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FOREIGN DIRECT INVESTMENT AND INCOME INEQUALITY IN NIGERIA

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This study investigated the effects of inward FDI on income inequality in Nigeria between 1980 and 2016. We applied the symmetric ARDL and the asymmetric NARDL methods to investigate the short-run and long-run relationships with and without structural breaks. The unit root tests revealed that the series are integrated of different order while the Bound test confirmed cointegration among the variables. The short run symmetric model revealed that past FDI inflows has the potential to reduce income inequality. The short run asymmetric model also showed that positive FDI shocks reduce income inequality while negative FDI shocks increases income inequality. While the long run symmetric ARDL supported the result, the long run asymmetric models were inconclusive. In addition, empirical suggested that the relationship between FDI and income inequality is a short run phenomenon. In addition, the presence of structural break has no significance in explaining the asymmetric impact of FDI on income inequality. Finally, the analysis revealed that inequality increases with population growth and reduces with increased domestic investment.

Keywords: *NARDL, Structural Breaks, Nigeria.*

INTRODUCTION

The benefits of FDI are many - it has evolved to become the most significant source of external capital, veritable supplement to domestic savings, it plays a significant role in domestic capital formation and closes domestic investment financing gaps.FDI facilitates access to foreign markets, supports employment generation and raises skills of local manpower. In addition, it provides a broad channel for technology diffusion which is crucial to generating technological spill-over to propel economic growth and development. The channels of such technological diffusion range from the transmission of ideas and new technologies to imports of high technology and acquisition of human capital. However, not every country has the same capability to access such advanced technology, thereby underscoring the importance of foreign direct investment (FDI) in diffusing such technological development. FDI by Multinational Corporations (MNCs) serves as a conduit for advanced technologies to reach developing countries.

Although the role of FDI inflows in the development process has been widely investigated especially with respect to the efficiency outcomes of FDI such as economic growth and productivity (Alfaro et al., 2004, Azman-Saini et al., 2010), there is hardly any evidence on the distributional effects of FDI on income equality in Nigeria. While some of the literature has found a positive impact of FDI on inequality (Baddeley, 2006; Benar, 2007; Pradhan, 2009; Wan, Lu and Chen, 2007; Alderson and Nielsen, 2002; Tsai, 1995; te Velde, 2003; Choi, 2006; Basu and Guariglia, 2007; Herzer, Hühne and Nunnenkamp, 2012), others have reported a negative impact (Jensen and Rosas, 2007; Adams, 2008; Das, 2005; Lee, 2006; Silva, 2007; Tisdell and Svizzero, 2004) or no effect (Milanovic, 2003; Sylwester, 2005). Perhaps, part of the controversy may be due to the aggregation of countries in a panel analysis framework, different methodological approaches and data periods.

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There are two competing arguments on the impact of FDI on income inequality (Farhan, Azman-Saini and Law 2014). In the first argument, FDI may help to decrease income inequality when capitals are invested in sector that utilizes abundant low-income unskilled labour (Deardorff and Stern, 1994). On the contrary, inward FDI may deteriorate income distribution due to wage spillovers given that multinational corporations (MNCs) usually pay higher wages to skilled and unskilled worker than their local counterparts due to their advantages on excess capital (Chase-Dunn, 1985).The possibility therefore is that the presence of MNCs would limit the share of local firms and affect their profitability. With profit declining, local firms are forced to reduce their cost by reducing the wage level and the number of workers (skilled and unskilled) they could employ to remain in the market. The implication is that higher inflows of FDI lead to more poverty, isolation, a neglect of local capabilities and larger inequality.

Perhaps, if FDI inflows were really responsible for rising inequality, then the policy implication would be that countries must reduce the inflows of foreign capital in order to prevent and reduce such an inequality. This is expected to raise a highly controversial and provocative policy dimension because it would be difficult to reconcile the positive effect of FDI on economic growth and its potential adverse effect on income inequality. As a result, the linkage between FDI and income inequality requires further research. Estimating the net impact of FDI on income inequality becomes an empirical question which must be approached very carefully, because potential issues of reverse causality, endogeneity problem, selection bias, and omitted variable bias that can lead to spurious results.

In other to address the challenges, Ucal, Haug and Bilgin (2016) employed the nonlinear auto-regressive distributed lag (NARDL) modelling approach to co-integration. A prominent advantage of this approach is that it can be applied regardless of whether variables have a unit root or are covariance stationary. In addition, the method corrects for endogeneity and serial correlation and allows for possibly asymmetric (i.e. nonlinear) adjustments of income inequality to movements in other variables. In other words, increases and decreases in other variables are allowed to affect income inequality differently. However, this study argues that the asymmetric adjustment of income inequality to FDI inflows is a short run phenomenon due to the volatile nature of the inflows. The argument is that the outcome of the simultaneous modelling of asymmetries in any underlying short run and long-run relationship and the patterns of dynamic adjustment depends on the nature of the variables being examined (in this case FDI). In addition, the study of Ucal, et al., (2016) did not conduct the analysis in the presence of structural breaks. This is because unexpected shift in time series can lead to huge forecasting errors and unreliability of the model. The lack of stability of coefficients is known to have frequently caused forecast failure and therefore we must routinely account for structural stability (the time-invariance of regression coefficients).

Taking the issues into consideration, the objective of this paper is to analyze the impact of FDI inflows on income inequality in Nigeria between 1980 and 2016. The choice of Nigeria is straight forward. Despite many challenges, Nigeria has remained one of the most sought after destinations for foreign direct investment (FDI). In 2014, Nigeria occupied the first position in FDI capital attraction and the second highest in FDI related new projects in Sub-Saharan Africa (SSA) (Ernst and Young, 2014). Given that the potential to attract foreign investors is not a static phenomenon, Nigeria has improved her prospects for FDI considerably over the last one decade through some conscious effort to facilitate rapid economic growth. Hence, the government has adopted various initiatives in its attempts to attract FDI. Such initiatives include fiscal incentives such as reduced tax rates, tax holidays and subsidies, exemptions from import duties, accelerated depreciation allowances, grants and modified environmental standards. Others include the signing of investment treaties and

investment promotion activities. Consequently, FDI inflows into Nigeria increased from $485.6 million in 1985 to $8.5 billion in 2009. Simultaneously, income inequality measured by gini index increased from 38.6 in 1985 to 42.9 in 2009. Hence, the parallel development of these two processes suggests that there might be some sort of relationship between them which is worth studying.

In addition, Nigeria has the largest economy in Africa and its role is the continent has been growing significantly due to the high levels of FDI inflows and outflows, its openness to international trade and its participation in the process of economic globalization in the continent. With *an estimated population of 184 million in 2015,* Nigeria is the most populous country in Africa and the seventh most populated country in the world (*CIA, 2015)*. Consequently, the assumption is that Nigeria's income inequality might influence the continents and global inequality. Moreover, there are rising public concerns about the socioeconomic outcomes of high income inequality particularly in the aftermath of the recent global slump in oil prices. Thus, this study seeks to determine whether the interaction between inequality and FDI holds in the Nigerian data and whether the impact is a short run phenomenon.

This paper tries to contribute to the existing literature by exploring the distributional impact of FDI in the context of income inequality. We addressed the issue by estimating the symmetric auto-regressive distributed lag (ARDL) and the asymmetric NARDL models in the presence of structural breaks and without structural breaks for the dynamic short and long run. The Bai and Perron (2003 and 2006) tests which determines breaks endogenously and detects multiple structural changes in linear models were employed for the structural breaks. These steps separate our work from the other country specific studies in the literature. The rest of this study is divided into five sections. Section two discusses the background to the study while section three focuses on the review of related studies. The methodology is highlighted in section four while section five focuses on empirical analysis. Section six concludes.

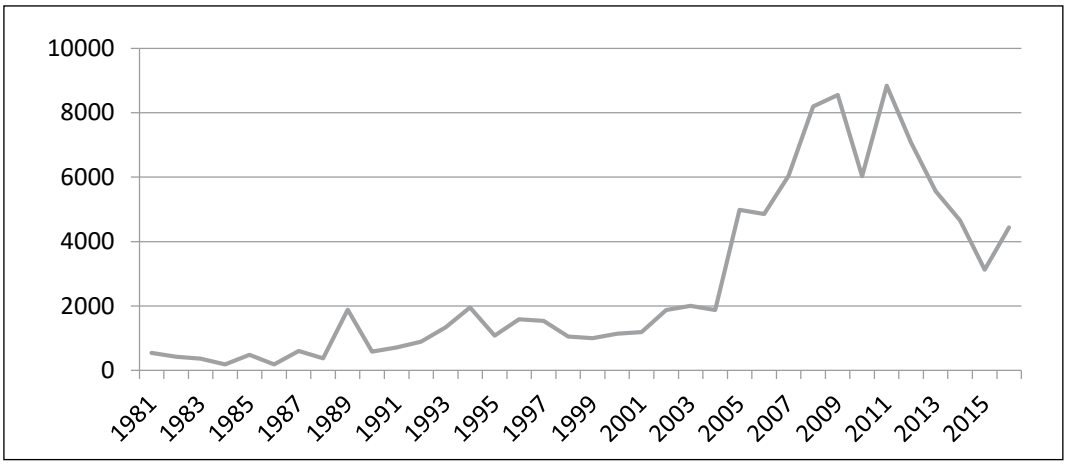
Stylized Facts on FDI and Inequality in Nigeria

With a population of over 180 million people, Nigeria is the most populous country in Africa and therefore among its largest markets. The country has abundant natural resources and an inexpensive workforce, and it is strategically located near many West African countries. The Nigerian Government tends to pursue a policy of economic liberalisation, promoting public-private partnerships and strategic alliances with foreign firms. Nigeria has also signed bilateral investment agreements with several countries in Europe, Latin America and Asia. Nevertheless, FDI in Nigeria assumed a downward trend between 1981 and 1984 due to the economic crisis witnessed from the collapse of crude oil. The oil-glut in 1980 and the subsequent collapse of the oil dependent economy led to a serious economic crisis that led to the slow growth rate of national output, the balance of payment crisis, the mounting national output, the balance of payment crisis, the mounting national debt and debt servicing burden, the collapse of the manufacturing sector, mounting unemployment and galloping inflation (stagflation) and deteriorating standard of living. During the period, FDI fell from US$542 million in 1981 to US$189 million in 1984. It was therefore inevitable that Nigeria adopt some remedial policies to address the economic problem at the instance of the International Monetary Fund (IMF) and the World Bank.

The adopted economic recovery programme was under the framework of the Structural Adjustment Programme (SAP). The core elements of SAP include debt rescheduling elimination of complex administrative controls, adoption of a realistic exchange rate policy, tariff structure designed to discourage imports and encourage exports, adoption of appropriate pricing policies

in all sectors with greater reliance on market force, rationalization and restructuring of public expenditure, privatization and commercialization of public enterprises. As a result, FDI increased from US$193 million to US$1884 million in 1988. Thereafter, the FDI inflow largely fluctuated and stood at US$1345 million in 1993. The economic challenges such as high inflation, shortage of foreign exchange, increased unemployment, low capacity utilization fiscal deficit and increased poverty incidence caused by SAP led to its discontinuation in 1994 when the government instituted the policy of guided deregulation.

Figure 1: Foreign Direct Investment, Net Inflows (BoP, Current Million US$)



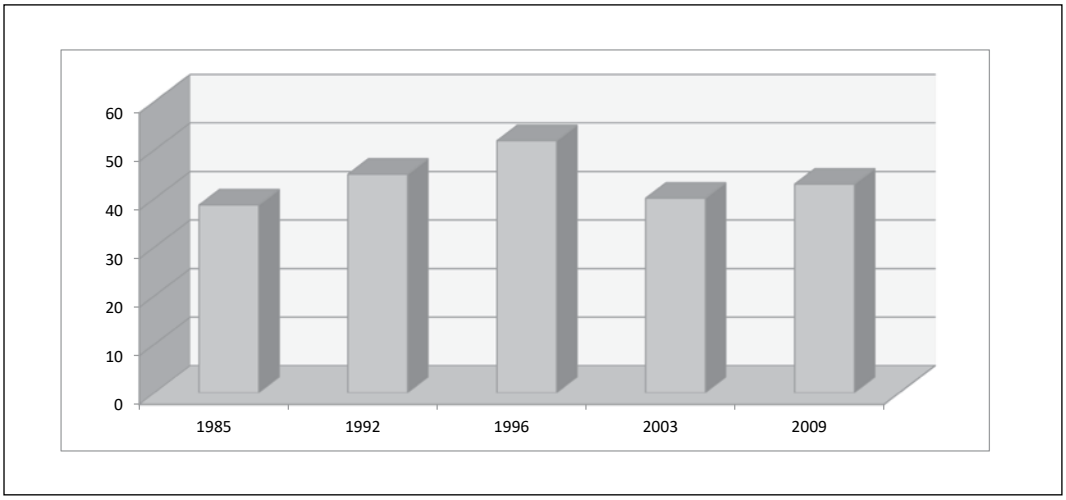
Source: World Bank World Development Indicator (2018)

The policy of guided deregulation necessitated the periodic government intervention in the foreign exchange market. The inflow from FDI increased to US$1959 million in 1994 but declined steadily to US$1051 million in 1998. The political challenges witnessed over the period were largely attributed to the dismal trend of the FDI inflow over the period. In addition, the economy continued to witness poor exchange rate management, high inflation, increased unemployment, corruption and low capacity utilization. The return to democracy in 1999 witnessed the adoption of the National Economic Empowerment and Development Strategy, consolidation of the banking sector and the establishment of the Nigerian Investment Promotion Counci (NIPC). Consequently, FDI inflow into the Nigerian economy increased steadily from US$1140 million in 2000 to US$8841 million in 2011. Another feature of this period was the emergence of Nigeria as preferred destinations for FDI.

The Nigerian Government introduced many programmes to boost FDI, notably in agriculture, exploitation and mining, oil and gas extraction, as well as in the export sectors. Tax incentives are granted to pioneering industries deemed beneficial for the economic development of the country and employment of its workforce (such as clothing); allowances facilitating capital investments and the deduction of interest on loans for gas companies are also planned. Outside of the oil and gas sector where investment is limited to joint ventures or production-sharing agreements, foreign companies are allowed to own 100% of businesses. Despite the initiatives, FDI inflows declined to US$7069 million in 2012 to US$4434 million in 2016 due the collapse of the crude oil prices that led to the falling of the economy into deep recession. The economic challenges cut across high inflation, unemployment, income inequality, high poverty incidence and weak capacity utilization among others.

In specific terms, income inequality was a major feature of the economic liberalization adopted by Nigeria from 1985. The greatest rise in income inequality in Nigeria was in the first ten years of market-oriented reforms when the average Gini index increased from 38.7 in 1985 to 45 in 1992 and 51.9 in 1996. Thereafter it declined 40.1 in 2003 but increased again in 2009 to 43.0. Among the major drivers of income inequality during the period of the market oriented reforms include wage decompression and growth of the private sector, restructuring and unemployment, changes in government expenditure and taxation, price liberalization and inflation, asset transfer and growth of property income (Mitra and Yemtsov, 2006). In addition, technological change and globalization are also listed as determinants of income inequality (Mihaylova, 2015). The implication is that if in the beginning of the period under study the main drivers of inequality were domestic related factors, it is assumed later on that globalization and FDI in particular will start playing an important role in shaping its dynamics.

Figure 2: Gini Index for Nigeria



Source: World Bank World Development Indicator (2018)

REVIEW OF LITERATURE

The empirical literature of FDI and income inequality is far from being conclusive. The reported findings in the literature have been quite diverse. While some studies found evidence of a detrimental income distributional effect of FDI, some other studies indicated that FDI reduces income inequality. Nevertheless, there exists some other group of studies that reported statistical independence between FDI and income inequality. The set of studies, which argued that FDI deepens inequality, is the most extensive in the literature. The studies however cut across panel data analysis, single country studies and within countries estimations.

For example, in a panel data analysis of 88 countries between 1967 and 1994, Alderson and Nielsen (1999) find a positive relationship between FDI and income inequality. In another study on Latin America, Herzer, Hühne and Nunnenkamp (2014) investigate the long-run impact of FDI on income inequality in five Latin American host countries, namely Bolivia, Chile, Colombia, Mexico and Uruguay by applying country-specific and panel cointegration techniques. According to their results, except for Uruguay, FDI contributes to widening income gaps in all individual

sample countries. In addition, pernicious distributional impact of FDI was reported by Reuveny and Li (2003) data on 68 countries between 1960 and 1996. In a panel data study on 119 developing countries in the period 1970-1999, Basu and Guariglia (2007) found that FDI fosters growth but also leads to an increase in income inequality in the host countries. These results were supported by (Weede and Tiefenbach, 1981; Herzer et al., 2013).

Several studies on a single country also reported that FDI leads to higher inequality. The notable studies among them include Feenstra and Hanson (1997) on Mexico, Lipsey and Sjoholm (2001) on Indonesia, Mah (2002) on South Korea, Zhang and Zhang (2003) on China, Nunnenkamp et al. (2006) on Bolivia. Halmos (2011) utilized time series data on 15 Eastern European countries and also reported that FDI leads to higher income inequality which the author explains with the increase in the return to skilled labor as a result of the technology transfer that accompanies FDI entry. Skuratowicz (2005) found out that FDI in Poland leads to higher demand for qualified labor and thus increases wage inequality (Mihaylova, 2015).

Among the within country studies, Choi (2006) analyses the relationship between FDI and income inequality within countries using pooled Gini coefficients for 119 countries from 1993 to 2002. The author reported that income inequality increases as FDI stocks (as a percentage of GDP) increase. Wei, Yao and Liu (2007) noted that a downside effect of rapid economic growth in China has been the ever rising inter-regional inequality and that FDI has been blamed for driving the Chinese regions apart. Employing the largest panel dataset for the Chinese regions between 1979 and 2003 and employing an augmented Cobb-Douglas production function, the study established that FDI has been an important factor of economic growth in China with the uneven distribution of FDI instead of FDI itself being responsible for the regional growth differences. Changkyu (2006) investigated the relationship between FDI (both inward and outward) and income inequality within countries. Adopting gini coefficient as an indicator for income inequality, the results revealed that both inward and outward FDI have potential impact in increasing the income inequality. However, the effect is greater for outward FDI compared to inward FDI. Moreover, the study reported that rich countries and fast growing economies tend to have even income distribution.

The result was also found to be valid at the sectoral level. Suanes (2016) analyzed the relationship between foreign direct investment (FDI) and income inequality in Latin America. It estimated the effect of FDI from a sectoral perspective, identifying three major sectors: the primary sector, manufacturing industry and services. Utilizing a panel analysis for 13 economies in the 1980-2009 period, empirical evidence was found for a positive effect of FDI on income inequality in the service and manufacturing sectors. There is however a time dimension on the validity of the FDI and income inequality results. For example, Herzer and Nunnenkamp (2011) in a study on 10 European countries between 1980 and2000, reported that FDI deepens income inequality but only in the short run. The study reported that FDI contributes to a decrease of inequality in the long run.

Mundell (1957) argued that FDI can reduce income inequality because FDI inflows increases the amount of capital in the host country, thereby leading to a rise in the marginal physical product of labour which leads to a rise in both nominal and real wages. An increase in wages results in a decline in income inequality (Faustino and Vali, 2011**)**. Thus, higher wages in foreign affiliates, as well as the wage gap between the management and the workers in these companies can reduce income inequality **(**Bandelj and Mahutga, 2008; Basu and Guariglia, 2007**).**Wu (2001) reports the same skilled wage premium from FDI, but attributes it to better intellectual property rights protection of foreign- invested enterprises rather than to labor market distortions. Hale and Long (2011) also find that FDI has direct and indirect effects on skilled labor. FDI firms pay more for skilled labor and the observed quality of that labor is higher than in private domestic firms. Thus, there are arguments that

for FDI to manifest positive distributional effects, policies aimed at improving poor people's access to education should be implemented (Jaumotte et al., 2008).

However, the second group of empirical studies which is less extensive reported that FDI decreases income inequality in the host country. The studies also cut across group of countries, single country studies and within countries analysis. By way of illustration, Celik and Basdas (2010) studied the effect of globalization on income inequality for both developed and developing countries. The results show that the increase in FDI inflows improves income inequality in both developed and developing countries. Herzer and Nunnenkamp (2013) use an estimated household income inequality Gini index for 8 European countries over the period from 1980 to 2000 and employ panel cointegration methodology. They found out that both inward and outward FDI, on average, reduce inequality in the long run. However, they revealed that there are large cross-country differences in the long-run effects. For example, in the case of inward FDI, FDI raises inequality for Spain, the poorest country in the sample, while FDI reduces it for Finland, the Netherlands, and Sweden.

Farhan, Azman-Saini and Law (2014) analyzed the impact of FDI inflows on income distribution in ASEAN-5 countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand). It investigated whether the inflows of FDI is associated with a greater income inequality within these countries. The empirical results, based on quantile regression analysis and data between1970 and 2011 revealed that FDI inflows have an inequality-reducing effects in Malaysia, the Philippines and Thailand. However, the findings for Singapore and Indonesia suggested that FDI perpetuates inequality. Mihaylova (2015) explored the impact of foreign direct investment (FDI) on income inequality in ten countries from Central and Eastern Europe (CEE) between 1990 and 2012. The study established that FDI has the potential to exert influence on income inequality but this effect varies depending on the level of education and economic development of the host countries.

In the case of the single country analysis, Ucal et al., (2016) explored the linkage between foreign direct investment (FDI) and income inequality in Turkey in the short- and long-run. The study applied the nonlinear auto-regressive distributed lag (NARDL) modelling approach between 1970 and 2008. The empirical results indicate the existence of long run relationship among the variables with asymmetric adjustment of the income distribution in the short- and long-run. The study reported the statistically significant negative impact of FDI on the Gini coefficient in the short- and long-run. Similarly, Msweli (2015) in the case of South Africa showed that there is a negative relationship between inequality and FDI. This implies that as foreign direct investment inflows increase, income inequality decreases.

The validity of the results also holds for within country estimations. Jensen and Rosas (2007) examined income inequality within states in Mexico as capital flows were liberalized between 1990 and 2000. They compared states that received a lot of FDI with those that received little FDI since most US multinationals choose to locate close to six border routes between the two countries. Using an instrumental variable at the cross-state level, they reported that states with lots of FDI had lower income inequality, measured by state-level Gini coefficients that include returns from labor and capital. Bhandari (2006) examined FDI in the USA and reported that it has a beneficial distributional impact although it is not homogeneous across states. A similar conclusion was reached by Chintrakarn et al. (2010), who established that FDI in the USA decreases inequality but this effect is again heterogeneous across states.

Sun and Chai (1998) examined the effects of FDI on economic growth in the eastern and western regions of China by using panel data across 16 provinces between 1986 and 1992. They found that the effect of FDI on economic growth was stronger in the eastern region and very weak

in the western region, which reinforced inter-regional economic inequality. Fu (2004) investigates the spillover and migration effects of exports and FDI and estimates their impact on regional income inequalities in China and found that exports and FDI played an important role in raising regional disparities.

The third group of studies, which failed to find statistically significant relationship between FDI and income inequality, increased the ambiguity of the empirical literature. For example, Mahler et al. (1999) investigated the relationship between international integration and domestic market inequality in developed market. Two major international integrations observed are foreign direct investment and trade. Adoption the Luxembourg Income Studies (LIS) database to represent income inequality, they found that both trade and FDI are not significant in explaining income inequalities. They concluded that globalization was not an important factor in explaining distribution of income in developed countries.

Taking a brief overview of the studies, it is obvious that the literature is inconclusive regarding the relationship between FDI and income inequality, although the studies reviewed have tried to generate a clearer understanding of the relationship between FDI and income inequality. There is therefore hardly any doubt that a possible relationship between FDI and income inequality could exist. Discounting all the evidence, amounts to throwing the baby out with the bath water. A fundamental reason why it is difficult to reach a definitive conclusion regarding the link is the number of factors that influences income inequality in a country. Foreign direct investment can have a significant impact on income inequality, but so can many factors that are related to income inequality. Thus, a positive (negative) relationship between FDI and income inequality could have well existed but because there is methodological problem, endogeneity issues, measures and data sources for inequality, coverage of countries, data periods, selectivity bias, specification error, the results have been largely inconclusive. The suspect may have shot the victim but the jury may still have insufficient evidence to indict her.

According to te Velde (2003), the effects of FDI on income inequality can be analyzed by looking at (i) Composition effect (foreign firms tend to locate in skill-intensive sectors or skill intensive segments within sectors) (ii) Skill-specific technological change (FDI could induce faster productivity growth of labour in both foreign (technology transfer) and domestic firms (spill-over effects). (iii) Skill-specific wage bargaining (skilled workers are usually in a stronger bargaining position than less-skilled workers because they posses key skills in relatively scarce supply and may have better negotiation skills to negotiate higher wages) and (iv) training and education(foreign firms generally undertake more training than their local counterparts).

However, the sectors in which FDI inflow into a country matter in other for it to affect income inequality. If the FDI flows to sectors such as oil and gas that is disconnected from other tiers and sectors of the economy such as Nigeria, it will offer little or no linkage and multiplier effect to the economy as a whole. Income inequality rather than decline will subside. In addition, certain complementary conditions such as skilled workers must be in place in other for the positive spillovers of FDI to reflect in the income inequality level. For example, the penetration of FDI in any developing country will lead to an increased demand for skilled workers which in turn will lead to an increase in the relative wages of those workers. Therefore, there will always be an improvement in the situation of workers considered qualified and a degradation of the situation of unskilled workers. Consequently, the availability of a pool of skilled workers is a *sine qua non* for FDI to impact on income inequality.

METHODOLOGY

Model Specification and Data Sources

The links between income inequality and FDI are complex. Following the approach of (Msweli 2015; Im and McLaren 2015; Ucal, et al., 2016; Suanes 2016), we estimate the impact of FDI on income inequality with the basic model:

$$INQ_t = \alpha_0 + \alpha_1 FDI_t + \alpha_2 SEC_t + \alpha_3 GDPGR_t + \alpha_4 POPGR_t + \alpha_5 GFCF_t + \varepsilon_t \quad (1)$$

where INQ is the estimate of the Gini index of inequality using the World Income Inequality Database, Fries Foreign direct investment, net inflows (% of GDP). Economic growth is measured by GDPGR **(**GDP growth (annual %)). Economic growth increases the income opportunities in a country but the increase may or may not benefit all members of the society. Also, there may be reverse causality from the income distribution to economic growth, depending on the level of development of a country, and more inequality could either help or hinder economic growth (Ucal, Bilgin, Haug 2016). Domestic investment is measured with GFCF (Gross fixed capital formation (% of GDP)). It is well known that FDI competes with domestic capital for domestic workers, which may possibly push up domestic wages and down the income to capital and therefore should be included as a control variable to capture the influence of domestic capital formation (investment) on the distribution of income (Im and McLaren,2015;Ucal, Bilgin, Haug 2016). Population growth is measured with POPGR which is the annual population growth rate (annual %). The assumption is that rapid rates of *population growth* will constrain the attainment of *higher* per capita incomes which increases inequality. The secondary school enrolment ratio (SEC) is a broad measure of education levels, or human capital, which reflects basic skill levels and therefore is related to returns to education and income. A priori, we expect $SEC < 0$; $GDPGR < 0$; $POPGR > 0$; $GFCF < 0$.The impact of FDI on income inequality is ambiguous.

Data for the Gini index is taken from the Standardized World Income Inequality Database (SWIID) developed by Solt (2009), which is one of the most comprehensive and comparable datasets on income inequality. As argued by Herzer et al. (2013), the SWIID combines information from the World Income Inequality Database (WIID) provided by the World Bank with information from the Luxembourg Income Study (LIS) database, which offers harmonized micro-data collected from multiple countries, and data from UNU-WIDER to create a dataset with greater coverage than the LIS data and greater comparability than the WIID. The data for foreign direct investment, gross fixed capital formation population growth rate, secondary school enrolment ratio are sourced from the World Bank World Development Indicator (WDI).

Estimation Technique

The study explored the nonlinear auto-regressive distributed lag (NARDL) modelling approach of Shin et al. (2014) in its attempt to empirically evaluate the distributional impact of FDI on income inequality. According to Hoang et al. (2016), the NARDL approach allows modelling the cointegration relation that exists between the dependent and independent variables. Other advantages of the NARDL modelling approach include its ability to be deployed to test both the linear and nonlinear estimation simultaneously. It also permits distinction between the short- and long-run effects from the independent variable to the dependent variable. Although, these advantages attributed to NARDL may as well be valid for nonlinear threshold Vector Error Correction Models (VECM) or smooth transition models. However, these latter models may yet suffer from the convergence

problem due to the proliferation of the number of parameters, which is not the case with the NARDL model. For example, unlike other error correction models where the order of integration of the considered time series should be the same, the NARDL model relaxes this restriction and allows the combination of data series that have different order of integration. Nonetheless, the present study will for the purpose of robustness, consider four regressions namely, linear ARDL (symmetric approach) with and without structural breaks and nonlinear ARDL (asymmetric approach) with and without structural breaks. We take each of these specifications in turn.

1. Symmetric ARDL Model without Structural Breaks

Following the standard framework of Pesaran et al. (2001), the symmetric ARDL model representation of income inequality –FDI specification in equation 1 above is given as:

$$\Delta INQ_t = \alpha_0 + \alpha_1 INQ_{t-1} + \alpha_2 FDI_{t-1} + \alpha_3' X_{t-1} + \sum_{i=1}^{N1} \lambda_i \Delta INQ_{t-i} + \sum_{j=0}^{N2} \gamma_j \Delta FDI_{t-j} + \sum_{j=0}^{N3} \psi_j \Delta' X_{t-j} + \varepsilon_t \quad (2)$$

where X_t is a $k \times 1$ vector controlling for other factors that matter for explaining income inequality namely, SEC, GDPGR, POPGR and GFCF. However, while the long run parameters for the intercept and slope coefficients are computed as $-\frac{\alpha_0}{\alpha_1}$, $-\frac{\alpha_2}{\alpha_1}$ and $-\frac{\alpha_3}{\alpha_1}$ given that in the long run $\Delta INQ_{t-i} = 0$, $\Delta FDI_{t-j} = 0$ and $\Delta' X_{t-j} = 0$, the short run estimates on the other hand can be obtained as λ_i, γ_j and ψ_j respectively for income inequality, FDI and other control variables in the model. In addition, since the variables in their first differences can accommodate more than one lag, determining the optimal lag combination for the ARDL becomes necessary.

The optimal lag length can be selected using the Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HIC) or Schwartz Information Criterion (SIC). The lag combination with the least value of the chosen criterion among the competing lag orders is considered the optimal lag. Consequently, the preferred ARDL model is used to test for long run relationship in the model. This approach of testing for cointegration is referred to as Bounds testing as it involves the upper and lower bounds. The test follows an F distribution. In this case, if the calculated F-statistic is greater than the upper bound value, there is cointegration However, if it is less than the lower bound, then there is no cointegration and if it lies between the lower and upper bounds, it means that the test is inconclusive. Consequently, the null hypothesis of no cointegration can be expressed as $H_0: \alpha_1 = \alpha_2 = \alpha_3 = 0$ while the alternative of cointegration is symbolized as $H_1: \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq 0$. Equation (2) can therefore be re-specified to include an error correction term as follows:

$$\Delta INQ_t = \delta \upsilon_{t-1} + \sum_{i=1}^{N1} \lambda_i \Delta INQ_{t-i} + \sum_{j=0}^{N2} \gamma_j \Delta FDI_{t-j} + \sum_{j=0}^{N3} \psi_j \Delta' X_{t-j} + \varepsilon_t \quad (3)$$

where $\upsilon_{t-1} = INQ_{t-1} - \varphi_0 - \varphi_1' X_{t-1}$ is the linear error correction term; the parameter δ is the speed of adjustment while the underlying long run parameters have been previously defined as

$$\varphi_0 = -\frac{\alpha_0}{\alpha_1} \text{ and } \varphi_1 = -\frac{\alpha_2}{\alpha_1}.$$

2. Asymmetric ARDL Model without Structural Breaks

While we assume linearity (symmetric) relationship between income inequality and FDI in both equations (2) and (3), the uncertainty characterising the movement of FDI implies that there is likelihood of non-linearity (asymmetric) in the extent to which FDI impact income inequality. The short- and long-run nonlinearities are introduced via positive and negative partial sum

decompositions of FDI. This is necessary because positive and negative changes in FDI are not likely to exert the same magnitude of impact on the inequality of income in Nigeria. This implies that ignoring such asymmetric effect particularly when it mater is tantamount to biasness in the estimates. We therefore re-specify the ADRL models in equation (2) and (3) in a nonlinear form to capture the potential asymmetric impact of FDI on income inequality. To achieve this, we decompose FDI into positive and negative changes to capture the probable asymmetric behaviour of its impact on income inequality following the NARDL approach of Shin et al. (2014). This approach which does not require identical order of integration [i.e. I(1)] for all the series in the model appears less computationally intensive compared to other asymmetric models and is given as:

$$\Delta INQ_t = \alpha_0 + \alpha_1 INQ_{t-1} + \alpha_2 FDI^+_{t-1} + \alpha_3 FDI^-_{t-1} + \alpha_4' X_{t-1} + \sum_{i=1}^{N1} \lambda_i \Delta INQ_{t-i} + \sum_{j=0}^{N2} \left(\gamma_j^+ \Delta FDI^+_{t-j} + \gamma_j^- FDI^-_{t-j} \right) + \sum_{j=0}^{N3} \psi_j \Delta X_{t-j} + \varepsilon_t \quad (4)$$

In equation (4), FDI has been decomposed into FDI_t^+ and FDI_t^- denoting positive and negative changes in FDI respectively. The decomposed FDI are defined theoretically as:

$$FDI_t^+ = \sum_{j=1}^{t} \Delta FDI_j^+ = \sum_{j=1}^{t} \max\left(\Delta FDI_j, 0\right) \quad (5a)$$

$$FDI_t^- = \sum_{j=1}^{t} \Delta FDI_j^- = \sum_{j=1}^{t} \min\left(\Delta FDI_j, 0\right) \quad (5b)$$

Thereafter, we can re-specify equation (4) to include an error correction term thus:

$$\Delta INQ_t = \alpha_0 + \tau \zeta_{t-1} + \sum_{i=1}^{N1} \lambda_i \Delta INQ_{t-i} + \sum_{j=0}^{N2} \left(\gamma_j^+ \Delta FDI^+_{t-j} + \gamma_j^- FDI^-_{t-j} \right) + \sum_{j=0}^{N3} \psi_j \Delta X_{t-j} + \varepsilon_t \quad (6)$$

In equation (6), the error-correction term that captures the long run equilibrium in the NARDL is represented as ξ_{t-1} while the associated parameter (τ) [the speed of adjustment] measures how long it takes the system to adjust to its long run when there is a shock. The error correction term can be expressed as $\xi_{t-1} = INQ_{t-1} - \phi_0 - \phi_1 FDI^+_{t-1} - \phi_2 FDI^-_{t-1} - \phi_3' X_{t-1}$. The coefficients $\phi_1 \left(= -\frac{\alpha_2}{\alpha_1} \right)$ and $\phi_2 \left(= -\frac{\alpha_3}{\alpha_1} \right)$ represent the long run parameters for positive and negative changes in FDI_t which is a vector denoting various factors that proxies for determinants of income inequality while the short run parameters are γ_j^+ and γ_j^- for the positive and negative FDI and ψ for other determinants of inequality in the model.

Similar to the linear ARDL, the long run is estimated only if there is presence of cointegration. Therefore, pre-testing for cointegration is necessary even under NARDL and this involves the Bounds testing approach. However, the underlying hypotheses for cointegration involve the long run asymmetric parameters. In other words, the null hypothesis of no cointegration expressed as $H_0: \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$ is tested against the alternative hypothesis of cointegration given as $H_1: \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq 0$. In addition, we also employ the Wald test for testing restrictions to ascertain whether the asymmetries matter both in the long run and short run. For the Wald test, the null hypothesis of no asymmetries - $H_0: \alpha_2 = \alpha_3$ (for the long run) and $H_0: \sum_{j=0}^{N1} \gamma_j^+ = \sum_{j=0}^{N2} \gamma_j^-$ (for short

run) is tested against the alternative of presence of asymmetries - $H_1: \alpha_2 \neq \alpha_3$ (for long run) and $H_1: \sum_{j=0}^{N1} \gamma_j^+ \neq \sum_{j=0}^{N2} \gamma_j^-$ (for the short run).

3. Symmetric ARDL Model with Structural Breaks

Under this scenario, we extend the models in equations (2) and (3) to include endogenous structural breaks. The model is specified below:

$$\Delta INQ_t = \alpha_0 + \alpha_1 INQ_{t-1} + \alpha_2 FDI_{t-1} + \alpha_3' X_{t-1} + \sum_{i=1}^{N1} \lambda_i \Delta INQ_{t-i} + \sum_{j=0}^{N2} \gamma_j \Delta FDI_{t-j} + \sum_{j=0}^{N3} \psi_j \Delta' X_{t-j} + \sum_{r=1}^{k} D_r B_{rt} + \varepsilon_t \quad (7)$$

The breaks in equation (7) are captured with the inclusion of $\sum_{r=1}^{k} D_r B_{rt}$ where B_{rt} is a dummy variable for each of the breaks defined as $B_{rt} = 1$ for $t \geq T_{B_r}$, otherwise $B_{rt} = 0$. The time period is represented by t; T_{B_r} are the structural break dates where $r = 1, 2, 3, \ldots, k$ and D_r is the coefficient of the break dummy. While all the other parameters have been previously defined, the study explored the Bai-Perron (2003) test which determines the breaks endogenously. This test is relevant when dealing with models with probable multiple structural changes over time. Apart from computational simplicity, the test allows for up to five (5) breaks in the regression model and is therefore considered a more general framework for detecting multiple structural changes in linear models. We also test for the existence of long run relationship in the presence of structural breaks using the Bounds test. Hence, the results obtained here would be compared with those from equation (2) to see if accounting for breaks in the regression is justified.

Consequently, the Wald test is used to test for the joint significance of structural breaks in equation (7). That is, we test $\sum_{r=1}^{k} D_r = 0$ against $\sum_{r=1}^{k} D_r \neq 0$. The non-rejection of the null hypothesis implies that structural breaks do not matter in the symmetric case while the rejection suggests the adoption of equation 7 (implying that the breaks are important and should be included in the model).

4. Asymmetric ARDL Model with Structural Breaks

Similar to the symmetric case, the identified structural breaks are also captured in the asymmetric case. This involves extending equation (4) to include the relevant break dummies. The general framework is given as:

$$\Delta INQ_t = \alpha_0 + \alpha_1 INQ_{t-1} + \alpha_2 FDI_{t-1}^+ + \alpha_3 FDI_{t-1}^- + \alpha_4' X_{t-1} + \sum_{i=1}^{N1} \lambda_i \Delta INQ_{t-i} + \sum_{j=0}^{N2} \left(\gamma_j^+ \Delta FDI_{t-j}^+ + \gamma_j^- FDI_{t-j}^- \right) + \sum_{j=0}^{N3} \psi_j \Delta X_{t-j} + \sum_{r=1}^{k} D_i B_{it} + \varepsilon_t \quad (8)$$

Again, while all the parameters remain as earlier defined, we also conduct structural break test to ascertain the significance of including the breaks in the NARDL model. In addition, we further verify the presence (or otherwise) of long run relationship [using the Bounds test] and asymmetry [using the Wald test] in the presence of structural breaks.

EMPIRICAL ANALYSIS

As a precondition for most time series analyses, we also subject the dependent and independent series to unit root test. We use efficient unit root tests namely Augmented Dickey-Fuller (ADF), Phillips Perron (PP) and Kwiatkowski, Phillips, Schmidt and Shin (KPSS) stationarity test. We also consider the Bai-Perron (2006) unit root test that accounts for structural breaks. The results are presented in Tables 1 and 2. The ADF stationarity test in Table 1 revealed that the series were found to be stationary at their level except the school enrolment variable which was found to be stationary after the first difference. Similarly, the PP test result showed that the income inequality and the school enrollment variables were found to be stationary after the first difference while all the other variables were found to be stationary at their levels. However, the KPSS test revealed that the variables are all stationary at their levels. The deduction from the unit root test is that the series exhibit different order of integration which indicated the suitability of the ARDL framework for modelling the FDI-income inequality nexus. Nevertheless, we further extend the unit root test in other to account for probable evidence of structure breaks in the series.

The Bai and Perron (2006) unit root test presented in Table 2 revealed that the order of integration is also mixed. The identified break dates however vary across the variables which implied that a standard test is required to determine the break dates when the series are jointly regressed. As a result, the study further employ a multiple regression structural break test by employing the Bai and Perron (2003) approach to determine joint break dates for the series. As shown in Table 2(b), the joint regression breaks dates identify in the context of this study are 1985, 1990 and 2002. Consequently, we take into account the presence of the structural break by employing the ARDL model with structural break and without structural breaks under the symmetric and asymmetric framework.

Table 1: Unit Root without Structural Breaks Test Results

Variable	ADF			PP			KPSS		
	Level	***First Difference***	***I(d)***	***Level***	***1st Diff***	***I(d)***	***Level***	***1st Diff***	***I(d)***
INQ	-2.9686**[a]	-	I(0)	-2.4847[b]	-3.7361***[a]	I(1)	0.1847***[b]	-	I(0)
FDI	-3.6767***[a]	-	I(0)	-3.6469***[a]	-	I(0)	0.1668***[a]	-	I(0)
GFCF	-3.2712**[a]	-	I(0)	-3.4878**[a]	-	I(0)	0.3706***[a]	-	I(0)
SEC	-0.6155[b]	-4.3596***[b]	I(1)	-1.0178[b]	-4.2777***[b]	I(1)	0.1761***[b]	-	I(0)
GDPGR	-4.5381***[a]	-	I(0)	-4.5456***[a]	-	I(0)	0.464459[a]	-	I(0)
POPGR	-6.2304***[a]	-	I(0)	-4.1000***[b]	-	I(0)	0.1252***[b]	-	I(0)

*Note: [a]Indicate a model with constant but without deterministic trend; [b] is the model with constant and deterministic trend as exogenous lags are selected based on Schwarz info criteria. ****, **, * imply that the series is stationary at 1%, 5% and 10% respectively. The null hypothesis for ADF and PP is that an observable time series is not stationary (i.e. has unit root) while that of KPSS tests for the null hypothesis is that the series is stationary.*

Table 2: Unit Root with Structural Break

(a): Perron(2006) structural unit root test results							
	Level			*First Difference*			
Variable	***Break Date***	***Coefficient***	***T-stat.***	***Break Date***	***Coefficient***	***T-stat.***	***I(d)***
INQ	1997	-0.3706	-2.6924	1994	-0.7721**	-4.6133	I(1)
FDI	1987	-0.8391	-5.0239**	-	-	-	I(0)
SEC	2003	-0.5030	-3.9268	1997	-0.6927**	-4.9256	I(1)
GFCF	2008	-0.3574	-4.0886	1993	-1.0360***	-5.8649	I(1)
POPGR	1988	-0.2786	-4.7692**	-	-	-	I(0)
GDPGR	2003	-0.9964	-7.4699***	-	-	-	I(0)

(b): Bai-Perron (2003) Structural break date	
Break Data	**Ranges**
	1980-1984
1985	1985-1989
1990	1990-2001
2002	2002-2016

Note: The Perron (2006) test are determined via appropriate Critical values from Table 1(e) model 2 in Perron (1997), which are -5.28 and -4.6 for 1% and 5% level of significance respectively.

Table 3 presents the estimation results without structural break. The first part of the Table, i.e., Table 3(a) highlights the short-run ARDL and NARDL estimates. The first column highlights the symmetry model (without breaks) while the second column presents the asymmetry results (without breaks). The second part of the Table, i.e., Table 3(b) presents the long-run ARDL and NARDL estimates while the third part, Table 3(c), highlights the asymmetry wald test results. In the ARDL symmetric model of Table 3a, the computed *F*-statistic (Wald test) for the bounds test of 4.58 was found to exceed the lower and upper bounds critical values. Therefore, the null hypothesis of no cointegration is rejected. This implies that income inequality, foreign direct investment, gross domestic fixed capital formation, gross domestic product growth rate and population growth in Nigeria are cointegrated.

In the short run analysis of the symmetric ARDL model, the results suggest that aggregate FDI inflow increases income inequality in Nigeria. There is a positive and significant relationship between FDI and income inequality at the instantaneous level. A 1% increase in FDI inflow increases income inequality by 0.004%. However, FDI inflow in the immediate past period is capable of reducing income inequality significantly in Nigeria. The FDI inflow variable with one year lag difference was negative and statistically significant. A 1% increase in the FDI stock in the immediate past year will reduce income inequality by 0.888%. This implies that there is a lag effect before FDI can reduce income inequality in Nigeria. The inflow of FDI in the current year may not be able to reduce FDI because it could take time for most foreign firms to commence operations given the need to acquire physical assets and employ qualified staff. This findings is in line with the study of Msweli (2015), Celik and Basdas (2010), Herzer and Nunnenkamp (2013), Farhan, Azman-Saini and Law (2014), Mihaylova (2015), Jensen and Rosas (2007), Bhandari (2006).

Table 3: Estimation Results (Without Structural Breaks)

	ARDL Model without Structural Break (Short Run and Long Run)		NARDL Model without Structural Break (Short Run and Long Run)[1]	
Table 3(a): Short Run ARDL and NARDL Estimates				
Variable	**Symmetry Model (without Breaks)**		**Asymmetry Model (without Breaks)**	
	Coefficient	***Std. Error***	***Coefficient***	***Std. Error***
Constant				
ΔFDI_t				
ΔFDI_{t-1}				
ΔFDI^{+}_{t-1}			-0.0115***	0.0039
ΔFDI^{-}_{t}			0.0106***	0.0037
ΔSEC_t	-0.0394***	0.0006	-0.00001	0.0016
$\Delta GFCF_t$	-0.2767***	0.0017	-0.0039**	0.0019
$\Delta POPGR_t$	0.3516***8685pality -FDI Equations in equality ome distribution. ome ther extend the analysis to determine whether accounting for str	0.0769	0.1862**	0.0764
$\Delta GDPGR_t$	0.2221***	0.0005	0.0002	0.0005
ECT	-0.2489**	0.0020	-0.1041	0.0983
$AdjR^2$	0.9634		0.9588	
$JB\ stat.$	0.2750 (0.8715)		0.5837 (0.7469)	
$F-stat.$	83.5824 (0.0000)		60.1719 (0.0000)	
$LM\ test$	1.5385 (0.2379)		1.1275 (0.3457)	
$ARCH\ test$	0.2802 (0.7576)		0.9411 (0.4018)	
Ramsey test	0.0572 (0.9549)		3.4243 (0.0799)	
Bound Test (F-stat.)	4.58**(3.79)		4.28**(3.61)	
Lag Selection (SIC)	(1, 2, 0, 2, 0, 1)		(1, 2, 0, 2, 0, 1)	

Table 3(b): Long-Run ARDL and NARDL Estimation				
Variable	**Symmetry Model**		**Asymmetry Model**	
	Coefficient	***Std. Error***	***Coefficient***	***Std. Error***
FDI_t	0.5144***	0.0227		
FDI_t^+			0.1625	0.1566
FDI_t^-			0.1892	0.1904
SEC_t	-0.0175***	0.0010	0.0201	0.0211
$GFCF_t$	-0.0903***	0.0037	-0.0232	0.0216
$POPGR_t$	0.1563***	0.0374	1.7878	2.0643
$GDPGR_t$	0.1014***	0.0047	0.0016	0.0057
Table 3(c): Asymmetry Wald Test Results				
			Short-Run W_{SR} F-stat. = 3.7184* (0.0681)	
			Long-Run W_{LR} F – stat. = 0.3349 (0.5692)	

*Note: ***, ** and * denotes significance at 1%, 5% and 10% level of significance, while the figures in parenthesis are the probability values. W_{LR} refers to the Wald test of long-run symmetry while W_{SR} denotes the Wald test of the additive short run symmetry condition.*

Nevertheless, the gross fixed capital formation (the proxy for domestic investment) was found to be negative and statistically significant. This implies that the higher the domestic investment, the lower the income inequality in the country. The Kuznets hypothesis that inequality increases with economic growth is confirmed in our analysis. The variable GDP growth has a positive and significant coefficient. Population growth has a positive and significant effect on economic growth. It shows that the higher the population growth, the higher the income inequality in Nigeria. The result further showed that in the short run secondary school enrollment is negative but not statistically significant. The indication is that the current school enrollment is not sufficient to reduce income inequality in Nigeria. It is possible that higher stock of school enrollment is required for income inequality reduction.

The long run estimates for the linear model is presented in Table 3(b). All the variables were found to be statistically significant. For example, the effect of aggregate FDI inflow is positive and statistically significant. This implies that an increase in FDI inflow will increase income inequality in the long run within the symmetric model without structural break. The secondary school enrollment variable is negative and now significant. Perhaps, given the fact that the accumulation of human capital takes some time, the impact is only felt in the long run. Hence, the acquisition of education will only reduce income inequality in the long run. Other variables such as gross fixed capital formation, population growth and GDP growth still retained their level of significance and their expected sign.

The analysis in Column 2 of Table 3a presents the asymmetry model result without structural breaks. In the asymmetric model of Table 3, the computed *F*-statistic (Wald test) for the bounds test (Pesaran et al., 2001) of 4.28 was found to exceed the lower and upper bounds critical values at the 5% level of significance. This indicates the presence of long run relationship among the variables in the presence of asymmetry. The asymmetry model requires the separation of FDI inflows into positive and negative FDI shocks. The short run of estimates of the asymmetry model revealed that positive shocks to FDI inflows into the country with one year lag negatively affect income inequality in Nigeria. This implies that a positive shock to FDI inflow in the immediate past period reduces income inequality in Nigeria. A 1% increase in positive FDI shocks reduces income inequality by 0.011% in Nigeria. This confirmed the result reported under the symmetric ARDL model that the impact of FDI on income inequality has a lag effect.

On the contrary, a negative shock to FDI inflow in the immediate past year was found to be positive and statistically significant. This indicates that negative shocks to FDI inflows in the immediate past year increase income inequality in Nigeria. A 1% increase in negative FDI shocks with one year lag increases income inequality by 0.010%. Although with the expected sign, the short run asymmetry model revealed the statistical insignificance effect of school enrollment in the estimation. The domestic investment (GFCF) and the population growth variable are still significant and retained their sign. It indicates that the higher the domestic investment, the lower the income inequality while the higher the population growth, the higher the income inequality. The GDP growth rate is positive but statistically insignificant. However, all the variables were found to be insignificant in the long run in the asymmetric model (Column 2, Table 3b).

However, while the cointegrating equation captured by error correction term (ECT) exhibits the expected sign in both symmetric and asymmetric models, the potential reversibility of income inequality from previous shocks seem significant mainly in the symmetric model (Columns 1 and 2, Table 3a). For example, the error correction term ECT (-1) in Column 1 of Table 3(a) is negative and statistically significant. The coefficient supported the results of the cointegration tests on the existence of a long-run relationship among the variables. The error correction term is -0.248 which indicates that 24.8% of the previous year's deviation from long-run equilibrium will be restored within one year. The ECT (-1) in Column 2 of Table 3(b) was however found to be insignificant. On the post estimation results, the null hypothesis of serial correlation and heteroscedasticity are consistently rejected for the symmetric and asymmetric models thereby confirming the viability and adequacy of the empirical estimates from both models as efficient and robust for policy inference.

Table 3(c) presents the short and long run Wald test results to determine the significance of asymmetries in the model. From the result in Table 3(c), we could only reject the null hypothesis of no asymmetry in the short run dynamic model (Short Run: W_{SR}) while we accept the null hypothesis of no asymmetry in the long run model (Long Run: W_{LR}). This finding indicates that the impact of

FDI on income inequality under the asymmetric framework is a short run phenomenon. Perhaps, this is one of the reasons behind the insignificance of the long run coefficients of the asymmetry model without structural break.

We further subject the findings to robustness check in the presence of structural breaks in the series. The result is presented in Table 4. The arrangement of the results followed the same order with Table 3. The ARDL symmetric and the NARDL asymmetric models are extended to determine whether the result will hold in the presence of structural breaks. In the ARDL symmetric model of Table 4(a), the computed *F*-statistic (Wald test) for the bounds test at 2.24 was found to be below the lower and upper bounds critical values. Therefore, the null hypothesis of no cointegration is accepted. This implies that the variables are not cointegrated in the presence of ARDL model with structural break.

Column 1 of Table 4a presents the results of the ARDL symmetric model with structural break. The short run estimates revealed that there is a positive and significant relationship between FDI and income inequality in Nigeria. This implies that FDI inflow in the current period increases income inequality in Nigeria. In addition, domestic investment (GFCF) is negative and significant. This supported our earlier findings that domestic investment reduces income inequality. The other control variables in the model also confirmed the earlier reported finding. School enrollment and GDP growth rate were found not to be significant in the model. Nevertheless, the immediate past level of income inequality was found to be a strong determinant of inequality. The long run estimation of the symmetric model with structural break confirmed the result of the symmetric model without structural break. The variables were found to be significant with the expected sign except school enrollment.

In the ARDL asymmetric model of Column 2 in Table 4(a), the computed *F*-statistic (Wald test) for the bounds test of 4.51 was found to exceed the lower and upper bounds critical values at the 5% level of significance. Therefore, the null hypothesis of no cointegration is rejected. This implies that the variables are cointegrated in the presence of structural break. The asymmetry result with structural break is presented in Column 2 of Table 4(a) and revealed the insignificance of the positive and negative FDI variables in the presence of structural break. This result indicates that positive and negative shocks to the FDI do not have any effect on income inequality in the presence of structural breaks. Domestic investment and population growth was found to be significant while GDP growth rate and school enrollment remained insignificant. All the variables were found insignificant in the long run in the asymmetric model with structural break (Table 4b).

The diagnostic and stability tests in Table 4(a) showed that the LM serial correlation test results, ARCH LM heteroscedasticity test results, Normality and Ramsey stability test results consistently reject their respective null hypothesis which confirmed the accuracy of the estimated models in the presence of structural breaks. Although the Bai-Perron (2003) multiple breaks regression test that was employed indicate three break dates of 1985, 1990 and 2002, the Wald restriction test identified the year 1985 as the most significant breaks date in the model. The dummy indicator of the structural break date was found to be statistically significant. Finally in Table 4(c), we reject both the null hypothesis of no asymmetry in the short run dynamic model (Short Run: W_{SR}) and the null hypothesis of no asymmetry in the long run model (Long Run: W_{LR}). This is a strong indication that the presence of structural break has no significance in explaining the asymmetric impact of FDI on income inequality. Rather, the presence of asymmetry is a short run phenomenon with no structural break.

Table 4: Estimation Results (Without Structural Breaks)

	ARDL Model With Structural Break (Short Run and Long Run)		**NARDL Model With Structural Break (Short Run and Long Run)**	
Table 4(a): Short Run ARDL and NARDL Estimation				
Variable	**Symmetry Model (with breaks)**		**Asymmetry Model (with breaks)**	
	Coefficient	***Std. Error***	***Coefficient***	***Std. Error***
Constant	0.3928	0.3831		
ΔINQ_{t-1}	0.2683**	0.1169		
ΔFDI_t	0.0043***	0.0016		
ΔFDI^{+}_{t-1}			-0.0043	0.0028
ΔFDI^{-}_{t}			0.0028	0.0037
ΔSEC_t	-0.0024	0.0014	-0.0020	0.0017
$\Delta GFCF_t$	-0.0048***	0.0016	-0.0039*	0.0020
$\Delta POPGR_t$	0.2983***	0.0934	0.6079**	0.2523
$\Delta GDPGR_t$	-0.0003	0.0005	0.0001	0.0005
$\Delta D1$	-0.0459**	0.0178	-0.0758**	0.0363
ECT	-0.3119***	0.0883	-0.1357**	0.0132
$AdjR^2$	0.9722		0.9682	
JB stat.	0.4817 (0.7860)		1.3850 (0.5003)	
$F-stat.$	85.9479 (0.000)		61.8683 (0.0000)	
LM test	3.1833 (0.0655)		3.0263 (0.0787)	
ARCH test	1.0023(0.3790)		0.1119 (0.8945)	
Ramsey test	0.4416 (0.5144)		2.6702 (0.1218)	
Bound Test (F-stat.)	2.24 (3.79)		4.51**(3.61)	
Lag Selection (SIC)	(2, 0, 1, 2, 0, 1)		(1, 1, 1, 1, 2, 1, 1)	

Table 4(b): Long-Run ARDL and NARDL Estimation				
Variable	Symmetry Model		Asymmetry Model	
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*
FDI_t	0.0139**	0.0056		
FDI_t^+			0.0367	0.0435
FDI_t^-			0.0626	0.0876
SEC_t	0.0013	0.0021	0.0062	0.0102
$GFCF_t$	-0.0104**	0.0043	-0.0088	0.0168
$POPGR_t$	0.9560**	0.3810	2.4214	3.1034
$GDPGR_t$	-0.0043*	0.0021	-0.0076	0.0087
D (1985)	-0.1474**	0.0679	-0.5582	0.8578
Table 4(c): Asymmetry Wald Test Results				
			Short-Run W_{SR} F-stat. = 1.7572 (0.2025)	
			Long-Run W_{LR} F-stat. = 0.2209 (0.5692)	

*Note: ***, ** and * denotes significance at 1%, 5% and 10% level of significance, while the figures in parenthesis are the probability values. W_{LR} refers to the Wald test of long-run symmetry while W_{SR} denotes the Wald test of the additive short run symmetry condition.*

CONCLUSION

This study investigated the effects of inward FDI on income inequality in Nigeria between 1980 and 2016 given the dearth of such studies. We apply ARDL and the nonlinear ARDL methods to investigate the short-run and long-run relationships between FD and income inequality in Nigeria. While past studies in the literature have assumed linearity (symmetric) relationship between income inequality and FDI, the uncertainty that characterizes the movement of FDI means there is likelihood of nonlinearity (asymmetric) in the degree to which FDI can affect income inequality. However, given the possibility of unexpected shifts in the FDI that can lead to huge forecasting errors and unreliability of the model, the symmetric ARDL and the asymmetric NARDL models were estimated with structural breaks and without structural breaks for the short and long run horizon. The Bai and Perron (2003 and 2006) tests which determines breaks endogenously and detects multiple structural changes in linear models were employed.

While the ADF and PP unit root tests revealed that the series are integrated of different order the KPSS test highlighted that the variables are stationary at their levels. The Bai and Perron (2006) also

corroborate the evidence that the order of integration is mixed. The different order of integration confirmed the suitability of the estimation techniques. Nevertheless, the joint regression breaks dates identified the years 1985, 1990 and 2002. Across the models, there is evidence of cointegration among the variables except in the case of the symmetric ARDL model without structural break. In the short run symmetric model, the study established the existence of cointegration among the variables. In the short run symmetric model, the estimates revealed that FDI has the potential to reduce income inequality but the manifestation is only after one year. While income inequality is increasing in the current level of FDI inflow, it is decreasing in the FDI inflow from last year. The long run symmetric ARDL supported the result.

The decomposition of FDI inflow into positive and negative series further corroborated the short run asymmetric model. It showed positive FDI shocks in the immediate past period reduce income inequality while negative FDI shocks increases income inequality. However, the positive and negative FDI inflows were not found to be significant in the long run asymmetric model. In addition, we could we could only reject the null hypothesis of no asymmetry in the short run dynamic model but accepted it for the long run dynamic model which suggested that the relationship between FDI and income inequality is a short run phenomenon. The proof that the current year FDI inflow increases income inequality was supported by the results from the symmetric ARDL in the short run and long run in the presence of structural break.

On the contrary, the asymmetric NARDL model with structural break indicates the insignificance impact of positive and negative FDI shocks on income inequality in the short and long run horizon. The null hypothesis of no asymmetry was accepted for both the short and long run dynamic models. This implied that the presence of structural break has no significance in explaining the asymmetric impact of FDI on income inequality. Rather, it was established that the presence of asymmetry is a short run phenomenon with no structural break. As for the other determinants of income inequality, the analysis revealed in significant terms that inequality increases with population growth and reduces with increased domestic investment across the models with or without structural breaks in the short and long run. There was however inconsistency with respect to the impact of school enrollment and GDP growth on income inequality. The error-correction coefficient, which determines the speed of adjustment, indicates that deviations from long-term inequality are significantly corrected within a reasonable time frame across the models. The model passes the various diagnostic and stability tests.

The implication is that FDI is a tool for changing the distribution of incomes in Nigeria but there is a lag effect. The empirical findings from the study requires policy makers to think of a strategy to reduce inequality while addressing the need to increase market seeking FDI in Nigeria as against resource seeking FDI that employ few hands. In addition, policies that will attract vertical FDI are needed as against the prevalent horizontal FDI. Appropriate government policies to enhance the spread and quality of education, training and infrastructure are also needed to make the continuous FDI inflow to reduce income inequality. For example, improving the level of human capital leads to an increase of the supply of skilled labor which improves the inequality-reducing effect of FDI and enhances the complementarity effect of FDI on the economy. Second, countries should introduce more policies which facilitate domestic investments in high value added activities and foster productivity. The analysis has been carried out at the aggregate level. Future research can address the linkage between FDI and income inequality by disaggregating FDI into services, agriculture and manufacturing. This is necessary to disentangle the effects of FDI components on income inequality. In addition, the microeconomic transmission with respect to firm level evidence should also be considered.

References / Notes

Unrestricted NARDL case allowing for both long- and short-run asymmetry.

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