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Growth-Maximising Budget Deficit in BRICS-T: A Panel Threshold Approach

Abstract. *The budget deficit affects the sustainability of macroeconomic stability for both developed and developing countries, although the reasons for their occurrence differ. The importance of budget deficit varies depending on whether it supports or hinders economic growth. This paper aims to estimate the growth-maximising budget deficit ratio in BRICS-T countries empirically. To calculate the growth-maximising budget deficit ratio, the panel threshold approach was used from 1990–2021. According to findings, the BRICS-T countries can maximise economic growth by keeping their budget deficit between 0.66% and 3.30% of GDP. The findings of this research point to the importance of fiscal discipline and support for moderate budget deficits for fiscal policymakers of BRICS-T countries. Moreover, it can be stated that the Maastricht Criteria has an extremely critical value not only for the European Union but also for the BRICS-T countries.*

Keywords: *economic growth, budget deficit, BRICS-T countries, panel threshold.*

JEL Classification: O47, H61, H68.

1. Introduction

Fiscal policies play an important role in the economic management of developed and developing countries. The financing of public expenditures with public revenues is generally accepted in the implementation process of fiscal policies. However, public expenditure is higher than public revenue in most countries. Thus, budget deficits are frequently seen in developed and developing countries. For instance, the share of budget deficit in the gross domestic product (GDP) over the past two decades has averaged 4.80% in Japan, 4.29% in the United States, 3.51% in the United Kingdom, and 2.32% in France. Moreover, the share of the budget deficit in GDP is 4.42% in Bahrain, 3.58% in Jordan, 2.94% in Algeria, and 2.79% in Sudan (IMF, 2023). The share of the budget deficit in GDP is also remarkable for country groups. For example, the share of budget deficit in GDP on

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average has been 2.61% in developed economies, 2.1% in emerging markets and middle-income economies, and 0.85% in the European Region in the past two decades (Worldbank, 2023). In addition, the 2008 global financial crisis and the COVID-19 pandemic, which affected almost the entire world in the past twenty years, had a damaging effect on the budget deficit. In other words, the governments responsible for protecting and increasing the welfare of society increased their public expenditures against these negative shocks, and budget deficits emerged at unprecedented levels for some economies. For example, while the share of budget deficit in GDP in the past two decades was 2.82% in Spain, it increased to 9.96% and 8% in 2009 and 2010, respectively, following the 2008 global financial crisis. Similarly, while the budget deficit in Portugal was 1.73% annually in the past two decades, it reached 7.16% and 8.68% in the years following the global financial crisis. The share of the budget deficit in GDP has been -0.36% in Germany in the past twenty years; however, in 2020 and 2021, the share of budget deficits in GDP in Germany increased rapidly due to the COVID-19 pandemic and reached 3.90% and 3.28%, respectively. Additionally, while the average share of budget deficit in GDP in South Korea in the past two decades was -0.53%, this value increased to 2.71% and 0.38% in 2020 and 2021. The same value in Israel was 0.22% on average in the past two decades, but it increased to 8.88% and 1.80% in 2020 and 2021 (Worldbank, 2023).

The differing budget deficit between countries has made it necessary for organisations such as the European Union (EU), which aims to be relatively consolidated in terms of economy and which is based on a monetary union, to take the initiative. Within the framework of this obligation, the member states of the EU came together in the Netherlands in December 1991 and signed the Maastricht Treaty. The treaty aimed to achieve a full monetary union at the end of the decade (Baun, 1995–1996). The policies to be followed in the first phase of the Economic and Monetary Union and the institutional changes necessary for their implementation were specified in this treaty.

In the second phase of the Economic and Monetary Union (January 1994–December, 1998), a great effort was made to achieve convergence between the member states' economies. For this reason, four measurement criteria were determined in the Maastricht Treaty: low inflation rates, stable exchange rates, low-interest rates, and sound public finances for all EU member states (Baimbridge et al., 1999). According to the Maastricht criteria, the sustainability of public finances is achieved by obtaining the government's budget position without excessive deficits. In implementing the relevant criterion, the Commission, while presenting its annual recommendations to the Council of Finance Ministers, examines compliance with the budget discipline based on two criteria: public debt and budget deficit. According to the budget deficit criteria, the share of the budget deficit in the economy in GDP should not exceed 3% at the end of the previous fiscal year. Otherwise, this rate should be reduced rapidly to nearly 3% (Polasek and Amplatz, 2003). By the mid-1990s, EU member states achieved a high degree of convergence. However, the article on the Maastricht criterion related to the fiscal sustainability of the public

sector negatively affected the new member states because the new member countries have less developed economies than the existing member countries. In addition, while production and labour productivity are high in the existing members, the production composition is not settled, and labour productivity is low in the new member countries. These countries have incurred high public expenditures to strengthen infrastructure, build institutional structuring, and achieve sustainable growth. Although the conditions in the Maastricht criteria seem clear, flexibility has been provided in practice. For example, the share of the budget deficit in GDP in Italy was about 9% between 1991–1996. The European Commission accepted the promise that the share of the budget deficit in GDP would be below 3% in 1997 and 1998 as the criteria for Italy's admission to the European Monetary Union (Mihaljek, 2004).

The Maastricht criterion is important for admission to the European Monetary Union. So, can this criterion be decisive as a macroeconomic performance indicator for many countries or country groups globally? Can the public sector's financial sustainability be guaranteed by taking the Maastricht criteria as a reference? To answer these questions, BRIS-T countries should be investigated. Although these countries are not EU members, they are critical to the world economy. For example, the total GDP of the BRICS-T countries in 2021 was $25.5 trillion. This value is 26.4% of the world's total production. In 2021, BRICS-T countries were above the average world economic growth level of 5.9%, with an average of 7%. The BRICS-T countries constitute approximately 42% of the world's population and realise approximately 21% of total global exports (IMF, 2023; World Bank, 2023). The budget balance values of the BRICS-T countries, which are extremely important for the global economy, in the past 20 years are shown in Figure 1.

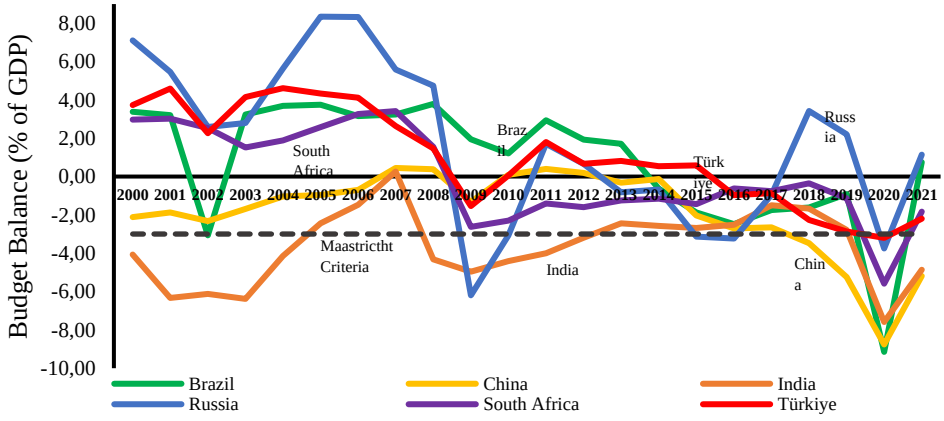

Figure 1. Budget balance in BRICS-T countries from 2000 to present
Source: IMF (2023).

Figure 1 shows the budget balance values for the BRICS-T countries. Accordingly, although the budget balance gives a surplus or deficit depending on

each country's internal dynamics, the devastating effect of two major shocks – the 2008 global financial crisis and the COVID-19 pandemic – on all economies is evident. In fact, when the BRICS-T countries are examined individually, only India and Russia deviated from the Maastricht criterion during the 2008 financial crisis. Moreover, these two countries quickly recovered their budget deficits and converged to the critical value again. However, the COVID-19 pandemic's impact on all countries was much more devastating. For example, the share of the budget deficit in GDP in China and Brazil increased up to 10% following the pandemic. The view of the budget performance that emerges from examining the BRICS-T as a group of countries appears in Figure 2.

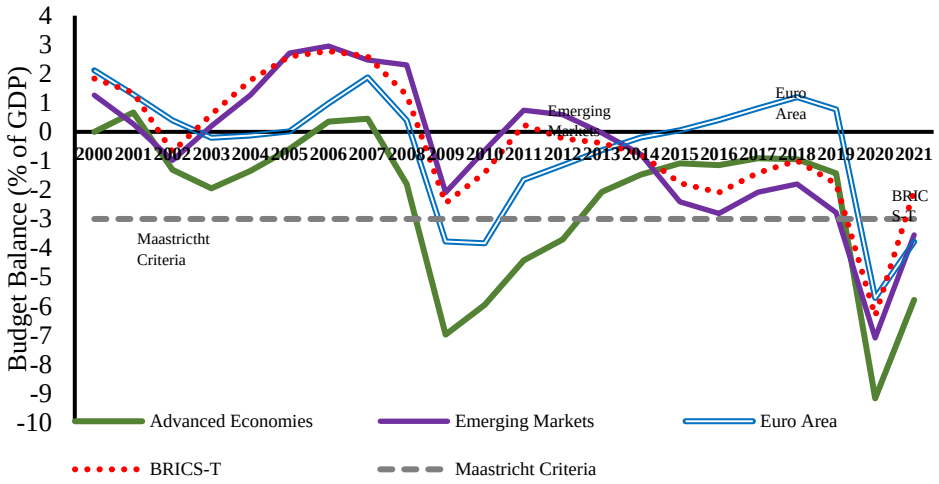

Figure 2. Comparison of budget performance of BRICS-T countries and different country groups
Source: IMF (2023).

Figure 2 shows the share of the budget balance in GDP for emerging markets, developed economies, EU economies, and BRICS-T countries. Accordingly, the country group that showed the worst budget performance in the two shocks in the past two decades is the group of developed economies. In the European Region, where the budget deficit criterion is valid, the budget balance quickly recovered during shock periods. In other words, it is noteworthy that the deficits that emerged due to the shock in the European Region tend to quickly return to the critical level of 3% within the scope of the criteria. As stated above, the budget deficit to GDP ratio differs in developed and developing countries. In some countries, the budget has a surplus, while in others, it has a constant deficit. Although the budget deficit-to-GDP ratios are small in some country groups, budget deficit shares are at serious levels in other country groups. In addition, the effects of shock periods on the budget also vary between countries or country groups. The values being so variable raises the question of whether there is an optimal budget deficit level for the economies.

The EU states that this rate should not exceed 3% within the scope of the Maastricht criteria to ensure the Monetary Union. At this point, the question "Is the 3% value only valid for EU member economies, or is it the optimal level for all economies?" is extremely important. Several empirical studies on this subject exist for individual countries and country groups. However, this question has not been explored for the BRICS-T countries, which are vital in the world economy. The primary motivation of the research is to contribute to the literature. Another motivation is the possibility of opening a policy debate with the calculation of the optimal budget deficit value for the BRICS-T countries. In accordance with these motivations, the research's main purpose is to estimate the budget deficit value range that maximises economic growth in BRICS-T countries and to guide policymakers as a result of empirical findings. In an analysis carried out for this purpose, panel threshold analysis is applied with the help of annual data between 1970–2021.The paper is organised as follows: the next section provides a brief overview of the literature, Section 3 defines the data, and methodology; Section 4 contains analysis and the empirical results; and Section 5 includes conclusion and recommendations.

2. Literature

There have been some theoretical discussions on the economic effects of the budget deficit. These discussions; the budget deficit affects the economies negatively, the budget deficit has no effect on the economies, and the budget deficit affects the economies positively. In addition, the developments in statistics and the regular publication of data enable the effects of budget deficits on the economy to be examined empirically. In this section, first, theoretical discussions on budget deficits are summarised, and then the relationship between budget deficit and macroeconomic indicators is shown in empirical studies.

2.1 Theoretical Literature

The public sector budget balance in an economy in the t period is as follows. Public expenditures are shown on the left side of the equation, and public financing sources are shown on the right.

$$G_t + r_t D_t \equiv T_t + \Delta D_t + \Delta M_t \quad (1)$$

In this expression, G_t is government expenditures in period t, $r_t D_t$gives the real interest rate $r_t$times total accumulated government debt D_t, T_t is total tax revenue, $\Delta D_t = D_{t+1} - D_t$ is the change in the stock of government debt, and ΔM_t; is the change in the money stock that is used for financing the government deficit. The left side of the equation shows expenditures. This side includes public expenditures and interest payments. If the public debt is high, interest payments will constitute a large part of total expenditures. The right-hand side of the equation shows public revenues. A main part of public expenditure is financed by taxes (T_t). However, when taxes are not high enough, public debt (ΔD_t) may be preferred to finance budget deficits.

In addition, governments can finance their budget deficits by increasing the money supply. In other words, the public sector can increase the money supply (ΔM_t)[1]. Equation (2) can be reached if Equation (1) is rearranged for the public sector budget deficit dynamics.

$$\Delta D_t \equiv (G_t - T_t) + r_t D_t \tag{2}$$

The term in parentheses is often referred to as the primary deficit. Budget deficits are directly related to the change in the public debt stock. In other words, budget deficits imply that $\Delta D_t > 0$, whereas budget surpluses imply a decreasing stock of debt $\Delta D_t < 0$.

Budget deficits are generally financed by governments' issuing bonds that are sold to households and that give their holder an interest rate of (r_t) every year. If the total debt is financed by bonds, the budget deficit (D_t) equals the stock value of all outstanding bonds. It is often assumed that government revenues and expenditures should add up in the long run. Therefore, a sustainable long-term fiscal policy should satisfy the conditions of Equation 3.

$$\sum_{t=1}^{\infty} \frac{G_t}{(1+r_t)^t} + D_0 \leq \sum_{t=1}^{\infty} \frac{T_t}{(1+r_t)^t} \tag{3}$$

According to Equation (3), for the budget balance in the infinite time horizon, the sum of the present value of future public expenditures and the initial debt level should not exceed the present value of all future tax revenues (Olsson, 2012).

2.1.1 Ricardian View

Should budget deficits be financed by higher taxes or bonds? This question forms the basis of the Ricardian equivalence literature pioneered by Barro (1974). The Ricardian equivalence analysis begins with an assumption about the intertemporal budget constraint of a household living in the infinite time dimension:

$$\sum_{t=1}^{\infty} \frac{c_t}{(1+r_t)^t} \leq d_0 + \sum_{t=1}^{\infty} \frac{y_t - \tau_t}{(1+r_t)^t} \tag{4}$$

In the model, the present value of lifetime consumption expenditures should not exceed the present value of the sum of disposable income (labor income [y_t] minus income taxes [τ_t]) plus the initial stock of bonds (d_0). If the economy is made up of L identical individuals, we can express the individual's constraint in Equation (4) in terms of $C_t = c_t L$, $D_0 = d_0 L$, $Y_t = y_t L$ ve $T_t = \tau_t L$. Moreover, when Equation (2)

[1] However, $M_t = 0$ is assumed because this situation rarely occurs especially in developed economies.

holds with equality, we know that $\sum_{t=1}^{\infty} T_t/(1+r_t)^t = \sum_{t=1}^{\infty} G_t/(1+r_t)^t + D_0$. Inserting this expression into (4) gives us:

$$\sum_{t=1}^{\infty} \frac{C_t}{(1+r_t)^t} \leq \sum_{t=1}^{\infty} \frac{Y_t}{(1+r_t)^t} - \sum_{t=1}^{\infty} \frac{G_t}{(1+r_t)^t} \tag{5}$$

According to Equation (5), the household's budget constraint is a function of the present value of public expenditures. The most important point to note in the model is that the time of taxation is not included in this equation. Therefore, it is not important for households to finance budget deficits with bond sales or taxes. Because in the model, the increase in disposable income from the temporary tax cut is saved to pay higher taxes in the future. This is the main result of the Ricardian equivalence hypothesis (Olsson, 2012). Finally, according to the Ricardian view, successive generations are linked through voluntary, altruistically motivated resource transfers. Under certain conditions, this refers to consumption is determined as a function of dynastic resources (that is, the total resources of a taxpayer and all of his descendants). As deficits merely shift the payment of taxes to future generations (the present discounted values of taxes and expenditures must match), they leave dynastic resources unaffected. Therefore, the budget deficit policy creates indifference (Bernheim, 1989).

2.1.2 Keynesian View

In the history of the world, before the 1930s, economies were based on a balanced budget. It is even known that before the 1930s, the budget surplus was given rather than the budget deficit. Budget surpluses, which were considered normal before the Great Depression, were used to cover the public debt incurred during times of war and recession. For example, the US government ran a budget deficit during recessions to cover the costs of wars and declining tax revenues. However, the government reduced the budget deficit by increasing taxes in the absence of wars, and even preferred the budget surplus again (Buchanan and Wagner, 1978).

According to Keynes, the amount of disposable income and consequent consumption can be increased with an expansionary fiscal policy implemented by increasing public expenditures or reducing tax rates (Brown-Collier and Collier, 1995). With this thought, Keynes emphasises the role of government in strengthening and stabilising the economy. According to Keynes, the biggest problem of a free economy is the lack of aggregate demand, which causes stagnation and inefficient use of resources. Public expenditures are needed to solve this problem and increase aggregate demand. Contrary to Ricardo's views, Keynes offers an encouraging view of the budget deficit, believing that even inefficient public expenditures in the economy will have a positive effect on the economy (Kettl, 1992).

2.2 Empirical Literature

In the period following the theoretical discussions on the budget deficit, especially in the 1990s, as a result of the developments in statistics and econometrics, researchers had the opportunity to examine the macroeconomic effects of the budget deficit empirically. Since then, many studies have examined the relationship between budget deficit and economic growth. Table 1 provides a summary of these studies in the literature.

Table 1. Literature of the effects of budget deficit on economic growth

Author(s)	Period	Country/ Region	Method(s)	Findings
Cebula (1991)	1971-1985	USA	2GLS	Budget deficits lead to slower economic growth.
Ewing and Yanochik (1999)	1977-1991	İtaly	Johansen Cointegration	Budget deficits prevent long-term economic growth.
Roy and Berg (2009)	1973-2004	USA	2SLS and 3SLS	An increase in budget deficits slows economic growth, but the current account deficit that accompanies the budget deficit increases economic growth.
Afonso and Alegre (2011)	1971-2006	15 EU countries	Panel ARDL	Budget deficit has a positive effect on economic growth in the long run.
Milojević et al. (2016)	2001-2011	Serbia	OLS	Budget deficits, which trigger inflation with the monetization process, have a negative effect on economic growth.
Bhari et al. (2020)	1980-2017	Malaysia	OLS, Granger Causality	Budget deficit has a positive effect on economic growth.
Sethi et al. (2020)	2001-2017	16 States in India	Panel Threshold	The budget deficit level that supports economic growth is between 3% and 3.9%.
Mavodyo (2023)	1975-2020	South Africa	Dynamic OLS	Budget deficits negatively affect economic growth. Causality is unidirectional from budget deficits to economic growth.

Note: The literature table consists of articles published in the journals at https://www.webofscience.com and prepared by authors.
Source: https://www.webofscience.com.

As stated in Table 1, many studies have been conducted on the effects of the budget deficit on economic growth since the 1990s. These studies differ from each other in terms of the period, sample group, and analysis method. In addition to these studies, many studies have examined the effects of budget deficits on alternative macroeconomic variables. Although the relationship between budget deficit and economic growth has been examined in many studies, it seems that the growth-

maximising budget deficit ratio is still worth researching. This research contributes to the literature in this direction.

3. Data and Methodology

The objective of this study is to determine the optimal budget deficit that maximises growth for the BRICS-T countries. The variables are selected on information from the Keynesian and Ricardian equation theories. These variables include the growth ge (government expenditure), ns (national savings), inv (total investment), inf (inflation rate), bd (budget balance), labo (employment rate), open (trade openness), exch (real exchange rate), and rate (real interest rate). Furthermore, the variable m2 represents the money supply. As some variables have missing observations between 1990 and 1995, these were obtained using the Cubic Hermite Spline interpolation method. A total of 17 observations were obtained using this method.

Our analysis followed a specific procedure. First, we carried out stationarity analyses of the cross-sectional dependence of our dataset. Then we used Pooled OLS (POLS), Fixed Effect (FE), Random Effect (RE), and Feasible Generalized Least Squares (FGLS) regression models to determine the pure relationships between the variables. The next step was to determine the threshold number. After determining this number, we determined the threshold value. We tried to determine the effect of the variables and the threshold range on growth by creating a dummy variable with this value and building new regression models. We applied diagnostic tests to each regression model and finally tested the reliability of the threshold value obtained using LR statistics. Our dataset is summarised as shown in Table 2.

Table 2. Summary information on variables

Variable	Code	Measure	Data Source
Economic Growth	$growth$	Growth Increase Rate	World Bank
Government Expenditure	ge	Government Expenditure (percent of GDP)	IMF
Gross Savings	gs	Gross Savings (percent of GDP)	World Bank
Investment	inv	Total Investment (percent of GDP)	Nasdaq Data Fabric
Inflation	inf	Inflation Rate (Consumer Prices)	World Bank
Budget Balance	bb	Net fiscal position (percent of GDP)	IMF
Labor Force	$labo$	Labor Force participation rate (percent of total population ages 15+)	World Bank
Trade	$open$	Trade (percent of GDP)	World Bank
Real Effective Exchange Rate	$exch$	REER (Cpi Based, Broad 64 Economies)	BIS (Bank for International Settlements) and Bloomberg Terminal
Real Interest Rate	$rate$	Lending Interest Rate (Adjusted for CPI)	IMF and Bloomberg Terminal

Variable	Code	Measure	Data Source
Money Supply	$m2$	Broad Money (percent of GDP)	IMF
Negative Economic Shocks	nes	1991-1993 Brazil and Russia; 1994, 2000-2001 Turkey; 2008-2009 each country; 2020-2021 each country; The *"nes"* variable was coded as 1 for the specified periods and countries.	
Countries: Brazil, China, India, Russia, South Africa, Turkey; Sample Period: 1990-2021; Data Interval: Annual; Technique for filling in missing data: Cubic Hermite Spline			

Source: Parameters used by authors.

The static panel threshold regression model that Hansen (1999) developed is used to determine the threshold value of the budget balance share in GDP. This model classifies the budget balance by dividing it into two separate regimes, below and above the threshold value. The mathematical formulation of the model is as follows:

$$growth_{it} = \beta_{11} + \beta_{12}(bb_{it})I(bb_{it} \geq \gamma) + \beta_{13}(bb_{it})I(bb_{it} < \gamma) + \alpha X_{it} + \mu_i + e_{it}$$

Here, X_{it} is the control variables; γ is the threshold value; μ_i is the fixed effects representing the heterogeneity of countries with different budget balance values; e_{it} is the error term that is independent and identically distributed ($e_{it} \sim iid(0, \sigma^2)$).

4. Analysis and Empirical Results

The descriptive statistics of our balanced panel data with 192 observations, consisting of 6 countries and 32-time dimensions, are shown in Table-3.

Table 3. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
growth	192	4.336	4.453	-12.918	14.231
ge	192	30.042	7.115	11.095	44.037
ns	192	26.019	10.117	12.251	51.788
inv	192	26.148	8.769	13.84	48.01
inf	192	73.18	326.383	-1.4	2947.7
bb	192	-3.878	3.953	-13.318	7.804
labo2	192	60.573	7.896	45.52	79.17
open	192	41.993	14.312	15.156	110.577
exch	192	97.665	24.916	47.952	179.74
rate	192	14.36	38.102	-39.1	222.788
m2	192	71.147	43.051	22.5	211.892

Source: Calculation made by authors.

According to this table, the growth range for the BRICS-T countries is between -12.92% and 14.23%. The budget balance is in the range of -13.32% and 7.8%.

In Hansen's (1999) panel threshold regression, the stationarity of the variables is essential to avoid the spurious regression problem. The first step is to determine the cross-sectional dependence to analyse the stationarity of the variables. In this study, we used the Breusch-Pagan (1980) and Pesaran (2004) tests to assess the

cross-sectional dependence. These three methods involve different approaches, such as different assumptions about the cross-sectional and time dimensions and correcting for potential biases by adding variance to the test statistics (Mercan and Karakaya, 2015). The statistics of these analyses are presented in Table 4.

Table 4. Analysis of cross section dependency

Test	Statistic	p-value
LM	16,9	0,3250
LM adj*	-,3947	0,6930
LM CD*	1,926	0,0541

*two-sided test, Bias-adjusted LM test of error cross-section independence, H_0: Cov(μ_{it}, μ_{jt}) = 0 for all t and i!=j

Source: Calculation made by authors.

First-generation stationarity tests are usually used in models without cross-sectional dependence, while second-generation tests are preferred when cross-sectional dependence exists (Pesaran, 2007). In this study, we decided to use the IPS (Pesaran and Shin, 2003) and LLC (Levin et al., 2002) stationarity tests. This is because there is no cross-sectional dependence in our data set. Stationarity test statistics are shown in Table 5.

Table 5. Stationary analysis

	Pesaran-Shin Test		Levin-Lin-Chu Test		
Variable	**Level W Statistics [p-value]**	**Difference W Statistics [p- value]**	**Level t^* Statistics [p-value]**	**Difference t^* Statistics [p- value]**	**Result**
growth	-5.105^{***} [0.00]	-10.78^{***} [0.00]	-3.999^{***} [0.00]	-5.214^{***} [0.00]	$I(0)$
ge	-1.336^{*} [0.09]	-6.872^{***} [0.00]	-0.495 [0.31]	-5.298^{***} [0.00]	$I(1)$
ns	-1.721^{**} [0.04]	-6.137^{***} [0.00]	-1.605^{*} [0.05]	-4.576^{***} [0.00]	$I(1)$
inv	-1.929^{**} [0.03]	-7.406^{***} [0.00]	-2.357^{**} [0.01]	-7.019^{***} [0.00]	$I(0)$
inf	-2.690^{***} [0.00]	-12.821^{***} [0.00]	-2.954^{***} [0.00]	-12.67^{***} [0.00]	$I(0)$
bb	-1.098 [0.14]	-8.137^{***} [0.00]	-1.094 [0.14]	-5.517^{***} [0.00]	$I(1)$
labo2	2.129 [0.98]	-3.659^{**} [0.00]	2.739 [0.99]	-11.31^{***} [0.00]	$I(1)$
open	-1.104 [0.13]	-10.70^{***} [0.00]	-1.099 [0.00]	-12.84^{***} [0.00]	$I(1)$
exch	0.181 [0.57]	-7.775^{***} [0.00]	-0.366 [0.36]	-7.162^{***} [0.00]	$I(1)$
rate	-4.212^{***} [0.00]	-8.542^{***} [0.00]	-3.290^{***} [0.00]	-7.590^{***} [0.00]	$I(0)$
m2	2.727 [0.99]	-6.462^{***} [0.00]	0.240 [0.59]	-5.372^{***} [0.00]	$I(1)$

Source: Calculation made by authors.

An examination of Table 5 shows that the variables growth, inv, inf, and rate are stationary at the level, while the other variables are stationary at the first difference. After these findings on the stationarity of the series, the relationships between the variables were determined by means of POLS, FE, RE, and FGLS regressions without the addition of the threshold variable to the model (Table 6).

Table 6. Results of regression models

Variable	POLS	FE	RE	FGLS
ge	$-,2886^{***}$ (0.048)	$-,1896^{***}$ (0.039)	$-,2016^{***}$ (0.045)	$-,2847^{***}$ (0.032)
Δgs	$,1056$ (0.158)	$,0425$ (0.134)	$,0477$ (0.13)	$,1301$ (0.147)
Δinv	$,3687^{***}$ (0.135)	$,3899^{***}$ (0.114)	$,3885^{***}$ (0.111)	$,4670^{***}$ (0.12)
inf	$-,0015$ (0.001)	$-,0020^{*}$ (0.001)	$-,0019^{*}$ (0.001)	$-,0001$ (0.001)
Δbb	$,3423^{**}$ (0.154)	$,3347^{**}$ (0.131)	$,3337^{***}$ (0.127)	$,3873^{***}$ (0.126)
$\Delta labo$	$-,0700$ (0.266)	$,0188$ (0.226)	$,0090$ (0.219)	$-,0872$ (0.236)
$open$	$,0104$ (0.023)	$,0651^{***}$ (0.024)	$,0603^{***}$ (0.023)	$,0172$ (0.019)
$\Delta exch$	$,0352$ (0.033)	$,0233$ (0.028)	$,0239$ (0.027)	$,0565^{**}$ (0.026)
$rate$	$,0082$ (0.011)	$,0133$ (0.01)	$,0131$ (0.01)	$,0045$ (0.007)
$\Delta m2$	$-,0555$ (0.039)	$-,0779^{**}$ (0.034)	$-,0765^{**}$ (0.033)	$-,0446^{*}$ (0.026)
nes	$-1,441^{**}$ (0.713)	$-1,973^{***}$ (0.609)	$-1,929^{***}$ (0.59)	$-1,317^{**}$ (0.576)
$constant$	$12,99^{***}$ (1.471)	$7,807^{***}$ (1.656)	$8,363^{***}$ (1.784)	$12,83^{***}$ (1.286)
**** p<.01, ** p<.05, * p<.1* *Robust standard errors in parentheses.*				
F Test: F(11, 174) = 12.44 Prob > F = 0,000 *Breusch Pagan Test: chi2(11) = 59.25 Prob > chi2 = 0,000* *Hausman Test: chi2(11) = 38.83 Prob > chi2 = 0,0001* *Mean VIF: 1.48* *Wald Test: chi2(6) = 102,61 Prob > chi2 = 0,0001* *Woolridge Serial Correlation Test: F(1, 178)=297.52 Prob > F = 0,0000*				

Source: Calculation made by authors.

According to Table 6, budget balance and investment have a positive and statistically significant effect on growth in all models. On the contrary, government expenditure and negative economic shocks negatively and statistically significantly affect growth rates. After testing the variables that trigger economic growth using different models, we conducted a threshold analysis to determine the value at which

the budget balance maximises growth. As a result of the analysis, we found that only one threshold is appropriate for the data set (Table 7).

Table 7. Determining threshold number

Threshold Variable	Sequence	Threshold Value	*p* value	95% Confidence Interval	Bootstrap Times
bd	Single	-0.6654	0,0467	[-3.3057, -0.6625]	300
	Double	0.1488	0,7000	[0.1485, 0.1531]	300
	Triple	3.2246	0,7500	[3.0222, 3.2344]	300

Source: Calculation made by authors.

We determined the effect of this variable on the budget using a single variable threshold regression, resulting in a value of -0.6654 for the single threshold number.

Table 8. Determining threshold value

Threshold Variable	Coefficient	Std. err.	*t* value	95% Confidence Interval	*p* value
$bb \geq -0.6654$	0.6085	.0811	7.50	[0.4482, 0.7688]	0.000
$bb < -0.6654$	0.3555	.0737	4.82	[0.2098, 0.5011]	0.000
F Test: F(5, 162) = 23,53 Prob > F = 0,000					

Source: Calculation made by authors

According to Table 8, the budget balance above -0.6654% positively affects the growth rate by 61%, while a budget balance below this value positively affects the growth rate by 36%. We created new regression models with the variable thci, which was created from the confidence interval of the obtained threshold value [-3.3057, -0.6625] (Table 9).

Table 9. Results of threshold regression models

Variable	POLS	FE	RE	FGLS
ge	$-,2752^{***}$ (0.039)	$-,1768^{***}$ (0.048)	$-,1893^{***}$ (0.045)	$-,2692^{***}$ (0.031)
Δgs	$,0853$ (0.157)	$,0275$ (0.134)	$,0323$ (0.129)	$,1331$ (0.144)
Δinv	$,3776^{***}$ (0.134)	$,3955^{***}$ (0.114)	$,3942^{***}$ (0.11)	$,4747^{***}$ (0.126)
inf	$-,0022$ (0.012)	$-,0023^{*}$ (0.011)	$-,0023^{**}$ (0.011)	$-,0004$ (0.001)
Δbb	$,3301^{**}$ (0.153)	$,3287^{**}$ (0.130)	$,3273^{***}$ (0.126)	$,3869^{***}$ (0.124)
$\Delta labo$	$-,0683$ (0.263)	$,0192$ (0.224)	$,0091$ (0.217)	$-,0689$ (0.229)
$open$	$,0109$ (0.023)	$,0668^{***}$ (0.023)	$,0621^{***}$ (0.022)	$,0225$ (0.019)
$\Delta exch$	$,0333$	$,0221$	$,0227$	$,0588^{**}$

Variable	POLS	FE	RE	FGLS
	(0.033)	(0.028)	(0.027)	(0.025)
rate	,0083 (0.011)	,0148 (0.01)	,0143 (0.01)	,0042 (0.007)
Δm2	−,0759* (0.041)	−,0906*** (0.035)	−,0896*** (0.033)	−,0637** (0.026)
nes	−1,319* (0.708)	−1,884*** (0.609)	−1,838*** (0.587)	−1,388** (0.561)
thci	1,199** (0.567)	0.883* (0.527)	0,898* (0.506)	1,192*** (0.459)
constant	12,22*** (1.501)	7,073*** (1.704)	7,642*** (1.815)	11,89*** (1.303)
*** p<.01, ** p<.05, * p<.1 Robust standard errors in parentheses.*				
F Test: F(5, 168) = 14,36 Prob > F = 0,0000 *Breusch Pagan Test: chi2(12) = 60.03 Prob > chi2 = 0,000* *Hausman Test: chi2(11) = 34.04 Prob > chi2 = 0,0007* *Mean VIF: 1.47* *Wald Test: chi2(6) = 78,05 Prob > chi2 = 0,0000* *Woolridge Serial Correlation Test: F(1, 179)=235.24 Prob > F = 0,0000*				

Source: Calculation made by authors.

The thci variable stands out as an interval that positively affects growth in all models, according to Table 9. The BRICS-T countries grow by running budget deficits, as they do in the developing class. These countries choose the path of growth through public spending due to their high dependence on capital flows. After our regression models passed all diagnostic tests, we analysed whether the budget deficit threshold fell within the confidence interval using the LR test proposed by Hansen (2000). As shown in Figure 3, our threshold confidence interval falls below the 95% confidence interval, which aligns with the Maastricht criteria.

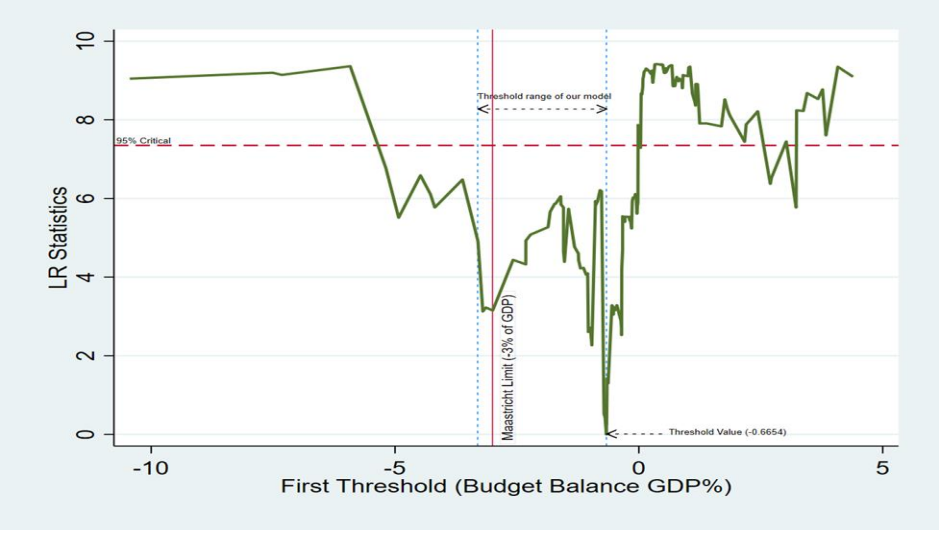

Figure 3. Confidence interval of threshold value
Source: Illustration by authors.

Our analysis followed a specific econometric and statistical procedure and found that the BRICS-T countries are growing by running budget deficits. These results suggest that budget deficits can stimulate growth, but that it is also important to keep budget deficits under control. Although budget deficits are not welcome in an economic context, the fact that the threshold range falls below the confidence interval suggests that the BRICS-T countries are fiscally disciplined.

5. Conclusions and Recommendation

BRICS-T countries have experienced a process in which trade openness and globalisation have accelerated since the 1990s. During this period, GDP increased steadily. However, the increase in public expenditures in BRICS-T countries, the occurrence of unexpected shocks, and the realisation of unforeseen expenditures caused budget deficits to increase. This research aims to identify the level of budget deficit that maximises economic growth for BRICS-T countries.

In the research, annual data for 1990–2021 were used to examine how the budget deficit changed between threshold values. As a result of the threshold analysis, a single threshold range that maximizes economic growth has been determined for the BRICS-T countries. According to this finding, BRICS-T countries can maximise economic growth by keeping their budget deficit between 0.66% and 3.30% of GDP. This result is also compatible with the Maastricht criteria.

The findings of this research point to fiscal discipline's importance for the fiscal policymakers of the BRICS-T countries. For example, policymakers should take measures to reduce negative shocks' distorting effects, such as the global financial crisis, regional banking crises, or the COVID-19 pandemic, on economic growth. Such negative shocks create unexpected increases in public expenditures and cause substantial deviations in budget deficits. Due to the increase in public expenditures in developed economies during the recent crises, significant deviations occurred in budget deficits. However, developed countries moved toward economic stability by reducing their budget deficits to the optimal level after the crisis because of their solid institutional and structural foundations. Developing countries such as BRICS-T may have difficulty returning to this optimal level, considering their structural and institutional weaknesses. Therefore, policymakers in these countries must implement structural and institutional arrangements as soon as possible.

Although this study provides important information on the level of budget deficit that maximises economic growth, it has some limitations. For example, the model assumes that taxes are fixed, and tax increases or decreases were not considered. In addition, the effects of the election processes on the budget deficit were excluded from the analysis. It is thought that more reliable results can be achieved by increasing the analysis period and the amount of data. Country-specific analysis can also provide more detailed results and better guide the policymakers of the relevant countries.

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