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Does Reduction in Inequality of Income Distribution Matter for Poverty Reduction? Evidence from Nigeria's Poverty Trends

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Abstract

In recent years, the debate on whether growth is sufficient for poverty alleviation or it should be accompanied by the establishment of income distribution policies has been a subject of controversy in economic development discourse. While the debate is still inconclusive, there are strong arguments that though growth is good for the poor; nonetheless, growth with redistribution is expected to provide even better outcomes. This study seeks to supplement the debate by providing empirical evidence from Nigeria's poverty trends. The paper estimated poverty elasticity with respect to growth and inequality, the theoretically well-established pro-poor growth index and growth-inequality trade-off index in the context of Nigerian economy spanning between the period 1970 and 2018 using ARDL-Bounds Testing Approach to Cointegration. The results obtained revealed that high poverty elasticity with respect to inequality measures confirm the importance of inequality in poverty reducing effort. Thus, economic growth policies that promote an increase in income in conjunction with a reduction in income disparities are more effective in combating poverty in Nigeria than those that focus only on raising RGDP per capita growth.

Keywords: Autoregressive Distributed Lag (ARDL) Model, Growth-Inequality Trade-Off Index, Income Inequality, Poverty Incidence; Pro-poor Growth Index, Nigeria
JEL: O15; 055

1. Introduction

Over the past four decades, two strands of literature analyzing the causes and determinants of poverty have evolved distinctly, namely: the traditional "developmentalist position", which explicates poverty in terms of lack of economic advancement, normally equated with insufficient economic growth and the "Marxist inspired" (and class-based) theories, which view poverty as a result of uneven development and exploitation, resulting in skewed asset and income distribution (Angelsen and Wunder, 2006; Ebong and Ogwumike, 2013; Fosu, 2017). These two schools of thought produce basically different predictions on whether and how economic growth can more often than not help to lessen poverty. According to the proponents of first view, for instance, growth is considered to be a powerful force for reducing poverty. High and sustained economic growth increases the labour demand and wages which in turn reduces poverty (Igbatayo and Igbinedion, 2006; Kamila and Baris, 2011; and Abba and Baba, 2014). As such poverty reduction policies should aim at fostering economic growth.

The belief was that rising incomes at the top end of the spectrum would lead to more jobs, less poverty and higher incomes at the lower end (Karnani, 2011). As long as an economy is growing, the benefits will eventually make their way through the system. In contrast to the first school of thought, the second view argues that while economic growth is undoubtedly a powerful mechanism for poverty reduction, yet a nation could experience economic growth without incurring any benefit on the poor - the rich get richer and the poor get poorer or even remain unaffected (Baden, Holliday, and Medhekar, 2015). Thus, the distribution of income is an essential determinant of poverty reduction. A rise in inequality while the economy is growing, may not only offset the poverty-reducing effects of growth, but may also retard subsequent growth (Eastwood and Lipton, 2000; Ravallion, 2011; and Cook, 2012).

On the empirical front, a vast amount of literature have explored the empirical implications of these two propositions. While the debate is still inconclusive, most empirical evidence (Naschold, 2002; Foster, Fozzard, Naschold, and Conway, 2002; Fosu, 2010a, 2010b; 2015, 2017) predominantly suggests that growth alone is not sufficient to tackle the problem of poverty, since the yield of growth may not be equally shared; it is reasoned that there does not exist an unavoidable trade-off between growth and equity (World Development Report, 2000, 2001; Jamal, 2014; Iyoko, 2017). As such, distribution can be pursued as an additional policy objective to enhance the poverty reducing effect of growth. Recent research has, thus, re-focused on the impact of inequality and growth on poverty. Like earlier literature, many studies still suggested that growth is, in practice the main tool for fighting poverty; yet, they also reiterated that the imperative of growth for combating poverty should not be misinterpreted to mean that "growth is all that matters" (Jamal, 2006). Growth is a necessary condition for poverty alleviation, no doubt, but inequality also matters and should also be on the development agenda (Srinivasan, 2001; Dagdeviren, 2001; Dagdeviren, Van Der Hoeven, and Weeks, 2004); as such, development strategy should be guided by the goal of reducing absolute poverty, which can be achieved by implementing country-specific combination of growth and distribution policies (Bourguignon, 2004; Tabosa, Castelar, and Irffi, 2016).

Keeping the above in view, this study seeks to supplement the debate by providing empirical evidence from Nigeria's poverty trends. Specifically, the paper seeks to estimate the poverty elasticity with respect to growth and inequality, the well-established pro-poor growth index and growth-inequality trade-off index in the context of Nigerian economy. This focus is motivated by the fact that; first, to date, poverty situation in Nigeria remains a paradox because its level appears as a contradiction considering the country's immense wealth. As of 2017, Nigeria is the world's 20th and Africa largest economy, with approximately 193 million population (National Population Commission, 2017), 15 % of the global labour force, a nominal GDP of worth more than $500 billion, purchasing power parity of $1 trillion and per capita income of $2,548 (National Bureau of Statistics, NBS, 2017) and an impressive growth record over the last three decades. Yet, as impressive as the above figures may appear, the rapid growth has not transformed the labour market and employment conditions in the country. The country's unemployment problem shows no signs of slowing down reaching 14.2% in the last quarter of 2016 to 18.8% in 2017, up from 13.9% in the preceding quarter of 2016, its ten consecutive time (NBS, 2017).

Secondly, close to 152 million Nigerians now lived below a poverty line of $2 per day, which means poverty is on the increase and that Nigeria may have highest number of poor population by the end of 2019, overtaking India (African Development Bank, 2018). In the light of the government's concern for poverty alleviation, numerous policies and programmes have been designed and implemented to meet the needs of the poor. Notable among these are Structural Adjustment Programme (SAP) of 1986 and National Economic Empowerment and Development Strategy (NEEDS) in 2004. However, like other reform packages, these strategies considered economic growth, only, as crucial to poverty reduction, thereby, assuming that the disparity in income distribution will be automatically solved. As such, other than through economic growth, less is known about the set of economic policies that have an additional impact on poverty alleviation.

Thirdly, while a large number of empirical studies have attempted to explore the relationship between income inequality, economic growth and poverty reduction; yet most of such empirical literature have been based on cross-country data for a particular region or for all countries with available data. The problem with such studies is the homogenous assumption across the countries, which is unrealistic because of difference in culture, social, economic and institutional conditions. Therefore, country specific studies are needed to fill the gap. Moreover, aside the fact that there are very few studies on developing countries as the bulk of the available empirical evidences focused on developed economies; in Nigeria, the few existing studies (aside from Adigun, Awoyemi, and Omonona, 2011, which estimated economic growth and inequality elasticities of poverty in rural Nigeria) that are available focused on how various government policies affect poverty reduction or the relationship between poverty and economic growth which by its nature have been far from been definitive on income inequality and growth effects on poverty reduction. Finally, since the challenge is at the country level where policy makers must seek the optimal mix of emphasis on economic growth versus inequality so as to maximize poverty alleviation, the findings from this study will present a useful comparative analysis that transcends the usual regional and cross country analysis.

The paper, thus, estimated the poverty elasticity with respect to growth and inequality, the well-established pro-poor growth index and growth-inequality trade-off index. The enormity of the these three components will give the relative sensitivity of poverty incidence levels to changes in redistribution and average income which can thus assist policy making decisions on either inequality reducing or growth promoting policies. In order to achieve this objective, this study is divided into five sections, one of which is the introduction. In the second section, a brief review of empirical research conducted during last two decades on poverty, inequality and growth is presented. However, the focus of this section is to highlight the links of inequality with growth and poverty. This is followed by a description of the database, models and econometric methodology in section three. An analysis and discussion of the results of the model estimations are presented in the fourth section. The fifth and last section depicts concluding remarks.

2. Literature Review

One of the most debatable questions in economic development discourse and among policy makers regarding poverty reduction is whether a country should worry about income distribution or let economic growth do the work of reducing poverty? While the debate is still inconclusive, there are strong arguments that growth is good for the poor, growth with redistribution is expected to provide even better outcomes (Ravallion and Chen, 1997; Tabosa, Castelar, and Irffi, 2016; Nikoloski and Gveroski, 2017). Hence, in this section of the study, before proceeding with an empirical analysis, a number of empirical studies that have been conducted on the inequality and growth effects on poverty, since economic growth alone has been shown to be ineffective in combating poverty is presented. Ravallion and Chen (1997), for instance, estimated the income elasticity of poverty (measured on the basis of the number of persons with incomes of less than US$ 1 per day) in a sample of developing countries and obtained a value of -3. This means that, for each 1% increase in the mean income level, the percentage of persons with incomes below the poverty line shrinks by 3%.

Sadoulet and Janvry (2000) investigated the relationship between economic growth, income inequality and poverty among Latin American countries from 1970-1994 taking into account the differences in income distributions. They asserted that, Latin American countries have exceptionally higher levels of income inequality than other regions at similar levels of average income per-capita. The study found that, growth significantly reduced poverty levels when there were low levels of income inequality. There is therefore a high cost of income inequality. The study recommended that income inequality in the region needs to be addressed through government policies since improving the distribution of income is unlikely to be achieved with economic growth alone. In addition, the study

also recommended that, in order for growth to significantly reduce absolute poverty in the region, income inequality must be sufficiently low and countries should have higher levels of education.

Aigbokhan (2000) investigated the inequality and poverty profile in Nigeria during the period 1985-1997, using data for the 1985/86, 1992/93 and 1996/97 national household income surveys conducted by the Federal Office of Statistics. Households were classified by sector (urban/rural), gender and region (geopolitical zones). The central objective was to examine how far poverty has been reduced by the policies introduced during the period, and particularly the pattern of growth these policies engendered. The food energy intake (FEI) method, a variant of the absolute poverty approach, was used. The issue of polarization in income distribution was also examined. The study found evidence of worsening inequality and poverty in spite of economic growth. It was found also that male-headed households seem to have fared worse, and that poverty is more pronounced in rural areas and in the northern regions (zones). The poor policy stance during the period is found to have contributed to increased poverty.

As Bourguignon (2004a, 2004b) stated, numerous hypotheses could explain why progressive redistribution may be growth-enhancing. Three of those are presented here. The first is based on credit market imperfections. It opines that redistributing capital from capital-rich enterprises or individuals to capital-poor and credit-constrained people increases efficiency, investment and growth. The second is a political economy argument based on redistribution in a democratic context. It is put forward that too much inequality in a redistributive democracy leads to more redistribution and less capital accumulation. The third relates to redistribution through social conflict: too much inequality may lead to social tension expressed through collectively organized or individually led violent redistribution. In addition, due to credit rationing, the poor often cannot afford the minimum initial investment in education or other investments, or cannot get insurance for their investments, even if they are profitable, since they lack collateral. Initial asset distribution has a negative effect on subsequent economic growth (see Naschold, 2002).

Jamal (2006) explored the linkages between poverty, growth and inequality in the context of Pakistan. Time series macro data were used for the period 1979 to 2002. Consistent poverty and inequality measures are interpolated to facilitate the estimation of poverty elasticity with respect to growth and inequality in a multivariate regression framework. The paper also attempted to find out macroeconomic and structural correlates of inequality. The empirical findings—high poverty elasticity with respect to inequality measures—confirm the importance of inequality in poverty reducing effort. Inflation, sectoral wage gap, and terms of trade in favour of manufacturing exacerbate inequality, while progressive taxation, investment and development expenditure on social services play a significant role in reducing inequality. The results also indicate a positive correlation between per capita GDP and income inequality.

Zhu, Luo and Zhang (2008) examined the growth performance, income inequality, and poverty reduction in eight Chinese provinces in rural and urban areas during the period of 1989-2004 using China Economic, Population, Nutrition and Health Survey data. It shows that thanks to the efficiency gain as reforms deepened, income growth was high. Poverty reduction could have been even more satisfactory if it was not for the sharp increase over time in income inequality, especially in urban areas and among the richest. A decomposition analysis based on household income determination suggests that the total income changes over these 15 years can be largely attributed to the increase in returns to education and difference in job remuneration. Reducing inequality of opportunity and improving access to basic education, especially in poor rural areas, is hence important for enhancing growth, lowering inequality, and fighting against poverty.

Tridico (2010) analyzed the effect of economic growth on poverty and income inequality in 50 emerging and transitional economies between 1995 and 2006. The study defined economic development as a broader process of economic growth that includes institutional changes and human development. The results obtained suggested that economic growth had no positive impact on poverty levels. Though the estimated average growth among these countries during the period is 4.7 percent, it was explained that because economic growth was not accompanied by other components of

development, poverty levels were not significantly affected. The study also investigated the impact of economic growth on income inequality and found that economic growth worsened income inequality during the period. According to the study, lower levels of education and public expenditure may have led to high income inequality. The study thus concluded that income inequality will increase with economic growth unless educational standards improve and governments promote good institutional quality as well as develop strategies to promote human development.

Lombardo (2011) evaluated poverty sensitivity to growth in mean incomes and distributional changes in Italy across its regions and over a period spanning from 1977 to 2004. The study used the "Survey on Household Income and Wealth" (SHIW) of the Bank of Italy to estimate the growth incidence curves and the income and inequality elasticities of poverty. Growth strongly determines the patterns of poverty; however, inequality appears to have strikingly characterized it as well. A 1% increase in mean income produces a reduction in the headcount index by around 2.8%, while a 1% increase in inequality increases it by around 2.2%. The heterogeneity in poverty rates between North, Centre and South may be due to the strong heterogeneity in the poverty elasticities, which in turn depend on the initial conditions of inequality and the initial level of development.

Adigun, Awoyemi and Omonona (2011) analyzed income growth and inequality elasticities of poverty in Nigeria over a period of time. The results were based on the analysis of secondary data obtained from National Consumer Survey of 1996 and 2003/2004 Nigeria Living Standard Survey. The study used changes in mean per capita expenditure as a yardstick of economic growth and adopt simple but powerful ratio estimates of Economic Growth and Inequality elasticities of poverty. The growth elasticity of poverty indicates that 1 percent increase in income growth will lead to 0.624 percent reduction in poverty. The inequality elasticity of poverty shows that a decrease of inequality by 1 percent would have decreased poverty by just 0.34 percent. The result implies that what matters for poverty reduction is mainly accelerated economic growth, redistribution and reductions in inequality

Fosu (2011) presented the global evidence on the transformation of economic growth to poverty reduction in developing countries, with emphasis on the role of income inequality. The focus is on the period since the 1990s when growth in these countries has generally surpassed that of the advanced economies. Both regional and country-specific data are analyzed for the USD1.25 and USD2.50 poverty ratios using the most recent World Bank poverty data. The study finds that *on average* income growth has been the major driving force behind both the declines and increases in poverty. The study, however, documents substantial regional and country differences that are masked by this 'average' dominant-growth story. While in the majority of countries, growth was the major factor behind falling or increasing poverty, inequality, nevertheless, played the crucial role in poverty behavior in a large number of countries. And, even in those countries where growth has been the main driver of poverty-reduction, further progress could have occurred under relatively favourable income distribution. For more efficient policymaking, therefore, idiosyncratic attributes of countries should be emphasized. In general, high initial levels of inequality limit the effectiveness of growth in reducing poverty while growing inequality reduces poverty directly for a given level of growth. It would seem judicious, therefore, to accord special attention to reducing inequality in certain countries where income distribution is especially unfavourable. Unfortunately, though, additional evidence in the present study points to the limited effects of growth and inequality-reducing policies in low-income countries.

Sboui (2012) evaluated the effects of growth and inequality on the dynamics of poverty in Tunisia from 1985 to 2005. To achieve this aim, two types of analyses were discussed. First, the study proceeded with the decomposition of changes in poverty into contribution of growth and a contribution due to the redistribution, according to the decomposition approaches suggested by Datt and Ravallion (1992) and Kakwani (1997). Secondly, the Pro-Poor Growth Index, developed by Kakwani and Pernia (2001), and the Poverty Equivalent Growth Rate, suggested by Kakwani and Son (2002), were applied to assess the degree of pro-poor growth with an emphasis on changes in distribution. The analysis of grouped data generated from surveys on Budget, Consumption and Household Standard of Living, held

by the National Institute of Statistics (NIS) showed that the receding of poverty in Tunisia is mainly due to economic growth. However, because of changes in inequality, which came along with the process of growth, the latter was not strictly pro-poor. In fact, the rich benefit proportionally more than the poor from growth.

Cheema and Sial (2012) estimated a set of fixed effects/random effects models to ascertain the long-run relationships between poverty, income inequality, and growth using pooled data from eight household income and expenditure surveys conducted between 1992/93 and 2007/08 in Pakistan. The results showed that growth and inequality play significant roles in affecting poverty, and that the effect of the former is substantially larger than that of the latter. Furthermore, growth has a significant positive impact on inequality. The results also showed that the absolute magnitude of net growth elasticity of poverty is smaller than that of gross growth elasticity of poverty, suggesting that some of the growth effect on poverty is offset by the rise in inequality. The analysis at a regional level showed that both the gross and net growth elasticity of poverty are higher in rural areas than in urban areas, whereas the inequality elasticity of poverty is higher in urban areas than in rural areas. At a policy level, the study recommended that, in order to reduce poverty, the government should implement policies focusing on growth as well as adopting strategies geared toward improving income distribution.

Goh, Luo, and Zhu (2014) examined the growth performance and income inequality in eight Chinese provinces during the period of 1989-2004 using the China Health and Nutrition Survey Data. The study showed that income grew for all segments of the population, and as a result, poverty incidence has fallen. However, income growth has been uneven, most rapidly in coastal areas, and among the educated. A decomposition analysis based on household income determination suggests that income growth can largely be attributed to the increase in returns to education and to the shift of employment into secondary and tertiary sector. Raymond (2014) investigated the relative impact of economic growth and changes in equality on poverty in Nigeria. The result of the study showed that both material and social resources do have impact on poverty in Nigeria. The study concluded that there would have been more progress in poverty reduction, particularly in the context of MDGs, if growth had been more equitable than available evidence suggests. In other words, there is room to make growth more pro-poor to enhance rapid reduction in poverty.

Using a cross-sectional time series data of the Middle East and North Africa (MENA) countries for the period 1985–2009, Ncube, Anyanwu and Hausken (2014), investigated the effect of income inequality on key societal development, namely economic growth and poverty, in the region. The empirical results showed that income inequality reduces economic growth and increases poverty in the region. Other factors having significant negative effect on economic growth in the MENA region include previous growth rate, exchange rate, government consumption expenditure or government burden, initial per capita GDP, inflation and primary education. On the other hand, variables positively and significantly associated with MENA's economic growth are domestic investment rate, urbanization, infrastructure development, and mineral rent as a percentage of GDP. In addition, apart from income inequality, other factors increasing poverty in the region are foreign direct investment, population growth, inflation rate, and the attainment of only primary education. Poverty-reducing variables in the region include domestic investment, trade openness, exchange rate, income per capita, and oil rents as a percentage of GDP.

Ogbeide and Agu (2015) assessed whether or not there is a causal relationship between poverty and inequality in Nigeria. Adopting Granger causality techniques, this study finds out that there is a direct line of causality between poverty and inequality as well as indirect channels through unemployment and low life expectancy on inequality which exacerbate poverty in Nigeria. Tabosa, Castelar, and Irffi (2016) analyzed the impact of economic growth and income inequality on poverty in Brazil in the years from 1981 to 2013. A dynamic panel model was used, estimated by the two-step generalized method-of-moments system developed by Blundell-Bond (1998), in order to analyse three scenarios: the first corresponds to the entire period covered by this study (i.e. 1981-2013); the second encompasses the years from 1981 to 1994 (the period leading up to the Real Plan); and the third is the

period from 1995 to 2013 (the years following the implementation of the Real Plan). The results indicate that economic growth policies that promote an increase in income in conjunction with a reduction in income disparities are more effective in combating poverty in Brazil than those that focus only on raising mean income levels. The findings also point to the existence of a pro-poor form of growth in the period following the Real Plan.

Nikoloski and Gveroski (2017) assessed the effects of growth and inequality on poverty in a country specific context for Macedonia. The study first estimated the poverty growth and inequality elasticity for the period from 2000 to 2014 and found that a higher level of inequality would reduce the poverty reduction efficiency of growth. In addition, the study calculated the theoretically well-established indicators such as: the inequality-growth trade-off index and pro-poor growth index which show that the growth in Macedonia during the above specified period has been generally anti-poor.

In summary, from the review of empirical literature above, with the distribution of income becoming increasingly important to economic development and poverty reduction a large number of empirical studies have attempted to explore the poverty-inequality-growth nexus. However, the focus of these literatures has been heavily biased towards cross-country and panel regressions. The problem with such studies is the homogenous assumption across the countries, which is unrealistic because of difference in culture, social, economic and institutional conditions. Therefore, country specific studies are needed to fill the gap. Moreover, aside the fact that there are very few studies on developing countries as the bulk of the available empirical evidences focused on developed economies, in Nigeria, the few existing studies that are available focused on how various government policies affect poverty reduction or the relationship between poverty and economic growth which by its nature have been far from been definitive on income inequality and growth effects on poverty reduction. This study, thus, will fill this gap.

3. Data and Methods

3.1. Sources and Type of Data

The study made use of annual time series secondary data on poverty (proxied by headcount), economic growth (proxied by GDP per capita), income inequality (proxied by Gini Coefficient) sourced from the publications of Central Bank of Nigeria Statistical Bulletin (2018), World Development Indicators (2018), United Nations Statistics Division National Accounts Main Aggregate Database (2018), Penn World Table, version 9.0 and United Nations University World Income Inequality Database WIID 3.4.

3.2. Theoretical Framework and Econometric Model

In this section, the study presents the theoretical framework and econometric model used in estimating the poverty elasticity with respect to growth and inequality, the well-established pro-poor growth index and growth-inequality trade-off index in the context of Nigerian economy. Following the works of Jamal (2006) and Nikoloski and Gveroski (2017) in which a simple model is presented to formalize the linkages *between poverty, growth and inequality*; this study adopts, though augmented by certain improvements and extensions by taking into account the objective of the paper, the Foster, Green and Thorbecke, FGT, (1984) poverty measure generally written as follows:

$$P_\alpha = \int_0^z \left(\frac{z-x}{z} \right)^\alpha f(x)dx \tag{1}$$

where, z is the poverty line, $f(x)$ is the density function of individual income x, and α is the parameter of inequality aversion. When $\alpha = 0$, P_α represents the headcount ratio; when $\alpha = 1$, P_α represents the poverty gap ratio; when $\alpha = 2$, P_α represents the severity of poverty measure.

As argued in Kakwani, Khandker and Son (2004), Son, (2007), Kakwani and Son (2008) and; Nikoloski and Gveroski (2017), in practice, these three measures (i.e. the headcount ratio, poverty gap ratio, and severity of poverty measure) of poverty generally depends on two factors: economic growth proxied by RGDP per capita growth and income inequality proxied by Gini index. Whereas an increase in RGDP per capita growth lessens poverty, an upsurge in income inequality increases poverty. Thus, following the literature, this study postulates that the degree of poverty in Nigeria depends upon these two factors formally written as follows:

$$P = \phi(\pi, \Psi) \tag{2}$$

where P, π, and Ψ are respectively poverty measure, RGDP per capita growth and Gini index measuring the relative income distribution. As depicted in equation 2, changes in poverty level can be decomposed into an inequality component and a growth component. The responsiveness of poverty incidence to changes in RGDP per capita growth when income inequality remains fixed can be measured by the poverty elasticity of growth defined as follows:

$$\lambda_\alpha = \left(\frac{\partial P}{\partial \pi} * \frac{\pi}{P} \right) < 0 \tag{3}$$

which is take to mean percentage change in poverty incidence in response to RGDP per capita growth rate of one percent provided income inequality measured by Gini index remains unchanged. Correspondingly, the poverty elasticity of inequality is defined as follows:

$$\beta_\alpha = \left(\frac{\partial P}{\partial \Psi} * \frac{\Psi}{P} \right) > 0 \tag{4}$$

which is take to mean percentage change in poverty incidence when Gini index increases by one percent while RGDP per capita growth remains constant.

Besides, by using these two elasticity indices, following Nikoloski and Gveroski (2017), the study calculated the inequality-growth trade-off index, IGTI, (also called marginal proportional rate of substitution) proposed by Kakwani (1993) as follows:

$$MPRS = \left(\frac{\partial \pi}{\partial \Psi} * \frac{\Psi}{\pi} \right) = -\frac{\beta_\alpha}{\lambda_\alpha} \tag{5}$$

The *MPRS* denotes the percentage of growth in RGDP per capita that is required to offset the increase in the Gini index by one percent. This suggests that, with a larger value of the growth-inequality trade-off index, the benefits of adopting pro-poor policies that reduce inequality will be greater. Additionally, following Kakwani and Son (2008) and Nikoloski and Gveroski (2017), the study calculated total poverty elasticity, ε_α, defined as the sum of the poverty elasticity of growth, λ_α, and the inequality effect measures of poverty reduction, β_α, which depicts how poverty changes as a result of changes in inequality that accompany the growth process

$$\varepsilon_\alpha = \lambda_\alpha + \beta_\alpha \tag{6}$$

As argued in Nikoloski and Gveroski (2017), economic growth is pro-poor if the change in inequality that accompanied growth reduces total poverty. That is, if the total elasticity of poverty is greater than the growth elasticity of poverty. Kakwani and Pernia (2000), in this context, postulated the idea of pro-poor growth index defined as the ratio of the total poverty elasticity to the growth elasticity of poverty as follows:

$$\varpi_\alpha = \frac{\varepsilon_\alpha}{\lambda_\alpha} \tag{7}$$

Premised on the magnitude of ϖ_α the growth process can be considered as anti-poor, pro-poor, or distribution neutral. On the one hand, the growth process is pro-poor if the change in inequality that accompanies it reduces total poverty; i.e. when ϖ_α is greater than 1. On the other hand, the growth process is anti-poor if the change in inequality that accompanies it increases total poverty; i.e. when ϖ_α is less than 1. Lastly, the growth process is distribution-neutral if the pro-poor growth index is around 1 (Son, 2007).

Given the above backdrop, in order to obtain poverty elasticity coefficients, we begin the analysis by estimating equation (2) with the following baseline specification:

$$\ln(Poverty) = \beta_0 + \beta_1(\ln RGDPpercapita) + \beta_2(\ln Gini) + \varepsilon \tag{8}$$

While an increase in average income (proxied for economic growth) is expected to lessen poverty, however, an upsurge in income inequality (proxied by Gini Coefficient) is expected to increase poverty. As such, the expected sign of the coefficient β_1 is negative while the expected sign of the coefficient β_2 is positive. Additionally, for policy analysis the study also include the interaction term $(\ln RGDPpercapita * \ln Gini)$ in order to assess the impact of inequality on the effect of economic growth or versa. Thus, in this case, the study excluded either the variable $\ln RGDPpercapita$ or $\ln Gini$ in order to avert potential multicolinearity downsides. Hence, the two alternative specifications estimated apart from the baseline model are as follows:

$$\ln(Poverty) = \alpha_0 + \alpha_1 \ln(RGDPpercapita) + \alpha_2(\ln RGDPpercapita * \ln Gini) + \varepsilon_{1t} \tag{9}$$

$$\ln(Poverty) = \lambda_0 + \lambda_1(\ln Gini) + \lambda_2(\ln RGDPpercapita * \ln Gini) + \varepsilon_{2t} \tag{10}$$

The sign α_1 is expected to remain negative while λ_1 is expected to be positive. This is because an increase in average income (i.e. RGDP per capita) is expected to lessen poverty, while an upsurge in income inequality is expected to increase poverty. Furthermore, α_2 is expected to be negative (when as average income increases and income distribution becomes more equal, the positive effect of income growth accompanied by equal redistribution of income brings about poverty alleviation) or positive (when as average income increases and income distribution becomes less equal, the positive effect of income growth on poverty alleviation is dampened). Conversely, λ_2 is expected to be negative (when income distribution becomes more equal as average income increases, the positive effect of equal redistribution of income accompanied by income growth brings about poverty alleviation) or positive (when income distribution becomes less equal as average income increases, the positive effect of income growth on poverty alleviation is dampened).

One of the limitations of equations (8, 9, & 10) is that they do not allow policymaker to differentiate the short-run contribution of factors to poverty incidence from the long run-run contribution. For instance, while poverty reduction policies (such as the major redistribution policy to make the tax structure pro-poor; investments, principally, in infrastructure to make economic growth pro-poor; structural reforms; public expenditure on education and health e.t.c.) are targeted toward achieving long-run results as it may takes time before they actually affect the lives of the very poor, however, the inclusion of lags (i.e. the short-run contribution of the factors) can help explain partial adjustment of poverty levels over time to long-run equilibrium. Also, with the downward trending nature of poverty levels, it is rational to assume that poverty incidence of a country in a particular period may depend on that of previous years' levels. As, such, how fast poverty levels change at the end of this period may depend on the initial levels of poverty. Thus, by ignoring the short-run dynamics of the factors to the overall poverty reduction process, vital insights are lost.

Besides, over a longer horizon, the determinants of poverty may be non-stationary. Therefore, estimating equations (8, 9, & 10) result in spurious relationships. To this end, in order to allow for some degree of persistence in the data generating process, equations (8, 9, & 10) are thus re-specified

as dynamic Autoregressive Distributed Lag (ARDL) model so as to account for both short and long-run behaviour of the determinants. This study considered ARDL model to be suitable for our empirical exercise because of the following reasons. First, it does not impose the restrictive supposition that all the variables under study should be integrated of the same order as the set of variables used in our empirical exercise is likely to be of a mix of $I(0)$ and $I(1)$ variables. Second, the approach is more suitable for the small and finite sample data period (Pesaran, Shin, and Smith, 2001). Third, given the nature of interrelation between average income (proxied by GDP per capita) and income inequality (proxied by Gini Coefficient) which are included in our models, the ARDL model is suitable to address possible endogeneity issue. As noted by Pesaran and Shin (1999), "appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct the residual serial correlation and the problem of endogenous regressors." Thus, the dynamic ARDL form of equations (8, 9, & 10) after including the lag dependent and independent variables becomes:

$$\Delta(\ln Poverty_t) = \rho_0 + \sum_{i=1}^{p} \beta_{1i} \Delta(\ln Poverty_{t-i}) + \sum_{i=0}^{q} \beta_{2i} \Delta(\ln RGDPpercapita_{t-i}) + \sum_{i=0}^{r} \beta_{3i} \Delta(\ln Gini_{t-i}) + \delta_1 \ln Poverty_{t-1} + \delta_2 \ln RGDPpercapita_{t-1} + \delta_3 \ln Gini_{t-1} + \varepsilon_{3t} \quad (11)$$

$$\Delta(\ln Poverty_t) = \alpha_0 + \sum_{i=1}^{s} \alpha_{1i} \Delta(\ln Poverty_{t-i}) + \sum_{i=0}^{t} \alpha_{2i} \Delta(\ln RGDPpercapita_{t-i}) + \sum_{i=0}^{u} \alpha_{3i} \Delta(\ln RGDPpercapita_{t-i} \times \ln Gini_{t-i}) + \lambda_1 \ln Poverty_{t-1} + \lambda_2 \ln RGDPpercapita_{t-1} + \lambda_3 (\ln RGDPpercapita_{t-1} \times \ln Gini_{t-1}) + \varepsilon_{4t} \quad (12)$$

$$\Delta(\ln Poverty_t) = \mu_0 + \sum_{i=1}^{v} \mu_{1i} \Delta(\ln Poverty_{t-i}) + \sum_{i=0}^{w} \mu_{2i} \Delta(\ln Gini_{t-i}) + \sum_{i=0}^{x} \mu_{3i} \Delta(\ln RGDPpercapita_{t-i} \times \ln Gini_{t-i}) + \vartheta_1 \ln Poverty_{t-1} + \vartheta_2 \ln Gini_{t-1} + \vartheta_3 (\ln RGDPpercapita_{t-1} \times \ln Gini_{t-1}) + \varepsilon_{5t} \quad (13)$$

where $\ln Poverty$, $\ln RGDPpercapita$, and $\ln Gini$ are the natural logarithms of poverty incidence, average income (proxied by RGDP per capita) and income inequality (proxied by Gini Coefficient) respectively. The $\delta's$, $\lambda's$ and $\vartheta's$ correspond to the long run elasticities whereas $\beta's$, $\alpha's$ and $\mu's$ capture the short-run elasticities of the models. Also, Δ denotes the first difference operator, ρ_0, α_0 and μ_0 are the drift components, ε_{3t}, ε_{4t} and ε_{5t} are white noise residuals. $(p,q,r), (s,t,u),$ and (v,w,x) are the maximum number of lags in the models to be selected on the basis of Hannan-Quinn information criteria (HQ), the Akaike information criteria (AIC), the Schwarz information criteria (SIC), the Log Likelihood (LL) and the Final Prediction Error (FPE). The estimated results of the equations (11, 12 & 13) are presented in tables 5 and 6 in Appendix 1.

3.3. Estimation and Analytical Techniques

The study employed Autoregressive Distributed Lag (ARDL) Model or Bound Testing Approach (Pesaran, *et al,* 2001). As discussed in the previous section, as regards the specification of the dependent variable in the empirical literature, the headcount ratio (defined as the proportion of a population that lives below the minimum level of income deemed adequate in a particular country); the poverty gap ratio (which measures the depth of poverty); and the severity of poverty (also known as gravity of poverty and corresponds to weighted average of the poverty gaps) are the three poverty measures usually employed. In this study, following Nikoloski and Gveroski (2017), and in particular, by taking into cognizance the objective of the study and for simplicity, the headcount ratio is incorporated as a measure for poverty incidence. As noted in the literature, existence of time series data on poverty in many developing countries, Nigeria inclusive, is not only scanty but also very difficult. As such, a number of proxies have been postulated in the empirical literature. Usually, however, three different variables have been most commonly used as proxy for the headcount ratio: annual income per

capita, per capita household final expenditure and per capita final consumption expenditure. Regrettably, annual income per capita and per capita household final expenditure are somewhat unreliable as both fail to account for other dimension of poverty (Odhiambo, 2009, 2011; Nindi and Odhiambo, 2015). On account of this limitation, the study decided to use per capita final consumption expenditure rather than per capita income as a proxy for poverty. Besides, as shown by previous studies, consumption expenditure among the poor is usually more reliably reported; and it is more stable than income (Nindi and Odhiambo, 2015).

Base on the above discussion, thus, in order to estimate the poverty elasticity with respect to growth and inequality, well-established pro-poor growth index and growth-inequality trade-off index in the context of Nigerian economy, *a five-stage procedure was followed*. *In the first stage*, the order of integration of the variables were determined using Augmented Dickey-Fuller (ADF) and the Phillips Perron (PP) unit root tests to avoid spuriousness of the result. *In the second stage,* the structural lags were determined on the basis of Hannan-Quinn information criteria (HQ), the Akaike information criteria (AIC), the Schwarz information criteria (SIC), the Log Likelihood (LL) and the Final Prediction Error (FPE). Following the suggestion of Granger (1988), *in the third stage*, a test of possible cointegrating relationship among the series was conducted. As such, the error correction representation of the ARDL models specified in equation (11, 12, & 13) were utilized to check co-integration. The Wald test (F-statistics) derived from the models form a critical part of ARDL procedure, which is helpful to assess the existence of long run relationship among the variables included in the model.

The computed F-test were then compared with the critical values provided by (Pesaran *et al,* 2001), Narayan, (2005), Samantaraya, and Patra (2014) for the hypothesis testing. According to them, the lower bound critical values assumed that the explanatory variables are integrated of order one. Therefore, if the computed F-statistic is less than the lower bound value, the null is not rejected. On the contrary, if the computed F-statistics is greater than the upper bound value, it implies existence of long-run relationship among the variables. Finally, if the computed F- statistics lies between the lower bound and upper bound, long run association between the variables becomes inconclusive. Once the long-run cointegrating relationship has been confirmed, *in stage four* of the ARDL model, the study proceeded to estimate the long coefficient of the equations (11, 12, & 13). *In stage five*, the short-run dynamic parameters is then obtained by estimating the Vector Error Correction model (VECM).

Finally, in order to check the robustness of the estimated regression results and also ensure that the model possesses the desirable BLUE properties different post-estimation diagnostic tests which include the Breusch-Godfrey serial correlation LM test, ARCH test for heteroskedasticity, Jacque-Bera normality test and Ramsey RESET specification test were undertaken. Finally, the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) were plotted in order to determine if the model is stable.

4. Empirical Results and Discussion

4.1. Results of Unit Root Tests

Before the detailed analysis of the study was undertaken, as a preliminary step, the study first of all established the order of integration of the series under consideration. Although, the ARDL approach does not require pre-testing of the variables included in the models, however, testing for unit root is still worthwhile in order to avert the potential risk of I(2) variables. To this end, the study applied two types of formal tests. The Augmented Dickey-Fuller test (ADF) and the Phillips-Perron test (PP) test. The choice of these two test statistics is informed by the fact that both tests control for higher-order autocorrelation. Both tests statistics were done for two alternative specifications at 1%, 5% and 10% level of significance. First it was tested with intercept but no trend, and then it was tested with both intercept and trend. The results for both tests are presented in tables 1 and 2 in Appendix I. As can be seen from the tables both tests consistently suggest that apart from economic growth (proxied by

RGDP per capita growth) and the interaction term $(\ln RGDPpercapita * \ln Gini)$ which are stationary at levels, income inequality (proxied by Gini Coefficient) and poverty incidence (proxied by per capita final consumption expenditure) became stationary when converted to their first differences, indicating that each is integrated of order one, denoted as I (1).

4.2. Results of Lag Length Selection Criteria

After conducting unit root test and confirmed that all the variables were either stationary at level, {I(0)} or first difference, {I(1)}, the long run relationships between poverty incidence, economic growth, income inequality and the interaction term were examined using Bounds Test Approach to Co-integration. However, before the test was applied, the choice of appropriate lag length was first determined. This is vital for two main reasons: to avert the problem of model misspecification and loss of the degrees of freedom. In the context of literature, VAR lag order selection criteria attributed to Hannan-Quinn information criteria (HIC), the Log Likelihood (LL), the Schwarz information criteria (SIC), Final Prediction Error (FPE) criteria and the Akaike information criteria (AIC) were usually considered. But then, each of these criteria has different penalty factors. Nevertheless, Liew (2004) postulated that the Akaike Information Criterion (AIC) and Final Prediction Error (FPE) are superior than the other criteria under study in the case of small sample (60 observations and below), in that both minimize the chance of under estimation while maximizing the chance of recovering the true lag length. For the purpose of this study, thus, given that there were 48 observations (1970-2018) and premise on the foundation of minimum value of the FPE and AIC criteria, the optimal lag order one was carefully chosen. The results are depicted in table 3 in Appendix 1.

4.3. Cointegration Test Results

Having established that, apart from economic growth proxied by RGDP per capita growth and the interaction term which are stationary at levels, income inequality proxied by Gini Index and poverty incidence proxied by per capita final consumption expenditure became stationary when converted to their first differences, following the suggestion of Granger (1988), a test of possible cointegrating relationship among the series was conducted. As noted in the literature, there are various techniques of conducting cointegration analysis among time-series variables. The well-known methods are: the residual-based approach proposed by Engle and Granger (1987) and the maximum likehood-based approach proposed by Johansen and Julius (1990) and Johansen (1992). This study employs the recently developed econometric technique of bound testing approach to co-integration in analyzing the data. The advantages of the technique include the fact that the endogeneity problems and inability to test hypotheses on the estimated coefficients in the long-run associated with the Engle-Granger (1987) method are avoided, the long and short-run parameters of the model under study are estimated simultaneously; and also allows a mixture of $I(0)$ and $I(1)$ variables as regressor with the implication that the order of integration of variables may not essentially be the identical. The results are presented in tables 4 in Appendix I. As can be seen from the table, the null hypotheses of no cointegrating relationship among RGDP per capita growth, Gini Index, poverty incidence proxied by per capita final consumption expenditure and the interaction term are rejected.

4.4.Long-Run Poverty Elasticities of Growth and Inequality Results

Having confirmed the existence of a long run equilibrium, the long- and short-run elasticities were estimated. The estimated long-run elasticities of the selected ARDL models along with the short-run elasticities are presented in tables 5 and 6 respectively in Appendix I. As can be seen from the table 5, premised on the first and second specifications (models 11 and 12 respectively), the poverty elasticity with respect to growth, as anticipated, has the expected sign, however, it was statistically insignificant as shown by the t-statistic and p-value, suggesting that, from the point of view of achieving the objective of poverty alleviation, the impressive economic growth experienced in Nigeria over the last

four decades has been unevenly distributed and has not been benefited the poor. For instance, with respect to model 11, as can be observed, for a one-percent point increase in economic growth proxied by RGDP per capita growth, holding other things constant, 0.467640 percent poverty reduction is induced in the long-run. In other words, this insignificant impact probably suggests although growth is good for the poor; nonetheless, economic growth accompanied by the establishment of income distribution and selective intervention policies is expected to provide even better outcomes. Similar findings were also observed in other studies (see for instance, Ram, 2006; Aigbokhan, 2008; Adigun, Awoyemi, and Omonona, 2011; Stephen and Simoen, 2013).

Unlike the poverty elasticity with respect to growth, however, from the table 5, with respect to the first and third specifications (models 11 and 13 respectively), theoretically, as expected, it is observed that the poverty elasticity with respect to inequality is positive and statistically significant as revealed by their *t*-statistics and *p*-values, suggesting again that economic growth in Nigeria has not improve the lives of the very poor; but rather, the 'growth processes' appears to have 'trickled-up' to the middle classes and the very rich, resulting in a worsening distribution of income. As such, ceteris paribus, a deteriorating income distribution is expected to aggravate poverty incidence. These results seem plausible and undoubtedly depicts the Nigerian economy where in spite of the increased economic growth achieved over the years, poverty persists unabated. Similar results were obtained in Adigun, Awoyemi, and Omonona, (2011) for the case of Nigeria, and Nikoloski and Gveroski, (2017) for the case of Macedonia.

For policy analysis, in specifications (12) and (13), the study found it desirable to include the interaction term $(\ln RGDPpercapita * \ln Gini)$ while retaining growth (Gini index) as independent variable and excluding Gini index (growth). From the estimated ARDL Model 12, as can be observed from the table 5, the elasticity coefficient of the *interactive term* is negative and statistically significant as expected. A higher level of income growth accompanied by a lower level of income inequality would increase the poverty reduction efficiency of growth at a rate of 2.842653 percentage points per each percentage point decrease in the Gini index. Correspondingly, from the estimated ARDL Model 13, as can be seen from the table 5, the elasticity coefficient of the *interactive term* is similarly negative and statistically significant, suggesting that a more equal redistribution of income accompanied by a higher level of economic growth would increase the poverty reduction efficiency of income redistribution at a rate of 0.965070 percentage points per each percentage point increase in the economic growth. These results, thus, suggest that economic growth policies that promote an increase in income in conjunction with a reduction in income disparities are more effective in combating poverty in Nigeria than those that focus merely on raising RGDP per capita growth. These results corroborate the empirical findings of White and Anderson (2000), Besley and Burgess (2003); and Nikoloski and Gveroski, (2017).

4.5. Short-Run Poverty Elasticities of Growth and Inequality Results

The estimated short-run elasticities of all the three ARDL specifications are presented in table 6 in Appendix I. In all the three specifications, as can be observed, discursively, the coefficients of the error correction terms, ECT(-1), are all negative and statistically significant at 5% level, indicating that short-run disequilibrium is corrected in the long-run equilibrium. Also, on the one hand, according to the models 11 and 12 specifications, as obtained from the long-run poverty elasticities of growth and inequality results, the elasticity coefficients of economic growth proxied by RGDP per capita growth remains negative but statistically insignificant; on the other hand, however, premised on the baseline and model 13 specifications, the poverty elasticity with respect to inequality is positive and statistically significant. That is, while economic growth reduces poverty, however, a rise in inequality raises it. Unlike its long-run negative significant impact, the elasticity coefficient of the *interactive term* is negative but statistically insignificant., suggesting that there may possibly be long lags between the time policies (such as the income redistribution and structural reforms policies) are implemented and the time when their impacts actually affect the lives of the poor.

4.6. Inequality-Growth Trade-Off Index and Total Poverty Elasticity Results

In addition, using the two estimated partial elasticity indices derived from the first specification (model 11), the study calculated the inequality-growth trade-off index, IGTI, (also called marginal proportional rate of substitution) proposed by Kakwani (1993) as follows:

$$IGTI = \left(\frac{\partial \pi}{\partial \Psi} * \frac{\Psi}{\pi} \right) = -\frac{\beta_\alpha}{\lambda_\alpha} = -\frac{1.459832}{-0.467640} = 3.12$$

An insight from this result suggests that an income growth rate of 3.12 percent to is needed to compensate for a one percent increase in the Gini index. The high value of the IGTI implies that it is of vital importance to know if there is a systematic tendency for inequality to increase with economic growth.

Also, from the first specification, the study calculated the pro-poor growth index defined as the ratio of the total poverty elasticity to the growth elasticity of poverty as follows:

$$\varpi_\alpha = \frac{\varepsilon_\alpha}{\lambda_\alpha} = \frac{(1.459832) + (-0.467640)}{-0.467640} = -2.12$$

Since ϖ_α is less than 1, premised on the previous augmentation, the study concluded that economic growth in Nigeria, during the period under review, has been generally anti-poor.

4.7. Post-Estimation Diagnostics Test for the selected ARDL Models

Since the ARDL models were estimated by simple least squares, all of the views and procedures available to equation objects estimated by least squares are also available for ARDL models. The R^2, the adjusted R^2, the F-statistic and the Durbin-Watson statistic for the selected models are depicted in panel B of table 5 in Appendix I. As can be observed from the table 5, the F-statistic which measures the overall significance of the estimated models were statistically significant (as shown by their *p*-values), implying that the models are fit and appropriate for the empirical estimates. Once more, as observed the explanatory power *(R^2)* of the model is high. Moreover, the Adjusted R^2 which measures the percentage of variation in poverty incidence that is jointly explained by the independent variables after the effect of insignificant regressor has been removed is also high. Also, the Durbin-Watson statistic which is used to test for autocorrelation of residuals in the model, in particular, the first order autocorrelation revealed the absence of serial autocorrelation.

Additionally, after estimating the selected ARDL models, in order to check the robustness of the estimated regression results and also ensure that the estimated models possessed the desirable BLUE properties, different post-estimation diagnostic tests (the Breusch-Godfrey serial correlation LM test, ARCH test for heteroskedasticity, Jacque-Bera normality test and Ramsey RESET specification test) were undertaken. All the tests disclosed that the estimated model possessed the desirable BLUE properties. Indeed, the models' residuals are serially uncorrelated, normally distributed and homoskedastic. Thus, the estimated set of results are devoid of the econometric problems of autocorrelation, misspecification and heteroskedasticity. This further reinforces the fact that the results reported are of policy significance.

4.8. Stability of the Model

In addition to the above diagnostic tests, the stability of long run estimates was tested by applying the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test. Such tests are recommended by Pesaran, Shin and Smith (1999, 2001). The test for the stability is necessary because according to Bahmani-Oskooee and Brooks (1999), the fact that variables are cointegrated does not necessarily imply that the estimated coefficients are stable. Following Pesaran and Pesaran (1997), the study tested for long-run coefficient stability on the basis

Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ) tests (i.e. cumulative sums and sums square of residuals) developed by Brown, Durbin, and Evans (1975) are applied. The hypothesis of the test is as follows:

H_0: All coefficients are stable in the model

H_1: All coefficients in the model is unstable

If the plot line does not crosses the boundary at any level then accept the Null hypothesis and reject the alternative hypothesis. Figures 1 and 2 (for model 11), figures 3 and 4 (for model 12) and figures 5 and 6 (for model 13), depicted I Appendix II, plot the *CUSUM* and *CUSUM* of squares statistics. The results clearly indicate the absence of instability of the estimated coefficients because the plot of the *CUSUM and CUSUMSQ* statistic(s) is within the confines of the five percent critical bounds. In effect, thus, the estimated long-run parameters are stable as there are no structural breaks. By implication, our parameters are reliable.

5. Conclusion

Over the years, the debate on whether growth is sufficient for poverty alleviation or it should be accompanied by the establishment of income distribution policies has been a subject of controversy in economic development discourse. While the debate is still inconclusive, there are strong arguments that though growth is good for the poor; however, growth with redistribution is expected to provide even better outcomes. This study seeks to supplement the debate by providing empirical evidence from Nigeria's poverty trends. The paper estimated poverty elasticity with respect to growth and inequality, the theoretically well-established pro-poor growth index and growth-inequality trade-off index in the context of Nigerian economy spanning between the period 1970 and 2018 using ARDL-Bounds Testing Approach to Cointegration. The results obtained revealed that high poverty elasticity with respect to inequality measures confirm the importance of inequality in poverty reducing effort. Thus, economic growth policies that promote an increase in income in conjunction with a reduction in income disparities are more effective in combating poverty in Nigeria than those that focus only on raising RGDP per capita growth.

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Appendix 1

Table 1: Stationarity Tests of Variables: Philips-Peron (PP) Test

Philips-Peron (PP) Test with Intercept only												
Variable	Level						1st Diff					
	Test Statistic	Critical Values			P-Values	Remarks	Test Statistic	Critical Values			P-Values	Remarks
		1%	5%	10%				1%	5%	10%		
lnPOV	-0.44591	-3.577723	-2.925169	-2.600658	0.8924	NS	-4.8021	-3.581152	-2.926622	-2.601424	0.0003	I(1)
dlnRGDP	-5.92867	-3.577723	-2.925169	-2.600658	0.0000	I(0)	***	***	***	***	***	I(0)
lnGINI	-1.20557	-3.577723	-2.925169	-2.600658	0.6645	NS	-4.74669	-3.581152	-2.926622	-2.601424	0.0003	I(1)
dlnRGDP*lnGINI	-5.69126	-3.577723	-2.925169	-2.600658	0.0000	I(0)	***	***	***	***	***	I(0)

Philips-Peron (PP) Test with Trend and Intercept												
Variable	Level						1st Diff					
	Test Statistic	Critical Values			P-Values	Remarks	Test Statistic	Critical Values			P-Values	Remarks
		1%	5%	10%				1%	5%	10%		
lnPOV	-1.78081	-4.165756	-3.508508	-3.18423	0.6981	NS	-4.75307	-4.170583	-3.51074	-3.185512	0.0020	I(1)
dlnRGDP	-5.97571	-4.165756	-3.508508	-3.18423	0.0000	I(0)	***	***	***	***	***	I(0)
lnGINI	-2.35677	-4.165756	-3.508508	-3.18423	0.3965	NS	-4.75774	-4.170583	-3.51074	-3.185512	0.0020	I(1)
dlnRGDP*lnGINI	-5.72715	-4.165756	-3.508508	-3.18423	0.0001	I(0)	***	***	***	***	***	I(0)

Source: Author's computation using E-view 9 (2018)
NS denotes nonstationary at level

Table 2: Stationarity Tests of Variables: Augmented Dickey-Fuller (ADF) Test

Augmented Dickey-Fuller (ADF) Test with Intercept only												
Variable	Level						1st Diff					
	Test Statistic	Critical Values			P-Values	Remarks	Test Statistic	Critical Values			P-Values	Remarks
		1%	5%	10%				1%	5%	10%		
lnPOV	-0.566479	-3.581152	-2.926622	-2.601424	0.8679	NS	-4.78201	-3.581152	-2.926622	-2.601424	0.0003	I(1)
dlnRGDP	-5.921049	-3.577723	-2.925169	-2.600658	0.0000	I(0)	***	***	***	***	***	I(0)
lnGINI	-0.879003	-3.577723	-2.925169	-2.600658	0.7863	NS	-4.72309	-3.581152	-2.926622	-2.601424	0.0004	I(1)
dlnRGDP*lnGINI	-5.691443	-3.577723	-2.925169	-2.600658	0.0000	I(0)	***	***	***	***	***	I(0)

Augmented Dickey-Fuller (ADF) Test with Trend and Intercept												
Variable	Level						1st Diff					
	Test Statistic	Critical Values			P-Values	Remarks	Test Statistic	Critical Values			P-Values	Remarks
		1%	5%	10%				1%	5%	10%		
lnPOV	-1.814238	-4.170583	-3.51074	-3.185512	0.6816	NS	-4.73644	-4.170583	-3.51074	-3.185512	0.0021	I(1)
dlnRGDP	-5.975791	-4.165756	-3.508508	-3.18423	0.0000	I(0)	***	***	***	***	***	I(0)
lnGINI	-2.216647	-4.165756	-3.508508	-3.18423	0.4696	NS	-4.73145	-4.170583	0	-3.185512	0.0021	I(1)
dlnRGDP*lnGINI	-5.724949	-4.165756	-3.508508	-3.18423	0.0001	I(0)	***	***	***	***	***	I(0)

Source: Author's computation using E-view 9 (2018)
NS denotes nonstationary at level

Table 3: Lag Length Selection Criteria Results

Lag Length Selection Criteria Results for Model 11					
Lag	LR	FPE	AIC	SC	HQ
0	NA	4.994876	10.12202	10.24247	10.16692
1	298.8856*	0.005092*	3.232128*	3.713905*	3.411730*
2	13.26375	0.005392	3.283082	4.126191	3.597385
3	5.856331	0.006907	3.515759	4.7202	3.964762
Lag Length Selection Criteria Results for Model 12					
Lag	LR	FPE	AIC	SC	HQ
0	NA	448.7531	14.62008	14.74053	14.66498
1	229.4949*	2.485378*	9.422645*	9.904421*	9.602246*
2	8.486878	2.984147	9.599306	10.44241	9.913608
3	13.26992	3.093044	9.620165	10.82461	10.06917
Lag Length Selection Criteria Results for Model 13					
Lag	LR	FPE	AIC	SC	HQ
0	NA	1.41779	8.862709	8.983153	8.907609
1	297.3275*	0.001501*	2.010818*	2.492594*	2.190419*
2	13.86679	0.001565	2.045902	2.889011	2.360205
3	5.887428	0.002003	2.27769	3.482132	2.726694

Source: Author's computation using E-view 9 (2018)

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

Table 4: Results of Bounds Test Approach to Cointegration

Results of Bounds Test Approach to Cointegration for Model 11			
Significance	Critical Value Bonds		Computed F-Statistic
	Lower Bound I(0)	Upper Bond I(1)	
10%	3.17	4.14	***15.42984***
5%	3.79	4.85	
2.5%	4.41	5.52	
1%	5.15	6.36	
Results of Bounds Test Approach to Cointegration for Model 12			
Significance	Critical Value Bonds		Computed F-Statistic
	Lower Bound I(0)	Upper Bond I(1)	
10%	3.17	4.14	***5.40992***
5%	3.79	4.85	
2.5%	4.41	5.52	
1%	5.15	6.36	
Results of Bounds Test Approach to Cointegration for Model 13			
Significance	Critical Value Bonds		Computed F-Statistic
	Lower Bound I(0)	Upper Bond I(1)	
10%	3.17	4.14	***16.22108***
5%	3.79	4.85	
2.5%	4.41	5.52	
1%	5.15	6.36	

Source: Author's computation using E-view 9 (2018)

Table 5: Estomated Long Run Elasticities for the Selected ADRL Models (Regress and InPOV)

Explanatory Variables	Model 11 ARDL (1, 0, 0)	Model 12 ARDL (1, 0, 0)	Model 13 ARDL (1, 0, 0)
dlnRGDP	-0.467640*	-0.517387*	
	{0.513087}	{0.916122}	
	[-0.911424]	[-0.564757]	
	{{0.7126}}	{{0.7072}}	
dlnGINI	1.459832*		1.459700*
	{0.252244}		{0.277272}
	[5.787382]		[5.264508]
	{{0.0080}}		{{0.0083}}
dlnRGDP*lnGINI		-2.842653*	-0.965070*
		{1.062788}	{0.248980}
		[-2.674713]	[-3.876094]
		{{0.0061}}	{{0.0072}}
C	7.79125	51.10857	7.904748
	{3.072684}	{96.027089}	{3.091655}
	[2.535650]	0.532231]	[2.556802]
	{{0.0149}}	{{0.5973}}	{{0.0142}}
Goodness-of-fit Measures			
R^2	0.996752	0.996361	0.996754
Adjusted R^2	0.996526	0.996107	0.996528
F-statistic	4399.153	3924.206	4401.955
Prob (F-statistic)	0.0000000	0.0000000	0.0000000
Durbin-Watson Stat	1.498459	1.418041	1.501507
Diagnostic Statistical Checking			
Breusch- Godfrey serial correlation LM test	3.248867*** {{0.1970}}	4.121794*** {{0.1273}}	3.248678*** {{0.1970}}
Breusch-Pagan-Godfrey test for heteroskedasticity	4.208657*** {{0.2398}}	2.641081*** {{0.4503}}	4.537814*** {{0.2089}}
ARCH test for heteroskedasticity	0.016385*** {{0.8981}}	0.051496*** {{0.8205}}	0.016856*** {{0.8967}}
Jacque-Bera normality test	2.963618** {{0.617665}}	2.031365** {{2.362155}}	1.965316** {{0.617141}}
Ramsey RESET specification test	[2.090226] {{0.4027}}	[1.953367] {{0.0575}}	[4.380916] {{0.4024}}

Notes:

1. { }, [ ] and {{ }} denote Std. Error, t-Statistic, Probability respectively

2. ***, ** and * depict Obs R-squared, Jacque-Bera Statistic and Coefficient respectively

Source: Author's computation using E-view 9 (2018)

Table 6: Estimated Short Run Elasticities for the Selected ADRL Models (Regres and: InPOV)

Explanatory Variables	Model 11 ARDL (1, 0, 0)	Model 12 ARDL (1, 0, 0)	Model 13 ARDL (1, 0, 0)
ECM(-1)	-0.025077*	-0.041000*	-0.024831*
	{0.012507}	{0.009367}	{0.012515}
	[-2.005088]	[-4.377068]	[-1.984153]
	{{0.0074}}	{{0.0038}}	{{0.0015}}
dlnRGDP	-0.001173*	-0.006222*	
	{0.003233}	{0.010230}	
	[-0.362767]	[-0.608184]	
	{{0.7186}}	{{0.5463}}	
dlnGINI	0.366078*		0.362457*
	{0.154761}		{0.152748}
	[2.365443]		[2.372910]
	{{0.0226}}		{{0.0222}}
dlnRGDP*lnGINI		-0.011656*	-0.002396*
		{0.019270}	{0.006010}
		[-0.604850]	[-0.398724]
		{{0.5485}}	{{0.6921}}

Notes: *, { }, [ ] and {{ }} denote Coefficient, Std. Error, t-Statistic, Probability respectively

Source: Author's computation using E-view 9 (2018)

Appendix 1

Figure 1: Plot of Cumulative Sum of Recursive Residuals CUSUM (Stability Test)

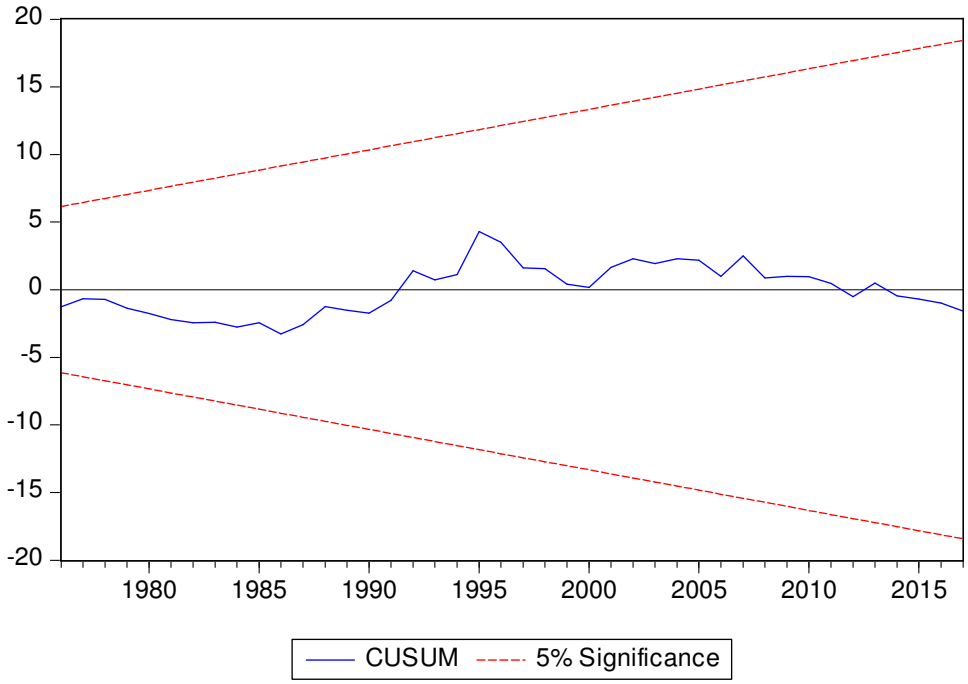

Figure 2: Plot of Cumulative Sum of Squares of Recursive Residuals CUSUMQ (Stability Test)

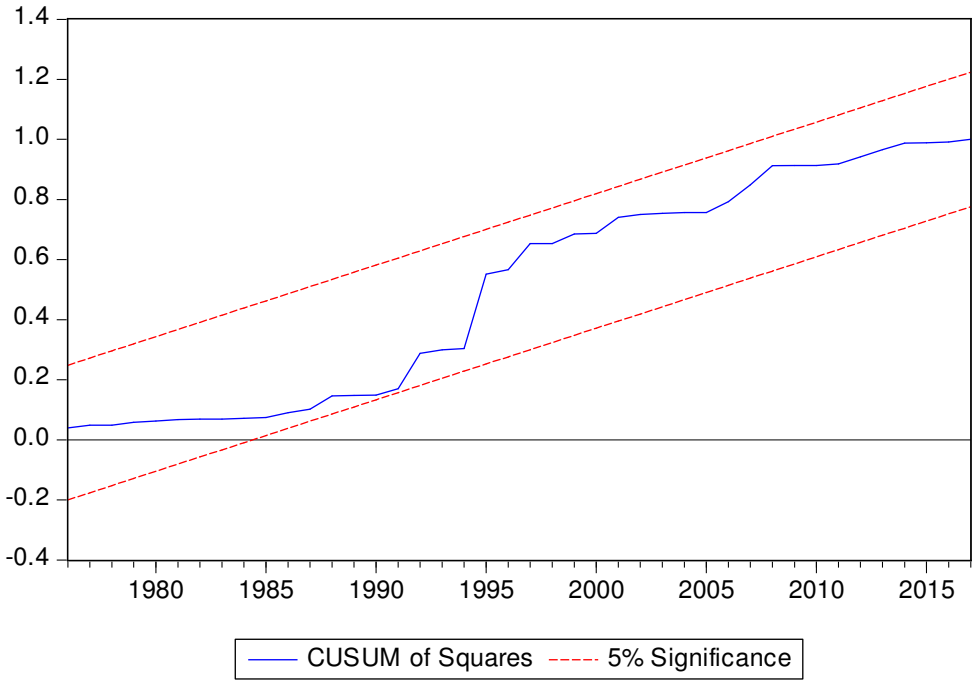

Figure 3: Plot of Cumulative Sum of Recursive Residuals CUSUM (Stability Test)

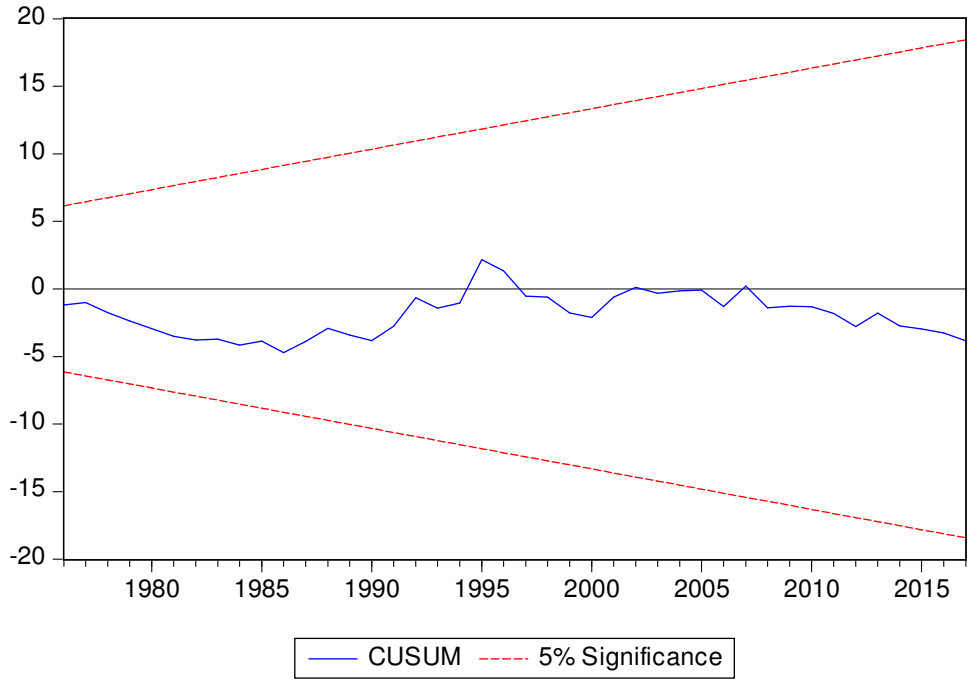

Figure 4: Plot of Cumulative Sum of Squares of Recursive Residuals CUSUMQ (Stability Test)

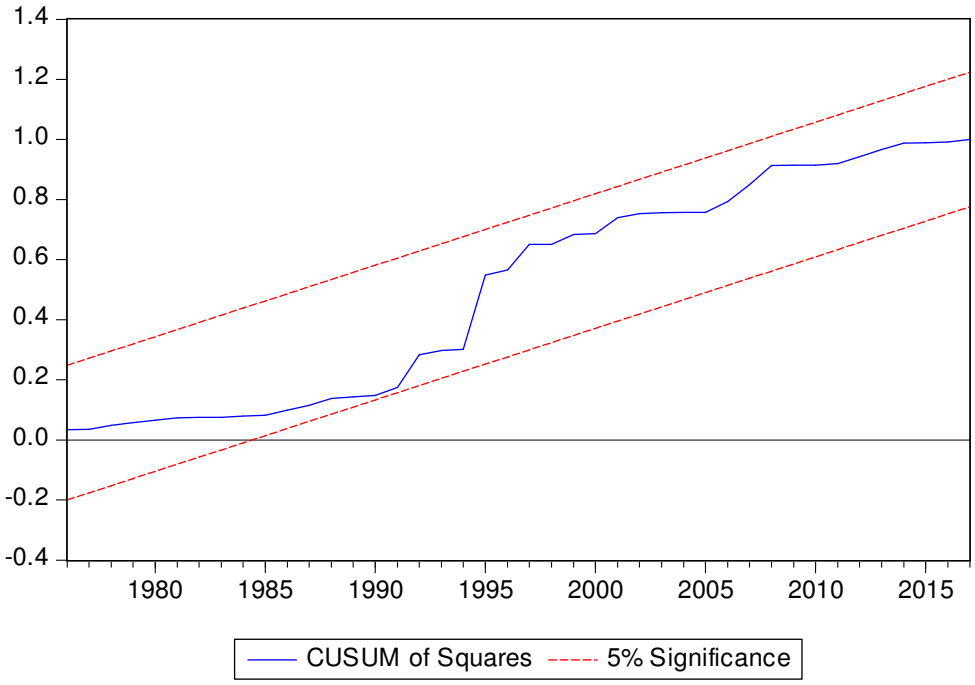

Figure 5: Plot of Cumulative Sum of Recursive Residuals CUSUM (Stability Test)

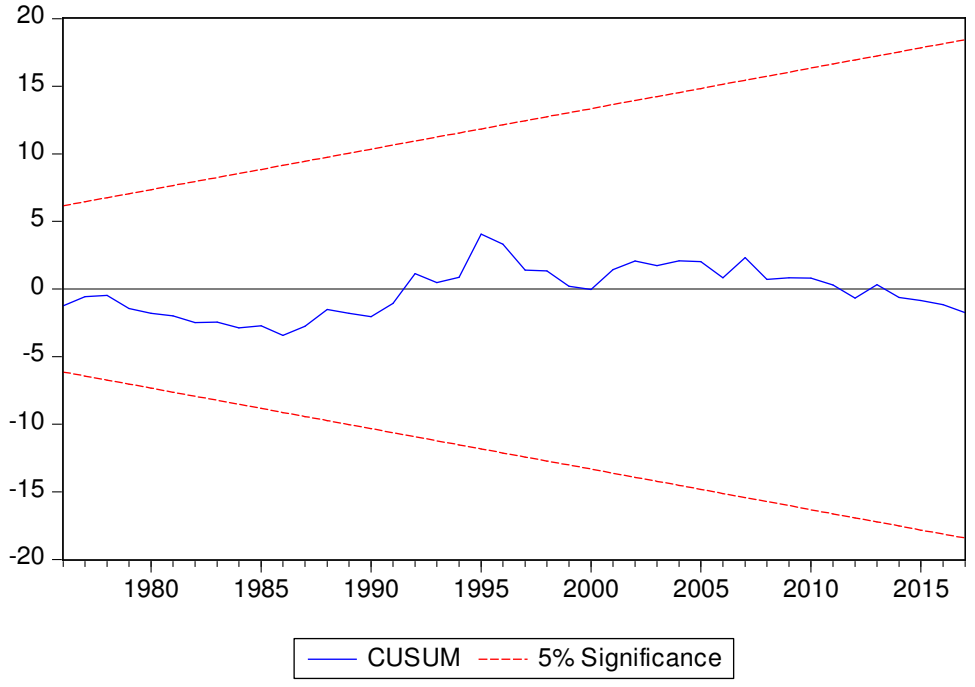

Figure 6: Plot of Cumulative Sum of Squares of Recursive Residuals CUSUMQ (Stability Test)