Zivot Andrews Test for Structural Break: A Consideration of Government Expenditure in Nigeria from Pre to Post Sap Era

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Abstract

This study examines Government Expenditure in Nigeria in the light of Zivot Andrews test for structural break**.** The specific objectives of the study were to ascertain if structural breaks existed during the pre SAP, SAP and post SAP periods for economic growth and aggregate spending in Nigeria during the period under study with the aid of secondary macroeconomic data sourced from World Bank Development Indicators (WDI) covering a period of 1970 to 2023. The method of analysis employed was auto regressive distributed lag (ARDL) technique using government expenditure on transport, communication, health, education and utility sectors as independent variables independent variables and Gross Domestic Product as the dependent variable. From the results we observed, there were structural breaks both highest peaks and lowest peaks experienced during the pre SAP, SAP and post SAP periods for economic growth and aggregate spending in Nigeria. The study therefore recommends that the government should not only increase its expenditure in the key sectors of the economy but should do so in line with the needs for these infrastructural facilities so that the economy can attain infrastructural development.

*Keywords***:** Zivot Andrews Test, Structural Break, SAP

Introduction

Structural breaks, defined as abrupt shifts or changes in the underlying parameters of a time series data are crucial phenomena in the field of Economics. Detecting these breaks accurately is essential for understanding the dynamics of the data used and making informed decisions. The Zivot-Andrews test, introduced by Zivot and Andrews (1992), is a widely used econometric tool for detecting structural breaks in time series data.

In Nigeria, sustaining economic growth is crucial for policymakers, as it is the driving force for moving the economy from a less developed state to a more developed one (Okoli, Nwokoye and Ezedebego, 2023). In order to sustain economic growth, government expenditure is very paramount in the development of any nation. Without spending on some growth-enhanced projects, growth is not attainable. These growth-enhanced projects

include, good roads, adoption of modern technology, good health care system, stable electricity, good educational facilities and so on. However, it is the proper implementation and monitoring of these projects that would ensure development. All these are capable of generating employment opportunities for the teeming Nigerian youths (Central Bank of Nigeria, 2020).

So many advanced nations of the world like China, USA, have developed their economy through government spending in various sectors of the economy like defense and agriculture. Government spending helps to create enabling environment for investment which will in turn increase the rate of employment in the economy (Todaro and Smith, 2011). It is also seen as an instrument of ensuring equitable distribution among citizens. Also, some African countries like Kenya, Morocco, Cote d'Ivoire, and South Africa which have developed to some extent, really spent a lot in the area of infrastructures. This has helped them in making production of goods and services efficient and easily distributed at low cost. It is therefore evident from the history of both advanced and some developing countries that government spending is inevitable for growth and development to take place (World Economic Outlook, 2014).

The Nigerian government has spent huge amounts for the development of capital infrastructure in the country over the years. For instance, in 2010, the government spent ₦883.87 billion on capital expenditure, ₦713.3 billion in 2011, ₦744.42 billion in 2012, ₦405.37 billion in 2013 and the list continues. In 2013, power sector had 80.17 per cent of budget releases, transportation sector had 50.49 per cent, health sector had 79.37 per cent and education sector had 65.37 per cent of budget releases respectively (Central Bank Nigeria [CBN], 2020). Despite statistical evidence of the huge amounts that have been consistently spent for the development of public infrastructures in Nigeria from the years before the introduction of SAP in Nigeria till date, public infrastructure development in Nigeria still requires more to be desired. The primary objective of this paper is to provide a comprehensive understanding of the Zivot-Andrew's test and its application in detecting structural breaks by presenting empirical and graphical examples to demonstrate the practical relevance of the test using the Nigerian scenario.

This research therefore aims to add to the existing body of literature by ascertaining the presence of structural breaks during the study periods for economic growth and aggregate spending in Nigeria. This will be achieved by providing answers to the following questions;

1. Were there structural breaks experienced during the pre SAP, SAP and post SAP periods for economic growth and aggregate spending in Nigeria?

By understanding these issues, policymakers and researchers can develop effective strategies for promoting economic growth in Nigeria which is all this research work is set to achieve. The hypotheses for the variables were tested in null form.

2. There were no structural breaks experienced during the pre SAP, SAP and post SAP

    periods for economic growth and aggregate spending in Nigeria.

Thus, the rest of the paper is structured into literature review, research methodology, findings presentation and discussion and conclusion and implication of the study.

Review of Literature

The theory postulated for this study is the Keynesian Theory of Government Expenditure. This theory was propounded by John Maynard Keynes in 1936. According to him, government expenditure as a fiscal policy can contribute positively to economic growth. He believed that increase in government spending will increase investment which will in turn stimulate growth in various sectors of the economy. Keynes further believed that government spending which is categorized as an exogenous factor would help boost the economy. He argued that government intervention would help reduce market failures and that during recession, increasing spending will help the economy out of recession.

To illustrate the application of the Zivot-Andrews test, we will present empirical examples using real-world datasets. These examples will cover various domains such as macroeconomics, financial markets, and climate science. We will interpret the results obtained from the test and draw insights regarding the presence of structural breaks in the data.

Ogbonnaya and Otta (2018) examined Nigeria's macroeconomic rates from 1970 to 2015 in search of structural breaks. The study focused on interest rates, exchange rates and inflation rates in Nigeria. Unit root tests to detect multiple breaks, LM approach to test for model stability, and the Chow test for identifying break dates were the analytic methods employed. The results show the presence of statistically significant breaks for the macroeconomic variables employed in the analysis thereby leading to the rejection of the null hypothesis. The paper recommends that the government should adopt the policy of switching regimes in order to reduce the occurrence of breaks in Nigerian time series data.

Awe and Gil-Alana (2019) studying structural breaks and the Nigerian economy was able to show that Nigeria's growth rate was unstable with non-linearities and structural breaks caused by erratic political institutions, poor economic management and insecurity from 1960 to 2017. The study recommends that the government should build stronger political structures that will enhance economic growth in the country.

Akpansung and Gidigbi (2020) studied government expenditure on debt management and economic growth nexus in Nigeria using structural breaks while employing the Johansen-Juselius cointegration, granger causality and bai-perron's multiple structural breaks procedures. The results show the existence of both short and long run relationships between government expenditure and economic growth but no causal relationship was established.

Jamani and Ukarin (2020) examined the existence of structural breaks in public expenditure shocks and human capital development in Nigeria from 1981 to 2018.The study employed the zivot and andrews unit root test for structural breaks, variance autoregressive (VAR) technique and the impulse-response functions technique and found that the impulse response functions were robust to structural breaks on the data employed. The study recommended that the government should ensure efficiency in public expenditures.

Nathaniel and Bekun (2020) sought to establish the existence structural breaks in government infrastructural expenditure and economic growth in Nigeria from 1971 to 2014 using vector error correction and granger causality tests. The results show that

granger causality test supported the neutrality hypothesis in the short run. The study therefore recommends that the government should embark on more appropriate fiscal policies.

Adeleye, Nathaniel, Ogunrinola and Ikuemonisan (2021) undertook a structural break analysis on the effects of financial deepening on income inequality in Nigeria using annual data from 1980 to 2015. Error correction approach within the framework of the autoregressive distributed lags (ARDL) model was the key econometric approach that was employed to study the long run and short run dynamics of the variables included in the model. The results show in the long-run, financial deepening and per capita income have positive impact on income inequality whereas the opposite is the case in the short run especially with the presence of structural breaks observed. The study recommends that the government when making decisions on issues relating to reducing income inequality, adequate room should be made for the presence of structural breaks to avoid making wrong inferences.

Biu and Nwakuya (2022) studied a consideration of government transition in Nigeria from military to civilian democratic government using structural breaks and applying it to six different regression models with the Pooled Regression model. Minitab 21 statistical software was the statistical tool employed on time series data from 1999 to 2020. The six regression models provided evidence that there was a structural break in the GDP due to the switch in Government. The pooled regression showed significant effect of the health expenditure on the GDP but could not identify any structural break. The paper recommends that the Nigerian government should consciously handle change in government to ensure that breaks are not experienced in the growth process of the economy.

Fasanya, Adekoya and Ajayi (2022) studied the relationship between oil price and stock returns using structural breaks for selected sectors in Nigeria using monthly data from January 2007 to December 2016. Both the linear and non-linear autoregressive distributed lag methods were the econometric tools employed in the analysis. From the results, the

authors could identify two structural breaks in some sectors that occur in 2008 and 2010/2011 which coincidentally correspond to the global financial crisis and the Arab spring respectively. The paper thus recommends that the government should make room for asymmetric effects and structural breaks when handling the nexus between sector returns to movement in oil prices in Nigeria.

Ismail and Oluwafunmilayo (2022) examined the effect of exchange rate shocks on ten sectoral stock returns in Nigeria using monthly data from January 2007 to December 2018 to ascertain symmetric and asymmetric relationship existing between exchange rate and sectoral stock returns in Nigeria. The result shows that only financial service sector moves in an asymmetric manner in the short and long period without taking account of structural breaks. Also, with structural breaks, none of the sectoral stock returns were asymmetric. The study recommends that since all sectors respond differently to exchange rate movements, the government should not use the information about a particular sector to forecast other sectors.

Okoli, Nwokoye and Metu (2022) examined the empirical relation between government expenditure on specific sectors of the Nigerian economy to establish the existence of structural breaks in government expenditure as a strong factor that influenced Nigeria's economic growth using time series data from 1970 to 2020 sourced from CBN Statistical Bulletin and National Bureau of Statistics. Zivot Andrews test and granger causality test were the econometric tools employed in the analysis with gross domestic growth rate as the dependent variable and government spending on transport, communication, health, education, and utilities sectors as the explanatory variables. The results show that there were structural breaks experienced during the study period for economic growth and aggregate spending in Nigeria while no causal link was established between the growth rate of the government spending for infrastructure and sectoral growth in Nigeria. The study therefore recommends that government should not only increase its expenditure on these key sectors but should do so in line with the provisions of the World Bank on infrastructural development so that government spending can positively contribute to sustained economic growth in Nigeria. This paper determined the exact impact of government's spending on these key sectors on Nigerian economic growth.

Olubiyi and Ibironke (2023) studied whether the Determinants of Government Expenditure in Nigeria are Symmetry or Asymmetry by employing structural breaks. Capital and recurrent expenditure was used to study government expenditure whereas nonlinear autoregressive distributed lag was employed to take care of asymmetry for time series data from 1981–2021. Model of government expenditure developed by Peacock and Wiseman (1961) combined with Devarajan et al (1996) and Giavazzi, et al (2000) models are developed and utilized. The results show that while government capital expenditure is countercyclical, recurrent expenditure is pro cyclical. Also asymmetric tax revenue shows potential to drive capital expenditure which significantly and positively influences recurrent expenditure and asymmetric behaviour of oil revenue and exchange rate also engenders capital expenditure. On the other hand, asymmetric behaviour of degree of openness and inflation rate negatively affects capital expenditure, asymmetric of tax revenue and oil revenue posted positive effect while exchange rate and degree of openness have negative effect on recurrent expenditure. The study recommends that following the nature of cyclicality of the component of government expenditure, the priority of government could be on capital expenditure since it will provide essential public goods required for the economy to flourish while bearing in mind that oil revenue is volatile, government should rely more on tax revenue than oil revenue.

Method

This is a quantitative analysis study that has the theoretical framework on the unbalanced growth theory which postulates that investment should be made in selected sectors rather than simultaneously in all sectors of the economy. Most underdeveloped or developing countries do not possess capital and other resources in such quantities as to invest simultaneously in all sectors. Therefore, investment should be made in a few selected sectors or industries for their rapid development, and the economies accruing from them can be utilized for the development of other sectors. Thus, the economy gradually moves from the path of unbalanced growth to that of balanced growth.

The study design will analytically follow the model of Okoli, Nwokoye and Ezedebego (2023),

GDPGR = β_0 + β_1GFCGR + β_2HDIGR + β_3TRANSGR + β_4COMMGR + β_5HTHGR + β_6EDUGR + β_7UTLGR + μ

The mathematical and econometrical form of the model with the variables converted to growth rates is given above with government expenditure decomposed into government spending on sectors such as transport, communication, health, education, and utilities. In order to fully analyse the specific objective, Zivot-Andrews test for presence of structural breaks was employed. It was done in such a manner that economic growth proxied by growth rate of gross domestic product was tested to ascertain if it experienced structural breaks during the pre SAP, SAP and post SAP periods. The government spending on the as transport, communication, health, education, and utilities were aggregated and tested to ascertain if it experienced structural breaks during the pre SAP, SAP and post SAP periods. This aimed at ascertaining if structure breaks existed within the periods under study and the most prominent break analysed.

Result

This section centres on the presentation and analysis of data used, interpretation of the result and discussion of the findings from the analysis conducted.

4.1 Unit root properties of the variables

Table 1 Unit root test results

Variable	ADF Statistic values	Test Critical values @ 5%	Order of Integration
GDPGR	-6.945333	-2.925169	I (0)
GFCGR	-6.761319	-2.925169	I (0)
HDIGR	-3.623757	-2.931404	I (1)
TRANSGR	-6.465626	-2.925169	I (0)
COMMGR	-7.060629	-2.925169	I (0)
HTHGR	-9.792461	-3.536601	I (1)
EDUGR	-8.631049	-2.936942	I (1)
UTLGR	-6.229138	-2.925169	I (0)

Source: Researchers' compilation (2024).

Following the results of Table 1, it can be seen that growth rate of human development index, growth rates of government spending on health sector and education sector passed the ADF test at first difference and integrated of the order I(1). This means that while GDPGR, growth rate of gross fixed capital, growth rates of government spending on transportation sector, communication sector and utility sector passed the stationarity test at level, the growth rate of human development index, growth rates of government spending on health sector and education sector were stationarized at first difference. Thus, the null hypothesis of no stationarity was rejected for all the variables in favour of the alternative hypotheses that there is stationarity for all the variables used in the study. We therefore concluded that the variables included in the model were stationary at both level and first difference.

4.2 To analyse the objectives of the study

In order to achieve the specific objectives of the study, it is observed that structure breaks existed within the periods under study and the analysis is carried out to show the three periods under study.
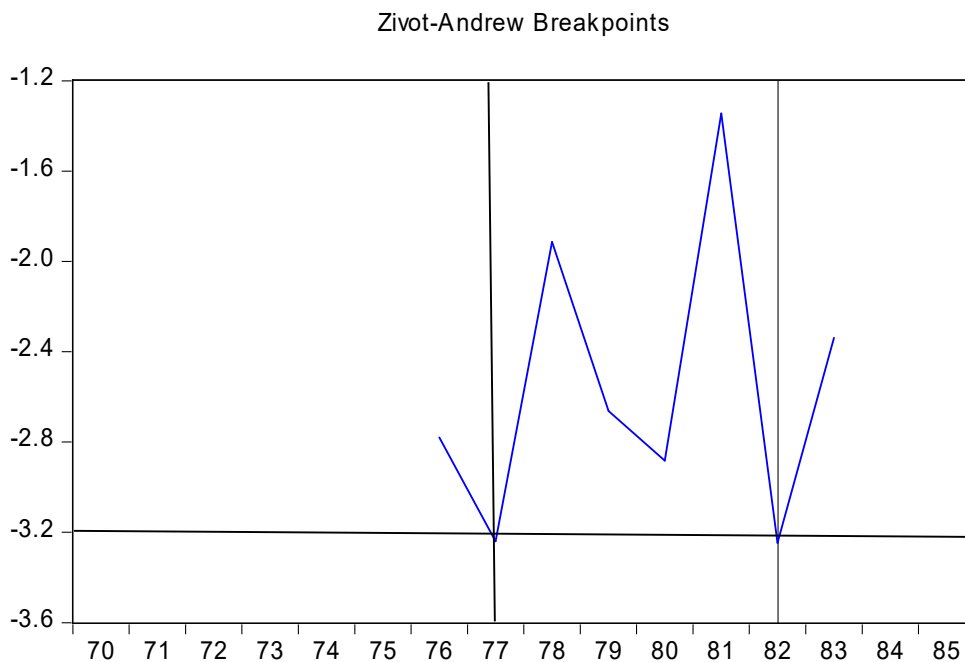
Pre-SAP Period

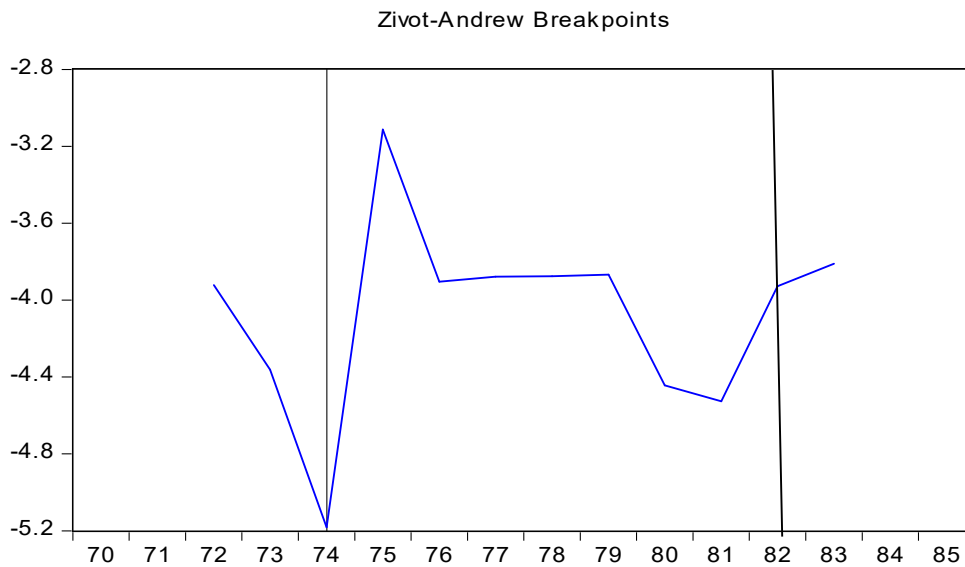Figure 1: Zivot-Andrew AGGREGATE SPENDING FOR PRE-SAP PERIOD

Figure 2: Zivot-Andrew GDP FOR PRE-SAP PERIOD

During the pre-SAP period, as the economy was enlarging, aggregate spending declined gradually until it got to -3.2 by 1977. It experienced accelerated increase to -2.0 by 1979 and then declined to -2.8 by 1981. It experienced another accelerated increase to -1.3 by 1981 before finally declining sharply in 1982 to that initial -3.2 where it was by 1977. These breaks took place within 1977 and 1982, a period short enough for the impact of huge government expenditure in the selected sectors to be felt within the economy (see Figure 1). On the other hand, the economy declined from -4.0 from 1972 to a sharp break of -5.2 by 1974 after which it accelerated sharply and peaked at -3.2 by 1975 and the experienced dwindling decline between 1976 and 1983 (see Figure 2). When the structural breaks in aggregate spending is studied in line with the structural breaks experienced in economic growth during the pre-SAP period, it is observed that aggregate spending had two lowest breaks of -3.2 in 1977 and 1982 and highest breaks of -1.3 in 1981 while economic growth had its lowest break of -5.2 in 1974 and highest break of -3.2 in 1975.
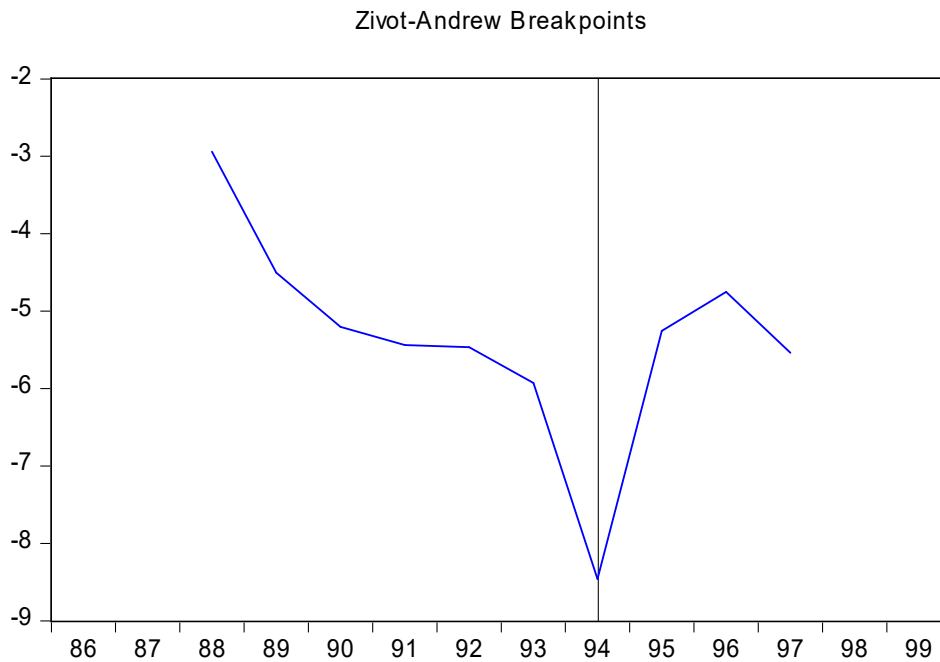
SAP Period

Zivot-Andrew Breakpoints

Figure 3: Zivot-Andrew AGGREGATE SPENDING FOR SAP PERIOD
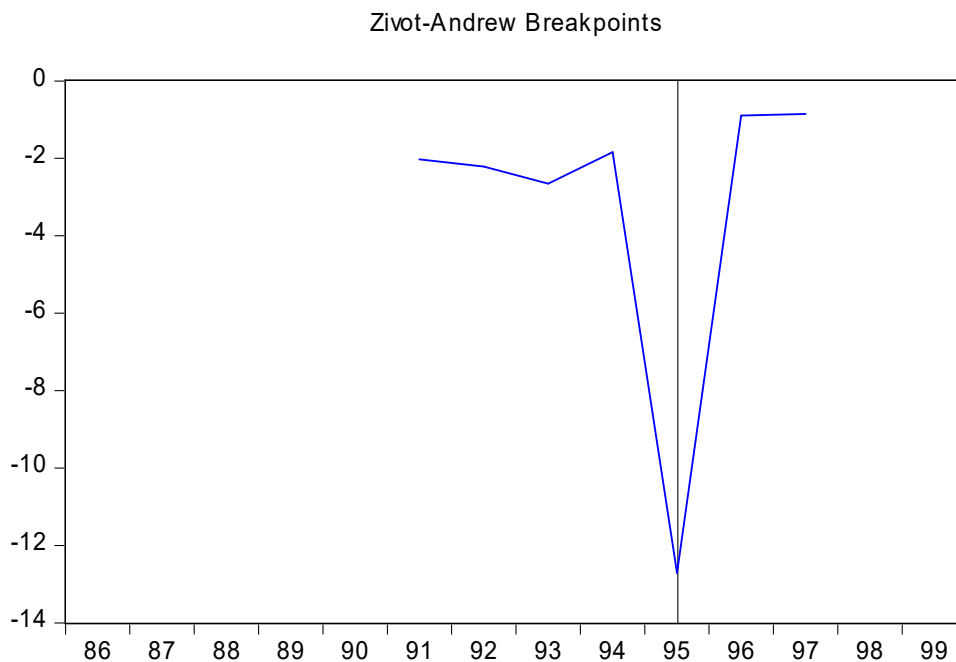
Zivot-Andrew Breakpoints

Figure 4: Zivot-Andrew GDP FOR SAP PERIOD

During the SAP period, as the economy was enlarging, aggregate spending declined consistently until it got to -8.4 by 1994. It increased sharply to -5 by 1995 before finally

declining (see Figure 3). Economic growth on the other hand was at almost a constant pace of -2 between 1991 and 1993 before declining sharply to -12.2 by 1995. It rose sharply and peaked at -1 by 1996 before finally declining (see Figure 4). When the structural breaks in aggregate spending is studied in line with the structural breaks experienced in economic growth during the SAP period, it is observed that aggregate spending had the lowest break of -8.4 in 1994 and highest breaks of -5 in 1995 while economic growth had its lowest break of -12.2 in 1995 and highest break of -2 in 1994.
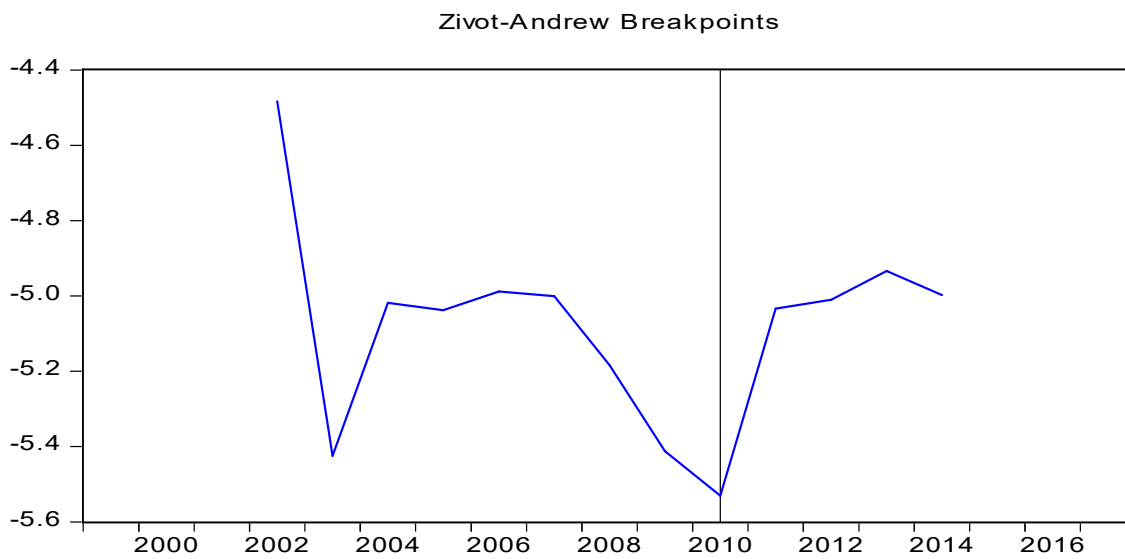
Post-SAP Period

Figure 5: Zivot-Andrew AGGREGATE SPENDING FOR POST-SAP PERIOD
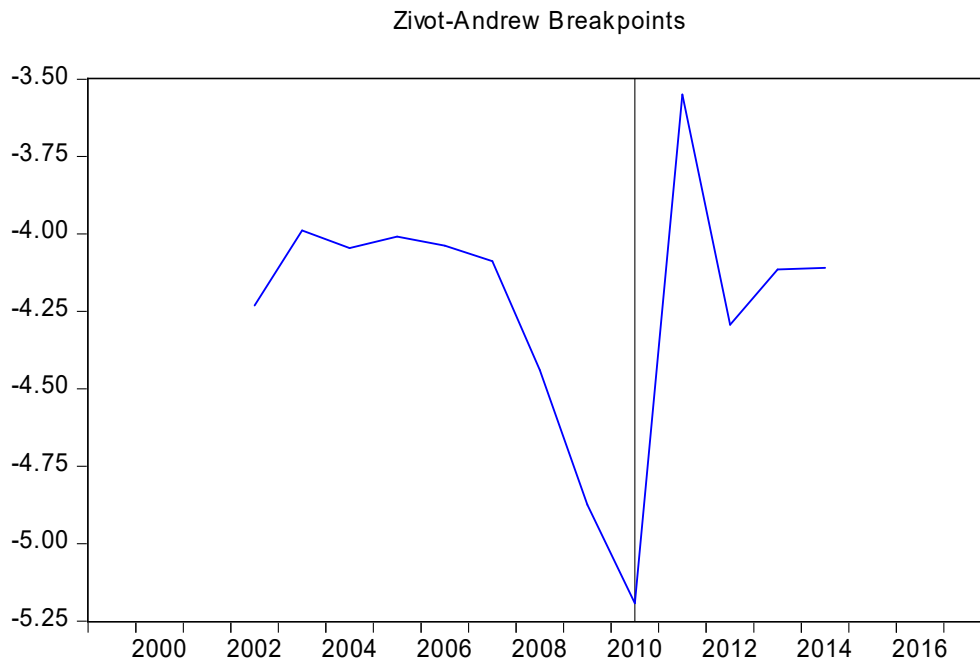
Figure 6: Zivot-Andrew GDP FOR POST-SAP PERIOD

During the post-SAP period, aggregate spending fell sharply from -4.5 to -5.4 by 2003 before rising -5 in 2004 and then experiencing dwindling decline from then till it reached -5.5 in 2010. It rose afterwards to -5 once again before finally declining (see Figure 5).GDP on the other hand had a dwindling decline between 2002 and 2006 before finally declining sharply to -5.2 in 2010. It accelerated sharply to -3.6 in 2011 before finally declining (see Figure 6). When the structural breaks in aggregate spending is studied in line with the structural breaks experienced in economic growth during the post-SAP period, it is observed that aggregate spending had two lowest break of -5.4 in 2003 and -5.5 in 2010 and two highest breaks of -5 in 2007 and -4.9 in 2013 while economic growth had its lowest break of -5.2 in 2010 and highest break of -3.6 in 2011.
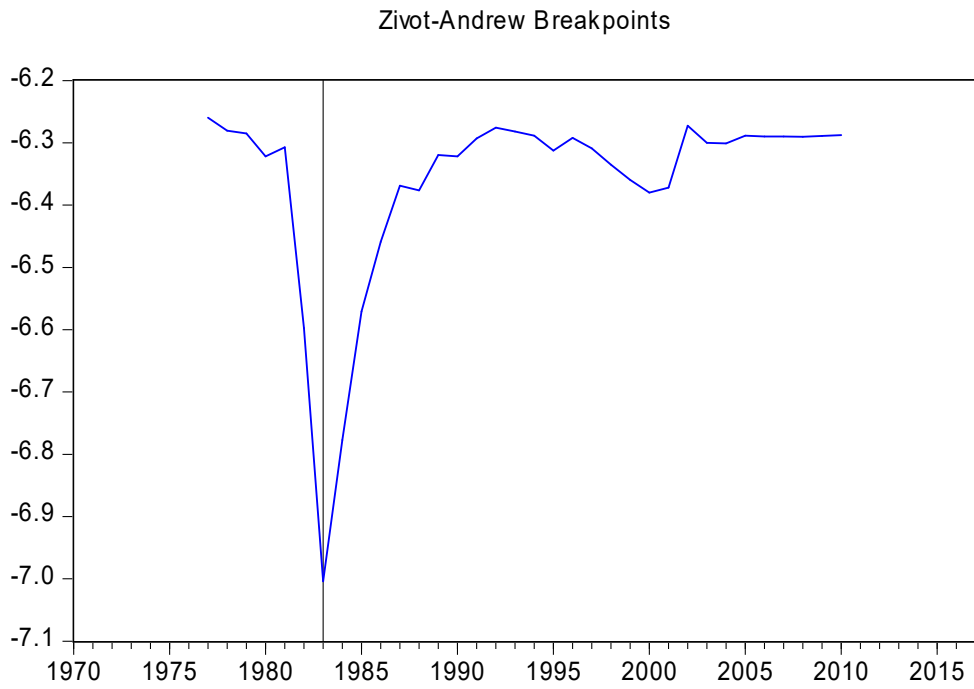
Entire study Period

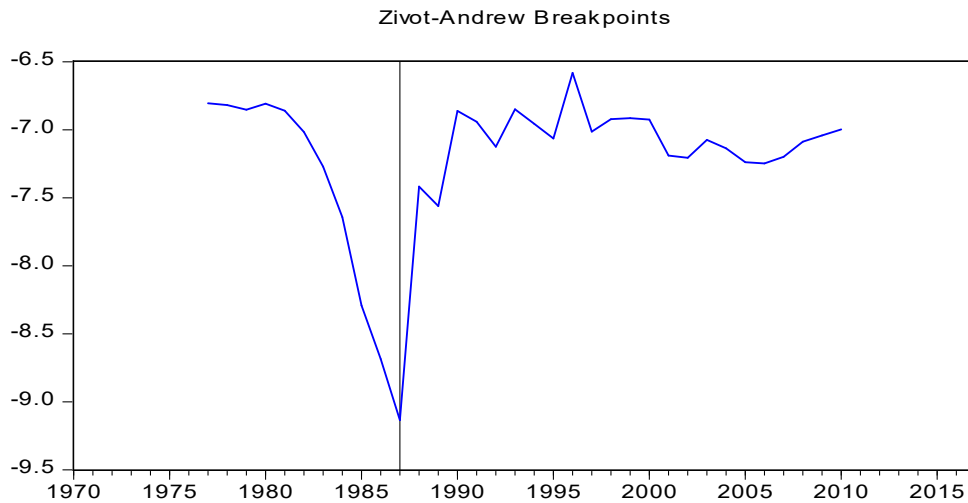Figure 7: Zivot-Andrew AGGREGATE SPENDING FOR ENTIRE PERIOD

Figure 8: Zivot-Andrew GDP FOR ENTIRE PERIOD

Finally during the entire study period, aggregate spending fell gradually from 1975 till it reached -7 by 1983. It rose consistently and remained in between -6.35 and -6.3 from 1985 to 2017 (see Figure 7).GDP on the other hand fell gradually from 1975 till it reached -9.2 by 1987. It rose consistently and remained in between -7.5 and -7 from 1988 to 2017 (see Figure 8). When the structural breaks in aggregate spending is studied in line with the structural breaks experienced in economic growth during the entire study period, it is observed that aggregate spending had the lowest break of -7 in 1983 and highest breaks remained consistently between -6.35 and -6.3 from 1985 to 2017 while economic growth had its lowest break of -9.1 in 1982 and highest breaks remained consistently between -7.5 and -7 from 1988 to 2017.

A careful look at the trend in the structural breaks between aggregate government expenditure and economic growth for the entire period show that aggregate government expenditure had the lowest break of -7 in 1983 and highest breaks remained consistently between-6.35 and -6.3 from 1985 to 2017 while for economic growth, its lowest break of -9.1 was observed in 1982 and its highest breaks remained consistently between-7.5 and -7 from 1988 to 2020. From this trend analysis, we observe that the gap between the upper breaks and the lower breaks is wide and we maintain that this observation made it impossible for aggregate government expenditure to drive economic growth within this period. The policy implication of this result is that there is a need for government to target

expenditure on these sectors under study in such a fashion as to achieving growth by ensuring that these expenditures are in line with the size and needs of the populace at every given time.

Evaluation of Research Hypotheses

This is the proposition that there were no structural breaks experienced during the pre SAP, SAP and post SAP periods for economic growth and aggregate spending in Nigeria as shown under the introduction. From the Zivot-Andrews test analysis, we observed there were structural breaks both highest peaks and lowest peaks experienced during the pre SAP, SAP and post SAP periods for economic growth and aggregate spending in Nigeria. This leads to the acceptance of the alternative hypothesis making us to conclude that there were structural breaks experienced during the pre SAP, SAP and post SAP periods for economic growth and aggregate spending in Nigeria.

Policy Implications of Findings

In analysing the specific objectives of the study, we observed that the economy witnessed the worst performance captured by negative growth rate of -12.4 in 1995 during the SAP period while in analysing the third objective, this study finds that there exists no causal link between the growth rate of government spending on all the sectors included in the model (transport, communication, health, education and utility sectors) and economic growth rate in Nigeria. This is not in line with the work of Akinlabi, Kehinde and Jegede (2011), Usman, Agbede and Bako (2016) reviewed. We therefore accept the alternative hypothesis that there were structural breaks experienced in the Nigeria within the study period.

Conclusion

In summary, this paper aids to contribute to the existing literature on structural break detection by providing a thorough examination of the Zivot-Andrews test. By enhancing our understanding of this test, researchers and practitioners will be better equipped to analyze time series data effectively and make informed decisions in their respective fields.

Evidences from the literature show the presence of structural breaks at the introduction of sensitive economics policies. From the findings, the study shows that the SAP policy embarked upon by the Nigerian government has impact on the economy by the presence of structural breaks observed from the Zivot-Andrew's test. This calls for concerted effort by the government to review and come up with new reform on infrastructure-growth policies, provide adequate infrastructural facilities and appropriate macroeconomic environment that will encourage public infrastructure development in the economy so that the huge amounts budgeted for infrastructural development in the country will promote economic growth.

Recommendation

The study therefore recommends thus:

1. The government should not only increase its expenditure in the key sectors of the economy including transport, communication, health, education, utility, petroleum and agricultural sectors but should do so in line with the needs for these infrastructural facilities so that the economy can attain infrastructural development.
2. The government of Nigeria should seriously work on creating enabling environment for increase in infrastructural development in Nigeria. This can be achieved through provision of adequate basic infrastructure, easy access to poverty alleviation programs, cutting bureaucracy and combating corruption.
3. The government should also monitor her spending by reducing wastages so that infrastructure can contribute positively to growth in the country. Policy makers in various sectors of the economy should come up with the right policy mix to ensure macroeconomic stability so as to improve the profile of public infrastructure in the economy. This is better achieved by promoting policies that will eschew fraudulent/corrupt practices and abnormal competition in Nigeria sectors and institutions.
4. The government should intensify the utilisation of the public-private-partnership (PPP) framework as government alone cannot finance infrastructural development in an emerging market economy like ours.

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