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Analysing The Effect of Climate Change On Budget Deficit Dynamics in Nigeria

Adams Echono
International School for Social and Business Studies, Slovenia
adams.echono@gmail.com

Abstract

This study analyzed the effect of climate change on budget deficit dynamics in Nigeria. ex-post facto design and quantitative technique using econometric tools were employed; Descriptive statistics were used to describe the properties of the data set, followed by testing for the stationarity properties of the time series used. (ARDL) the model was used to estimate results. The results revealed that flooding control expenditures and biodiversity expenditures have a positive, non-significant effect on the budget deficit, air pollution control expenditures have a positive effect on the budget deficit, while the cost of desert encroachment control expenditures has a negative, non-significant effect on the budget deficit in Nigeria. The cost of desert encroachment control expenditures in Nigeria should be rationalized to ensure that such expenditures, which currently do not affect the budget deficit, are kept low and an enabling environment be created to attract foreign private investment to boost revenue and encourage the use of cleaner energy.

Keywords: climate change, budget deficit, climate-related expenditures

1.0 INTRODUCTION

Climate change and natural disasters pose a growing threat to both developed and developing countries, with developing countries being particularly vulnerable due to limited financial and institutional resources. Climate change can exacerbate revenue volatility and slow potential GDP growth, weakening governments' fiscal positions. Policies aimed at identifying and evaluating cross-cutting spending on climate change help increase transparency and align development goals. However, support for climate change-related innovation often places a claim on government budgets through research and development subsidies or tax breaks. This leads to governments resorting to borrowing to bridge revenue, posing dire consequences for macroeconomic stability and financial responsibility. Nigeria, an emerging economy, faces a paradoxical situation with increasing climate change expenditures, potentially impairing the sustained functionality of the country's budget and resulting in a high debt profile. For instance, Nigeria's public debt stock which includes external and domestic debt stood at 87.38 trillion (113.42 US Dollars) in q2 of 2023 (Nigerian Bureau of Statistics, 2024). This has raised the empirical question of whether climate change expenditures has been impacting negatively on fiscal sustainability in the country.

Empirical studies attempted to investigate the impact of climate change on fiscal sustainability, particularly budget deficits in developing economies. However, only Mello and Vazquez (2022) linked climate change to fiscal policy. This study aims to analyze the effect of climate change on budget deficits dynamics in Nigeria.

2.0 REVIEW OF RELATED LITERATURE

The need for balance in public spending and tax revenues at the national level is paramount for fiscal sustainability in many countries. This is challenging even in the best of times. Climate change is posing significant challenges to fiscal sustainability, as it may lead to increased public expenditures for disaster relief, infrastructure reconstruction, and other sectors like agriculture and tourism. This could reduce the tax base and exacerbate budgetary imbalances. In the USA, climate change is projected to reduce GDP by 1% in 2050, with extreme weather events and droughts causing significant budgetary and debt effects. The US government is estimated to allocate between $9 and $28 billion per year for these costs, which may double in the 2060-20100 period.

Climate change impacts GDP and fiscal balances, but not government budgets. Bachner and Bednar-Friedl's study estimates a 1.2% decrease in Austria's government budget in 2050 due to direct effects such as increased climate-induced relief payments and unemployment benefits. The reduction may reach 1.4% due to non-climate public consumption reduction. Extreme temperatures in the Middle East and North Africa (MENA) region pose significant challenges to development, particularly in agriculture, food security, and livelihoods. The region is the most water-scarce in the world, with over 60% of the population living in high and very high water-stressed areas. The agricultural sector contributes to about 6% of the region's GDP and employs around 13% of the population.

2.1.0 Concept of Climate Change

Climate change refers to long-term shifts in temperatures and weather patterns due to changes in the sun's activity or large volcanic eruptions. Human activities, such as burning fossil fuels, deforestation, agriculture, and land-use changes, are causing greenhouse gas emissions that trap the sun's heat and raise temperatures. The main greenhouse gases causing climate change include carbon dioxide and methane, which come from various sources such as gasoline, coal, and agriculture. Human activities have caused global warming faster than at least two thousand years, with the Earth's surface temperature now 1.1°C warmer than in the late 1800s and 100,000 years. The consequences of climate change include intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms, and declining biodiversity. The World Bank (2022) also defines climate change as significant variation in average weather conditions over several decades or longer.

NASA (2022) defines climate change as a long-term change in Earth's weather patterns, affecting local, regional, and global climates. Global warming, primarily caused by human activities, is the long-term heating of Earth's surface since the pre-industrial period. The Intergovernmental Panel on Climate Change at the United Nations defines climate change as a change in the state of the climate that persists for decades or longer. It may be due to natural internal processes, external forcings, or persistent anthropogenic changes in the atmosphere or land use.

2.1.1 Concept of Budget Deficit

A balanced budget is essential for a state or country, but externalities like climate change can push it towards deficit financing. Budget deficits are excess expenditures over revenue, linked to balance of payments deficits. These deficits can be financed through borrowings, aids, innovations, or other sources. The major problem of macroeconomic management in developing countries like Nigeria is the persistence of budget deficits and current account disequilibrium, leading to overall balance of payments disequilibrium. The Nigerian economy experienced frequent budget surpluses and deficits between the 1960s and 1969, with the first twin deficits occurring in 1970 and 1972. The co-existence of surpluses in the fiscal balance and current account balance in 1973 and 1974 was due to windfall revenue in oil sales.

The Nigerian economy experienced a twin deficit between 1981-1983 due to government finances increasing expenditure and oil price volatility. Post-Structural Adjustment Programme (SAP) policies led to deficits in the budget and current account balance from 1986-1989. The imbalance in Nigeria's current account position is primarily due to fluctuating oil prices, which can't be satisfied by domestic supply. Fiscal deficits are the main cause of macroeconomic imbalances in Nigeria, including high inflation, current account deficit, high indebted economy, and slow economic growth. Government efforts to reduce these deficits have not yielded desired results. The deficit budget problem in Nigeria is attributed to poor performance of the non-oil sector and non-oil exports, fluctuating crude oil prices, and low income from direct investment abroad. Flexible exchange rate regimes can cause budget deficits, inflation, balance of payments deficits, and current account disequilibrium.

2.2 Theoretical Review

Two theories namely; the Greenhouse Theory of Climate Change and the Positive Signaling Theory of Fiscal Sustainability were reviewed. This is because these two theories underscore the interaction between Climate Change and Fiscal Sustainability.

2.2.1 Greenhouse Theory of Climate Change

The Greenhouse Theory of Climate Change, a concept developed by scientists like Fourier, Pouillet, Foote, and Tyndall, suggests that human activities have led to an increase in atmospheric concentrations of radiatively active gases, pushing the climate system out of equilibrium with solar energy. The theory predicts that the climate system will be restored by warming the surface-troposphere system and cooling the stratosphere, with predicted changes exceeding natural climate variations in historical times. The theory emphasizes the importance of the greenhouse effect, which has caused the Earth's average temperature to rise by 14 degrees Celsius over the past 150 years. This theory is relevant to the current study, as it suggests that over-emphasised climate disequilibrium is putting pressure on financial expenditures in Nigeria, leading to fiscal unsustainability.

2.2.2 Positive Signaling Theory of Fiscal Sustainability

Information asymmetry is a significant issue in the business environment, and the positive signaling theory suggests that economic agents have an incentive to disclose positive information about their commitment to sustainable finance goals to signal good news to external parties. Sustainability reporting, a manifestation of the Total Business Benefit (TBL) approach, is increasingly used to attract and retain customers, employees, supply chain partners, and investors. Sustainability reporting promotes transparency and corporate accountability, and reduces information asymmetry between managers and investors. The positive signaling theory is relevant to the present study, as it highlights the incentive for countries to disclose positive information about their commitment to climate change projects and programs to signal good news to the international community, attract foreign direct investments, and seek foreign technical support for implementing a National Sustainability Finance Policy.

2.3 Empirical Literature

Abbass et al. (2022) conducted a study on climate change impacts, adaptation, and sustainable mitigation measures, focusing on hypothetical scenarios and identifying sustainability issues. The study found that government involvement is crucial for long-term development, and that mitigating climate change's impact is essential. The current study focuses on its effect on budget deficit dynamics. Mello and Vazquez (2022) used regression analysis to explore the implications of climate change on public finances and fiscal policy. Both studies are relevant, but the differences in variable combinations and data analysis methods highlight the differences between their approaches. The focus on climate change and fiscal sustainability is crucial for global sustenance.

Gobna, Usman, and Mohammed's study on public debt sustainability measures and its growth implications for the Nigerian economy found that the public debt-to-oil revenue ratio (PDOR) negatively impacts economic growth in the short and long run. They suggested that improved government non-oil revenue could enhance economic growth. Lodi, Marin, and Marco Modica's study on budget outcomes in Italian municipalities after floods found substantial impacts on capital expenditure and revenues from transfer, depending on resilience and vulnerability. Hui, Shen, Tong, Zhang, and Liu's study on fiscal pressure and air pollution in resource-dependent cities in China found that fiscal pressure aggravates air pollution emissions, worsening in mature-type cities. The study also found that the increase in the number of years in the office of top local government leaders exacerbated the negative effect of fiscal pressure on air pollution.

Hui, Shen, Tong, Zhang, and Liu's (2022) study focused on fiscal pressure and air pollution, while the current study is domesticated in Nigeria. Ibrahim, Ahmed, Arodudu, Abubakar, Dang, Mahmoud. Shaba, and Shamaki (2021) applied geospatial analysis to explore land use and land cover changes in the Sahel Region. Results showed that areas covered by sand dunes doubled over 25 years, with 10.1 km2 of vegetation converted to sand dunes, indicating 14 times more deforestation than afforestation.

The study found a mismatch between climate change indicators and desertification, with increasing rainfall and lower temperatures not translating into positive feedback for desertification. The study also projected a high probability of more farmlands being converted to sand dunes by 2030 and 2045 if current practices prevail.

3.0 METHODOLOGY

The study employed ex-post facto design and a quantitative technique in which econometric tools were used to analyse the data collected from the secondary source. Descriptive statistics were used to describe the properties of the data set, followed by testing for the stationarity properties of the time series used. The study adopted Auto-regressive Distributed Lags (ARDL) to evaluate effect of climate change on financial responsibility in Nigeria. This will be informed in anticipation of s mixed order of integration from Unit Root test since most economics series are integrated in a mix order.

The model in Abdul, Adamu and Ogwuche (2017) was adapted for the study. The choice was informed by similarities in theoretical adoption with substituted variable combination, which became the basis for the model in this study. The original form of the model was specified as follows:

$GDP = f(BIODA)$ - 3.1

Where;

GDP = Gross domestic product and

BIODA = Bilateral Disbursement of Official Development Assistance

The present study shall adapt Abdul, Adamu and Ogwuche's (2017) by replacing the former's use of BIODA with climate change (CC) while GDP will be replaced by budget deficit (BUD). The modified model is specified as follows:

BUD = $f(CC)$ - 3.2

The study also considered public expenditures on the control of climate change impacts like flooding (FCE), biodiversity (BCE), pollution (PCE) and cost of desert encroachment (CDE). Using these proxies for climate change, the study model is further modified as follows:

BUD = $f(fce, bce, pce, cde)$ - - - - - -- -- (3.3)

The stochastic form of equation 3.3 can be expressed as:

BUD = $\beta_0 + \beta_1 fce + \beta_2 bce + \beta_3 pce + \beta_4 cde + \mu$ - - - - (3.4)

Where:

β_0 = constant term,

β_1-β_4 = parameter estimates and

μ = error term.

The stationarity test revealed mixed order integration. Consequently, ARDL model was specified and estimated.

ARDL form of the model is stated as:

BUD = $\beta_0 + \beta_1 fr + \beta_2 fce + \beta_3 bce + \beta_4 pce + \beta_5 cde + \mu$ … …. … …. … (3.5)

$\text{BUD}_{t-1} = \beta_0 + B_1 fr_{t-1} + \beta_2 fce_{-1} + \beta_3 bce_{t-1} + \beta_4 pce_{t-1} + \beta_5 cde_{t-1} + \mu_t$ ... ... (3.6)

$ECM = \beta_0 + \beta_1 fr_{t-1} + \beta_2 fce_{t-1} + \beta_3 bce_{t-1} + \beta_4 pce_{t-1} + \beta_5 cde_{t-1} + \mu_t$ ... ... (3.7)

The log form of the models is

$infs_{t-1} = \beta_0 + \beta_1 infs_{t-1} + \beta_2 infcet_{t-1} + \beta_3 inbce_{t-1} + \beta_4 inpce_{t-1} + \beta_5 incde_{t-1} + \mu_t$ ... (3.8)

The dependent variable will be proxy by debt to GDP ratio (DGR), budget deficit (BUD) and tax to GDP ratio (TGR).

The ARDL forms of Models 3.5 – 3.7 therefore become:

$\text{BUD} = \beta_0 + \beta_1 \text{BUD} + \beta_2 fce + \beta_3 bce + \beta_4 pce + \beta_5 cde + \mu$ ... . (3.9)

$\text{BUD}_{t-1} = \beta_0 + B_1 \text{BUD}_{t-1} + \beta_2 fce_{-1} + \beta_3 bce_{t-1} + \beta_4 pce_{t-1} + \beta_5 cde_{t-1} + \mu_t$ ... ... (4.0)

$ECM = \beta_0 + \beta_1 \text{BUD}_{t-1} + \beta_2 fce_{t-1} + \beta_3 bce_{t-1} + \beta_4 pce_{t-1} + \beta_5 cde_{t-1} + \mu_t$ ... ... (4.10)

The log form of the models is

$\text{BUD}_{t-1} = \beta_0 + \beta_1 \text{BUD}_{t-1} + \beta_2 infcet_{t-1} + \beta_3 inbce_{t-1} + \beta_4 inpce_{t-1} + \beta_5 incde_{t-1} + \mu_t$ (4.11)

Where:

BUD = budget deficit; *FCE* = flooding capital expenditures; *BCE*= biodiversity capital expenditures; *PCE*= pollution capital expenditures, and *CDE*= cost of desert encroachment management. β_0 = intercep μ = stochastic term

3.2 A-Priori Expectations

This study analysed the effect of climate change on budget deficit dynamics in Nigeria using secondary data. The study used descriptive statistics to describe the properties of the data, followed by testing for stationarity properties of the time series and adopted the Auto-Regression Distributed Lag (ARDL) for its analysis. The a-priori expectations of the study are stated as follows:

i. $\beta_1<0$; ii. $\beta_2<0$; *iii.* $\beta_3<0$; *iv.* $\beta_4<0$; $\beta_5<0$. This means that the costs of climate change control are expected to affect fiscal sustainability negatively in Nigeria.

4.0 RESULTS AND DISCUSSION

Descriptive analysis, ARDL and Toda Yamamoto analysis results are presented and analyzed in this section.

4.1 Descriptive Statistics

Descriptive statistics such as mean, standard deviation, skewness, kurtosis ad Jargue-Bera are used to analyse the study.

Table 1: Summary of Descriptive Statistics of the Study Variables

	BUD	FCE	BCE	PCE	CDE
Mean	4.577311	9.471116	11.07745	13.10107	8.389884
Maximum	8.870481	14.05990	16.08910	16.31400	15.68060

Minimum	0.000000	2.934350	2.475860	9.173310	1.342570
Std. Dev.	2.581856	3.527679	3.713710	2.377795	5.403318
Skewness	-0.058672	-0.483476	-0.666585	-0.393652	-0.055795
Kurtosis	1.889712	2.161131	2.824039	1.721156	1.314938
Jarque-Bera	2.181390	2.867718	3.164532	3.946761	4.990799
Probability	0.335983	0.238387	0.205509	0.138986	0.082463
Observations	42	42	42	42	42

Source: Authors Computation, 2023 (Eviews-10)

Table 1 shows the summary statistics on the variables used in the study for test of normality properties of residuals in the data set. The standard value of Skewness of a symmetric distribution, such as normal distribution is zero. The Skewness values for all the series used in the study are close to zero which suggests that they are Skewness normal. The Kurtosis of a normal distribution is 3. The Kurtosis distribution measures the peakness of a distribution that is usually assumed to be normal. As shown in Table 1, the series values were not far from 3, as such, they do not exhibit characteristic of a distribution with a high peak and flat tails called leptokurtic (k>3). They also do not have substantially flat-topped curves and thinner tails called platykurtic (k<3), but they have generally exhibited mesokurtosis (k=3) suggesting a normal distribution.

Jarque – Bera results show that the series are not significant at 0.01 levels and thus, failed to reject the null hypothesis of a normal distribution. It is therefore, clear that the series are subject to distribution that is not different from the normal one.

4.2 The Stationarity Test

The stationarity test was performed to determine the stationarity properties of the time series.

Table 2: Stationarity Test Results

Variable	ADF Test Statistics	Critical Values	Order of Integration
BUD	-1.979513	-2.926622	I(1)
FCE	2.155364	-2.926622	I(1)
BCE	-0.132500	-2.926622	I(1)
PCE	-3.612142	-2.926622	I(0)
CDE	2.103310	-2.926622	I(1)

Note: The tests include intercept and trend; * *significant at 1%;* ** *significant at 5%*

Source: Authors Computation, 2023 (Eviews-10)

As shown in Table 2, the results of the Phillip Perron test indicate that four variables were found non-stationary at levels and at a 5% level of significance, while one variable (PCE) was found to be stationary. The four were, however, stationary at first difference. Hence, the unit-roots PP test for the variables was accepted at the first difference for the variables of interest, indicating a mixed order of integration. Since the series was not integrated in mixed order, the Autoregressive Distributed Lag (ARDL) can be used to estimate its short-run and long-run inter-relationships.

4.3 Autoregressive Distributed Lag (ARDL) Results Before estimating the climate change effect on the budget deficit in Nigeria, a stationarity test was conducted to examine the stationarity properties of the series so as to establish a long-run relationship between the series and also determine the short-run dynamics.

Table 3: ARDL Bound Testing for Co-Integration Result

F-Bounds Test Null Hypothesis: No levels of relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	2.323363	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Source: E-views 10 Output.

From the result of co-integration in Table 3, it was observed that the F-statistic value of 2.323363 was less than the lower bound [I(0)] and the upper bound [I(1)] critical values of 2.56 and 3.49 respectively, at 5% level of significance. Therefore, it was inferred that there is no co-integration between series. Thus, the error correction model (ECM) and log-run model could not be estimated. This necessitated the analysis of the ARDL Regression short-run estimates.

Table 4: Summary of ARDL (2.0.0.0) Regression Short-Run Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
BUD(-1)	0.848014	0.163856	5.175359	0.0000
BUD(-2)	-0.359912	0.173722	-2.071771	0.0462
FCE	0.144289	0.196368	0.734790	0.4677
BCE	0.006341	0.076981	0.082371	0.9348
PCE	0.285008	0.289623	0.984064	0.3322
CDE	-0.020113	0.035957	-0.559361	0.5797
C	-2.646536	2.082433	-1.270886	0.2127
R-squared	0.868310	Mean dependent var		4.731933
Adjusted R-squared	0.844367	S.D. dependent var		2.547961

S.E. of regression	1.005181	Akaike info criterion	3.005841
Sum squared resid	33.34283	Schwarz criterion	3.301394
Log-likelihood	-53.11681	Hannan-Quinn criteria.	3.112703
F-statistic	36.26479	Durbin-Watson stat	2.059779
Prob(F-statistic)	0.000000		

Source: E-views, (10.0)

Results of Table 4 show that a unit change in the lagged value of budget deficit results in a 35.99 per cent negative effect on budget deficit in Nigeria. A unit change in the cost of flooding control expenditures has a 14.42 per cent positive non-significant effect on the budget deficit in Nigeria. This suggests that flooding control expats higher budget deficit, hence impeding deficit, hence impeded fiscal sustainability in Nigeria. Similarly, when the cost of biodiversity expenditures changed by 1%, it exerted a 0.6341 per cent positive non-significant effect on the budget deficit in Nigeria. This implies that an increase in the cost of biodiversity expenditures leads to a higher budget deficit in Nigeria. In the same vein, with a 1% change in the cost of pollution control expenditures, there was a 28.50 per cent positive effect on the budget deficit in Nigeria. This suggests that an increase in the cost of pollution control expenditures leads to an increase in the budget deficit in Nigeria. A unit change in the cost of desert encroachment control expenditures has a 2.01 per cent negative non-significant effect on the budget deficit in Nigeria. Thus, there is no evidence suggesting the cost of desert encroachment control expenditures encourages higher budget deficits, despite the findings suggesting that climate change stimulated higher budget deficits in Nigeria.

Table 5: Residual Test Results of the ARDL Model

Test Statistics	Probability	Decision
Serial Correlation CHSQ (BGS)=	0.7469	No serial Correlation
Heteroskedasticity CHSQ =	0.7572	Residuals are homoscedastic
Linearity Test (Ramsey Reset Test)	0.1841	Model is linear

Source: *E-views 10 Output*

Table 5 shows no evidence that the residuals based on Breausch-Godfrey Serial Correlation LM Test results are affected by autocorrelation. The Breausch-Pagan-Godfrey heteroskedasticity test results indicate that the residuals are homoscedastic (that is, they have constant variance). Thus, the series is reliable. Based on the result of the Ramsey Reset Test, the model is also specified correctly.

4.4 Discussion of Findings.

Climate change and natural disasters pose a growing threat to both developed and developing countries, with developing countries being particularly vulnerable. A study found that flooding control expenditures in Nigeria led to a higher budget deficit, affecting fiscal sustainability. This finding disagrees with that of Lodi, Marin and Marco Modica (2022), who, while empirically testing the dynamics of budget outcomes of Italian municipalities in the aftermath of floods, found substantial impacts in terms of increased capital expenditure and revenues from transfer, which also depended on the degree of resilience and vulnerability.

Similarly, biodiversity expenditures also had a positive effect on the budget deficit, indicating that increased costs lead to higher deficits. The study finding was in line with that of Abbass, Qasim, Song, Murshed, Mahmood and Younis (2022), who reviewed the global climate change impacts, adaptation, and sustainable mitigation. Findings revealed that government involvement is necessary for long-term development through strict accountability of resources and regulations implemented in the past to generate cutting-edge climate policy. Air pollution control expenditures also had a positive effect on the budget deficit, indicating that increased costs lead to increased deficits. This finding is consistent with that of Hui, Shen, Tong, Zhang and Liu (2022), which showed that air pollution emissions increased significantly as financial pressure became severe, worsening in mature-type resource-dependent cities. Desert encroachment control expenditures had a negative effect on the budget deficit, suggesting that desertification is more a result of human activities rather than climate change.

5.0 CONCLUSION AND RECOMMENDATIONS

The study suggests that climate change positively impacts Nigeria's budget deficit, but the cost of desert encroachment control expenditures does not. The study concludes that climate change has a positive effect on budget deficits,

To stabilize the economy, an enabling environment should be created to attract foreign investment to boost revenue and focus on addressing flooding issues through collaboration with international donor agencies, reducing the debt-to-GDP ratio, and analyzing the economic and social profitability of debt-financial projects. Monitoring externally borrowed funds for government projects for judicious utilization should be encouraged, and regular empirical investigations should be conducted to prevent over-exceeding the optimal debt ratio and encourage cleaner energy use.

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Dependent Variable: BUD
Method: ARDL
Date: 02/03/24 Time: 08:09
Sample (adjusted): 1984 2023
Included observations: 40 after adjustments
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic): FCE BCE PCE CDE
Fixed regressors: C
Number of models evaluated: 162
Selected Model: ARDL(2, 0, 0, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
BUD(-1)	0.848014	0.163856	5.175359	0.0000
BUD(-2)	-0.359912	0.173722	-2.071771	0.0462
FCE	0.144289	0.196368	0.734790	0.4677
BCE	0.006341	0.076981	0.082371	0.9348
PCE	0.285008	0.289623	0.984064	0.3322
CDE	-0.020113	0.035957	-0.559361	0.5797
C	-2.646536	2.082433	-1.270886	0.2127

R-squared	0.868310	Mean dependent var	4.731933
Adjusted R-squared	0.844367	S.D. dependent var	2.547961
S.E. of regression	1.005181	Akaike info criterion	3.005841
Sum squared resid	33.34283	Schwarz criterion	3.301394
Log likelihood	-53.11681	Hannan-Quinn criter.	3.112703
F-statistic	36.26479	Durbin-Watson stat	2.059779
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Error Correction Regression
Dependent Variable: D(BUD)
Selected Model: ARDL(2, 0, 0, 0, 0)
Case 2: Restricted Constant and No Trend
Date: 02/03/24 Time: 08:12
Sample: 1982 2023
Included observations: 40

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(BUD(-1))	0.359912	0.146917	2.449761	0.0198
CointEq(-1)*	-0.511898	0.127766	-4.006536	0.0003

R-squared	0.287381	Mean dependent var	0.187725
Adjusted R-squared	0.268628	S.D. dependent var	1.095318
S.E. of regression	0.936719	Akaike info criterion	2.755841
Sum squared resid	33.34283	Schwarz criterion	2.840284
Log likelihood	-53.11681	Hannan-Quinn criter.	2.786373
Durbin-Watson stat	2.059779		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signify.	I(0)	I(1)
F-statistic	2.323363	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

ARDL Long Run Form and Bounds Test
Dependent Variable: D(BUD)
Selected Model: ARDL(2, 0, 0, 0, 0)
Case 2: Restricted Constant and No Trend
Date: 02/03/24 Time: 08:11
Sample: 1982 2023
Included observations: 40

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	-2.646536	2.082433	-1.270886	0.2127
BUD(-1)*	-0.511898	0.159730	-3.204774	0.0030
FCE**	0.144289	0.196368	0.734790	0.4677
BCE**	0.006341	0.076981	0.082371	0.9348
PCE**	0.285008	0.289623	0.984064	0.3322
CDE**	-0.020113	0.035957	-0.559361	0.5797
D(BUD(-1))	0.359912	0.173722	2.071771	0.0462

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

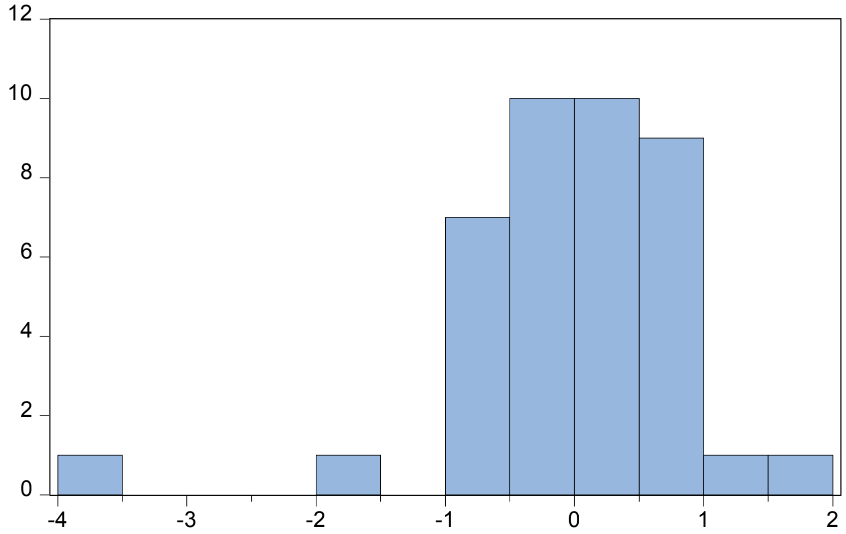
Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FCE	0.281871	0.369703	0.762425	0.4512
BCE	0.012387	0.151455	0.081789	0.9353
PCE	0.556767	0.531909	1.046733	0.3028
CDE	-0.039291	0.066104	-0.594380	0.5563
C	-5.170045	3.784891	-1.365969	0.1812

EC = BUD - (0.2819*FCE + 0.0124*BCE + 0.5568*PCE -0.0393*CDE - 5.1700)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	2.323363	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
			Finite Sample: n=40	
Actual Sample Size	40			
		10%	2.427	3.395
		5%	2.893	4
		1%	3.967	5.455



Series: Residuals	
Sample 1984 2023	
Observations 40	
Mean	-3.23e-16
Median	0.123813
Maximum	1.912976
Minimum	-3.845360
Std. Dev.	0.924632
Skewness	-1.633519
Kurtosis	8.967809
Jarque-Bera	77.14715
Probability	0.000000

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.294525	Prob. F(2,31)	0.7469
Obs*R-squared	0.745891	Prob. Chi-Square(2)	0.6887

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 02/03/24 Time: 08:16
Sample: 1984 2023
Included observations: 40
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BUD(-1)	0.527797	0.824142	0.640421	0.5266
BUD(-2)	-0.277169	0.408471	-0.678552	0.5025
FCE	0.024686	0.205618	0.120059	0.9052
BCE	0.006444	0.081557	0.079006	0.9375
PCE	-0.292994	0.581588	-0.503782	0.6180
CDE	-0.001462	0.036801	-0.039718	0.9686
C	2.392387	4.671840	0.512087	0.6122
RESID(-1)	-0.580873	0.860192	-0.675283	0.5045
RESID(-2)	-0.147601	0.446506	-0.330569	0.7432

R-squared	0.018647	Mean dependent var	-3.23E-16
Adjusted R-squared	-0.234605	S.D. dependent var	0.924632
S.E. of regression	1.027384	Akaike info criterion	3.087017
Sum squared resid	32.72108	Schwarz criterion	3.467015
Log likelihood	-52.74034	Hannan-Quinn criter.	3.224412
F-statistic	0.073631	Durbin-Watson stat	1.938318
Prob(F-statistic)	0.999664		

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.562049	Prob. F(6,33)	0.7572
Obs*R-squared	3.708639	Prob. Chi-Square(6)	0.7160
Scaled explained SS	10.05614	Prob. Chi-Square(6)	0.1223

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/03/24 Time: 08:16
Sample: 1984 2023
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.359665	5.111912	-0.265980	0.7919
BUD(-1)	-0.241576	0.402230	-0.600592	0.5522
BUD(-2)	0.434742	0.426449	1.019447	0.3154
FCE	-0.327515	0.482040	-0.679435	0.5016
BCE	-0.016147	0.188972	-0.085447	0.9324
PCE	0.266430	0.710961	0.374747	0.7102
CDE	0.142690	0.088267	1.616586	0.1155

R-squared	0.092716	Mean dependent var	0.833571
Adjusted R-squared	-0.072245	S.D. dependent var	2.382921
S.E. of regression	2.467497	Akaike info criterion	4.801914
Sum squared resid	200.9219	Schwarz criterion	5.097468
Log likelihood	-89.03828	Hannan-Quinn criter.	4.908777
F-statistic	0.562049	Durbin-Watson stat	2.305422
Prob(F-statistic)	0.757196		

Ramsey RESET Test
Equation: UNTITLED
Specification: BUD BUD(-1) BUD(-2) FCE BCE PCE CDE C
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.357524	32	0.1841
F-statistic	1.842870	(1, 32)	0.1841

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	1.815642	1	1.815642
Restricted SSR	33.34283	33	1.010389
Unrestricted SSR	31.52719	32	0.985225

Unrestricted Test Equation:
Dependent Variable: BUD
Method: ARDL
Date: 02/03/24 Time: 08:17

Sample: 1984 2023
Included observations: 40
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic):
Fixed regressors: C

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
BUD(-1)	0.468519	0.322998	1.450532	0.1566
BUD(-2)	-0.211889	0.203266	-1.042424	0.3050
FCE	0.020153	0.214387	0.094004	0.9257
BCE	0.050046	0.082553	0.606233	0.5486
PCE	0.156432	0.301269	0.519245	0.6072
CDE	0.008365	0.041241	0.202838	0.8405
C	-0.909286	2.422025	-0.375424	0.7098
FITTED^2	0.054506	0.040151	1.357524	0.1841

R-squared	0.875481	Mean dependent var	4.731933
Adjusted R-squared	0.848243	S.D. dependent var	2.547961
S.E. of regression	0.992585	Akaike info criterion	2.999848
Sum squared resid	31.52719	Schwarz criterion	3.337624
Log likelihood	-51.99696	Hannan-Quinn criter.	3.121977
F-statistic	32.14131	Durbin-Watson stat	2.147899
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 02/03/24 Time: 08:20
Sample: 1982 2023
Included observations: 40

Dependent variable: FCE

Excluded	Chi-sq	df	Prob.
BCE	1.018624	2	0.6009
PCE	5.397340	2	0.0673
CDE	0.331071	2	0.8474
All	8.712705	6	0.1904

Dependent variable: BCE

Excluded	Chi-sq	df	Prob.
FCE	0.614733	2	0.7354
PCE	1.643101	2	0.4397
CDE	1.318561	2	0.5172
All	6.257725	6	0.3949

Dependent variable: PCE

Excluded	Chi-sq	df	Prob.
FCE	2.602558	2	0.2722
BCE	4.435647	2	0.1088
CDE	0.569301	2	0.7523
All	12.11662	6	0.0594

Dependent variable: CDE

Excluded	Chi-sq	df	Prob.
FCE	4.487139	2	0.1061
BCE	3.731477	2	0.1548
PCE	0.829698	2	0.6604
All	8.252912	6	0.2202