in the previous year, minus the primary deficit in the previous year. The construction of this measure can be briefly summarized as follows.

First, government primary expenditure (*Exp*) and government revenue (*Rev*), in percent of GDP, are regressed on a time trend (*Trend*) and unemployment rate (*Unemploy*):

[3] Fiscal impulse is defined as the discretionary change in the budgetary position designed to control the automatic responsiveness of revenue and expenditures to cyclical fluctuations.

$$Exp_t = \alpha_{e0} + \alpha_{e1} Trend_t + \alpha_{e2} Unemploy_t + u_t ,$$

$$Rev_t = \alpha_{r0} + \alpha_{r1} Trend_t + \alpha_{r2} Unemploy_t + \eta_t ,$$

where α is the estimated coefficient and u_t and η_t are the error terms. Next, after the coefficients and error terms are estimated, the values of the government's primary expenditures and revenue that would normally occur in year *t* if the unemployment rate remained unchanged from the previous period (*t*-1) can be computed as:

$$Exp_t(Unemploy_{t-1}) = \hat{\alpha}_{e0} + \hat{\alpha}_{e1} Trend_t + \hat{\alpha}_{e2} Unemploy_{t-1} + \hat{u}_t$$

$$Rev_t(Unemploy_{t-1}) = \hat{\alpha}_{r0} + \hat{\alpha}_{r1} Trend_t + \hat{\alpha}_{r2} Unemploy_{t-1} + \hat{\eta}_t$$

Blanchard's fiscal impulse (*BFI*) in year *t* is then the difference between the estimated primary deficit in a given year and the primary deficit in the previous year:

$$BFI_t = (Exp_t(Unemploy_{t-1}) - Rev_t(Unemploy_{t-1})) - (Exp_{t-1} - \mathrm{Re}\, v_{t-1}).$$

As was suggested by Blanchard (1990), the advantages of this measure are its simplicity, as it requires less explicit forecasts in its construction[4]. Consequently, *BFI* will be used as the measure of discretionary fiscal policy response throughout this study. A fiscal contraction (fiscal tightening) is defined when *BFI* is less than -0.5 percent of GDP. A fiscal expansion (or fiscal stimulus) is when *BFI* is more than 0.5 percent of GDP. When *BFI* is between -0.5 and 0.5 percent of GDP, fiscal policy is defined as neutral.

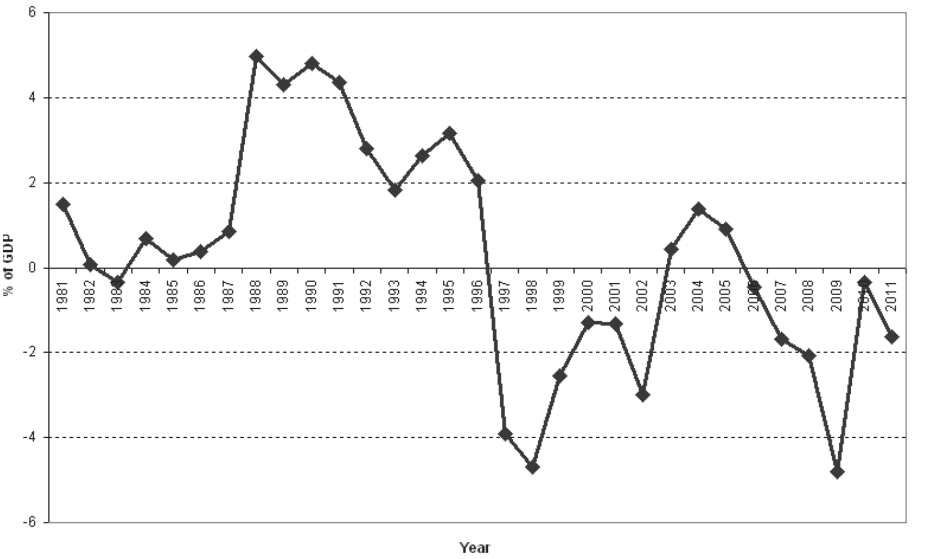
Thailand's primary fiscal balance is illustrated in Figure 1. During the past three decades, Thailand's fiscal policy has been relatively disciplined with the government running, on average, a slight primary balance surplus at 0.4% of GDP per year. Nonetheless, fiscal policy in Thailand could be classified into 2 sub-periods: before and after the 1997 financial crisis. Prior to 1997, the government showed consistent fiscal discipline in achieving a

[4] Other measurements of discretionary fiscal policy, such as the elasticity-based fiscal impulse measure (a cyclically adjusted primary balance), requires the assumption on a benchmark year and estimations of potential output, as well as the output gap, which could present conceptual problems and empirical difficulties.

primary surplus over 2.1 percent of GDP. However, after 1997, the primary surplus became a persistent deficit at -1.7 percent of GDP. The fiscal policy showed remarkable expansions in the past decade, particularly during the 1997 Asian financial crisis and the recent 2008/09 global financial crisis, in which the primary deficit peaked at -4.7% of GDP in 1997-1998 and -4.8% of GDP in 2009.

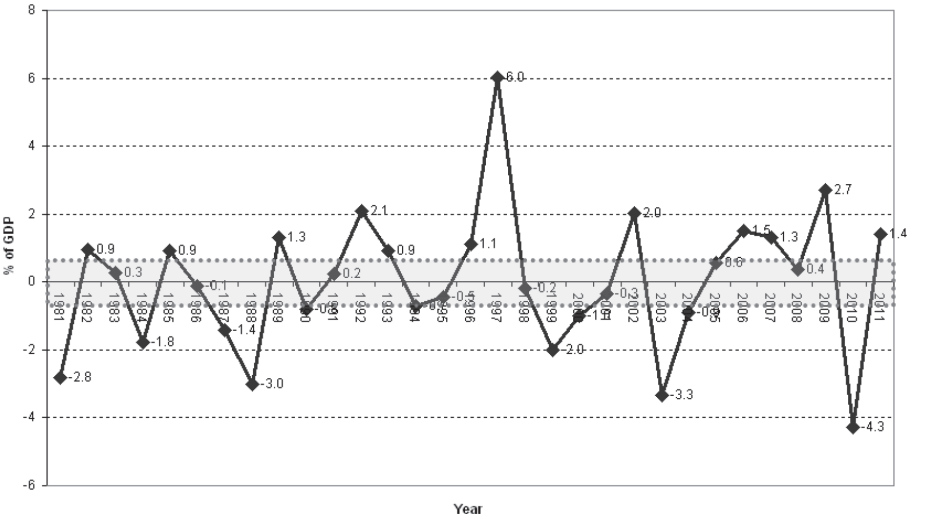
Using the *BFI* measure, it is illustrated in Figure 2 that Thailand's fiscal policy discretion during the period from 1981-2011 is a neutral stance with an overall *BFI* measure at nearly zero (average *BFI* = 0.017 percent of GDP). During the 1980s, fiscal policy in Thailand fluctuated between positive and negative fiscal impulses. However, *BFI* measures indicate that in the post-1997 financial crisis, the Thai government has been exercising more fiscal policy discretion, which slightly gears towards positive fiscal impulses. This is evident from the average *BFI* value at +0.25 percent of GDP during the post-1997 period, compared to -0.2 percent of GDP during the pre-1997 period.

Figure 1 Thailand's primary fiscal balance



Source: CEIC Data Company Ltd.

Figure 2 Thailand's Blanchard fiscal impulse (*BFI*)



Note: Positive indicates loose fiscal policy; negative indicates tight fiscal policy.
Source: Calculated by authors.

2.2 Discretionary fiscal policy and its response

To analyze the link between discretionary fiscal policy and change in economic cycles and non-economic shocks (climate variability), an econometric model of determinants of discretionary fiscal policy responses can be formulated as:

$$BFI_t = \beta_0 + \beta_1 BFI_{t-1} + \beta_2 YGAP_{t-1} + \beta_3 NONELECTED_{t-1} + \beta_4 PUBDEBT_{t-1} + \beta_2 C\lim ate_{t-1} + \varepsilon_t ,$$

where β is the estimated coefficient and ε is the error term. The lagged dependent variable BFI_{t-1} is included, since discretionary fiscal policy in year *t* is likely a function of last year's fiscal policy response.

Since Thailand does not adopt a cyclically adjusted balance rule, the fiscal adjustment in response to economic cycles is partly under government discretion. Hence, it is modeled that discretionary fiscal policy is a reaction function of the economic cycle, as measured by the output gap (*YGAP*), computed as the difference between actual and potential GDP as a percentage

of potential GDP[5]. If a government tries to ensure debt sustainability by using less of a fiscal stimulus and more of a fiscal tightening policy during economic booms (or when actual GDP is beyond its potential) and using more of a fiscal impulse to help stabilize the economy in times of recessions (or when actual GDP is below its potential), the estimated output gap variable is hypothesized to be negative for the use of a countercyclical fiscal policy. On the other hand, the estimated coefficient is expected be positive if a government follows a pro-cyclical fiscal policy. Likewise, the level of the stock of public debt as a percentage of GDP (*PUBDEBT*) may be another important factor that a government is concerned with. By making the fiscal policy response a function of the public debt, a government may use less of a fiscal impulse with an increase in public debt to ensure fiscal solvency. Hence, the estimated coefficient of the public debt is hypothesized to be negative.

Political institutions can also have an effect on discretionary fiscal policy use, as suggested by Fatás and Mihov (2003). In the case of Thailand, the democracy process has not been quite stable during the last 30 years as there were a total of 20 elected and non-elected government cabinets during this period. One of the prime candidates for the measure of the political institution is the origin of the government particularly whether it is democratically-elected or not.

Different origins of governments can lead to dissimilar policy objectives and motives to use discretionary fiscal policy responses. For instance, since the expected time of the (post-coup) military regime is relatively short, those non-elected governments may be concerned less with the long-term fiscal sustainability of a country. They may associate more with a fiscal stimulus, as compared to elected governments. By focusing on this perspective of political institutions, a dummy variable for non-elected governments (*NONELECTED*) is introduced. The variable takes on the value of one for non-elected governments and zero for elected governments. In addition, the time trend variable (*TREND*) is optionally included to capture the pattern of change over time on the use of a discretionary fiscal policy.

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[5] In this paper, potential output is based on an estimate of trend GDP trend using the Hodrick-Prescott (HP) filter (see Hodrick and Prescott, 1997).

It is important to point out that fiscal policy preparation in Thailand normally takes one year of planning by the Bureau of the Budget, which is followed by Parliamentary deliberations and an approval process. Therefore, the discretionary policy response component, which is shown in the BFI, is also planned one year ahead of the actual budgetary execution. Thus, all explanatory variables, except the time trend, are lagged one year.

Climate is a vector of the measures of climate variability and climate shocks, the variables of interest. Climate variability usually refers to variations in the mean state of climate indicators, such as temperature and precipitation. For climate indicators, this study uses monthly rainfall and the monthly maximum and minimum temperature of six parts of Thailand from the period of 1951 to 2011, obtained from the Thai Meteorological Department. This 61 year time span is clearly enough to calculate the long-run mean state of each climate indicator. Four climate indicators are used in this analysis: total rainfall (*RAIN*) and cumulative growing degree months (*GDM*) for each rainy season (May to October), denoted as "*RAINR*" and "*GDMR*", and for each agricultural year (May this year to April next year), denoted as "*RAINA*" and "*GDMA*", in Thailand.

The total rainfall is calculated by simply adding the average monthly rainfalls; whereas *GDM* is a variation of the modified growing degree days (*GDD*) formula, applying monthly data[6]. Basically, *GDM* measures the air temperature contribution of each month relating to plant growth and development. It can be calculated using the following formula:

$$GDM = \frac{T_{\max} + T_{\min}}{2} - T_{base}$$

where $T_{\max}$ and $T_{\min}$ are the maximum and minimum monthly temperatures, in which they are truncated at the upper and lower development thresholds, the temperatures at which plant growth and development begins to decrease. T_{base} is the minimum development threshold temperature. Since the major crop grown in Thailand is rice, the suitable temperature range for growing rice is between 15 °C and 35 °C. Hence, T_{base} is set equal to 15 °C and $T_{\max}$ and $T_{\min}$

[6] For more details of the modified growing degree days (*GDD*) formula, see Fraisse et al. (2007) and Skoufias and Vinha (2011).

are truncated at 35 °C and 15 °C, respectively. For instance, if the maximum temperature for a given month is above 35 °C, in this case, $T_{\max}$ is set at 35 °C.

Climate variability refers to variations in the mean state of climate indicators. For the measure of climate variability (*VAR*), this study proposes using the root mean square errors over the last five-year spans for each climate indicator. It is given by:

$$VAR_t = \sqrt{\frac{\sum_{j=0}^{4} \hat{\varepsilon}_{t-j}^2}{5}},$$

where $\hat{\varepsilon}_t$ is the estimated error term from an OLS (ordinary least squares) estimation of each climate indicator regressed on a constant term and time trend variable over the period of 1951-2011.

In contrast, climate shocks usually refer to severe natural disasters. This study follows Skoufias and Vinha (2011) in defining climate shocks by those observations where the estimated error term is more than one standard deviation from the long-run mean of a climate indicator. Hence, this study constructs a climate shock dummy variable (*SHOCK*) for each climate indicator. *SHOCK* is equal to one for the periods of climate shocks and zero otherwise. Climate shocks can have an adverse impact on economic output. In the agricultural sector, severe drought and inundation result in a loss of farm production and/or interference with normal crop growth. In the manufacturing sector, water is often one of the major key inputs for industrial production. However, as we have seen in late 2011, heavy floods can cause havoc and disrupt industrial production. Other economic sectors are also affected by changing climate; these sectors include tourism and public health.

However, as illustrated in Table 2, the correlations between the economic shocks, as measured by the output gap, and the eight climate variability indicators, show that only the variability of the cumulative growing degree months for the rainy season (*GDMR*) and for the agricultural year (*GDMA*) has a strong negative correlation with economic cycles, as measured by the output gap. The other six climate variability indicators illustrate no correlation pattern at 5 percent level of statistical significance. Even though these remaining climate variability measures do not significantly correlate

with economic cycles, their effects on economic development should not be overlooked, as they may have significant implications on long-term economic development, which could not be captured by annual output data alone.

An example of the negative implication of climate shocks on economic development is illustrated by Skoufias et al. (2011). They showed the impacts of weather shocks on the stature of children in Mexico, such that rainfall-shock children are shorter in height, regardless of their region or altitude, due potentially to declining agricultural incomes and the prevalence of communicable diseases. Thus, the government may have to allocate additional budgets to overcome the ill-effects from the impact of non-economic shocks arising from climate variability. Hence, appropriate fiscal policy should provide specific responses to economic cycles as well as non-economic shocks.

Table 2 Spearman correlation coefficient matrix

PANEL A VARIABLE	*YGAP*	*VAR (GDMR)*	*SHOCK (GDMR)*	*VAR (GDMA)*	*SHOCK (GDMA)*
YGAP	1				
VAR (GDMR)	-0.5187 ***	1			
SHOCK (GDMR)	-0.2133	0.3676 ***	1		
VAR (GDMA)	-0.4402 **	0.6985 ***	0.2682 **	1	
SHOCK (GDMA)	-0.2936	0.1808	0.2839 **	0.3636 ***	1
VAR (RAINR)	0.0498	-0.002	0.0754	-0.1184	-0.037
SHOCK (RAINR)	0.3321 *	-0.2485 *	-0.2345 *	-0.22	-0.2666 **
VAR (RAINA)	-0.3181 *	-0.0633	-0.0535	-0.1528	-0.1554
SHOCK (RAINA)	0.0885	-0.1351	-0.1239	-0.0147	-0.1683

PANEL B VARIABLE	*VAR (RAINR)*	*SHOCK (RAINR)*	*VAR (RAINA)*	*SHOCK (RAINA)*
VAR (RAINR)	1			
SHOCK (RAINR)	0.4992 ***	1		
VAR (RAINA)	0.6977 ***	0.3283 **	1	
SHOCK (RAINA)	0.1759	0.4307 ***	0.3506 ***	1

Note: ***, **, * indicate significance levels at 1%, 5%, and 10%.

For the model estimator technique, this study employs the standard OLS estimator. Since the model contains the lagged dependent variable, the OLS estimator is inconsistent if the error terms are, in particular, serially correlated[7]. Hence, this study performs Durbin's alternative statistic test for serial correlation. The test results cannot reject the null hypothesis of no first order serial correlation. In addition, the Breusch-Pagan test for heteroskedasticity is applied. The null hypothesis of homoskedasticity cannot be rejected. Hence, the OLS estimation produces consistent estimators in this study.

2.3 Estimation results

Table 3 presents the estimation results for the baseline specification. In general, the results reveal that the output gap variable is illustrated to be strongly robust and statistically significant from zero and positive. The other explanatory variables estimated coefficients are mostly found to be insignificant. These results indicate that the aim of the discretionary fiscal policy used in Thailand is only to correct for economic cycle fluctuations. However, the effects turn out to be pro-cyclical, rather than the desired counter-cyclical fiscal policy, since there is a loose fiscal policy in good times and a tight fiscal policy in bad times. As such, there is no economic stabilization feature. This finding points to the problems of overspending (government deficit bias) in good times[8]. Hence, Thailand is in real need of fiscal rules that help constrain the discretionary use of pro-cyclical adjustments.

The baseline model was extended to include climate variability indicators; these estimation results are displayed in Table 4. All climate variables do not seem to have any implications on the use of discretionary fiscal policy in Thailand, as the estimated coefficient of climate variables are not significant. Nonetheless, this finding should be interpreted with caution, since it does not mean that Thai governments did not attempt to make any fiscal adjustments responding to these types of non-economic fluctuations.

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[7] For more detailed explanations on problems with a lagged dependent variable, see Chapter 12 of Woodridge (2006).

[8] As summarized by Schaechter et al. (2012), two basic explanations of the deficit bias include governments' shortsightedness and the common pool problem, in which different interest groups compete and push toward overspending in good years, leaving no room for counter-cyclical adjustments in bad years.

Table 3 Determinants of discretionary fiscal policy

EQUATION VARIABLES	(1) BFI_t	(2) BFI_t	(3) BFI_t	(4) BFI_t
BFI_{t-1}	-0.190	-0.218	-0.253	-0.255*
	(0.121)	(0.129)	(0.155)	(0.145)
$YGAP_{t-1}$	0.0779**	0.0742**	0.103*	0.102*
	(0.0303)	(0.0327)	(0.0551)	(0.0586)
$NONELECTED_{t-1}$		1.005	0.861	0.840
		(0.820)	(0.865)	(1.072)
$PUBLICDEBT_{t-1}$			0.0197	0.0182
			(0.0431)	(0.0511)
$TREND_t$				0.0025
				(0.0516)
Constant	0.229	0.122	-0.500	-0.557
	(0.323)	(0.374)	(1.580)	(2.000)
Observations	30	30	28	28
Adjusted R^2	0.311	0.333	0.343	0.343

Note: Figures in parentheses are robust standard errors.
***, **, * indicate significance levels at 1%, 5%, 10%.

Table 4 Determinants of discretionary fiscal policy

EQUATION VARIABLES	(1) BFI_t	(2) BFI_t	(3) BFI_t	(4) BFI_t	(5) BFI_t	(6) BFI_t	(7) BFI_t	(8) BFI_t
BFI_{t-1}	-0.252	-0.249	-0.269	-0.224	-0.255	-0.235	-0.252	-0.287
	(0.151)	(0.167)	(0.168)	(0.161)	(0.162)	(0.184)	(0.160)	(0.184)
$YGAP_{t-1}$	0.125*	0.124*	0.112*	0.111*	0.0991	0.107*	0.102*	0.104*
	(0.0615)	(0.0624)	(0.0580)	(0.0623)	(0.0585)	(0.0543)	(0.0579)	(0.0606)
$NONELECTED_{t-1}$	1.035	0.998	0.939	1.112	0.845	0.994	0.860	0.725
	(0.885)	(0.943)	(0.858)	(1.080)	(0.894)	(0.707)	(0.887)	(0.789)
$PUBLICDEBT_{t-1}$	0.0283	0.0279	0.0219	0.0274	0.0143	0.0178	0.0189	0.0215
	(0.0436)	(0.0437)	(0.0438)	(0.0464)	(0.0484)	(0.0452)	(0.0430)	(0.0411)
$VAR\ (GDMR)_{t-1}$	0.734	0.763						
	(0.893)	(0.963)						
$SHOCK\ (GDMR)_{t-1}$		-0.130						
		(0.870)						
$VAR\ (GDMA)_{t-1}$			0.183	0.352				
			(0.315)	(0.396)				
$SHOCK\ (GDMA)_{t-1}$				-1.010				
				(1.001)				
$VAR\ (RAINR)_{t-1}$					-0.00257	0.00249		
					(0.00953)	(0.0101)		
$SHOCK\ (RAINR)_{t-1}$						-0.750		
						(0.852)		
$VAR\ (RAINA)_{t-1}$							-0.000558	-0.00199
							(0.0103)	(0.0107)
$SHOCK\ (RAINA)_{t-1}$								0.452
								(0.682)
Constant	-1.697	-1.671	-1.061	-1.475	-0.0319	-0.366	-0.380	-0.383
	(2.113)	(2.125)	(1.864)	(2.092)	(2.418)	(2.291)	(2.463)	(2.518)
Observations	28	28	28	28	28	28	28	28
Adjusted R^2	0.362	0.363	0.350	0.389	0.345	0.368	0.343	0.353

Note: Figures in parentheses are robust standard errors. ***, **, * indicate significance levels at 1%, 5%, 10%.

As stated previously, the Thai government normally sets aside a contingency budget appropriation under the regular annual budget for unexpected events. If it is sufficient enough to finance all of the expenditures related to climate variability and climate shocks, there would be no real need for more discretionary spending. During the time period covered in this study (1980-2011)[9], it is possible to hypothesize that the contingent budget is sufficient to cover the losses from unexpected events, since Thailand has not been experiencing large-scale non-economic shocks, except for the flood disaster in 2011. The insignificant impact of the climate variables could also mean that the Thai government provides less importance to climate variability, resulting in no discretionary response in terms of the fiscal adjustments, even when the need for public spending is high. However, further in-depth studies are needed in order to confirm this hypothesis.

3. Climate Variability and Government Budget Expenditures

3.1 Model specification

In Thailand, the budget expenditure framework is determined by four economic agencies: the National Economic and Social Development Board, Ministry of Finance, Bureau of the Budget, and the Bank of Thailand. However, at the line-ministry level, budget allocations are appropriated by the Bureau of the Budget, with consultations from the NESDB for large-scaled capital expenditure projects. The fiscal budget cycle begins on the 1st of October of the previous calendar year and runs to the 30th of September of the current calendar year. At the execution-level, it is unclear whether climate variability is taken into account in budget planning and appropriation.

Hence, the relationship between climate variability and a ministry's budget expenditures is examined by estimating the following regression of government expenditures:

$$Budget_{i,t} = \beta_0 + \beta_1 X_{t-1} + \beta_2 GAP_{t-1} + \beta_3 Climate_{t-1} + \varepsilon_t,$$

[9] It is noteworthy that this study's time period does not include the year 2012, where the government announced and exercised large discretionary fiscal spending in response to the flood crisis that occurred in late 2011.

where $Budget_{i,t}$ is the ratio of ministry i's budget expenditures to GDP, as a percentage, in fiscal year t. Since it is ex ante budgeting process by approximately one year, thus, all explanatory variables are lagged one year.

X is the set of control variables. As suggested by Larcinese et al. (2006) and Levitt and Snyder (1995), this set of variables includes the level of development, measured by the logarithm of real income per capita (*GDPPC*), the size of the population (*POP*), the unemployment rate (*UNEMPLOY*), and demographics. This study uses the young-age dependence, measured by the percentage of young dependents aged between 0 and 14 years old (*DEP14*), and the old-age dependence, measured by the percentage of old dependents aged 65 and above (*DEP65*), to measure the effects of demographics. Moreover, the time trend variable (*TREND*) is added to capture the overall pattern of change over time. The year 2003 dummy variable (*YEAR2003*) is included to capture the structural change of Thai ministries that occurred in 2003[10].

For the explanatory variables of interest, the study separates economic fluctuations, as represented by the output gap (*YGAP*), to examine the effects of economic cycles on a ministry's budget expenditures. In addition, a set of climate variability indicators, *Climate*, is introduced into the model to capture the effects of non-economic shocks. The estimated effects on annual government budget expenditures come from non-discretionary and discretionary budget components.

Since the focus of this study is primarily on the impact of climate variability and the way in which the government formulates its ministry's budget expenditures, the scope of the ministries included in this analysis is narrowed to the six ministries whose budgets include climate-related spending. Thus, it is hypothesized that weather and climate variability should have implications on the policy and work programs of the following ministries: Ministry of Agriculture and Cooperatives (e.g., setting with agricultural policy, supporting farmers' production), Ministry of Transport (e.g., involving the

[10] In 2003, five new ministries were established (by splitting some departments from the existing ministries): the Ministry of Tourism and Sports, Ministry of Social Development and Human Security, Ministry of Natural Resources and Environment, Ministry of Information and Communication Technology, and Ministry of Energy.

construction and building of damaged infrastructure in the event of natural disasters), Ministry of Interior (e.g., overseeing the social welfare of people affected by climate variability), Ministry of Industry (e.g., setting industrial policy, overseeing industrial production), Ministry of Science and Technology (e.g., in charge of the Thailand Meteorological Department and performing research and development (R&D) on climate-related issues), and Ministry of Public Health (e.g., overseeing the social welfare of people affected by climate variability)[11].

Besides the six ministries' budget expenditure model estimations, the ratio of the total government budget to GDP is also regressed on the same set of explanatory variables to assess their effects on the overall government budget expenditures. For the model estimation techniques used in this analysis, the standard OLS estimator is employed. Serial correlation and heteroskedasticity problems are tested, in which the Durbin-Watson test statistic cannot reject the null hypothesis of no first order serial correlation. The White test statistics also cannot reject the null hypothesis of homoskedasticity.

3.2 Estimation results

For the basic determinants of the total government budget as percentages of GDP, according to the baseline equation in Table 5 (Equation 1), only two of the explanatory variables are shown to be statistically significant: the level of development of Thailand and the size of the population. The findings indicate that the ratio of total government budget increases with the country's per capita income increased. And it decreases as the size of the population rises.

The economic cycle, measured by the output gap, has an insignificant impact on the ratio of the total government budget expenditures to GDP, in spite of the pro-cyclical effects from the discretionary fiscal policy found in the previous section. Perhaps this is because the pro-cyclical effects of the discretionary fiscal policy are completely offset by the counter-cyclical effects from the non-discretionary government budgetary spending.

[11] Based on the latest Fiscal Year 2012, these six ministries' budget allocations accounted for 23.4 percent of the total government expenditures.

The effects of climate variability and climate shocks (Equations 2 to 9) are only found to be significant and robust for the variability of cumulative growing degree months for each rainy season, *VAR*(*GDMR*), and the variability of total rainfall for each agriculture year, *VAR*(*RAINA*). The size of total government budget is associated with an increase in the variability of total rainfall for each agricultural year. However, it is shown to decrease with the increase in the variability of cumulative growing degree months for each rainy season. This finding is inconsistent with the expectations. The increase in the variability and shocks of the climate variable are expected to have negative effects on agricultural production and total national output (from that crop). A government may have to increase its spending on the social welfare program to help farmers mitigate these adverse effects. In addition, with the reduction in the national output, governments may try to stabilize the economy by using a fiscal stimulus policy, such as an increase in government spending. Hence, the relationship between climate variability and the total government budget is expected to be positive.

It must be re-emphasized that the combined effects of non-discretionary budgetary spending and discretionary fiscal policy may counter each other. Since it was illustrated in the previous section that all climate variables have no implications on the use of discretionary fiscal impulses, the estimated coefficients of the climate variables that are significant must only come from the effects of non-discretionary government budgetary spending.

Tables 6 to 10 present the factor determinants of government budget expenditures at the line-ministry level. Referring to Table 6, the baseline model estimations (without climate variables) for all six ministries are summarized as follows.

In general, when estimating each ministry's budget expenditures separately, the overall goodness of fit of the model is substantially improved from the model of the total budget expenditures, which could imply that budgetary spending decisions for each ministry are determined differently. Hence, it may be more appropriate to examine each ministry separately, when compared to examining the total government budget alone. The level of development of Thailand, as measured by the logarithm of real income per capita, turns out to have a significant and positive impact on the size of all received ministries' budgets.

Table 5 Baseline results (Dependent variable: Total government budget expenditures (% of GDP))

EQUATION	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
ln $(GDPPC)_{t-1}$	14.70*	1.958	3.675	7.626	10.81	12.34	12.52	11.17	10.62
	(8.230)	(9.565)	(9.968)	(7.167)	(8.890)	(8.010)	(7.918)	(6.999)	(7.452)
ln $(POP)_{t-1}$	-105.3**	-146.7**	-147.7**	-182.4***	-181.0***	-80.91*	-55.78	-20.06	-21.20
	(38.41)	(52.82)	(55.60)	(53.54)	(53.27)	(46.29)	(52.27)	(52.34)	(52.21)
$UNEMPLOY_{t-1}$	0.550	0.436	0.470	0.327	0.410	0.365	0.303	0.439	0.463
	(0.390)	(0.343)	(0.345)	(0.370)	(0.360)	(0.399)	(0.391)	(0.365)	(0.387)
$DEP14_{t-1}$	0.768	-0.890	-0.737	-0.834	-0.438	0.156	0.185	1.149	1.089
	(0.795)	(1.105)	(1.190)	(1.121)	(1.051)	(0.783)	(0.849)	(0.904)	(0.907)
$DEP65_{t-1}$	-1.534	-2.538	-2.658	-3.318	-3.729*	1.748	3.468	1.085	1.147
	(2.444)	(2.932)	(3.221)	(2.480)	(2.087)	(3.596)	(3.953)	(2.301)	(2.371)
$TREND_{t-1}$	1.460	1.661	1.719	2.038**	2.215***	0.318	-0.299	0.359	0.346
	(0.942)	(1.101)	(1.241)	(0.943)	(0.764)	(1.327)	(1.455)	(0.898)	(0.918)
$YGAP_{t-1}$	-0.0349	0.0010	-0.00596	-0.0348	-0.0472	-0.0268	-0.0198	0.0063	0.0091
	(0.0543)	(0.0447)	(0.0486)	(0.0428)	(0.0516)	(0.0541)	(0.0463)	(0.0513)	(0.0551)
$VAR\ (GDMR)_{t-1}$		-1.440**	-1.357*						
		(0.665)	(0.715)						
$SHOCK\ (GDMR)_{t-1}$			-0.132						
			(0.517)						
$VAR\ (GDMA)_{t-1}$				-0.652*	-0.516				
				(0.338)	(0.347)				
$SHOCK\ (GDMA)_{t-1}$					-0.428				
					(0.824)				
$VAR\ (RAINR)_{t-1}$						0.0226	0.0322*		
						(0.0156)	(0.0171)		
$SHOCK\ (RAINR)_{t-1}$							-0.773		
							(0.499)		
$VAR\ (RAINA)_{t-1}$								0.0225**	0.0214**
								(0.00845)	(0.0082)
$SHOCK\ (RAINA)_{t-1}$									0.151
									(0.387)
Constant	1,715**	2,595**	2,594**	3,178***	3,113***	1,343	907.9	235.1	261.5
	(685.9)	(992.8)	(1,021)	(989.0)	(983.1)	(809.7)	(910.8)	(946.7)	(939.7)
Observations	31	31	31	31	31	31	31	31	31
R-squared	0.566	0.620	0.621	0.613	0.621	0.591	0.628	0.666	0.667

Note: Figures in parentheses are robust standard errors. ***, **, * indicate significance levels at 1%, 5%, 10%.

The size of the population is also relevant at the line-ministry budget level. Four out of six ministries (except the Ministry of Interior and Ministry of Science and Technology) illustrated that their budgetary expenditures decreased with an increase in the Thai population. The unemployment rate is found to have a significant and positive effect on the Ministry of Transport and Ministry of Interior' budget expenditures.

For demographics, as the percentage of young dependents (*DEP14*) increases, the Ministry of Interior experiences a rise in the budget expenditures received. Likewise, the percentage of old dependents (*DEP65*) also has positive implications on the Ministry of Science and Technology, but has negative effects on the Ministry of Public Health and Ministry of Industry. The negative effects of demographic changes on the Ministry of Public Health's budget expenditures are surprising. It is normally expected that the Ministry of Public Health would receive more budgets when the number of dependents increases. On the contrary, the findings indicate that the Ministry of Science and Technology is the one who gets more budget money as the number of old dependents increases.

For the impact of the output gap, the Ministry of Public Health shows a counter-cyclical effect of the fiscal policy at the ministerial level. This is contrary to the finding of pro-cyclical effects found in the discretionary fiscal policy response. It can be indicative that non-discretionary budgetary spending outweighs discretionary budgetary spending in contributing to counter-cyclical fiscal policy. However, it is surprising to observe that economic cycles do not have a significant impact on other five ministries' budgetary spending, especially the Ministry of Interior where it should have been more budget allocated in times of economic downturns to alleviate the negative impact to the local population.

In terms of climate variability, the study focuses on temperature and rainfall variability. According to Table 7, the results from the cumulative growing degree months for the rainy season (*GDMR*) illustrate that three ministries (Ministry of Agriculture, Ministry of Interior, and Ministry of Public Health) receive smaller budgets when *GDMR* variability increases. This surprisingly negative relationship is consistent with the total government budget expenditures. Nonetheless, it is found that *GDMR* shocks result in a

decrease in budgetary spending by the Ministry of Industry. For the variability and shocks of the cumulative growing degree months for each agricultural year (*GDMA*), in Table 8, the overall results show statistical insignificance. With one exception, the variability of *GDMA* reduces the Ministry of Agriculture and Cooperatives and Ministry of Interior' budgetary spending.

The variability of the total rainfall for each rainy season measure (*RAINR*) was found, in Table 9, that there is a positive relationship with the Ministry of Transport and Ministry of Public Health, while other ministries are not found to be significant. In addition, shocks of rainfall for the rainy season measure have no significant effect on the budgetary spending for these six ministries. For total rainfall for each agricultural year measure (*RAINA*), there is a positive and significant relationship between the variability and the budgetary spending for the Ministry of Agriculture and Cooperatives and Ministry of Industry, as illustrated in Table 10. In addition, the shocks of *RAINA* increase budgetary spending by the Ministry of Transport.

In general, the findings in this section indicate that the Thai government treats the variability of temperature and rainfall differently in budget formulation and execution and may provide inadequate consideration for climate variability and climate shocks in fiscal policy formulation in Thailand. Moreover, the negative relationship in the variability and shocks of *GDMR* and *GDMA* and budgetary spending for several ministries is somewhat contrary to expectations, which may indicate lack of consideration for climate variability and potential misallocation of budgetary funds.

Table 6 Baseline results

(Dependent variable: a ministry's budget expenditures (% of GDP))

EQUATION	(1) Ministry of Agriculture and Cooperatives	(2) Ministry of Transport	(3) Ministry of Interior	(4) Ministry of Science and Technology	(5) Ministry of Public Health	(6) Ministry of Industry
ln $(GDPPC)_{t-1}$	2.361**	3.730***	7.048***	0.443**	2.621***	0.130**
	(1.089)	(0.726)	(1.771)	(0.207)	(0.716)	(0.0557)
ln $(POP)_{t-1}$	-19.77***	-24.00***	3.767	1.459	-24.74***	-0.952**
	(4.982)	(6.667)	(8.924)	(1.335)	(6.209)	(0.393)
$UNEMPLOY_{t-1}$	0.0404	0.0429**	0.114**	0.0001	0.0322	0.0007
	(0.0421)	(0.0200)	(0.0533)	(0.0059)	(0.0227)	(0.0016)
$DEP14_{t-1}$	-0.128	-0.134	0.654***	0.0216	-0.127	-0.0021
	(0.0900)	(0.0976)	(0.200)	(0.0193)	(0.0885)	(0.0069)
$DEP65_{t-1}$	-0.0917	-0.122	-0.0248	0.152***	-0.575*	-0.0260**
	(0.188)	(0.258)	(0.360)	(0.0440)	(0.288)	(0.0119)
$TREND_{t-1}$	0.0559	0.0540	0.108	-0.0461***	0.222**	0.0093**
	(0.0637)	(0.0814)	(0.112)	(0.0142)	(0.0817)	(0.0034)
$YEAR2003_t$	-0.196*	0.210	-0.956***	-0.192***	-0.0797	-0.0168
	(0.0959)	(0.177)	(0.206)	(0.0268)	(0.204)	(0.0107)
$YGAP_{t-1}$	-0.0048	-0.0059	-0.0048	-0.0010	-0.0081*	-0.0001
	(0.0063)	(0.0046)	(0.0116)	(0.00098)	(0.0040)	(0.00029)
Constant	339.2***	404.9***	-140.3	-28.59	421.2***	15.96**
	(86.06)	(118.9)	(162.1)	(23.54)	(110.2)	(7.044)
Observations	31	31	31	31	31	31
R-squared	0.937	0.926	0.878	0.899	0.881	0.903

Note: Figures in parentheses are robust standard errors.
***, **, * indicate significance levels at 1%, 5%, 10%.

Table 7 The impact of variability and shocks of *GDMR*

(Dependent variable: a ministry's budget expenditures (% of GDP))

EQUATION	(1)	(2)	(3)	(4)	(5)	(6)
	Ministry of Agriculture and Cooperatives		Ministry of Transport		Ministry of Interior	
ln $(GDPPC)_{t-1}$	0.736	0.685	3.298***	2.829**	3.206	2.040
	(1.139)	(1.071)	(1.134)	(1.258)	(2.118)	(1.781)
ln $(POP)_{t-1}$	-22.11***	-22.04***	-24.62***	-23.98***	-1.757	-0.165
	(6.035)	(6.261)	(6.847)	(6.588)	(8.505)	(7.548)
$UNEMPLOY_{t-1}$	0.0259	0.0249	0.0390*	0.0300	0.0792**	0.0568
	(0.0346)	(0.0342)	(0.0205)	(0.0242)	(0.0348)	(0.0336)
$DEP14_{t-1}$	-0.299**	-0.303**	-0.179	-0.216	0.249	0.159
	(0.112)	(0.111)	(0.123)	(0.132)	(0.216)	(0.199)
$DEP65_{t-1}$	-0.127	-0.122	-0.131	-0.0871	-0.107	0.00194
	(0.220)	(0.235)	(0.268)	(0.246)	(0.375)	(0.324)
$TREND_{t-1}$	0.0567	0.0546	0.0542	0.0356	0.110	0.0635
	(0.0764)	(0.0821)	(0.0861)	(0.0822)	(0.128)	(0.112)
$YEAR2003_t$	-0.279*	-0.280*	0.188	0.175	-1.153***	-1.183***
	(0.148)	(0.153)	(0.180)	(0.164)	(0.143)	(0.108)
$YGAP_{t-1}$	-0.00003	0.0002	-0.0046	-0.0027	0.00648	0.0112
	(0.0054)	(0.0053)	(0.0058)	(0.00645)	(0.0114)	(0.0108)
$VAR\ (GDMR)_{t-1}$	-0.179**	-0.182**	-0.0477	-0.0709	-0.424***	-0.481***
	(0.0654)	(0.0676)	(0.0600)	(0.0653)	(0.111)	(0.0971)
$SHOCK\ (GDMR)_{t-1}$		0.0038		0.0347		0.0863
		(0.0381)		(0.0393)		(0.0745)
Constant	398.2***	397.5***	420.6***	414.2***	-0.677	-16.49
	(107.6)	(111.3)	(122.5)	(117.6)	(155.1)	(139.1)
Observations	31	31	31	31	31	31
R-squared	0.952	0.952	0.927	0.930	0.917	0.921
Model	(7)	(8)	(9)	(10)	(11)	(12)
	Ministry of Science and Technology		Ministry of Public Health		Ministry of Industry	
ln $(GDPPC)_{t-1}$	0.450	0.438	1.446	0.877	0.0446	0.111
	(0.311)	(0.378)	(0.872)	(1.005)	(0.0737)	(0.0683)
ln $(POP)_{t-1}$	1.469	1.485	-26.42***	-25.65***	-1.076**	-1.166***
	(1.485)	(1.527)	(6.499)	(6.015)	(0.435)	(0.399)
$UNEMPLOY_{t-1}$	0.000172	-0.00005	0.0217	0.0108	-0.00008	0.0012
	(0.0063)	(0.0087)	(0.0174)	(0.0211)	(0.0015)	(0.0016)
$DEP14_{t-1}$	0.0223	0.0214	-0.251**	-0.295**	-0.0111	-0.00598
	(0.0337)	(0.0383)	(0.101)	(0.127)	(0.0094)	(0.00847)
$DEP65_{t-1}$	0.152***	0.153***	-0.600*	-0.547**	-0.0278**	-0.0340**
	(0.0450)	(0.0460)	(0.297)	(0.259)	(0.0123)	(0.0126)
$TREND_{t-1}$	-0.0461***	-0.0466***	0.2220**	0.2000**	0.0094**	0.0120***
	(0.0145)	(0.0161)	(0.0859)	(0.0750)	(0.00345)	(0.0038)
$YEAR2003_t$	-0.192***	-0.192***	-0.140	-0.155	-0.0212	-0.0195
	(0.0281)	(0.0279)	(0.207)	(0.184)	(0.0141)	(0.0126)
$YGAP_{t-1}$	-0.0010	-0.00099	-0.0047	-0.00235	0.0001	-0.00015
	(0.0012)	(0.00147)	(0.0041)	(0.0047)	(0.00029)	(0.000245)
$VAR\ (GDMR)_{t-1}$	0.0008	0.0002	-0.130***	-0.158***	-0.00946	-0.0062
	(0.0206)	(0.0239)	(0.0401)	(0.0492)	(0.0058)	(0.00585)
$SHOCK\ (GDMR)_{t-1}$		0.00086		0.0421		-0.0049**
		(0.0169)		(0.0430)		(0.00196)
Constant	-28.84	-29.00	463.9***	456.1***	19.08**	19.97**
	(27.46)	(28.03)	(115.7)	(110.6)	(7.929)	(7.235)
Observations	31	31	31	31	31	31
R-squared	0.899	0.899	0.902	0.907	0.920	0.930

Note: Figures in parentheses are robust standard errors.

***, **, * indicate significance levels at 1%, 5%, 10%.

Table 8 The impact of variability and shocks of *GDMA*

(Dependent variable: a ministry's budget expenditures (% of GDP))

EQUATION	(1)	(2)	(3)	(4)	(5)	(6)
	Ministry of Agriculture and Cooperatives		Ministry of Transport		Ministry of Interior	
ln $(GDPPC)_{t-1}$	1.050	1.105	3.148***	2.595**	4.346**	3.013
	(0.888)	(1.031)	(0.862)	(0.965)	(1.802)	(1.993)
ln $(POP)_{t-1}$	-25.26***	-25.36***	-26.44***	-25.40***	-7.551	-5.059
	(5.931)	(6.143)	(5.754)	(5.750)	(12.03)	(11.88)
$UNEMPLOY_{t-1}$	0.0013	0.0027	0.0255	0.0110	0.0328	-0.0021
	(0.0269)	(0.0303)	(0.0261)	(0.0284)	(0.0545)	(0.0586)
$DEP14_{t-1}$	-0.305**	-0.300**	-0.212*	-0.259**	0.290	0.176
	(0.110)	(0.120)	(0.107)	(0.112)	(0.223)	(0.232)
$DEP65_{t-1}$	-0.151	-0.161	-0.148	-0.0437	-0.147	0.104
	(0.218)	(0.241)	(0.212)	(0.226)	(0.443)	(0.467)
$TREND_{t-1}$	0.0885	0.0920	0.0685	0.0322	0.175	0.0879
	(0.0723)	(0.0805)	(0.0701)	(0.0754)	(0.147)	(0.156)
$YEAR2003_t$	-0.421**	-0.415**	0.110	0.0476	-1.420***	-1.570***
	(0.150)	(0.163)	(0.145)	(0.152)	(0.304)	(0.315)
$YGAP_{t-1}$	-0.00399	-0.0042	-0.0055	-0.0036	-0.0031	0.0016
	(0.0041)	(0.0046)	(0.0040)	(0.0043)	(0.0084)	(0.0088)
$VAR\ (GDMA)_{t-1}$	-0.111***	-0.108**	-0.0492	-0.0755*	-0.228***	-0.292***
	(0.0361)	(0.0436)	(0.0350)	(0.0408)	(0.0732)	(0.0842)
$SHOCK\ (GDMA)_{t-1}$		-0.0059		0.0597		0.144
		(0.0522)		(0.0489)		(0.101)
Constant	451.4***	452.6***	454.7***	442.7***	91.05	62.13
	(107.9)	(111.0)	(104.7)	(103.9)	(218.9)	(214.7)
Observations	31	31	31	31	31	31
R-squared	0.956	0.956	0.932	0.937	0.916	0.924
Model	(7)	(8)	(9)	(10)	(11)	(12)
	Ministry of Science and Technology		Ministry of Public Health		Ministry of Industry	
ln $(GDPPC)_{t-1}$	0.579**	0.525*	2.046**	1.486	0.0914	0.104
	(0.249)	(0.288)	(0.866)	(0.970)	(0.0641)	(0.0742)
ln $(POP)_{t-1}$	2.030	2.131	-27.15***	-26.10***	-1.116**	-1.139**
	(1.662)	(1.715)	(5.786)	(5.781)	(0.428)	(0.442)
$UNEMPLOY_{t-1}$	0.0042	0.0028	0.0150	0.0003	-0.00048	-0.0002
	(0.0075)	(0.00846)	(0.0262)	(0.0285)	(0.0019)	(0.0022)
$DEP14_{t-1}$	0.0400	0.0354	-0.205*	-0.252**	-0.0074	-0.0063
	(0.0308)	(0.0334)	(0.107)	(0.113)	(0.0079)	(0.0086)
$DEP65_{t-1}$	0.158**	0.168**	-0.601**	-0.495**	-0.0278*	-0.0301*
	(0.0611)	(0.0674)	(0.213)	(0.227)	(0.0158)	(0.0174)
$TREND_{t-1}$	-0.0495**	-0.0530**	0.236***	0.199**	0.0103*	0.0111*
	(0.0203)	(0.0225)	(0.0705)	(0.0758)	(0.0052)	(0.0058)
$YEAR2003_t$	-0.169***	-0.175***	-0.179	-0.241	-0.0235**	-0.0222*
	(0.0419)	(0.0454)	(0.146)	(0.153)	(0.0108)	(0.0117)
$YGAP_{t-1}$	-0.0011	-0.0009	-0.0078*	-0.0058	-0.0001	-0.00015
	(0.0012)	(0.0013)	(0.0040)	(0.0043)	(0.0003)	(0.0003)
$VAR\ (GDMA)_{t-1}$	0.0115	0.00896	-0.0487	-0.0753*	-0.0033	-0.0027
	(0.0101)	(0.0122)	(0.0352)	(0.0410)	(0.0026)	(0.0031)
$SHOCK\ (GDMA)_{t-1}$		0.0058		0.0604		-0.0013
		(0.0146)		(0.0492)		(0.0038)
Constant	-40.27	-41.44	470.5***	458.3***	19.29**	19.56**
	(30.23)	(30.99)	(105.3)	(104.5)	(7.786)	(7.989)
Observations	31	31	31	31	31	31
R-squared	0.905	0.906	0.891	0.899	0.910	0.910

Note: Figures in parentheses are robust standard errors.

***, **, * indicate significance levels at 1%, 5%, 10%.

Table 9 The impact of variability and shocks of *RAINR*

(Dependent variable: a ministry's budget expenditures (% of GDP))

EQUATION	(1)	(2)	(3)	(4)	(5)	(6)
	Ministry of Agriculture and Cooperatives		Ministry of Transport		Ministry of Interior	
ln $(GDPPC)_{t-1}$	2.282**	2.291**	3.477***	3.481***	6.497***	6.526***
	(1.055)	(1.061)	(0.733)	(0.759)	(1.837)	(1.805)
ln $(POP)_{t-1}$	-19.85***	-18.30***	-24.25***	-23.64***	3.223	7.830
	(5.160)	(6.228)	(6.648)	(7.017)	(10.45)	(9.364)
$UNEMPLOY_{t-1}$	0.0332	0.0299	0.0200	0.0186	0.0637	0.0537
	(0.0473)	(0.0479)	(0.0214)	(0.0214)	(0.0592)	(0.0577)
$DEP14_{t-1}$	-0.166	-0.162	-0.254*	-0.253*	0.391	0.404
	(0.126)	(0.137)	(0.126)	(0.127)	(0.285)	(0.288)
$DEP65_{t-1}$	0.00578	0.104	0.189	0.228	0.652	0.944
	(0.236)	(0.289)	(0.262)	(0.295)	(0.582)	(0.608)
$TREND_{t-1}$	0.0194	-0.0155	-0.0625	-0.0763	-0.146	-0.249
	(0.0851)	(0.103)	(0.0900)	(0.103)	(0.201)	(0.216)
$YEAR2003_t$	-0.164	-0.169	0.309*	0.307	-0.739***	-0.754***
	(0.139)	(0.145)	(0.179)	(0.183)	(0.247)	(0.231)
$YGAP_{t-1}$	-0.0046	-0.0042	-0.0052	-0.0050	-0.0033	-0.0021
	(0.0063)	(0.0061)	(0.0045)	(0.0046)	(0.0114)	(0.0101)
$VAR\ (RAINR)_{t-1}$	0.0009	0.0014	0.0029**	0.0031**	0.0063	0.0078*
	(0.0023)	(0.0022)	(0.0013)	(0.0014)	(0.0037)	(0.0039)
$SHOCK\ (RAINR)_{t-1}$		-0.0433		-0.0171		-0.129
		(0.0532)		(0.0419)		(0.114)
Constant	343.2***	316.2***	417.7***	407.0***	-112.3	-192.5
	(92.24)	(110.9)	(119.9)	(125.9)	(191.4)	(171.5)
Observations	31	31	31	31	31	31
R-squared	0.937	0.939	0.937	0.937	0.892	0.901
EQUATION	(7)	(8)	(9)	(10)	(11)	(12)
	Ministry of Science and Technology		Ministry of Public Health		Ministry of Industry	
ln $(GDPPC)_{t-1}$	0.434*	0.439**	2.315***	2.319***	0.133**	0.133**
	(0.221)	(0.210)	(0.774)	(0.795)	(0.0510)	(0.0520)
ln $(POP)_{t-1}$	1.450	2.206	-25.04***	-24.35***	-0.950**	-0.964**
	(1.389)	(1.407)	(5.374)	(5.572)	(0.404)	(0.459)
$UNEMPLOY_{t-1}$	-0.00067	-0.0023	0.0044	0.0029	0.00095	0.00098
	(0.0074)	(0.0064)	(0.0258)	(0.0268)	(0.00215)	(0.0021)
$DEP14_{t-1}$	0.0175	0.0196	-0.273*	-0.271*	-0.0007	-0.0007
	(0.0314)	(0.0311)	(0.133)	(0.136)	(0.0085)	(0.0087)
$DEP65_{t-1}$	0.163**	0.211***	-0.198	-0.154	-0.0296*	-0.0305*
	(0.0601)	(0.0620)	(0.230)	(0.272)	(0.0144)	(0.0170)
$TREND_{t-1}$	-0.0501**	-0.0671***	0.0805	0.0651	0.0107**	0.0110**
	(0.0200)	(0.0215)	(0.0736)	(0.0909)	(0.0047)	(0.0053)
$YEAR2003_t$	-0.189***	-0.191***	0.0412	0.0390	-0.0180	-0.0180
	(0.0328)	(0.0337)	(0.216)	(0.221)	(0.0122)	(0.0126)
$YGAP_{t-1}$	-0.0010	-0.0008	-0.0073*	-0.0071	-0.0001	-0.0001
	(0.0010)	(0.0008)	(0.0042)	(0.0043)	(0.0003)	(0.0003)
$VAR\ (RAINR)_{t-1}$	0.000098	0.0003	0.00349**	0.0037*	-0.00003	-0.00003
	(0.0004)	(0.0004)	(0.0017)	(0.0019)	(0.0001)	(0.0001)
$SHOCK\ (RAINR)_{t-1}$		-0.0211		-0.0191		0.0004
		(0.0135)		(0.0338)		(0.0034)
Constant	-28.15	-41.30	436.7***	424.8***	15.81**	16.06*
	(25.04)	(25.42)	(97.69)	(100.1)	(7.371)	(8.276)
Observations	31	31	31	31	31	31
R-squared	0.899	0.914	0.906	0.908	0.903	0.903

Note: Figures in parentheses are robust standard errors.

***, **, * indicate significance levels at 1%, 5%, 10%.

Table 10 The impact of variability and shocks of *RAINA*

(Dependent variable: a ministry's budget expenditures (% of GDP))

EQUATION	(1)	(2)	(3)	(4)	(5)	(6)
	Ministry of Agriculture and Cooperatives		Ministry of Transport		Ministry of Interior	
ln $(GDPPC)_{t-1}$	2.085**	2.160**	3.772***	3.541***	6.800***	6.493***
	(0.962)	(0.959)	(0.715)	(0.631)	(1.668)	(1.770)
ln $(POP)_{t-1}$	-14.36**	-14.21**	-24.82***	-25.29***	8.635	8.020
	(5.333)	(5.409)	(7.673)	(6.749)	(11.47)	(10.77)
$UNEMPLOY_{t-1}$	0.0312	0.0280	0.0443**	0.0542**	0.105*	0.118*
	(0.0412)	(0.0424)	(0.0206)	(0.0191)	(0.0559)	(0.0586)
$DEP14_{t-1}$	-0.120	-0.112	-0.135	-0.160	0.661***	0.628**
	(0.0843)	(0.0822)	(0.0966)	(0.0969)	(0.230)	(0.227)
$DEP65_{t-1}$	0.0719	0.0634	-0.147	-0.120	0.122	0.157
	(0.186)	(0.187)	(0.297)	(0.256)	(0.359)	(0.364)
$TREND_{t-1}$	-0.0222	-0.0203	0.0659	0.0603	0.0377	0.0303
	(0.0660)	(0.0661)	(0.102)	(0.0880)	(0.116)	(0.116)
$YEAR2003_t$	-0.138*	-0.138*	0.201	0.201	-0.905***	-0.905***
	(0.0682)	(0.0738)	(0.174)	(0.146)	(0.264)	(0.237)
$YGAP_{t-1}$	-0.0014	-0.0018	-0.0064	-0.0052	-0.0018	-0.0002
	(0.0060)	(0.0059)	(0.0045)	(0.0043)	(0.0106)	(0.0115)
$VAR\ (RAINA)_{t-1}$	0.0019***	0.0021**	-0.0003	-0.0008	0.0017	0.0011
	(0.0006)	(0.0007)	(0.0008)	(0.0007)	(0.0016)	(0.0016)
$SHOCK\ (RAINA)_{t-1}$		-0.0204		0.0628*		0.0832
		(0.0343)		(0.0349)		(0.0839)
Constant	246.4**	242.9**	419.0***	429.8***	-223.8	-209.4
	(92.80)	(93.85)	(136.0)	(121.1)	(211.0)	(198.1)
Observations	31	31	31	31	31	31
R-squared	0.950	0.951	0.926	0.936	0.883	0.888
EQUATION	(7)	(8)	(9)	(10)	(11)	(12)
	Ministry of Science and Technology		Ministry of Public Health		Ministry of Industry	
ln $(GDPPC)_{t-1}$	0.409**	0.403*	2.555***	2.459***	0.111**	0.115**
	(0.195)	(0.201)	(0.730)	(0.720)	(0.0510)	(0.0495)
ln $(POP)_{t-1}$	2.127	2.115	-23.43***	-23.62***	-0.578	-0.571
	(1.566)	(1.600)	(7.339)	(7.332)	(0.387)	(0.387)
$UNEMPLOY_{t-1}$	-0.0010	-0.00075	0.0300	0.0341	0.00005	-0.0001
	(0.0056)	(0.0062)	(0.0236)	(0.0238)	(0.00148)	(0.00147)
$DEP14_{t-1}$	0.0226	0.0220	-0.125	-0.135	-0.0015	-0.0011
	(0.0201)	(0.0211)	(0.0954)	(0.101)	(0.0054)	(0.0052)
$DEP65_{t-1}$	0.172***	0.173***	-0.535	-0.524	-0.0147	-0.0151
	(0.0536)	(0.0542)	(0.322)	(0.311)	(0.0131)	(0.0129)
$TREND_{t-1}$	-0.0557***	-0.0559***	0.203**	0.201**	0.0039	0.0040
	(0.0181)	(0.0184)	(0.0952)	(0.0931)	(0.0049)	(0.0048)
$YEAR2003_t$	-0.185***	-0.185***	-0.0659	-0.0660	-0.0129	-0.0129*
	(0.0289)	(0.0289)	(0.210)	(0.202)	(0.0077)	(0.00747)
$YGAP_{t-1}$	-0.0006	-0.0006	-0.0073*	-0.0068	0.0001	0.00008
	(0.0010)	(0.0010)	(0.0041)	(0.0042)	(0.0003)	(0.0003)
$VAR\ (RAINA)_{t-1}$	0.0002	0.0002	0.00047	0.0003	0.0001**	0.0001**
	(0.0002)	(0.0002)	(0.0006)	(0.0006)	(0.00006)	(0.00006)
$SHOCK\ (RAINA)_{t-1}$		0.0017		0.0259		-0.0010
		(0.0112)		(0.0358)		(0.0021)
Constant	-40.06	-39.76	398.8***	403.2***	9.536	9.360
	(27.67)	(28.32)	(130.0)	(130.9)	(6.834)	(6.838)
Observations	31	31	31	31	31	31
R-squared	0.905	0.905	0.883	0.886	0.929	0.930

Note: Figures in parentheses are robust standard errors.

***, **, * indicate significance levels at 1%, 5%, 10%.

4. Conclusions and Policy Considerations

This paper attempts to empirically analyze the use of discretionary fiscal policy and overall fiscal responses, including components of discretionary spending and non-discretionary spending, to economic cycles and non-economic shocks in terms of climate variability in Thailand. In response to economic cycles, the Thai government is found to implement its discretionary fiscal policy in a pro-cyclical manner in which the positive output gap has a positive relationship with a fiscal stimulus. However, the output gap turns out to have an insignificant impact on total government budget expenditures. This finding may indicate that the pro-cyclical effects of the discretionary budget component are completely offset by the counter-cyclical effects of the non-discretionary component. In other words, pro-cyclical discretionary fiscal policy negates the counter-cyclicality of non-discretionary fiscal policy, resulting in overall fiscal spending in Thailand to have an "ineffective" neutral stance. At the ministry-level, most ministries selected in this study (except the Ministry of Public Health) also show a neutral stance of fiscal spending behavior in response to the output gap.

On climate variability, it seems that the Thai government does not take much into consideration in relation to the effects of climate variability and climate shocks in the use of its fiscal policy discretion. When the analysis is on government budget expenditures, the effects of climate variability on total government budget expenditures are mostly silent. With two exceptions, firstly, an increase in the variability of cumulative growing degree months for each rainy season has a surprisingly negative impact on the ratio of the total government budget to GDP which is contrary to expectation that government would increase its spending budget given an increase in the temperature variability. Secondly, an increase in the variability of total rainfall for each agricultural year has a positive impact on the size of total government budget. At the ministry level of budgetary spending, climate variability has some impacts on the budget allocation, but the associations are often not indicative and may even be opposite from expectations in that the government should allocate higher budgets in cases of increasing climate variability. Perhaps this indicates the problem of government budget insufficiency and/or misallocation to address the climate variability issue in Thailand.

In conclusion, this study points towards the need for more stringent fiscal rules for Thailand to overcome the "pro-cyclical discretionary-biased" fiscal policy, as well as greater systematic consideration for climate variability and climate shocks during the budget formulation process. These two issues will have major implications for Thailand's fiscal policy. Fiscal responses to economic stabilization and non-economic shocks have persistently occurred in the last five years, primarily through discretionary-based actions, by issuing special Emergency Decrees. This may lead to unsustainable public debt levels in the near future. As such, the discretionary use of fiscal policy is found to be inefficient and should be restricted.

In dealing with economic stabilization, Thailand may need to rely more on automatic-stabilizer mechanisms and consider adopting fiscal rules to overcome pro-cyclical discretionary-based fiscal policy, such as a cyclically-adjusted budget balance rule or a budget balance over the business cycle. Furthermore, adopting fiscal balance over the political cycle rule may be one of the most challenging fiscal rules for Thailand. Countering non-economic shocks, particularly climate variability, is even a more daunting task for the government. A new generation of fiscal rules beyond the output gap may need to be developed. For example, a "new" structural fiscal balance rule that accounts for climate variability and climate shock adjustments may have to be considered. This will encourage the government to set aside savings during a normal period for dealing with non-economic shocks.

However, under the exceptional circumstances of non-economic shocks (such as extreme natural disasters) requiring a special escape clause, the IMF study (2009) suggests conditionality for escape clauses, such as clear specifications and limitations on the range of factors that trigger escape clauses. This should elucidate the clear path back to the rule and medium-term fiscal sustainability. In addition, for Thailand, deviations with the escape clause should be only temporary with a clear plan and timeframe for servicing the incurred debt. The ceiling and size of new public debt issued should be specified and legally-binding. Moreover, Thailand may require an independent fiscal agency to ensure credibility and good governance of the policies implemented under the escape clause.

In summary, the process of legislating, implementing and enforcing fiscal law/rules should be thoroughly reviewed to ensure strict adherence to a fiscal discipline, while allowing for some flexibility in times of unexpected natural calamity. Besides, as suggested by Kreimer (2002), over the medium term, the government should begin to examine market-based mechanisms to deal with natural disasters, such as an insurance scheme for infrastructure and private properties, as well as a weather insurance program for farmers for better risk management from changing weather patterns. Moreover, another option for Thailand would be the establishment of a calamity fund, such as the FONDEN program, Mexico's natural disaster fund, in which the government annually allocates budgetary funds for expenditures on post-disaster responses[12]. This type of program would allow for a more non-discretionary fiscal tool by obligating government saving during normal periods to deal with unexpected future natural disasters as well as to promote fiscal sustainability. In any case, these proposed ideas require further studies.

The synchronization of greater fiscal discretion at times of high uncertainty and the likelihood for non-economic shocks in terms of climate variability creates new challenges for achieving fiscal sustainability and sound public debt management in Thailand in the future.

Acknowledgements

The authors wish to acknowledge the financial assistance from the United Nations Conference on Trade and Development (UNCTAD)'s sovereign debt management project.

[12] For more information on the FONDEN program, please see http://www.gfdrr.org/gfdrr/node/1259

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