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Assessing the impact of Thailand's government consumption and tax shocks with a non-recursive SVAR model

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Abstract

In this paper, we identify the impact of government consumption and tax shocks on key aggregate variables in Thailand. Our approach builds upon the seminal work of Blanchard and Perotti (2003), which is extended to consider the small-open economy characteristics. The tax elasticity of output is estimated with the ARDL-ECM model. Given the calibrated elasticity of tax to output, our main findings suggest that government consumption shocks generate a short-lived impact on aggregate output and their disaggregated components. The magnitude of its five-year cumulative impact on aggregate output is around 0.9 times. Meanwhile, the impact of tax shocks is slightly lower, with a magnitude around -0.7. Our results are robust to different detrending methods.

Keywords: Fiscal policy, SVAR models, non-recursive identification, Business cycles

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1. Introduction

Recent years have seen a growing debate over the effectiveness of fiscal policy in Thailand. The discussion has been ongoing since the outbreak of COVID-19, when several public programs were launched to stabilize the adverse effects of the global pandemic issue. The debate is expected to be further intensified as the government is expected to launch many more controversial fiscal programs. Despite their extensive implementation, few have yet to conclude if the impact of those policies is worthwhile economically. This requires the least extent to which the aggregate impact of fiscal programs can be measured, let alone the distributional consequences of each policy that hits different target groups of stakeholders.

In this paper, we offer some preliminary evidence on the impact of government consumption spending and tax cuts on aggregate output and its disaggregated component. Our methodology is a VAR-based framework, adapted from the seminal work of Blanchard and Perotti (2003). The model takes into consideration some specific features that better characterize the aggregate fluctuations of the Thai economy. We construct a simple baseline five-variable VAR model, comprising three domestic variables and two external variables. The latter two are treated as controlled variables, capturing the key external factors that could potentially generate the fluctuations in Thai domestic variables.

The proposed VAR model is estimated using the data between 2001Q1 and 2023Q1. Given the estimated VAR model, we argue that the model can be used to identify domestic fiscal shocks using a *non-recursive procedure*. We postulate that there exists a cyclically adjusted tax revenue to the variations in output, capturing the so-called automatic stabilizer effect. This cyclical relation is not directly estimated from the SVAR but instead calibrated using external information. In our work, we estimate the tax elasticity of output using the ARDL-ECM model. Meanwhile, government consumption is adjusting to the variations in output with a one-period lag. The latter is to consider the decision and implementation lag commonly found in fiscal practices. With these imposed restrictions, we then quantify the impulse responses and numerically measure the accumulative effects of the two fiscal shocks on aggregate output and some of its disaggregated components.

The main findings suggest that expansionary government spending shocks generate a short-lived impact, with the tailwind mostly concentrated in the first four quarters after the implementation of spending programs. Then, the natural responses that follow have shown the headwind resistance that causes a negative change in aggregate output and its selected disaggregate component. As a result, the overall accumulative impact is small. The five-year accumulative impact of government spending shocks, i.e., the medium-run spending multiplier, is 0.9 times. On the other hand, the effect of tax hikes impacts the macroeconomy to a lesser extent than the spending shock does. In our study, we found that the five-year cumulative impact of tax shocks, i.e., the medium-run tax multiplier, is -0.8 times. The estimated figures of both spending and tax multipliers are not at odds compared to cross-country studies and other international-level studies. Furthermore, our robustness study shows that the estimate figures are roughly in line across alternative models with different detrending methods applied to the original data.

Related literature: After the GFC 2008, we have seen ongoing debates on the effectiveness of fiscal policy, and voluminous studies have been produced with plenty of international evidence extensively documented; see, e.g., Ramey (2011) and Batini et al. (2015). In terms of the methodological framework, the approach to quantitative fiscal study can be divided into three main strands. One is to estimate the fiscal multiplier using a time series method such as SVAR, or structural factor-augmented VAR technique. Our paper falls along the line of this strand of literature and considers Blanchard and Perotti (2003) as our starting motivation, as well as many others as extensions; see, e.g., Yang (2005), Mountford and Uhlig (2009), and Merten and Ravan (2010). The second is to estimate the fiscal multiplier using local projections. The approach circumvents the main problem of the basic SVAR approach, where an anticipated fiscal program might be expected in advance, making it less credible to recover the structural shocks from the innovation representation (see, e.g., Lippi and Reichlin (1994) and Leeper et al. (2013)). Oscar Jorda (2005) began the research area in this respect, and many others have followed this tradition in the context of policy studies. Dime et al. (2021) is a related example along this line, with their focus on the context of selected Asian countries. The last approach is to investigate the impact of fiscal policies in full-blown DSGE models; see, e.g., Zubairy (2014), Kormilitsina and Zubairy (2018), Sims and Wolf (2018), and Bouakez et al. (2023).

In terms of the main quantitative results, our results are in line with Dime et al. (2021), where estimates of the fiscal multipliers of some selected Asian countries are quite small. For a specific analysis of Thailand, debates over its effectiveness have been drawn from previous studies that either relied on a single-equation approach or SVAR models with structural shocks identified by Cholesky decomposition (see, e.g., Sawangsilp (2008)). While being a good starting point for subsequent work, both approaches are argued to have their own drawbacks. The former has a lack of treatment for endogeneity relationships, causing biased inferences on the effect of fiscal shocks. Meanwhile, the latter partially overcomes the endogeneity issues but renders the main difficulties in recovering the proper or credible fiscal impulses.

Organization of this paper: In the next section, we discuss the empirical framework. We describe the structure of our SVAR model and present some technical considerations about the shock-identification procedure. In the third section, we discuss the nature of fiscal data in Thailand, consider their statistical properties, focus on the specification of the model, and present all key quantitative results obtained from our baseline study. The main highlight is the simulated impulse response functions and the estimated fiscal multipliers, both for government consumption and taxes. In the fourth section, we present some additional evidence that shows the robustness of our result. In the final section, we conclude our work, discuss some limitations, and envision the future path for future research agendas that could be explored.

2. An empirical model of fiscal policy: Identified fiscal shocks.

This section outlines a brief discussion on the identification of fiscal shocks using time series methods developed by Blanchard and Perotti (2003) and explain how to properly apply the technique in the context of Thailand. To systematically analyze this issue, we begin with considering a general specification of SVAR model given by:

$$A_0 y_t = \sum_{i=1}^{p_y} A_i y_{t-i} + \sum_{i=0}^{p_z} B_i z_{t-i} + D u_t \text{ --(1)}$$

where y_t represents a vector of n-endogenous variables, z_t represents a vector of m-exogenous variables, and u_t represents a vector of *i.i.d.* structural shocks. $\{A_i\}_{i=0}^{p_y}$, $\{B_i\}_{i=0}^{p_z}$ and D represent the "structural" coefficient matrix that governs the structural relationships in our structural VAR model.

To *parsimoniously* understand the interaction between fiscal factors and key domestic variable, define $y_t = (Gc_t, T_t, GDP_t)'$. This vector of economic variable includes Gc_t (real government consumption), T_t (total tax revenue), GDP_t (real GDP). It is natural to believe that a small open-economy is subjected to the foreign vulnerabilities. To incorporate some other independent sources of domestic fluctuations, define z_t as event-based variables or external variables that are considered as exogenous variables to the domestic economy. The general assumption given (1) is a parsimonious version of open-economy VAR model that could be used to analyze the implication of Thailand's fiscal policy.

To empirically parameterize (1), one usually rewrites the SVAR model in terms of its equivalent reduced-form version. The specification can be expressed as follows:

$$y_t = \sum_{i=1}^{p_y} A_i^* y_{t-i} + \sum_{i=0}^{p_z} B_i^* z_{t-i} + e_t \text{ --(2)}$$

where $A_i^* = A^{-1}A_i,\ B_i^* = A^{-1}B_i$ and $e_t = A^{-1}Du_t$ is the VAR innovations.

The reduced-form VAR (2) can be efficiently estimated by OLS and MLE. Given the efficient estimation techniques applied to (2), the reduced-form innovations e_t can be derived, and hence usable to recover the underlying structural shocks (u_t). This can be accomplished under certain identification assumptions. One procedure commonly used by many VAR studies is to assume the recursiveness among contemporaneous relationships of current-period aggregate variables and obtain the structural shocks by the Cholesky decomposition. However, for fiscal policy analysis, the choice of such a restriction becomes inappropriate. An alternative to the common recursive identification approach is to adopt the non-recursive structural restrictions instead. A famous one is owing to the contribution by Blanchard and Perotti (2003). According to their study, the author argued for the role of institutional features as a source to identify exogenous government spending and tax shocks. Considering the realistic features of institutional aspects, it is commonly believed that government spending typically responds to economic development with lag adjustment; meanwhile, the variations in tax revenue are contemporaneously tied to the fluctuation in real economic activities through the notion of an automatic stabilizer of fiscal and tax rules. Given these imposed institutional features, the imposed identifying restrictions can be mathematically represented by:

$$Ae_t = Du_t \quad \text{--- (3)}$$

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & A_{GDP}^{T} \\ A_{Gc}^{GDP} & A_{T}^{GDP} & 1 \end{bmatrix} \begin{bmatrix} e_t^{Gc} \\ e_t^{T} \\ e_t^{GDP} \end{bmatrix} = \begin{bmatrix} D_{Gc}^{Gc} & 0 & 0 \\ 0 & D_T^T & 0 \\ 0 & 0 & D_{GDP}^{GDP} \end{bmatrix} \begin{bmatrix} u_t^{Gc} \\ u_t^{T} \\ u_t^{GDP} \end{bmatrix},$$

where A_j^i captures the contemporaneous response of i-th variable to j-th variable, D_j^i is the direct impact of *i-th* structural shock on its corresponding innovation terms.

Because of the natural assumption on both decision and implementation lag of fiscal spendings, the representation above indicates that innovation in government consumption (e_t^{Gc}) is driven by the structural shocks of government consumption (u_t^{Gc}). Meanwhile, with the assumption on the automatic stabilizer of tax rule, A_{GDP}^{T} captures the feedback interaction of innovation of tax revenue (e_t^{T}) to the innovation in real economic activities, i.e. real GDP (e_t^{GDP}). The expected sign of the coefficient is negative. Lastly, innovations in both government consumption (e_t^{Gc}) and tax (e_t^{T}) should directly affect the innovation in the real GDP (e_t^{GDP}). The expected signs of each coefficient are negative and positive, respectively.

One difficulty is to casually parameterize (3) under the possible confounding relationship between aggregate activities and the tax rule. As Blanchard and Perotti argued in their work, parametrization of (3) requires some external information so that one can circumvent the famous endogeneity problem, which could distort the inference on the fiscal shocks and hence their implication. In their work, the author estimates the elasticity of aggregate tax to output from the weighted average of the elasticity of disaggregated tax revenue to output. As a limitation in the data, we slightly adapt their recommended approach and separately estimate the elasticity of tax to output with an ARDL-ECM model; the SVAR model then becomes an over-identified system. With this approach, the estimated figures should better reflect the contemporaneous relationship between current-period tax revenue and current-period than directly uncovering the relationship from the just-identified SVAR model.

3. **Estimation results**

3.1 Data and Measurement

In our baseline study, we use the data set between 2001Q1 and 2023Q1. The choice of this sample period of study is rationalized for at least two reasons. First, the selected period sufficiently covers at least three to four complete phases of Thai business cycles. Second, since 2001 Q1, Thailand has adopted an explicit inflation targeting policy with a flexible exchange rate. Therefore, the selected observation period should represent the current regime of the Thai economy. Table 1 below shows the complete list of aggregate variables used in the study, as well as the summary of the order of integration of each log-level series and their mnemonic.

Table 1 Data source, mnemonic, and summary of statistical properties

Data	Source and Construction methods	Order of integration*	Mnemonic	Transformation
Real GDP or Real Output	CEIC; originally collected by NESDB	I(1)	RGDP	Logarithm
Real Government consumption	CEIC; originally collected by NESDB	I(1)	RGC	Logarithm
Real Tax revenue	CEIC; Original series are compiled in nominal terms. There was a break in the measurement of government transfer data. As a result, we use the nominal gross rate as the proxy for tax revenue. We transform the data into real terms by dividing the nominal tax revenue by the GDP deflator. The obtained series are then adjusted seasonalized by X11 method.	I(1)	RGREV_SA	Logarithm
Trade-weighted GDP	Thailand's trade-weighted average log of real GDP. Data is taken from Mohaddes and Rasissi (2024)	I(1)	world_rgdp	Logarithm
Oil price	CEIC; averaged daily series in the respective quarter	I(1)	poil_dubai	Logarithm
Real Private consumption	CEIC; originally collected by NESDB	I(1)	RPC	Logarithm
Real Private investment	CEIC; originally collected by NESDB	I(1)	RPINV	Logarithm

Note: * We used an ADF statistic to assess each individual series' unit root property, assuming a constant and a linear trend model specification. The results in the table are based on the 5% threshold of significance.

We briefly summarize the salient features of the data used in our study. First, all series have exhibited positive trend growth. As plotted in figure 1 and summarized in table 2 below, the average historical growth of each series has been in line between 3% and 5%. In terms of their statistical properties, we tested for the presence of a unit root in each individual series and found that all have a unit root.

Secondly, in terms of their cyclical fluctuations, one notes that both private investment and tax revenue are highly volatile. Their standard deviations are two times higher than those of the real GDP. In terms of the co-movement properties, each aggregate series is procyclical to real GDP, with a positive correlation between real GDP growth and other aggregate indicators. However, the evidence for the procyclical behavior of government consumption is not strong. The correlation is low and statistically insignificant.

Thirdly, from a long-term point of view, each series is highly likely to be co-integrated. We note that the share of each aggregate variable in real GDP has been constant over time. Considering the period between 2001 and 2023, the average share of government consumption to real GDP, as well as that of tax revenue to real GDP, are around 14.5% and 18.6%, respectively. The long-term share of private consumption and private investment in real GDP has been around 53.6% and 18.3%, respectively. While the shares have fluctuated within a small range, we note a possibility of a structural break after 2008. There is slight evidence that there has been a shift in the share of government consumption to real GDP since the Global Financial Crisis (GFC) in 2008. The average figure marginally rose from 13.1% before the GFC to 15.4% after the GFC.

Figure 1: Historical growth of key aggregate variables

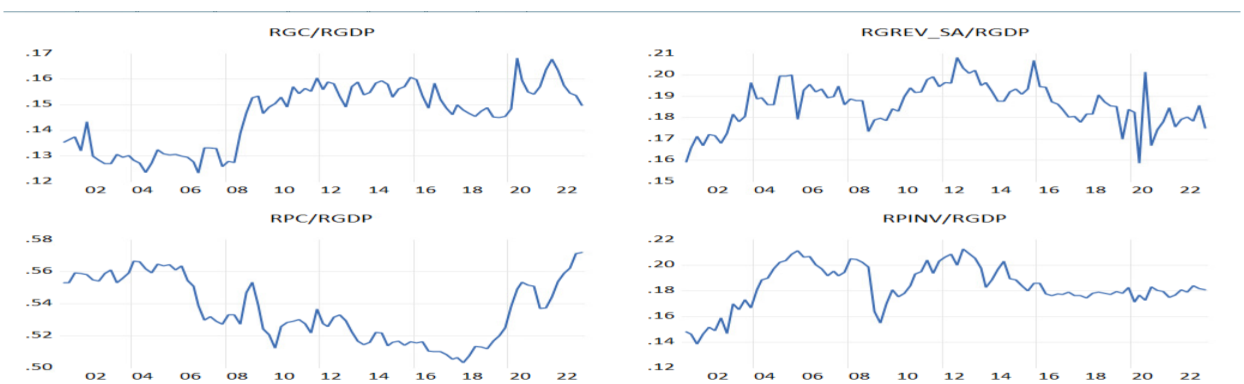
Note: (i) The symbol D(x) is referred to first difference of x. DLOG(x) is referred to first difference of log(x). The mnemonic of each variable follows the summary in table 1. (ii) The figures plot the annualized growth.

Table 2: Summary of business cycles properties

Data	Average growth (%)	S.D.	Cor(dlog(x), dlog(real GDP))	P-value
Real GDP or Real Output	3.22	0.020	-	-
Real Government consumption	3.62	0.029	0.120	0.258
Real Tax revenue	3.63	0.059	0.604	0.000*
Real Private consumption	3.36	0.017	0.831	0.000*
Real Private investment	4.21	0.049	0.493	0.000*
Trade-weighted real GDP	3.71	0.012	0.694	0.000*
Oil price	4.78	0.012	0.406	0.000*

Note: (i) Pairwise correlation statistic is calculated from the correlation between change in log-level of each aggregate series and change in log-level of real GDP. (ii) *, **, *** is referred to the significant level of 1%, 5%, and 10%, respectively.

Figure 2: Share of fiscal variables and GDP component to Real GDP and Average share



Variables	Measurement concept	2001 - 2008	2009 - 2023	2001-2023
RGC/RGDP	Government consumption to real GDP	13.10	15.41	14.58
RGEV_SA/RGDP	Tax revenue to real GDP	18.39	18.73	18.60
RPC/RGDP	Private consumption to real GDP	55.17	52.73	53.61
RPIV/RGDP	Private investment to real GDP	18.25	18.45	18.38

3.2 VAR Estimates and Structural coefficients

In our baseline specifications, we use the dataset between 2001Q1 and 2023Q1 and estimate the reduced-form VAR model. As each individual series has unit root, we then consider two specifications. One is the log-level estimation guided by the long-run relationship; meanwhile the other is the first difference of log-level specification. To the former, the model includes a simple linear time trend in each equation. To the latter, the model includes only constant terms. We treat trade-weighted real GDP and oil price as exogenous variables, and incorporate three dummy variables into both specifications, namely, DUM_GFC, DUM_FLOOD and DUM_COVID. Table 3 below summarizes the list of dummy variables.

Table 3: List of dummy variables

Dummy variables	Explanations	Periods
DUM_GFC	Periods under US subprime and Global Financial crisis in 2007 and 2008	2007Q4 - 2009Q1
DUM_FLOOD	Periods under flooding situation in Thailand	2011Q3 - 2012Q2
DUM_COVID	Periods under Lockdown and Travel restrictions during the COVID in Thailand	2020Q2 - 2021Q4

The optimal lag specification is determined using various criteria. The predicted choice of lag length varies between one lag and three lags, depending on the choice of inferential statistic. However, in the reporting analysis, we balance the choice of lag specification as suggested by the inferential statistic with the judgments over the limited sample size observation; we choose to estimate the model with two lag periods to sufficiently induce and capture the dynamic interaction among aggregate variables.

Given the estimated reduce-form VAR, we then identify the fiscal shocks along the line of Blanchard and Perotti; one imposes restrictions on the contemporaneous coefficient matrix as indicated in Section 2 above. In our work, the cyclical fluctuation of tax revenue to output is imposed using external information where the elasticity of tax to output is separately estimated by the ARDL model; see, e.g., Hill et al. (2022). To do this, we first performed a bound test to check if the cointegrating relationship exists under the possible mixture of data with I(0) and I(1). In the baseline sample periods, the F-statistic for the bound test is 3.68, while the size-dependent 10% significant threshold for the existence of the cointegrating relationship is 3.61. Given this, the ARDL-ECM model can be appropriately applied to the data. As shown in Table 4 below, the estimated coefficient of the contemporaneous relationship between tax and output obtained from the ARDL-ECM model is around 1.57.

Table 4: Estimates of Elasticity of tax to output

Periods	2001Q1-2023Q1	1993Q1-2023Q1	1993Q1 – 2000Q4
Estimates of Tax-Elasticity-to-output	1.57 * (0.170)	1.55 * (0.169)	0.83*** (0.48)

Note: The estimate is taken from the coefficient of the ARDL-ECM model. We pick the contemporaneous coefficient to represent the estimate of elasticity of tax to output. For the sample period between 1993Q1-2000Q4, the specification does not admit ARDL-ECM model. The model is estimated with ordinary first difference where we include four-period lagged variable of change in the log of real GDP in the equation.

*, **, *** denote the significant level of 1%, 5%, and 10%, respectively.

Given the calibrated elasticity of tax to output, table 5 below reports the estimates of our non-recursive SVAR model. We note first that the over-identifying restriction holds; from the reporting Chi-square statistic, we cannot reject the null hypothesis in both models. Secondly, the structural coefficients have their signs consistent with the expected direction, but with statistically insignificant value of $\boldsymbol{A_{Gc}^{GDP}}$ under the log-level specification. A guided interpretation of the coefficients reported in the table below is that innovation in government consumption positively impacts innovation in output. Meanwhile, innovation in tax negatively affects innovation in output.

Table 5: Estimates of Structural coefficients under baseline specifications

Coefficients	Log-Level specification		First-difference Specification	
	Value	Standard Error	Value	Standard Error
$\boldsymbol{A_{GDP}^{T}}$	-1.57	0.170	-1.57	0.170
$\boldsymbol{A_{Gc}^{GDP}}$	-0.03	0.024	-0.123**	0.058
$\boldsymbol{A_{T}^{GDP}}$	0.1***	0.055	0.101**	0.057
$\boldsymbol{D_{Gc}^{Gc}}$	0.065*	0.004	0.030*	0.002
$\boldsymbol{D_{T}^{T}}$	0.033*	0.002	0.032*	0.002
$\boldsymbol{D_{GDP}^{GDP}}$	0.015*	0.001	0.016*	0.001
Chi-square (1)	0.023 (*P-value: 0.6314*)		3.45 x 10^{-7} (*P-Value = 0.9995)*	

Note: (i) Each coefficient reported in the table is referred the structural coefficient matrix given by $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & A_{GDP}^{T} \\ A_{Gc}^{GDP} & A_{T}^{GDP} & 1 \end{bmatrix} \begin{bmatrix} e_t^{Gc} \\ e_t^{T} \\ e_t^{GDP} \end{bmatrix} = \begin{bmatrix} D_{Gc}^{Gc} & 0 & 0 \\ 0 & D_{T}^{T} & 0 \\ 0 & 0 & D_{GDP}^{GDP} \end{bmatrix} \begin{bmatrix} u_t^{Gc} \\ u_t^{T} \\ u_t^{GDP} \end{bmatrix}$, where all diagonal elements are normalized to one.

(ii) *, **, *** are referred to the significant level of 1%, 5% and 10%, respectively.

(iii) The coefficient A_{GDP}^{T} is estimated using the external information. The reporting values are taken from table 4 above.

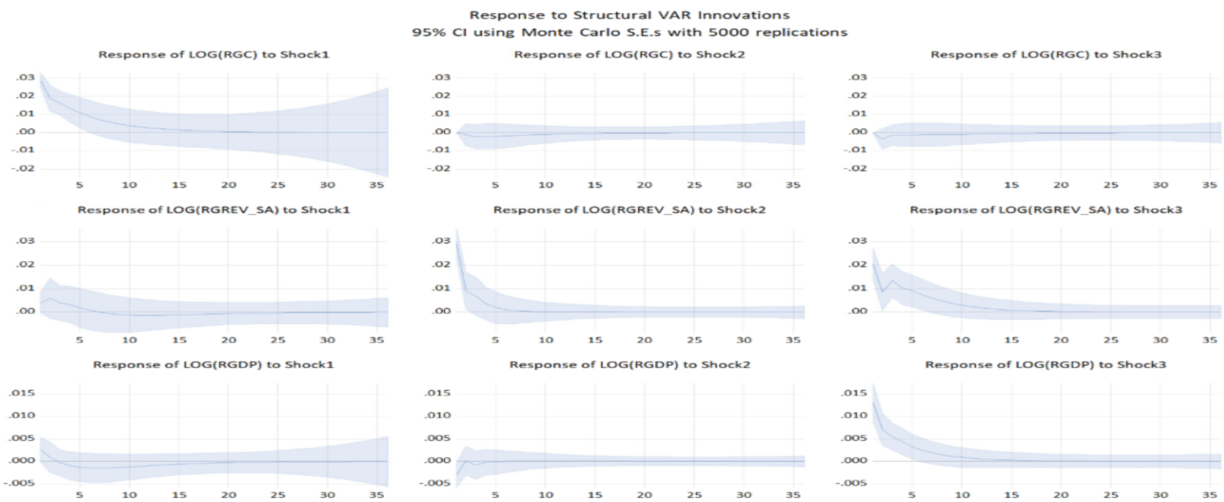
3.3 Dynamic responses under identified shocks

Following the estimated structural models presented in sub-section 3.2, we simulate the dynamic impulse response functions using the Monte Carlo technique. Figure 3 and Figure 4 below show the dynamic response of key aggregate variables to the identified shocks, namely government consumption shocks, tax shocks, and business cycle shocks.

The impact of government consumption shocks and tax shocks varies according to model specifications $(\log(x))$, as well as the impact horizon periods. Under the log-level specification, government consumption shocks generate a positive impact on output during the first couple quarters. The effect slowly disappears and becomes negative. Given the shaded area around the mean impulse response function representing the confidence interval, we argue that the impact is statistically insignificant. For tax shocks, the impact is to generate a recession. The decline in economic activities has been consistent throughout all impact horizon periods. Lastly, we note the evidence of strong business cycle shocks. In particular, the impact is found to be statistically significant at 95%, with the procyclical movement of tax revenue to the shocks and the countercyclical movement to the shocks. However, the response of government consumption to business cycle shocks is small and appears to be statistically insignificant.

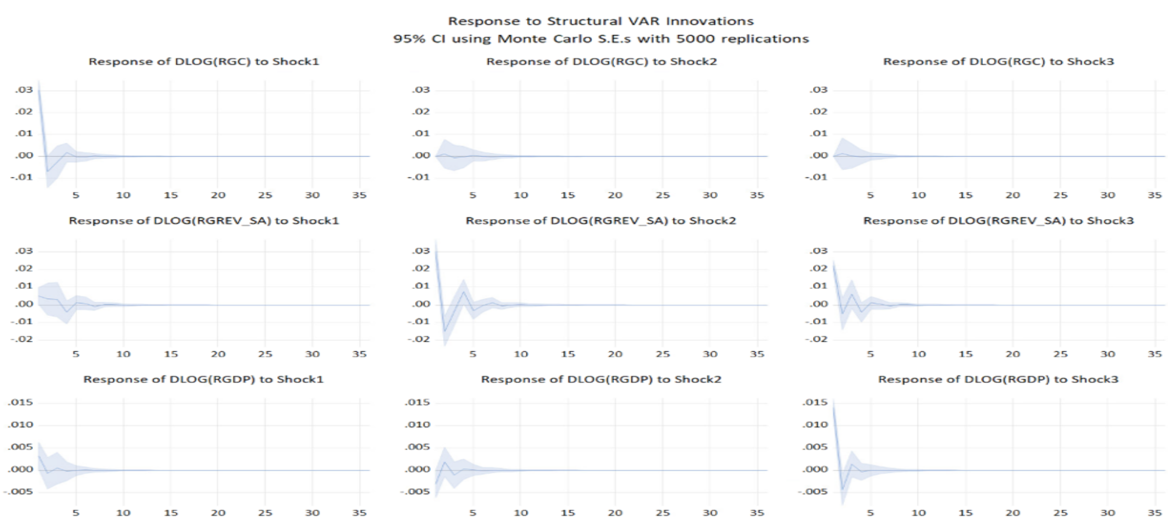
Under the first difference in log-level specification $(\Delta\log(x) \ or \ dlog(x))$, government consumption shocks positively generated a strong impact on output growth during the first two quarters. The effect then oscillates negatively and positively at the moderate level and is statistically insignificant; one can observe that the shaded 95% confidence interval of impulse responses lies below the zero line. A similar result can be found in the case of tax shocks. That is, tax shocks negatively generate a strong impact on output growth during the very short-term period. Then, in all subsequent periods, the effect becomes weaker and statistically insignificant. Closely related to the finding under the log-level specification, government consumption is insensitive to changes in the business cycle conditions; the impulse response function is close to zero and statistically insignificant under the first difference specification.

Figure 3: Responses of aggregate variables to identified shocks under the Log-Level specification



Note: Shock 1: government consumption shocks; Shock 2: tax shocks; Shock 3: output shocks. For the first row of the figure, each curve represents the dynamic response of the log of government consumption to each of the three identified shocks. For the second row of the figure, the curve represents the dynamic response of the log of tax revenue to each of the three identified shocks. Lastly, the curve shown in the last row represents the dynamic response of the log of real GDP to each of the three identified shocks. The shaded area for each impulse response provides the confidence interval band of 95%, obtained from 5,000 repetitive Monte Carlo simulations.

Figure 4: Responses of aggregate variables to identified shocks under the first-difference of Log-Level specification.



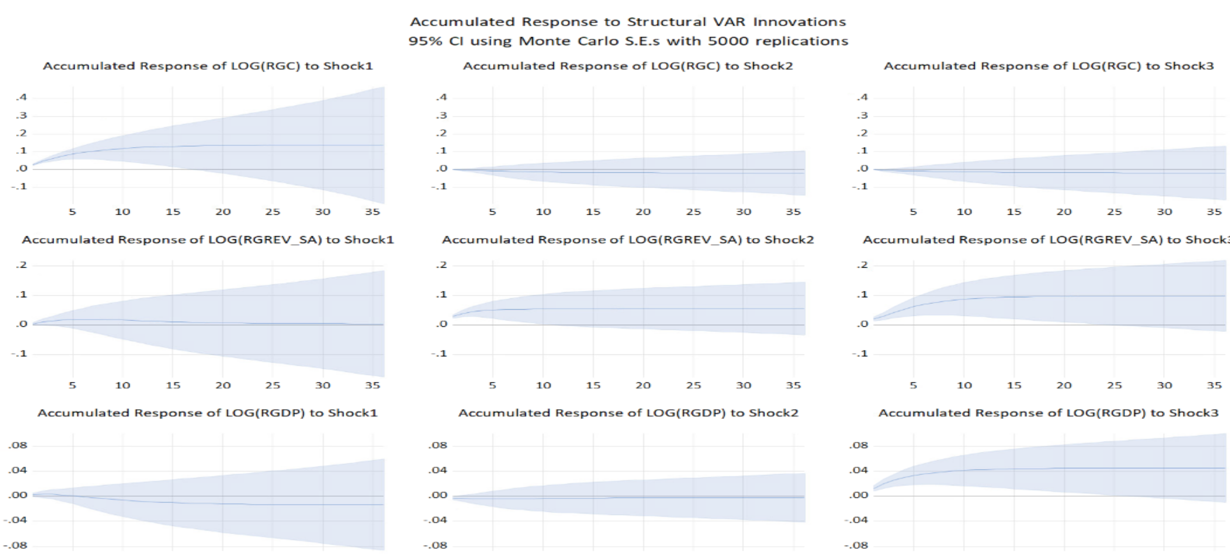
Note: Shock 1: government consumption shocks; Shock 2: tax shocks; Shock 3: output shocks. For the first row of the figure, each curve represents the dynamic response of the log of government consumption to each of the three identified shocks. For the second row of the figure, the curve represents the dynamic response of the log of tax revenue to each of the three identified shocks. Lastly, the curve shown in the last row represents the dynamic response of the log of real GDP to each of the three identified shocks. The shaded area for each impulse response provides the confidence interval band of 95%, obtained from 5,000 repetitive Monte Carlo simulations.

3.4 Accumulative effects of fiscal instrument shocks and fiscal multipliers

As illustrated in the previous subsection, fiscal shocks generate a persistent impact on aggregate output. To properly gauge the overall impact of each identified fiscal shock, it might be more meaningful to consider the accumulative result. Figures 5 and 6 show the dynamic path of the cumulative effect of each aggregate variable on the identified shocks. The path is constructed from Monte Carlo simulations, with the shaded area covering the 95% confidence interval bands.

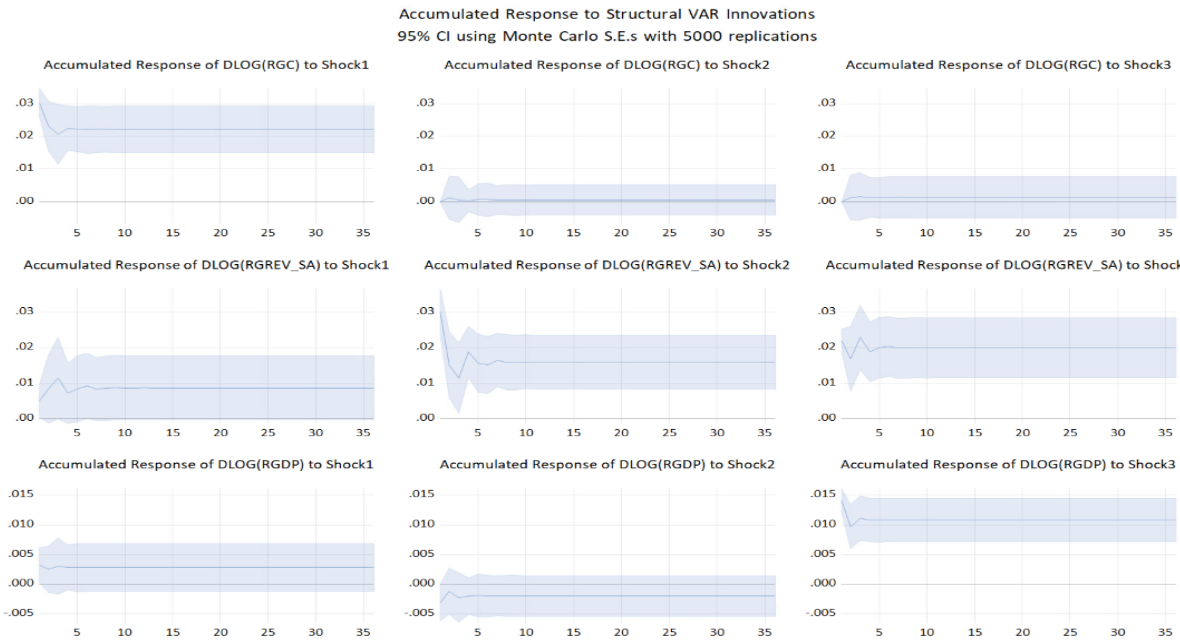
For the log-level specification, we found the accumulative effect of fiscal shocks on output insignificant. While the figure shows the negative cumulative effect of government consumption shocks on aggregate output, one cannot reject the hypothesis that the figure is not equal to zero. Against this backdrop, we argue that the impact of government consumption shocks is at best zero. When applying the analysis to the tax shocks, we found similar results where the cumulative effect of tax shocks was insignificant as well. Contrary to the results under the first-difference specification, aggregate output is positively impacted by government consumption shocks but negatively responds to tax shocks. The reporting cumulative effect, as shown in the figure, is significant at the 10% level.

Figure 5: Cumulative Responses of aggregate variables to identified shocks under the Log-Level specification.



Note: Shock 1: government consumption shocks; Shock 2: tax shocks; Shock 3: output shocks. For the first row of the figure, each curve represents the dynamic response of the log of government consumption to each of the three identified shocks. For the second row of the figure, the curve represents the dynamic response of the log of tax revenue to each of the three identified shocks. Lastly, the curve shown in the last row represents the dynamic response of the log of real GDP to each of the three identified shocks. The shaded area for each impulse response provides the confidence interval band of 95%, obtained from 5,000 repetitive Monte Carlo simulations.

Figure 6: Cumulative Responses of aggregate variables to identified shocks under the first difference of log-level specification



Note: Shock 1: government consumption shocks; Shock 2: tax shocks; Shock 3: output shocks. For the first row of the figure, each curve represents the dynamic response of the log of government consumption to each of the three identified shocks. For the second row of the figure, the curve represents the dynamic response of the log of tax revenue to each of the three identified shocks. Lastly, the curve shown in the last row represents the dynamic response of the log of real GDP to each of the three identified shocks. The shaded area for each impulse response provides the confidence interval band of 95%, obtained from 5,000 repetitive Monte Carlo simulations.

Supplementary to the accumulative dynamic response, a commonly used indicator that helps quantify the magnitude of fiscal impact is the *fiscal multiplier*. As argued in Mountford and Uhlig (2009), the impact of fiscal shocks on aggregate variables, both fiscal and non-fiscal ones, is typically persistent. Therefore, the fiscal multipliers should vary with the time horizon. Following the practice in ongoing literature, we define the *k-period ahead fiscal multiplier* as the ratio between the discounted sum of k-period ahead change in real GDP and the discounted sum of k-period ahead change in fiscal instrument, both of which are attributed to each corresponding fiscal shock. Given the annualized real interest rate, the mathematical formula for the fiscal multiplier at each given impact horizon period can be given by:

$$M_{rgc}^{RGDP}(k) = \frac{\sum_{k=1}^{T} \frac{\Delta RGDP_k}{(1+r)^{k-1}}}{\sum_{k=1}^{T} \frac{\Delta RGC_k}{(1+r)^{k-1}}},$$

where change in real GDP ($\Delta RGDP_k$) and change real government consumption (ΔRGC_k) are attributed to the identified government consumption shocks, and

$$M_{tax}^{RGDP}(k) = \frac{\sum_{k=1}^{T}\frac{\Delta RGDP_k}{(1+r)^{k-1}}}{\sum_{k=1}^{T}\frac{\Delta RGREV\_SA_k}{(1+r)^{k-1}}},$$

where change in real GDP ($\Delta RGDP_k$) and change real government tax revenue ($\Delta RGREV\_SA_k$) are attributed to the identified tax shocks.[2]

Table 6 below reports the output multiplier of government consumption and tax shocks at each given period of impact horizons. Under the log-level specification, the output multiplier of government consumption has been positive, but less than one, during the first four quarters (first year). The estimated figures then become negative at the end of the second year and eventually converge to the medium-run multiplier at -0.121. As can be observed from Figure 5 above, the cumulative impacts are not statistically significant at 95%. For the tax shocks, the instantaneous output multiplier is -0.545, suggesting a contractionary effect on output after a surprised increase in real tax. The estimated figures have remained negative for all impact horizons, with the medium-run output multiplier of tax around -0.557.

Having turned into the first-difference specification, the output multiplier of government consumption was 0.736 in the initial period. The figure quickly reaches its peak effect at 1.021 in the third quarter and gradually falls in all subsequent periods. The medium-run output multiplier of government consumption is 0.893. For the effect of identified tax shocks, the output multiplier is -0.545; the figure is the same as that estimated under the log-level specification. In line with the output multiplier of government consumption, the estimated figure of the tax multiplier peaks in the third quarter and gradually falls in all subsequent periods to reach its medium-run value of -0.656.

Given the reporting values explained above, we note two important points here. First, while the figure of the output multiplier slightly differs across alternative specifications, one should view these reporting statistics as evidence against the effectiveness of fiscal actions. In all cases, the multipliers are less than one, or at best moderately small. Second, the nature of the ways of the ways in which fiscal shocks affect the economy is concentrated in the first year. Indeed, from the reporting figures, we found that the first-year fiscal multiplier explains

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[2] Appendix 1 provides detailed method to convert the simulated impulse response function of log-level and change in log-level measurement into the cumulative multiplier of level variables.

80% to 90% of the overall medium-run value of the fiscal multiplier. This is evidence suggesting the short-lived impact of fiscal action as a countercyclical policy.

Table 6: Output multipliers under the baseline sample period (2001Q1 until 2023Q1)

Specification	Impact horizon (Quarters)	1	2	3	4	8	12	16	20
Level Estimation	Gc Multipliers	0.226	0.074	0.042	0.010	-0.069	-0.104	-0.116	-0.120
	Tax Multipliers	-0.543	-0.363	-0.367	-0.371	-0.446	-0.511	-0.542	-0.554
First Difference	Gc Multipliers	0.736	0.759	1.021	0.881	0.890	0.894	0.893	0.893
	Tax Multipliers	-0.545	-0.411	-1.057	-0.555	-0.653	-0.657	-0.656	-0.656

Note: The figures show the cumulative impact of an increase in one unit of real government consumption and one unit of tax shocks on real GDP. To convert the change in log-scaled variable into the change in level of each aggregate variable, we multiply the estimated log-scaled change with the reciprocal steady-stat ratio. Then, we discount the future change of each variable with 3% interest rate to obtain the output multiplier; calculated figures are not sensitive to the assumption on discount rate.

4) Some Extensions and Robustness Study

4.1 Impact of fiscal instruments on real private consumption and real private investment

A natural question arises: is the impact of fiscal shocks on each disaggregate component of real GDP large or small? To answer this question, we extend the baseline model and incorporate real private consumption and real private investment into the SVAR. To work with this experiment in a manageable fashion, each disaggregate variable is added to the original specification one at a time. The extended model is then used to trace out the dynamic multiplier of fiscal shocks on each disaggregate variable. Having applied the notion of the k-period ahead multiplier defined above, table 7 below reports the estimated figures for private consumption and private investment multipliers.

Table 7: Real private consumption multiplier and real private investment multiplier

Multiplier for	Impact horizon (Quarter)	1	2	3	4	8	12	16	20
Private consumption	Gc Multipliers	0.247	0.517	0.697	0.668	0.681	0.678	0.678	0.678
	Tax Multipliers	-0.536	-0.626	-1.342	-0.523	-0.747	-0.744	-0.741	-0.741
Private Investment	Gc Multipliers	0.264	-0.034	-0.001	0.165	0.110	0.104	0.105	0.105
	Tax Multipliers	-0.344	-0.062	0.498	-0.125	-0.002	0.002	0.001	0.001

Note: Figures are estimated under the sample observation between 2001Q1 and 2023Q1. We only report the main result under the first-difference specification.

As one may see, the dynamic impact of fiscal shocks on private consumption closely traces the effect as found in the output multiplier. The impact of both government consumption shocks and tax shocks on private consumption reaches its peak effect within three quarters. Then, the consumption multipliers slowly decline and eventually converge to 0.678 and -0.741 on the medium-term horizon (24 quarters), respectively. Both figures are in line with those of the output multipliers. On the other hand, government consumption and tax shocks weakly impact private investment. The multiplier at the initial period is smaller than those of the consumption multipliers. As the time passes by, the multiplier declines slowly and converges to 0.105 and 0.001 at the medium-term horizon (20 quarters). The figures are statistically significant at 95%. Against the two findings, we argue that both government consumption and tax shocks affect the aggregate fluctuations through the consumption channel; the effect through the private investment channel is trivial.

4.2 Effect of shocks under alternative detrending methods

As mentioned in Section 2, original data are classified as I(1) processes. Therefore, an appropriate method to handle trending components, as well as model specifications, should be carefully selected. As there are a number of methods to handle this issue, the choice of detrending method could potentially affect the inference of our analysis. To understand the effect of this issue, we performed the robustness test to check if the results varied with the choice of detrending method. That is, we estimated two alternative SVAR models. One is to construct the cyclical component from the HP filter, while the other is to derive the cyclical variables from linearly detrended data with multiple break points. The former is a non-linear filter that is commonly used in business cycle literature. However, the famous end-point problem issues could seriously affect the statistical inference of our study; see, e.g., Hamilton (2018). While a simple linear or quadratic detrending process might be advocated to partially resolve the end-point problem, there is several empirical evidences showing the changing nature of potential growth over time. The choice of the latter detrending method is therefore to recognize the drawback of the HP filter while at the same time recognizing the limitation over the size of sample estimates that prevents us from selecting a more efficient technique; see, e.g., Muller and Watson (2018).

Table 8 below summarizes the key figures of the estimated fiscal multiplier under alternative detrending methods. In terms of the directional relationship, the results show that fiscal multipliers behave differently across two alternative detrending methods. Government consumption shocks generate a positive impact on output, while tax shocks generate a contractionary effect. The magnitude of the government consumption multiplier remains small under both alternative specifications, comparable to the figures obtained from the first-difference specification. On the other hand, the impact of tax shocks identified under a linear trend with multiple break points is higher than that estimated from the other two models. While the size of the tax multiplier is greater than one, the magnitude of the medium-run effect remains moderate, around -1.45.

Table 8: Output multipliers under two alternative specifications for detrending methods

Detrending methods	**Impact horizon (Quarter)**	**1**	**2**	**3**	**4**	**8**	**12**	**16**	**20**
HP Filter	Gc Multipliers	0.636	0.505	0.335	0.234	0.180	0.174	0.174	0.174
	Tax Multipliers	-0.525	-0.388	-0.458	-0.484	-0.542	-0.548	-0.548	-0.548
Linear Trend with multiple break points	Gc Multipliers	0.696	0.710	0.431	0.262	0.295	0.294	0.294	0.294
	Tax Multipliers	-1.468	-1.839	-1.532	-1.452	-1.451	-1.450	-1.450	-1.450

Note: Figures are estimated under the sample observation between 2001Q1 and 2023Q1. In the first extended specification, each individual log-level series is detrended by the HP filter. Then the deviation from the log-level trended series is used to represent the cyclical component. For the extended multiple trend break model, each individual log-level series is fitted with a linear trend break specification. Multiple break points are detected by the method developed by Bai and Peron (1998).

5. Conclusions and Discussions

In this paper, we offer preliminary evidence on the impact of government consumption and tax shocks using a non-recursive SVAR identification method adapted from the seminal work by Blanchard and Perotti (2003). With some specificity on the characteristics of the Thai economy incorporated into the VAR model, our main findings are in line with literature addressing the effectiveness of fiscal policy. That is, we cast doubt on whether practical implementation of fiscal actions can be potentially effective at the aggregate level. As measured by the discounted accumulative effect over the medium run (5-year horizon), both aggregated GDP and some selected components have their multipliers that are less than one in most cases. The findings then offer evidence in favor of the Keynesian interpretation of Thailand's macroeconomic dynamic with a limited impact of fiscal actions.

While our study has revisited the classic issue and offered some results to the recent debate over fiscal programs, there is an issue that is worth pursuing further to better our understanding on the implication of fiscal policy in Thailand. The issue is a concern over the possibility of confounding shocks that are identified under the SVAR method. Admittedly, this problem can arise for at least two possible reasons. One is due to the insufficient number of variables included in the VAR model. The other is due to the anticipated effect of fiscal shocks, resulting in an invertibility problem between reduced-form VAR innovations and structural shocks. These are difficulties that have yet to be addressed in Thailand, even though some past research suggests that the main findings are less likely to be overturned (see, for example, Merten and Ravan (2010, 2011)).

To address the concerns raised above, future studies may use one of the three approaches and further analyze the robustness study. First, as argued in Yang (2005), one may incorporate financial or fast-responding variables into the VAR specification to alleviate the confounding problem. Second, one might work along the lines of local projections (Jorda 2005) to investigate both linear and non-linear effects of fiscal policies. Thirdly, recent advances in sign-restricted identification methods (Mountford and Uhlig 2009) can offer insights on the credibly identified impact of fiscal shocks, both anticipated and unanticipated. All these could potentially improve our understanding of the long-standing question, i.e., whether the argument on the limited effect of fiscal policy is firmly robust in Thailand.

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Appendix 1 Explanatory note on the calculated fiscal multiplier

The specification given by the two baseline SVAR models result in the following simulated accumulative impulse response function,

$$M_{\log(rgc)}^{\log(RGDP)}(k) = \frac{\sum_{k=1}^{T} \frac{\frac{\Delta \log(RGDP_k)}{\Delta u_{rgc,k=1}}}{(1+r)^{k-1}}}{\sum_{k=1}^{T} \frac{\frac{\Delta \log(RGC_k)}{\Delta u_{rgc,k=1}}}{(1+r)^{k-1}}}, \text{ and}$$

$$M_{\log(tax)}^{\log(RGDP)}(k) = \frac{\sum_{k=1}^{T} \frac{\frac{\Delta \log(GDP_k)}{\Delta u_{tax,k=1}}}{(1+r)^{k-1}}}{\sum_{k=1}^{T} \frac{\frac{\Delta \log(RGREV\_SA_k)}{\Delta u_{rgc,k=1}}}{(1+r)^{k-1}}},$$

where $\Delta u_{rgc,k=1}$ is the underlying structural shocks on real government consumption that arises in the initial period, and $\Delta u_{tax,k=1}$ is the underlying structural shocks on real tax revenue that arises in the initial period. The two proposed notion capture the idea of long-term cumulative elasticity of

As of the linearity assumption in the VAR model, we can impose, without loss of generality that $\Delta u_{rgc,k=1} = \Delta u_{tax,k=1} = 1.$ Note that the first-order Taylor's approximation yields us the following property, $\frac{\Delta \log(y)}{\Delta \log(x)} = \frac{\Delta y}{\Delta x} \times \frac{x}{y}$. Having applied this result to our analysis, one can show that the fiscal multipliers at each given impact horizon periods, evaluated as the stead-state ratio of fiscal variable to real GDP, can be given by,

$$M_{rgc}^{RGDP}(k) = \frac{\sum_{k=1}^{T} \frac{\Delta RGDP_k}{(1+r)^{k-1}}}{\sum_{k=1}^{T} \frac{\Delta RGC_k}{(1+r)^{k-1}}} = M_{\log(rgc)}^{\log(RGDP)}(k) \times \left(\frac{1}{RPC-to-RGDP\ ratio}\right),$$

$$M_{tax}^{RGDP}(k) = \frac{\sum_{k=1}^{T} \frac{\Delta RGDP_k}{(1+r)^{k-1}}}{\sum_{k=1}^{T} \frac{\Delta RGREV\_SA_k}{(1+r)^{k-1}}} = M_{\log(tax)}^{\log(RGDP)}(k) \times \left(\frac{1}{TAX-to-RGDP\ ratio}\right).$$