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ARTICLE

Dynamic relationship between budget deficit and current account deficit in the light of Nigerian empirical application

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Abstract
This research empirically investigates the link between current account deficit and the budget deficit for Nigeria with the use of annual time series spanning 1980–2016. These deficits have significant implications on the country's macroeconomic stability and overall growth. The research makes use of autoregressive distributed lag technique and traditional Granger causality tests to achieve the research objective. The outcome of the study upheld the presence of twin deficit hypothesis for Nigeria and discards not only the Ricardian equivalence proposition, but also the reverse and bi-directional causality hypotheses. This is supported by Granger causality test that the relationship runs unidirectionally from budget deficit to current account deficit. Therefore, it is logical to assert that the source of the country's current account deficit problems could be traced to the mounting fiscal imbalances.

Keywords Twin deficit hypothesis · Structural break · Current account deficit · Autoregression · Cointegration · Nigeria

JEL Classification E62 · C22 · F32

1 Introduction

The recent reappearance of large deficits on both external and internal accounts across the globe is attracting a lot of interest in economic literature. This has re-echoed the long age dispute between *Keynesian–Mundell–Fleming on and Ricardian Equivalence perspectives* on the nature and direction of causality between the current account deficits and budget deficits. The subsistence of a

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positive link between these variables has long been disputed in economic literature, since huge trade imbalances were seen with massive federal fiscal imbalances in the US economy, particularly in the early parts of the 1980s and 2000s (Çatik et al. 2015). These deficits are regarded as "twins" based on the observation that implementing higher budget deficits as a fiscal policy stance ultimately leads to a deterioration of the current account balance.

It has been observed that the need for fiscal consolidation in most major developed countries and the increasing requirement for greater public expenditure on basic and critical infrastructure in developing countries are among the most important economic issues confronting the global economy. These needs are perceived as the remote causes of persistent fiscal deficits and current account deficits irrespective of whether the country affected is high or low income. This fact is based on the understanding that huge budget deficits have the propensity of crowding out domestic private investment through interest rates increases. In the same way, a huge current account deficit has the propensity of decreasing a county's competitiveness, shifting of wealth to foreigners, waning of gains from international trade, and probably initiating a currency instability.

In historical perspective, the first major fiscal deficit financing programme introduced in Nigeria was the contraction of the $1b jumbo loan after the civil war of 1967–1970 for the reconstruction, reconciliation, and rehabilitation of the war-torn country. Additionally, significant pressure from the citizens manifestly added to increased spending by the public authorities. This was essentially caused by the increased understanding within the populace that public spending could lead to development. Another reason for the surging budget deficits has to do with high inflationary trend caused by loose public funds that are indirectly linked with real production. Given the high price levels, labourers often bargain for wage increases adding to the burden of the government. Since the substantial amount of the workforce is under government employment, the government response to demands further compounds the situation. Mbanefoh (1993) contends that the fragile balance of payment position experienced was due partly to the financing of budget deficits through money creation and mounting interest repayments on loans. Other factors accounting for the upsurge in deficits are attributable to many factors, such as decreased government revenue (especially fall in commodity prices, shallow tax base) and increased government spending, especially on the rising social infrastructure and security; large public sector; political instability; the systemic failure of institutional values; and to the ever-increasing expenditure and national defiance.

The graphical illustration of the current account deficits and fiscal deficit to GDP ratio depicted in Fig. 1 demonstrates that the variables move in the same direction and largely rest in the negative territory which indicates poor performance of the internal and external sectors of the economy. A similar correlation could be seen on the scatter diagram in "Appendix 1".

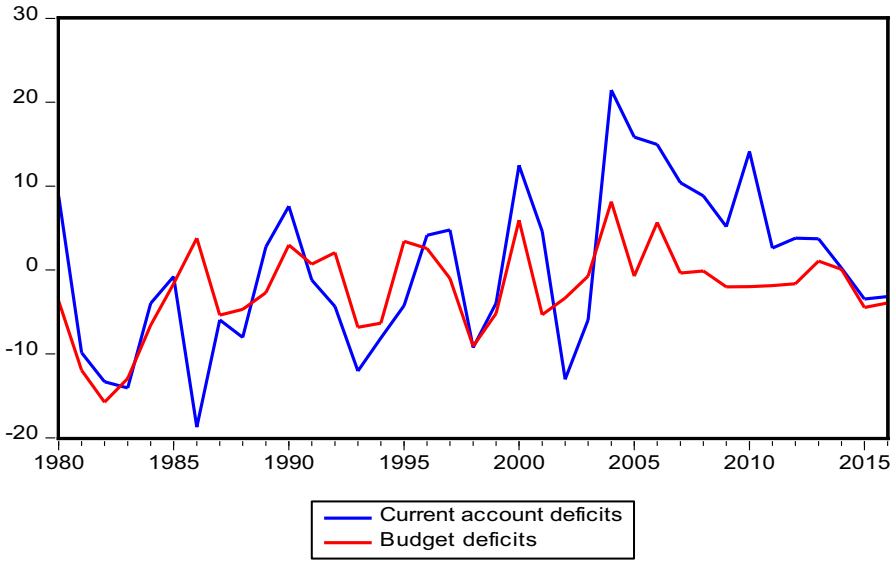

Fig. 1 Current account and fiscal balances from 1980 to 2016. *Source*: obtained using data from African Development Bank, 2017

The underlying data show that Nigeria's budget was largely in deficit during the whole period of analysis (1980–2016).[1] The only periods that budget surplus was recorded are 1990–1990, 1995–1995, 2000, 2004–2006, and 2013–2014 only. These fluctuations have significant implications on the country's current account balances and government spending ability. Over the last 40 years now that Nigeria has implemented several policies to deal with among other things, these two deficits but the internal and external accounts of the still remain largely in crisis. The country recorded the highest budget deficit of about 15% of GDP and current account deficits about 13% of GDP in 1982 in the wake of economic recession. The unparalleled expansion in the especially high budget deficits since 1980s attracted the interest of the World Bank and the International Monetary Fund (IMF), as it was recognized that the trend in fiscal imbalance was not sustainable. The government expenditure-driven growth is often regarded as one close cause of budget deficit in the country.

[1] The scope of the study: 1980 to 2016 substantially captures the period when Nigeria experienced major policy regime changes. Since the country's independence in 1960, the most notable economic crisis the economy experienced started in the early 1980s that led to the introduction of the structural adjustment programme of 1986. Since then, Nigeria has implemented several policies to deal with, among other things, these two deficits, but the internal and external accounts of the balance of payment still remain largely in crisis. The global financial crisis of 2007/2008 as well as the recent economic recession of 2015/2016 also falls with the scope of the analysis. The debt relief programme of 2003/2004 gave surging external debt service obligations, rebasing of GDP, and change from pegged exchange rate system to floating system in 2016. On the political side, the coups and counter coups (1984, 1985, 1993) and shift from military administration to modern democracy (1999 to date) all fell within the scope. Therefore, the scope captures important periods in which major economic events occurred.

The highest positive fiscal balance was in 2004, following the debt cancellation/relief for highly indebted countries. From 2005 to 2014, public deficit stood at only −0.18%. However, this dramatically changed in 2015, where budget deficits increased to 4.45% with further signs of increasing beyond the universally accepted threshold of 3% of GDP. To compound the problem, interest repayment on loans at the moment already takes about 30% of federal government revenue, which is higher than that of Kenya (12.34%), South Africa (10.23%), India (25.65%) and even the entire Sub-Saharan Africa (3.30%), South Asia (11.24%), East Asia (6.29%), and Latin America and Caribbean (10.45%).[2] This raises concern about the sustainability of the fiscal position of the economy over the medium and long terms, especially with the recently acquired $2.5b Eurobond from international financial markets.

Simultaneously, intermittent imbalances have characterized the external account balance. The only periods that the current account experiences positive growth include: 1980, 1989–1990, 1996–1997, 2000–2001, and 2004–2014 only. Huge deficits have been recorded in this account since 2015. This study perceives a close relationship between budget deficit and the external account deficit when a cursory scrutiny is carried out. However, understanding the precise causation path of the variables needs further investigation; hence, the necessity for the study.

Another motivation of the study is the conflicting submissions of Ahmad and Aworinde (2015) and Alkswani (2000). While the former upheld the twin deficit hypothesis for Nigeria for the period, 1980 and 2009, the latter found that twin deficit hypothesis may not be relevant for an economy that depends on oil exports as in the present case. The author contends that since government spending is central in an oil-dependent economy for productive purposes and distribution of national wealth and given that export of oil products is the most important contributor of national income and explains the capacity of government expenditure, oil-dependent economy may not rely on taxes (or any form of budget deficit financing) to cover government overheads. Therefore, he found a reverse causality between the two deficits of the oil-based economy of Saudi-Arabia. According to the author, this would arise if the government of a country makes use of its fiscal stance to target the current account balance. Thus, Nigeria being an oil-based economy represents a suitable context to shed more light on the validity of the relationship between these deficits by the application of ARDL-bounds test in the presence of structural breaks and with a complementary method of Granger causality.

The present paper seeks to investigate the relationship between the budget deficits and the current account deficits in Nigeria from 1980 to 2016. These deficits have significant implications on the country's macroeconomic stability and overall growth. Consequently, understanding the relationship between these variables will shed more light on the suitable reforms desirable to be adopted to deal with these dilemmas, and hence, adding to literature on the universal relevance and adaptability of the hypothesis. In line with the research objective, we can overtly state the research questions as:

[2] This is so, when we consider debt service as % government revenue only, not debt-GDP or debt stock–GDP ratio.

1. Is there any long-run relationship between current account deficits and budget deficits in Nigeria from 1980 to 2016?
2. If the above holds, what is the exact causality path between the variables?

The structure of the research is as follows: following the introduction, Section 2 covers theoretical back ground and brief literature review followed by derivation of the core variables in Sect. 3. Section 4 deals with econometric model specification, and empirical estimation in Sect. 5. Section 6 offers the conclusion.

2 Literature and theoretical overview

As earlier noted, the Twin Deficits Hypothesis is a presupposition that fiscal deficit is a primary cause of current account disequilibrium. This is to say that when the government revenue does not match its expenditure, a budget deficit situation arises, based on the fact that the economy is operating at the capacity where all productive resources are fully utilized and output is maximized. In this scenario, if the budget deficit rises, and savings remain unchanged, then either investment must decrease or net export must fall, causing a trade imbalance. There are four different verifiable scenarios that could be employed to investigate this nexus, which may include Keynesian and Mundell–Fleming model, Ricardian Equivalence Hypothesis, current account targeting hypothesis, and bi-directional causality.

The traditional *Keynesian* and *Mundell–Fleming Model* paradigm contends that there is a direct connection between budget deficit and current account deficit. Specifically, the budget deficit is assumed to be the principal determinant of current account deficit acting through tax cut and or increase in borrowing which could raise the aggregate demand and productivity, and consequently enhanced the overall growth of domestic income. Accordingly, such improvement in domestic income propels higher import demand which has the capacity of deteriorating the external performance and deteriorates the current account balance. Following this tradition, the Mundell–Flemming model further contends that increase in budget deficit does not merely raise the level of aggregate demand, but also the real rate of interest. With increase in the cost of capital (i.e. real interest rates), foreign capital is attracted into the domestic income which leads to appreciation of domestic currency and in that way encourages demand for import and discourages exports through loss of competitiveness in the global market. This incidence essentially leads to external disequilibrium, especially when the foreign exchange policy is a floating system. Providing empirical evidence, Tang (2013) used general equilibrium analysis to examine the long-run causal link between fiscal deficit, trade deficit, and financial deficit and confirmed that the variables move in the same direction. Interestingly, the results revealed that the one-way causality moves from the external to the internal sector. Abell (1990) provides more evidence on the relationship between the two deficits. He contends that the relationship could be indirect such that the causality runs from fiscal deficit to higher rate of interest, to inflow of foreign assets, to an appreciation of the real effective exchange rate, and ultimately to the current account. The Keynesian and Mundell–Fleming model has also been validated by

Summers (1986), Salvatore (2006), Fleegler (2006), Egwaikhide et al. (2002), and Onafowokan and Owoye (2006), among others.

The second scenario to the explanation of whether the twin hypothesis holds is the *Ricardian Equivalence Hypothesis.* Buchanan (1976) revived the Ricardo hypothesis also referred to as the Ricardian Equivalence Hypothesis (hereafter REH) in the seminal work of Barro (1974). Based on this perspective, an intertemporal reallocation between taxes and fiscal stance of the government has no real effects on real interest rate, the magnitude of investment, or the current account deficits. Putting it differently, the nonexistence of any Granger causality link between the two deficits would be consistent with *REH*.

The Ricardian[3] equivalence contends that for a given course of government spending, a budget deficit which is financed through current taxes leads to a rise in future taxes that have comparable current value as the early tax cut. The public authorities can execute their spending either through taxes or by selling bonds. Given that bonds are a form of loan, they are repayable in the future, potentially by increasing taxes in the future period. The preference is, thus, to either tax now or tax at a later time. In the circumstance that the government finances a number of additional expenditures through deficits, i.e. it chooses to tax later, according to the *REH* proposition, taxpayers are forward-looking agents and will expect paying higher taxes in the future. As a result, tax payers would possibly raise their savings to offset any upcoming extra tax, i.e. they decrease their current consumption to achieve this. The effect on aggregate demand would be the same as if the government had chosen to tax at the present time. This argument could be interpreted in line with the common maxim that there is no a free lunch anywhere, and public spending must be compensated for at the present or later on, with the total present value of receipts set by the total present value of spending. Several empirical works over time have arisen to support the *REH* theory (Enders and Lee 1990; Evans and Hasan 1994; Kaufmann et al. 2002; Ganchev 2010; Njoroge et al. 2014).

The third paradigm regarding the twin deficit hypothesis is the current account targeting hypothesis (CATH). Here, the overall position is that there is a one-way causality running from the current account deficit to the budget deficit. Reverse causality originates from the perspective that disequilibrium in the external sector causes the budget deficits to expand. Chang and Hsu (2009) empirically observed that distortions in the external account balance retards the rate of growth of domestic income; causing low tax revenue leading to a rise in budget deficit. This outcome has also been documented by Kim and Roubini (2008) and Sobrino (2013) that large current account deficit could trigger economic slowdown and consequently ignite

[3] This essentially means the view of David Ricardo in relation to the present subject under discussion. The phrase '*Ricardian equivalence hypothesis'* was first established in the macroeconomic scientific community by Buchanan (1976). Subsequently, Gerald (1977) standardized Ricardo's reservations regarding this outcome. Accordingly, macroeconomists who did not find similar results as Ricardo are somewhat referred to as *'non-Ricardian'*. In general, David Ricardo (1951) remains the pioneer of this theory. Barro (1974) clearly notes that, the ascription or acknowledgement of the equivalence hypothesis to Ricardo is fitting even if he had some pessimisms relating to some assumptions of the theorem.

financial crisis. The correction of this may require huge government interventions to restore or 'bail out' the ailing financial system to lessen the effect of the crisis.

The fourth and final strand of the hypothesis is a situation in which a bi-directional causality exists. Therefore, there is no substantial evidence for the public authorities to lessen its deficit financing objective for the purposes of eradicating the imbalance in the current account. Given the above scenarios, policy prescription regarding *TDH* in a broad spectrum might show a discrepancy according to the nature of the association established. Arize and Melindreros (2008) using VAR and VEC as well as Chang and Hsu (2009) using the modified Wald test and Granger non-causality among others found a two-way causality existing between the variables. Arize and Melindreros (2008) conclusively contend that budget-curtailing policies ought to be augmented with some well-articulated programmes, by concentrating on policies towards promoting export performance, productivity enhancement, and export-friendly exchange rate policy.

Quite a few studies have provided conflicting results regarding the link between budget deficit and the current account deficit. These conflicts in the overall predictions could be ascribed to data, scope of analysis, econometric procedures, country-specific issues, and structure of production among others, making the twin deficit quandary an attention-grabbing concern and research problem that authorizes a constant investigation.

3 Derivation of current account deficits and budget deficits in national accounts

The relationship between current account and budget deficit is fundamentally derived from the national income identity as follows:

$$Y = C + I + G + X - M, \tag{1}$$

where Y is the level of domestic income (GDP); C is the level of consumption; I is the level of investment; G is the level of government spending, X is the level of export, and M is the level of import. The current account (CA) is given by the gap between the level of export (X) and import (M). When the determinants in the initial function (Eq. 1) are arranged differently, the CA turns out as:

$$\mathrm{CA} = Y - (C + I + G). \tag{2}$$

Here, the second item on the right-hand side of Eq. 2 ($C+I+G$) is analogous to the total expenditure of locals or what is referred to as domestic absorption. Under a close economic system, the total national savings (S) is identical to the total investment (I) and, since $Y-C=S$,

$$S = I + \mathrm{CA}. \tag{3}$$

It could be stated from Eq. 3 that an economy has the leverage of financing its investment activities from domestic and overseas sources provided that it operates an open economic system. The macroeconomic and policy implication of the above is that policies towards enhancing investments necessarily exert negative effect on

the current account deficit. On the contrary, policies that could lessen both private and public consumption exert a positive effect on the current account balance. It is possible to clearly disaggregate total savings in the economy into private (S^{p}) and government savings (S^{g}):

$$S^{p} = Y - T - C \tag{4}$$

and

$$S^{g} = T - G. \tag{5}$$

It is assumed here that all government revenue is derived from taxation. Therefore, T represents the government revenue. Making use of Eqs. 4 and 5 and algebraically replacing in Eq. 3 produce:

$$S^{p} = I + CA + (T - G) \tag{6}$$

or

$$\mathrm{CA} = S^{p} - I - (T - G). \tag{7}$$

It is concluded from Eq. 7 that an increase in the government or budget deficit would possibly lead to a rise in the current account deficit on the condition that such increase in budget deficit lessens gross national savings. Assuming that the present tax revenue does no change such that ($S^{p} - I$) remains constant, any raise in momentary government expenditure would definitely make the budget deficit to increase ($T - G$), hence directly affecting the current account in the same way. Likewise, budget deficit financing arising from increased assets purchases lessens the current account positive balance, which implies deterioration of the external account balances

3.1 Description of data and sources

To achieve the research objective, five variables are included in the linear model. These include: budget deficit, current account deficit, real interest rates, real effective exchange rate, and real GDP growth.

$$\mathrm{CAD} = \beta_1 + \beta_2 \mathrm{BUD} + \beta_1 \mathrm{RGDP} + \beta_3 \mathrm{IR} + \beta_4 \mathrm{REER} + \mathrm{DUMI} + \varepsilon_t. \tag{8}$$

CAD is a representation of the gap between the value of exports and current value of imports as a ratio of GDP. Budget deficit (BUD) represents the gap between revenue arising from taxes and government spending as percentage of GDP ($T - G$). The interest rate is proxied by actual prime lending cost to the private sector (IR), while the real effective exchange rate (REER) is used as a proxy for relative prices. Interest rate and the real effective exchange rate are basically incorporated to measure the overall fluctuations in capital. Real GDP growth measures business cycle or fluctuation in growth as used by Kim and Roubini (2008). While CAD and BUD were taken from the African Development Bank, REER and IR are from World Bank Development indicators and index mundi, respectively. RGDP is calculated from GDP at constant 2010 basis prices obtained from the statistical bulletin of Central Bank of Nigeria.

4 Econometric methodology: autoregression distributed lag (ARDL) model

The study uses autoregressive distributed lag (ARDL) methodology to determine the long-run relationships among the variables. This econometric procedure was developed by Pesaran et al. (2001) for testing the cointegrating relationship. One rationale behind using the ARDL approach is that it outperforms other cointegration techniques when the variables are integrated at different orders. Therefore, conducting stationarity tests may only be necessary to ascertain that none of the variables are integrated at any order higher than one. Note that the ordinary least square method (OLS henceforth) would have been appropriate if the series are all stationary at a similar level. Secondly, according to Johansen approach (1991), vector error correction (VEC) would be sufficient only if the entire variables are stationary at first difference. In comparison with the data-intensive VEC model, the ARDL-bounds testing methodology has good small sample properties, given that it depends on the estimation of a single equation. Thirdly, it has a decisive benefit, thanks to the application of lags in the estimation; the bound test gives unbiased parameter estimates of the long run, irrespective of the endogeneity of some of the regressors. Hence, endogeneity is less of a dilemma if the errors in the ARDL model are serially uncorrelated. This is a fact that apparently affects all macroeconomic variables including the ones used in the present paper. After all, the ARDL model has become progressively more admired in the latest era (Jayaraman and Choong 2009).

The rationale of the estimation is to get an equation of the form:

$$\mathrm{CAD}_t = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \cdots \delta_k Z_k, \tag{9}$$

where CAD_t is the "long-run" level of current account deficits, there are k potential determinants Z_i, and all variables are measured in growth rates to capture the long-run effects.

To acquire equations similar to (9), we proceed in two stages. In the initial step, we estimate an autoregressive distributed lag of the form:

$$\Delta\mathrm{CAD}_t = \sum_{j=1}^{n} a_j \Delta\mathrm{CAD}_{t-j} + \sum_{j=1}^{k}\sum_{j=0}^{n} b_{i,j}\Delta Z_{i,t-j} + \sigma\mathrm{CAD}_{t-1} + \sum_{i-1}^{k} d_i Z_{i,t-1} + u_i, \tag{10}$$

where Δ is the first difference of the variable and σ is the speed of adjustment of the dependent current account deficits towards the long-run equilibrium as given in Eq. (9). b_i and d_i are the short- and long-run multipliers of the independent variables, respectively. u_i is the error term. Z is a set of potential determinants of *CAD* including dummy variables: *BUD, RGDP, REER*, and *IR*. Dum_i are intercept dummy variables (0 and 1 before and after the period) that capture the dynamics corresponding to 1986, 1994, and 2002.

The initial step in the ARDL estimation requires the understanding of the statistical properties of the variables. Therefore, the study ascertains the stationary of the variables using augmented Dickey–Fuller (ADF), Philips–Perron, and Zivot–Andrews unit root test (*ZAU*). Within the first stage of the model estimation,

test of the statistical adequacy of the model is carried out. This has to do with determination of the optimal lag structure to be included as well as confirmation of standard diagnostic tests. The Schwarz criteria[4] is used to determine the appropriate lag length of the variables. The inclusion of three maximum lags was sufficient to pass the diagnostic tests including the Breusch–Godfrey test for serial correlation, the Breusch–Pagan–Godfrey test for heteroskedasticity, and the autoregressive conditional heteroskedasticity (*ARCH*) errors.[5] Similarly, given that the data have structural breaks, CUSUM test is carried out.

Following the confirmation of the adequacy of the model, the second step begins by testing for the subsistence of a level or long-run relationship. Two main approaches are often used. The first is the *t test* to determine the speed of correction coefficient σ. To establish or accept a long-run relationship with no suspicion, the absolute value of the *t-statistics (t-stat henceforth)* ought to lie beyond the (asymptotic) upper critical value (or upper bound) of Pesaran et al. (2001) and vice versa. On the contrary, if the value of *t-stat* lies between the lower and upper bound, then the existence of a relationship is indecisive. The only condition for acceptance is only when the entire variables are integrated at order zero (i.e. stationary). The study basically expects the error correction coefficient, σ, to be negative and significant to establish a cointegrating relationship.

The second approach in the second stage is the *F-test.* Here, the *F-test* ascertains the joint significance under the null hypothesis that σ and d_i coefficients in Eq. 9 are jointly equal to zero.

$$H_0 : \sigma = 0 = d_i = 0, \tag{11}$$

$$H_1 : \sigma \neq 0 \neq d_i \neq 0. \tag{12}$$

Once more, the existence of a long-run relationship is accepted when the *F-stat* rests beyond the upper critical bound. Similar decisions as in *t-stat* could be given in the other two scenarios: within or below the lower critical bound.

As complementary method, the present study employs Granger causality to determine the direction of causation between the current account deficits and budgets deficits. Based on the brief literature and theoretical review, it is worth mentioning that reverse causality running from current account deficit to budget deficit could be another possible scenario of causation which ARDL may not be able to ascertain clearly. In the same vein, bi-directional causality could also occur. Therefore, while ARDL provides information on the cointegration, the wisdom of using Granger causality is to determine the precise direction in which the variables are causality related

[4] We estimated (ARDL 1, 0 1 2 and 3). See "Appendix 3" for the output of lag selection.

[5] We reject the null hypotheses that (1) there is no autocorrelation in the residuals (Breusch–Godfrey), (2) variances are constant (Breusch–Pagan–Godfrey-test), and (3) that there are no ARCH errors, when the p values in parentheses are less than 0.05. Again, we reject the hypothesis that the distribution is not normal when the p values corresponding to Jarque–Bera χ^2 statistics are less than 0.05.

5 Empirical examination

5.1 Unit root test

As earlier stated, prior to the estimation of the model, a unit root test ought to be carried out to ascertain the order of integration of the variables. Nevertheless, for a scope of study as in the present one, it is extremely probable that there could be a structural break in the variables. Accordingly, the ordinary augmented Dickey–Fuller (ADF) and Philips–Perron (PP) tests may not be sufficient, as it is liable to accept the null hypothesis of nonstationarity when it is not. The structural break in the stationarity test was initially suggested by Perron (1989). However, Zivot and Andrews (1992) among others consider Perron's test as inadequate, because it considers structural breakpoints exant. It is suggested that the suitable evaluation process ought to be the one in which the break dates are endogenously selected by the data.

Consequently, the study also employs the test suggested by Zivot and Andrews (1992) (hereafter, ZAU) to test the null hypothesis of a unit root. ZAU test is a chronological test that uses the complete sample and utilizes diverse dummy variables for every potential break date. A break period is selected where the *t-stat* is smallest (in absolute levels), which gives the most convincing proof against the null assumption. Generally, the ZAU test is always carried out based on three models:

$$y_t = \alpha_0 + \delta DU_t(\lambda) + Bt + \rho y_{t-1} + \sum_{i=1}^{i=k} \Delta y_{t-j} + e_t, \tag{13}$$

$$y_t = \alpha_0 + Bt + \gamma DT_t(\lambda) + \rho y_{t-1} + \sum_{i=1}^{i=k} \Delta y_{t-j} + e_t, \tag{14}$$

$$y_t = \alpha_0 + \delta DU_t(\lambda) + Bt + \gamma DT_t(\lambda) + \rho y_{t-1} + \sum_{i=1}^{i=k} \Delta y_{t-j} + e_t, \tag{15}$$

where $DU_t(\lambda)$ is a shift dummy variable, $DT_t(\lambda)$ is a time dummy variable, and e is the disturbance term, $DU_t\lambda = 1$, if $t > T\lambda$ and zero if not; and $DT_t(\lambda) = t - T\lambda$, if $t > T\lambda$ and zero if not. δ and γ are the degree of change in the level and trend slope, respectively, which occurs at $t = T\lambda$. Equation (13) allows for a one-period change in the level of the variable; Eq. (14) permits a one-period change in the slope of the trend equation, and Eq. (15) allows for a blend of one-period change in the level and the slope of the trend equation of the variable.

Accordingly, it is possible to test the null hypothesis for all the equations, $\rho = 0$, which suggests that the variable (y_t) follows a random walk process with a drift parameter without any structural break, while the alternative hypothesis $\rho < 0$ suggests that the variable follows a trend stationary pattern with a one-period break taking place at an unidentified point in time. *ZAU* test perceives all points as probable break dates and performs regression for every likely break period one after another.

Table 1 Unit root test result

Augmented Dickey–Fuller[1]	Philips–Perron[1]			
	Level	First difference	Level	First difference
Current account deficit (CAD)	−4.35***	–	−3.55**	–
Budget deficit (BUD)	−3.51**	–	−10.31***	–
Real GDP (RGDP)	−4.58***	–	−4.58***	–
Interest rate (IR)	−2.33	−5.21***	−2.31	−6.62***
Real effective exchange rate (REER)	−4.55***	–	−4.47***	–
Zivot–Andrews (1992) Unit root[2]		*t*-stat (ρ)		Break date
Current account deficit (CAD)		−5.41***		2011
Budget deficit (BUD)		−3.38***		2008
Real GDP (RGDP)		−6.04***		1998
Interest rate (IR)		−4.19***		1986
Real effective exchange rate (REER)		−4.95***		1987

Source: author's computation

***, **, *Indicates stationary at 0.01, 0.05, and 0.10, respectively

[1]The critical values at 0.01, 0.05, and 0.10 are approximately −3.62, 2.96, and −2.62, respectively

[2]The critical values of *ZAU* with intercept at 0.01, 0.05, and 0.10 are −5.34, −4.936, and 4.58 and with trend: −4.80, −4.42, and −4.11, respectively

Table 2 Multiple break test

Bai–Perron tests of 1 to M globally determined breaks
Estimated break dates:
1: 1987
2: 1987, 2001
3: 1986, 1991, 2001
4: 1985, 1990, 1996, 2002
5: 1985, 1990, 1996, 2002, 2007

Source: authors' computation

Considering the result of the traditional *ADF* and *PP* tests in Table 1, we assert that all the variables are stationary at the level, except interest rate which attained stationarity after first differencing. Moving further, we *ZAU* test reject the null hypothesis of nonstationarity with structural break in the intercepts for all the variables. Since the variables comprise different orders of integration, to assert on a unique statistical structure of the variables is not possible, which is precisely one of the motivations behind using the ARDL technique.

Even though these break dates are plausible, we carried out a multiple break test of the entire model variables using global versus none as presented in Table 2. The overall outcome shows that the means of the estimated coefficients exhibit variability largely in agreement with the results obtained with the *ZAU* break test.

However, only a few of them entered the final equations based on their respective significant levels. These include Dum 1986, Dum 1994, and Dum 2002.[6]

While break date in Dum 1986 is linked with the first phase of the implementation of IMF/World Bank-motivated trade liberalization policy of 1986, Dum 1994 is included based on the recursive estimates.[7] This is reasonable if we consider the introduction of the unified exchange rate system (1986–1994) where the first- and second-tier markets were merged into foreign exchange market (FEM). This possibly has some implications on capital flows and hence the transmission channels, in which budget deficits and current account deficits are related. Similarly, 2002 could have some implications from increase in oil prices and euphoria of democratic governance that encourage private sector-led growth.

5.2 Discussion of research findings

From Table 3 where Eq. (10) is estimated, it is evident that the entire regressors are significant and correctly assigned. It is clear that the core independent variable-budget deficit is statistically significant at the 0.01 level and has the highest magnitude in influencing the current account deficit. Hence, a one percent increase in budget deficits increases current account deficits by 1.634469%. The positive coefficient means that the *'twin deficits'* hypothesis is upheld in the context of Nigeria. This is consistent with earlier the outcome reported by Ahmad and Aworinde (2015).

As indicated earlier, the inclusion of other regressors in the analysis is to show the possible channel through which the current account deficit is affected. The coefficient of real GDP growth is statistically significant at the 0.01 level. Hence, the growth of domestic income has the tendency of increasing the current account deficit as explained by the saving channel. Therefore, one percent increase in real income growth leads to 0.753128% increase in the current account deficit. Similarly, the interest rate variable is significant at the 0.01 level. The result shows that a one percent rise in the real interest rate leads to a proportionate decline in the current account deficit. On the one hand, the estimated coefficient of real effective exchange rate is also statistically significant at the 0.05 level and indicates that an appreciation of the local currency leads to a fall in export competitiveness and to a rise in net imports, hence compounding the current account deficit crisis. Putting it differently, an overvalued

[6] Ahmad and Aworinde (2015) note that most of these breaks are a result of policy regime changes in reaction to economic challenges that led to fall in oil prices, however, aggravated by inefficient domestic economic policies. The country launched several economic reforms between 1986 and 1994. These covered almost all sectors of the economy, which included subsidy removal, huge public expenditure cut, liberalization of foreign exchange market, and trade. These had significant implications on the economy's indices such as employment and price level. Rises in oil prices recorded in the 2000s tend to have significant consequences on the country's budget deficit series as revealed by the research outcome.

[7] We improve the selection of the dummies by carefully observing the results of recursive regression. This further gives more information on the stability and structure of our variables (see "Appendix 2" for recursive regression).

Table 3 Long-run estimates

Method: ARDL approach				
Sample: 1980–2016				
Included observations: 36				
Dependent variable: current account deficit, CAD				
	Coefficient	Std. Error	*t*-statistics	Probability
Long-run estimates				
Speed of adjustment, σ	− 0.957341	0.085416	− 11.20794	0.0000***
Budget deficit, (BUD)	1.634469	0.267023	6.121077	0.0000***
Real GDP growth, RGDP	0.753128	0.111624	6.746998	0.0000***
Real interest rate, IR	− 1.000938	0.192894	− 5.189052	0.0001***
Real effective exchange rate, REER	0.071538	0.027787	2.574493	0.0191**
Dum 1986	− 31.77724	5.251309	− 6.051299	0.0000***
Dum 1994	3.985802	2.203280	1.809031	0.0239**
Dum 2002	1.634469	0.267023	6.121077	0.0872*
Diagnostics				
Jarque–Bera Normality test	4.70(0.09)			
Breusch–Godfrey autocorrelation	0.85(0.72)			
Breusch–Godfrey heteroskedasticity	0.97(0.92)			
ARCH	0.50(0.48)			
Bounds testing[1]				
F-stat	20.55***			
t-stat	8.39***			

Source: Authors' computation

***, **, *Significant at 0.01. 0.05 and 0.10 level

[1]The decision as to whether there is a long-run relationship between the variables

***, **,*Indicates rejection of the null hypothesis of the absence of a long-run relationship at 0.01, 0.05, and 0.10 significant levels when the *F-stat* or the absolute value of *t-stat* falls outside the upper critical bounds of Pesaran et al. (2001). The upper critical values for $n \geq 35$ for *F-stat* at 0.01, 0.05, and 0.10 are 6.368, 4.63, and 3.898, respectively. Similarly, the values are 4.60, 3.99, and 3.66 for *t test*

exchange rate makes an economy less competitive, discourages exportation, and in turn encourages importation, hence, deteriorating the external balance of the economy. In general, given the significance of the transmission channels, we assert that they are important mechanisms through which budget deficit financing stance of the government affects the current account deficit. Similarly, the results of all the endogenous structural break dummy variables (Dum 1986, Dum 1994, and Dum 2002) are statistically significant at 0.01, 0.05, and 0.1, respectively. The negative sign of Dum 1986 perhaps reflects some seeming positive impacts of trade liberalization on reducing current account deficits as evidenced in Fig. 1. The rest of the breakpoints tend to increase the current account deficit.

5.3 Cointegration and long-run dynamics

As earlier stated, the model follows Pesaran et al. (2001) and below is the estimated output:

The unrestricted error correction result shows that the variables are cointegrated. This is evidenced by the fact that the error correction term, σ, satisfies the necessary and sufficient conditions of a negative and statistically significant variable. This means that any movement into disequilibrium is immediately corrected with the speed of 95% annually.

Regarding bounds test results, since the *F-stat* is significant with the highest precision as value falls outside the critical bounds at all levels of significance, the null hypothesis of no long-run relationship is rejected and it is concluded that there is a long-run relationship between the variables. Similarly, this conclusion is upheld when the absolute value of *t-stat* is considered; hence, the conclusion about the cointegration of the variables is not nonsensical.

The Breusch–Pagan–Godfrey test for heteroskedasticity indicates that the variances from the model is constant and converge in the long-run. This is supported by ARCH test which indicates that there are no ARCH effects in the model. In addition, serial correlation LM shows that the errors are uncorrelated over time. In essence, errors in one period are independent of the preceding ones. Similarly, the variables are normally distributed. Hence, the parameter estimates are valid and without econometric problems.

Similarly, to further validate the robustness of the research outcome, CUSUM tests proposed by Brown et al. (1975) is conducted and the outcome is given in "Appendix 4". The test is applied to the residual of the evaluated econometric model. The assessment is based on the cumulative sum of recursive residuals regarding the first set of N observed data. It is well run recursively and is graphed against the structural break periods. When the graph of CUSUM statistic falls within a 0.05 level significance (represented by two direct lines whose functional form is specified in Brown et al. (1975), in that case the estimated elasticity coefficients of the variables are stable. The result shows that the plot of CUSUM statistic is inside the 0.05 level of significance, demonstrating that the estimated model is stable.

5.4 Test for causality

The unit root tests (Table 1) imply that the order of integration for the variables is not uniform. Therefore, this study only concentrates on the core variables of the study, since they both follow the $I(0)$ process. This is necessary to satisfy the theoretical requirement of the methodology. The Granger causality tests in the ARDL environment can be undertaken in the following form:

$$\mathrm{CAD}_t = \alpha_0 + \boldsymbol{\Phi}_k \mathrm{CAD}_{t-1} + \sum \omega_k \mathrm{BUD}_t - k + \varepsilon_t, \tag{16}$$

$$\mathrm{BUD}_t = \delta_0 + \eta_k \mathrm{BUD}_{t-1} + \sum \lambda_k \mathrm{CAD}_{t-j} + \varepsilon_t. \tag{17}$$

Table 4 Pairwise Granger causality tests

The null hypothesis	Observation	Coefficient/of *F*-stat	Probability value
CAD does not Granger cause BUD	33	0.96767	0.4433
BUD does not Granger cause CAD		4.03886	0.00121***

***Indicates that the variable is significant at the 0.01 level

Here, the objective is to determine whether or not one of the variables (CAD) could be predicted by the other variable (BUD) if the incorporation of the historical observation of BUD or its lag values lessens errors in prediction of CAD and vice versa. This is then compared to an equation that only incorporates the past observations of CAD and BUD.

The appropriate hypotheses involved in Granger causality are as given below:

$$H_0 = \omega_1 = \omega_1 = \cdots \omega_k = 0 \quad \text{vs.} \quad H_1 = \omega_1 \neq \omega_2 \neq \cdots \omega_k \neq 0.$$

Equation (16) implies that BUD does not Granger cause CAD.

In a similar manner, Eq. (17) is tested as follows:

$$H_0 = \lambda_1 = \lambda_2 = \cdots \lambda_k = 0 \quad \text{vs.} \quad H_1 \neq \lambda_1 \neq \lambda_2 \neq \cdots \lambda_k \neq 0.$$

This suggests that the lagged values of CAD have no effect on BUD, as opposed to the alternative that lagged values of CAD are important determinants of BUD.

In Table 4, it is shown that Granger causality runs from BUD to CAD at the 0.01 level of significance. The outcome complements the ARDL test that twin deficit problem exists for Nigeria and it runs from budget deficits to current account deficits. Hence, the Keynesian–Mundell–Fleming approach is supported.

6 Conclusion

The connection between the current account deficit and budget deficit is investigated. The analysis was conducted on annual data spanning 1980–2016 for Nigeria. The study has been based on the autoregressive distributed lag (ARDL) approach and Granger causality tests. Based on the brief literature and theoretical review, it is it possible to have reverse and bi-directional causality scenario of causation, which ARDL may not be able to ascertain. Therefore, while ARDL gives insights into the cointegration in both short- and long-run periods, the understanding of using Granger causality is to determine the precise direction in which the variables are causality connected. The outcome of the ARDL signifies that the budget deficit, the real GDP, the current account deficit, interest rates, and the real effective exchange rates in Nigeria have long-run relationship. The short-run dynamics of the model estimated shows that the system adjusts back to equilibrium quickly. The Granger causality result shows that there is a unidirectional causality between the variables running from budget deficit to the current account deficit. It is, therefore, concluded that the Keynesian–Mundell–Fleming approach, which concludes that budget deficit is one of the causes of current account disequilibrium, is sufficient and satisfactory

in the light of Nigerian application. Therefore, the study rejects not only the Ricardian equivalence proposition, but also the reverse and bi-directional causality hypotheses. In this case, it would be appropriate to state that the gap between private investment and private savings, the gap between government revenue and government spending, international trade competitiveness of export industries as well as the pattern of import have the propensity to exert enormous impacts on the current account position of the economy.

Looking ahead, managing these deficits is undeniably an important national agenda article for the Nigerian economy. Along this line, controlling BUD and CAD complemented with an appropriate policy coordination of monetary and fiscal blend is indispensable to support the macroeconomic stability and sustainability in the economy. It is recommended that if the twin deficit quandary must be avoided, Nigeria ought to start by implementing policies towards reducing budget deficits, strengthening its budgetary institutions so as to ensure that there is fiscal discipline; budget deficit to GDP ought to be set at a sustainable ratio of below 3 percent of GDP as given in the EU-stability pact.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Appendix 1

See Fig. 2.

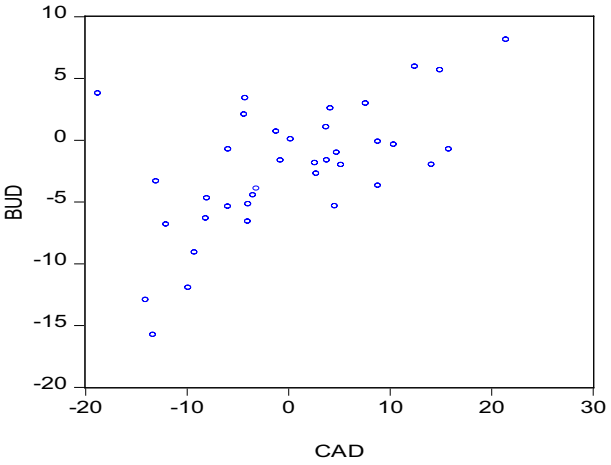

Fig. 2 Scatter diagram of current account and budget deficits

Appendix 2

See Fig. 3.

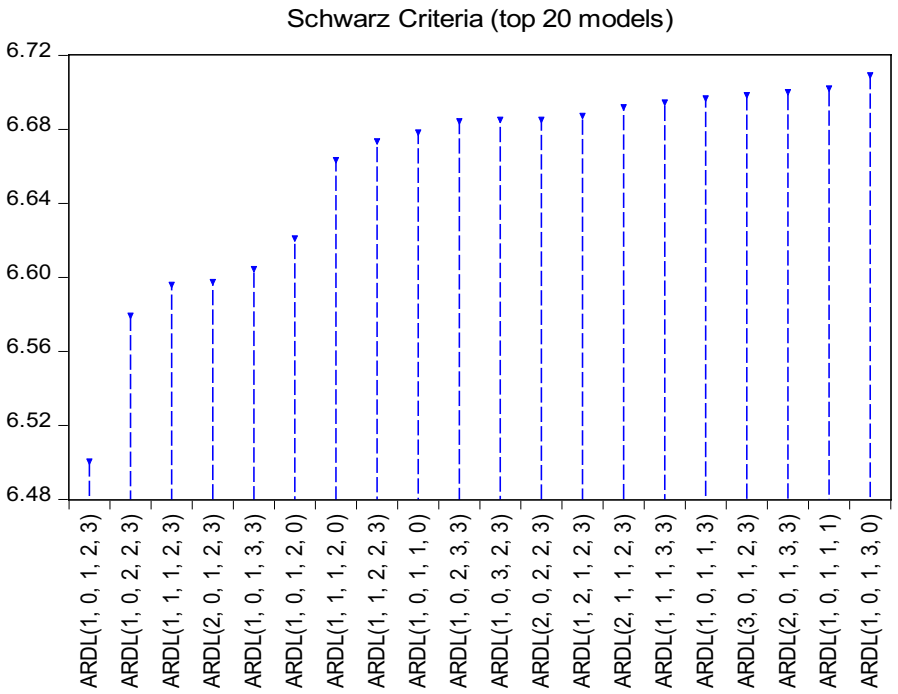

Fig. 3 Lag selection criteria

Appendix 3

See Fig. 4.

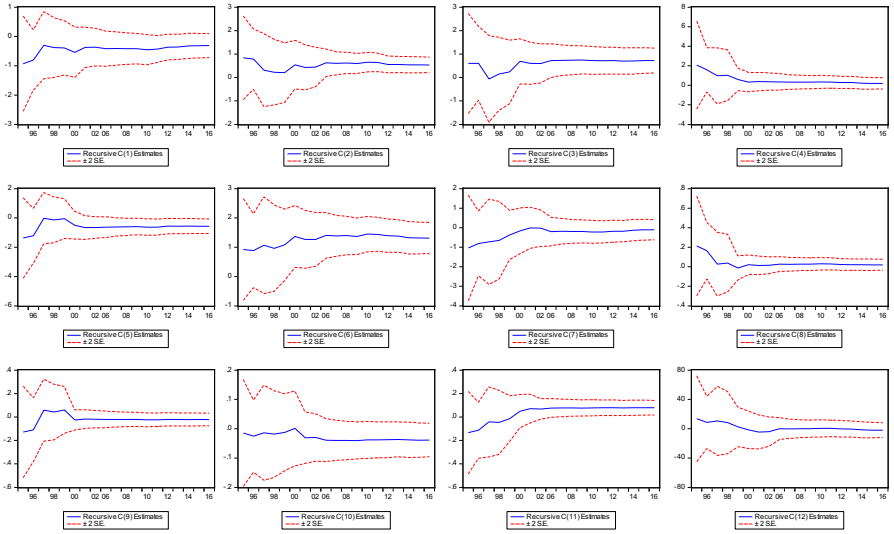

Fig. 4 Recursive regression plots

Appendix 4

See Fig. 5.

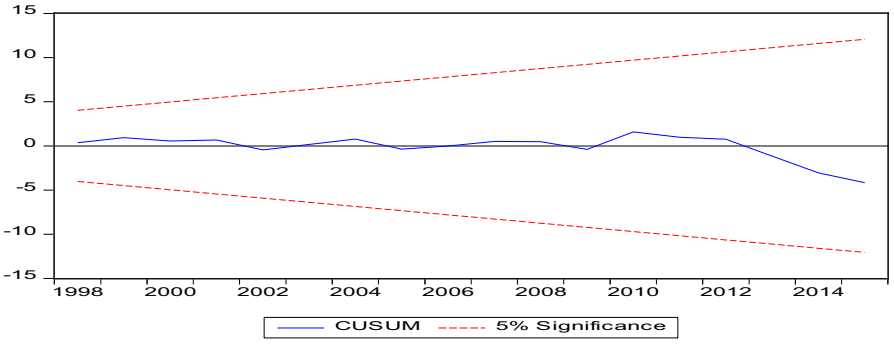

Fig. 5 Cusum test of recursive residuals

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