INEQUALITY, POVERTY AND SUSTAINABLE DEVELOPMENT IN NIGERIA

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Abstract.
This study examined the nexus between inequality, poverty, and sustainable development in Nigeria, emphasizing their implications for policymaking. Despite Nigeria's notable economic growth, persistent income inequality and poverty present formidable obstacles to achieving the Sustainable Development Goals (SDGs). The study utilized annual time-series data from the CBN Statistical Bulletin and the World Bank Development Indicator, spanning 1991 to 2021, and employed the fully modified ordinary least squares (FMOLS) technique. The variables considered include the sustainable development index (SDI), Gini coefficient (GINI), poverty index (POVI), CO2 emissions (GHE), per capita income growth rate (PCGR), and unemployment rate (UNMP). Since income inequality (as measured by the Gini coefficient) and sustainability have a negative correlation, the results imply that higher inequality impedes the achievement of the Sustainable Development Goals (SDGs) in Nigeria. The poverty index demonstrates a positive relationship with sustainable development, though it lacks statistical significance at the conventional 5% level. Moreover, per capita income growth rate, unemployment rate, and CO2 emissions emerge as potential drivers of sustainable development, albeit with nuanced interpretations and environmental sustainability concerns. Finally, the estimated model's unidirectional and bidirectional relationships were validated by Granger causality tests, which show that shifts in the rate of growth of CO2 emissions, per capita income, unemployment rate, poverty index, and income inequality occur before shifts in sustainable development. The study recommends comprehensive policy measures such as progressive taxation and social welfare to mitigate income disparities and foster inclusive, sustainable development. Additionally, policymakers are urged to prioritize inclusive economic growth through infrastructure investment and targeted interventions to address the unexpected link between unemployment and the Sustainable Development Index.

Keywords: Sustainable development, gini coefficient, poverty, CO2 emissions, granger causality.
JEL Codes: C32, E01, G29

1.0 Introduction

Nigeria is a country with immense potential and daunting challenges. Despite significant economic growth in recent years, income inequality in Nigeria remains among the highest globally, with a small elite amassing vast fortunes while the majority languish in poverty (Uduu, 2022). This disparity is not confined to wealth alone but manifests in unequal access to education, healthcare, clean water, and other essential services, perpetuating cycles of deprivation and marginalization. Nigeria has committed to achieving the Sustainable Development Goals (SDGs) through leadership and support from the United Nations (UN) and its partners (SDGs, 2020). However, due to the complex web of socioeconomic inequalities that permeate the country's landscape, the effective implementation of these goals in Nigeria continues to remain elusive. The SDGs are a global call to action to end poverty, protect the earth's environment and climate, and ensure that people everywhere can enjoy peace and prosperity (Ekhator, Miller, & Igbinosa, 2022). Nigeria has a slim chance of attaining Goal 1 of the SDGs (no poverty) as the poverty headcount continues to increase, whether at a $1.90 per day or $3.20 per day poverty threshold (Akinloye, 2018). Besides, the 2022 National Multidimensional Poverty Index (MPI) report assesses poverty across four dimensions: health, education, living standards, and work and shocks. According to the report, Nigeria fared worse than countries like South Africa, Kenya, Ghana, and Egypt. The national MPI for Nigeria is 0.257, indicating that poor people in Nigeria experience just over one-quarter of all possible deprivations. The report, which sampled over 56,000 households across the 36 states of the Federation and the FCT, was conducted between November 2021 and February 2022 and provides multidimensional poverty estimates at the Senatorial District level. The Nigeria MPI (2022) is calculated using 15 indicators grouped under four dimensions: health, education, living standards, and work and shocks (Nigeria MPI report 2022). The full report, which contains further details and insights from the survey, is hosted on the NBS website. The report has policy implications for poverty reduction efforts and is embedded within the Medium-Term National Development Plans (Nigeria MPI Report 2022). The Nigeria MPI is positioned to play a pivotal role in the hands of discerning stakeholders, including policymakers at various levels of government, academia, civil society, and the public.

Statement of Problem:

Nigeria, often referred to as the "Giant of Africa," faces significant challenges related to income inequality and poverty, which have profound implications for the realization of sustainable development goals (SDGs). Despite being the continent's largest economy, Nigeria's annual growth rate has been declining, and poverty remains a pervasive issue. The top 1% of the population in Nigeria has 37 times more income than the bottom 50%, and the country ranks 100th out of 163 countries in terms of wealth inequality (World Bank, 2022). Additionally, 39.1% of its population lives below the income poverty line of US$1.90 a day, despite enormous resources, which is far below other sub-Saharan African countries like Rwanda (60%), Zambia (64.4%), and Mozambique (68.7%) (UNDP, 2018; UNDP, 2016). Economic inequality in Nigeria has reached extreme levels, with significant disparities between the affluent urban Southern Region and the rest of the country. According to Oxfam, between 2004 and 2010, inequality in Nigeria significantly worsened, with the upper class benefiting from an arbitrary tax and the government paying a very low minimum wage, contributing to growing inequality (World Inequality Report, 2022). The World Poverty Clock (2018) reported that 86.9 million people in Nigeria lived on less than $1.90 per day in June 2018, and this number increased to

over 91 million by February 2019 (World Bank, 2022). According to the World Bank, Nigeria's poverty rate rose from 40 percent in 2018 to 46 percent in 2023, with the number of poor people increasing from 79 million to 104 million. The National Bureau of Statistics (NBS) also indicated that 40.1 percent of people in Nigeria were poor based on the 2018–19 national monetary poverty line. The situation is made worse by high unemployment rates; in the fourth quarter of 2020, Nigeria's unemployment rate was 33.3% (Jonathan & Utz, 2023). The data reflect the significant and persistent challenges of poverty and income inequality in Nigeria, which require comprehensive and sustained efforts to address them. Compared to some other African countries, Nigeria has the largest proportion of people living in extreme poverty (86.9 million), while Tanzania, Kenya, South Africa, and Zambia have about 19.9 million, 14.7 million, 13.8 million, and 9.5 million people, respectively, living in extreme poverty (Worldwide Poverty Clock, 2018). The extreme wealth gap in Nigeria perpetuates cycles of poverty and marginalization, posing significant challenges to the achievement of key Sustainable Development Goals (SDGs) such as zero hunger, quality education, decent work, and economic growth (Ighobor, 2018).

The challenges of inequality intersect with other dimensions of disadvantage, including gender, geography, and ethnicity, exacerbating social tensions and undermining social cohesion. In Nigeria, gender inequality is high and widespread across areas of economic opportunity, such as enforcement of legal rights, access to education, health, and financial services, as well as outcomes like labour force participation, entrepreneurship, political representation, and income, further entrenching disparities and perpetuating cycles of poverty (Adeosun & Owolabi, 2021).

Additionally, the World Development Indicators (2013), the Central Bank of Nigeria (2013), and the World Bank (2022) claimed that the level of income inequality astronomically rose from 15.7% in 2010 to 73% and 75% in 2011, 2012, and reduced to 0.41% in 2013. In 2018, income inequality was 37.3% and was reduced to 35.1% in 2019. The Gini Index also decreased by 1.2% between 2021 and 2022 (from 0.494 to 0.488%), respectively. This implies that less than 25% of Nigerians are actually living above poverty indicators in the economy (Aladejana, Alabi, & Bolaji, 2019; Fasoranti & Aladejana, 2019). The effective implementation of sustainable development goals in Nigeria faces formidable obstacles as the benefits of development initiatives accrue unequally, leaving behind those most in need of assistance. Weak governance, corruption, and inadequate infrastructure further complicate efforts to address inequality and poverty, exacerbating the challenges faced by policymakers and stakeholders (Ucha, 2010).

In more recent times, studies like Sala (2014), Cingano (2014), Ogundipe *et al*. (2016), Garza-Rodriguez (2018), Ebunoluwa & Yusuf (2018), McKnight (2019), Osabohien *et al*. (2019), Nwosa and Ehinomen (2020), Dada and Fanowopo (2020), and Aderounmu *et al.* (2021) have shifted interest to examining the opposite relationship: whether poverty is good or bad for growth. However, the discussion often overlooks the underlying causal relationship among the variables. Despite the controversial findings revealed in the review of recent empirical literature, few studies, including Achimugu (2012), Egugbo (2020), Ighodalo (2021), and Utuk (2022), have investigated poverty and sustainable socio-economic development in Africa, particularly the Nigerian experience. These studies not only failed to capture the complexity of the causal relationships among variables but also lacked proper examination of the relationship between poverty and sustainable socio-economic development. Additionally, these studies lacked theoretical support, and econometric analysis was completely missed out. To improve current understanding, a thorough examination of the connection and implications between poverty,

inequality, and the SDGs' implementation in Nigeria is necessary in order to create focused interventions and frameworks for policy that address root causes and encourage inclusive growth. By identifying and understanding the causal links between these variables, policymakers can better address the challenges faced by marginalized communities and implement effective strategies to ensure that no one is left behind in the pursuit of sustainable development.

Objective of the Study

i. To analyse the impact of inequality and poverty on the implementation of sustainable development goals in Nigeria.
ii. ii. examined the causal relationship among the variables in the model.

2.0 Research methods

Theoretical framework.

For a comprehensive understanding of the interplay between inequality, poverty, and sustainable development in Nigeria, the "Capability Approach" stands out as a particularly suitable theoretical framework for this study. The capability approach was developed by Amartya and Nussbaum (1992), as cited in Ndubuka & Rey-Marmonier (2019). It provides a robust normative framework for assessing and addressing human development and well-being.

It focuses on individuals' capabilities to lead lives they value and emphasizes the importance of expanding freedoms and opportunities to achieve valuable functioning. This framework is well-suited for examining the impact of inequality and poverty on the implementation of sustainable development goals in Nigeria because it considers not only material deprivation but also broader dimensions of human flourishing, such as education, health, social inclusion, and political participation. By assessing people's capabilities and freedoms, policymakers and stakeholders can identify the underlying structural factors that limit opportunities for disadvantaged groups and develop targeted interventions to enhance well-being and promote sustainable development. Overall, the capability approach offers a holistic lens through which to analyze the complex dynamics of inequality, poverty, and sustainable development in Nigeria, making it a strong contender for the best theoretical framework for this work. In addition, this study analyzes the impact and causal relationship between inequality, poverty, and sustainable development goals in Nigeria, for the period 1991–2021, using fully modified ordinary least squares (FMOLS) estimation techniques. This will facilitate our ability to induce flexibility by contributing the dynamic significance of the variables for sustainable development in a unified manner for the period of the study. The data used for this study include the sustainable development index, GINI coefficient (a proxy for inequality), poverty index, unemployment rate, and per capita income growth rate based on annual Nigerian country-level data obtained from the CBN statistical bulletin and Fact Sheet of the National Bureau of Statistics (NBS) on various issues.

Model Specification:

$$SDI = f(GINC, POVI, GHE, PCGR, UNMP) \quad \text{.....(i)}$$

$$SDI_I = \beta_0 + \beta_1 GINC_i + \beta_2 POVI_i + \beta_3 GHE_i + \beta_4 PCGR_i + \beta_5 UNMP_i + \mu_i \quad \text{.....(ii)}$$

Where; SDI = sustainable development index, GINC= gini coefficient, POVI= poverty index, GHE= CO2 emissions (kg per 2015 US$ of GDP), PCGR= per capital income growth rate, UNMP= unemployment rate. β_0 = Constant, $\beta_1, \beta_2, \beta_3, \beta_4$ & β_5 = Coefficient The *a-priori* expectation is: $\beta_1 > 0; \beta_2 < 0; \beta_3 > 0; \beta_4 > 0; \beta_5$.

3.0 Presentation and Analysis of Results

Descriptive Statistics

Table 1: Descriptive Statistics

Statistic	SDI	GINI	PVI	GHE	PCGR	UNM
Mean	0.52	0.47	21.54	0.37	10.59	4.13
Median	0.51	0.55	20.90	0.31	10.61	3.90
Std. Dev.	0.04	0.27	9.78	0.15	0.47	0.61
Skewness	0.52	-1.02	0.11	0.34	-0.06	2.08
Kurtosis	1.65	2.45	1.56	1.41	1.37	6.25
Jarque-Bera	3.73	5.74	2.76	3.88	3.44	35.90
Probability	0.16	0.06	0.25	0.15	0.18	0.00
Sum	16.11	14.66	667.60	11.42	328.29	127.87
Sum Sq. Dev.	0.04	2.21	2870.81	0.66	6.59	11.24
Obs.	31	31	31	31	31	31

***Source*:** Researcher's Compilation, (2024).

Table 1 above shows the descriptive statistics of SDI, GINI, PVI, GHE, PCGR, and UNM. From the descriptive statistics result above, the PVI has the highest central value of a discrete set of numbers, followed by PCGR, UNM, SDI, GINI, and GHE. According to the median value, the distribution of PVI is the most skewed, followed by that of PCGR, UNM, GINI, SDI, and GHE. Moreover, findings revealed that PVI has the highest value around the mean, followed by PCGR, UNM, SDI, GINI, and GHE, while the Jarque-Bera test statistics revealed that the residuals of SDI, GINI, PVI, GHE, PCGR, and UNM were normally distributed at the 5% significance level.

Preliminary Test

Test for Correlation

Table 2: Correlation Analysis

	SDI	GINI	PVI	GHE	PCGR	UNM
SDI	1.00					

GINI	-0.01	1.00				
	-0.63	-----				
PVI	-0.33	1.12	1.00			
	-0.94	0.44	-----			
GHE	-0.01	0.01	1.33	1.00		
	-0.86	0.29	0.94	-----		
PCGR	-0.02	-0.05	-4.40	-0.07	1.00	
	0.94	-0.43	-0.99	-0.96	-----	
UNM	0.02	-0.14	-3.03	0.14	0.14	1.00
	0.69	-0.85	-0.52	0.51	0.51	----

***Source*:** Researcher's Compilation, (2024).

From Table 2 above, the correlation coefficient between sustainable development index (SDI) and Gini coefficient (GINI) is approximately -0.01. This suggests a very weak negative correlation between the Sustainable Development Index (SDI) and the Gini coefficient (GINI), which measures income inequality. Also, the correlation coefficient between poverty index (PVI) and GINI is approximately 0.44, indicating a moderately positive correlation between political violence and income inequality. Lastly, the correlation coefficient between per capita income growth rate (PCGR) and CO2 emissions (GHE) is approximately -0.07, suggesting a very weak

negative correlation between per capita income growth rate and CO2 emissions. The correlation analysis suggests potential economic implications, such as a negative relationship between income inequality and sustainable development and positive links between the poverty index and income inequality. These findings can inform policymakers about the interconnectedness of these factors and guide efforts to promote sustainable development and reduce inequality.

Table 3: Results of Unit Root Test

Test at Level					Test at first level difference			
Variable	Test Statistic	5% critical value	Remark	S/NS	Test Statistic	5% critical value	Remark	S/NS
SDI	1.05	-2.96	I(0)	NS	-4.02	-2.96	I(1)	S
GINI	-0.91	-2.96	I (0)	NS	-5.41	-2.96	I(1)	S
PVI	-1.61	-2.96	I (0)	NS	-3.82	-2.96	I(1)	S
GHE	-2.58	-2.98	1(0)	NS	-5.07	-2.96	I(1)	S
PCGR	-0.64	-2.96	1(0)	NS	-7.58	-2.97	I(1)	S
UNM	-0.30	-2.97	1 (0)	NS	-9.19	-2.97	I(1)	S
Where; S indicates Stationary; NS non-Stationary								

Source: *Researcher's Compilation, 2024 from E-view-9*

Table 3 shows the results of the Augmented Dickey Fuller (ADF) test conducted at both the level and first differences. The results indicate that none of the variables were stationary at level 1, meaning they are integrated in order I ((1)). SDI, GINI, PVI, GHE, and PCGR display stationarity (S) at the first difference level, indicating they do not suffer from a unit root problem. This determination is made based on their t-statistics, which surpass the critical values at a significance level of 5% in absolute terms.

Results for Johansen Co-Integration Test

Table 4: Johansen Co-Integration Test

Trace Max-Eingen Statistics				Max-Eingen Statistics			
H_0	**Trace Statistics**	**Critical value at 5% level**	**Prob.**	**H_0**	**Max-Eingen Statistics**	**Critical value at 5% level**	**Prob.**
None*	148.42	95.75	0.00**	None*	61.35	40.08	0.00*
At most 1*	87.07	69.82	0.00**	At most 1	31.35	33.88	0.10
At most 2*	55.72	47.86	0.01**	At most 2	25.6	27.58	0.09
At most 3*	30.12	29.80	0.05**	At most 3	16.86	21.13	0.18
At most 4	13.26	15.50	0.11	At most 4	12.09	14.27	0.11
At most 5	1.18	3.84	0.28	At most 5	1.18	3.84	0.28
*Trace test indicates 4 co-integrating eqn.(s) at the 0.05 level, Max-eigen value test indicates 1 co integrating eqn.(s) at the 0.05 level; denotes rejection of the hypothesis at the 0.05 level ** indicates statistically significant.*							

Source: Researcher's Compilation, (2024).

The co-integration test is reported in Table 4. From the results, the rank trace test indicates rejection of the null hypothesis of no significant cointegration at the 1% level for four co-integrating equations, while the maximum Eigenvalue in the same table 3 indicates significant co-integration equations at the 1% level. The results therefore suggest the existence of a long-run equilibrium relationship between the sustainable development index (SDI) and the independent variables in the model.

Fully Modified Least Squares Result

Table 5: Fully Modified Least Squares (FMOLS) (Dependent Variable: SDI)

Variables	Coefficient	Std. Error	T-statistic	Prob.
C	0.43	0.03	13.02	0.00
GINI	-0.11	0.03	-3.28	0.00**
PVI	0.00	0.00	0.31	0.76
PCGR	2.74	2.46	11.12	0.00**
UNM	0.01	0.00	2.78	0.01**
GHE	0.05	0.02	2.79	0.01**
R-squared 0.99; Adjusted R-squared 0.98; Durbin-Watson stat 1.55				
****** Stationary at 5% level of significant				

***Source*:** Researcher's Compilation, (2024).

Table 5 above shows that the Gini coefficient (GINI) has a negative coefficient of -0.11 and is statistically significant, suggesting that higher levels of income inequality are allied with lower sustainable development (SDI) in Nigeria. The economic implication of the negative coefficient for the Gini coefficient (GINI) suggests that higher income inequality is linked to a lower Sustainable Development Index (SDI). This implies that societies with more unequal income distribution may struggle to achieve sustainable development goals effectively. This is in line with the studies of Rasaki and Olusola, 2021; Angbas, Pam and Eshaleku, 2018; Clementi, Fabiani, and Molin, 2019; Ewuini *et al*., 2015; Alao, 2015; and Dauda, 2021, which arrived at a similar conclusion that a negative relationship exists between the inequality (gini coefficient) and sustainable development. Also, the positive coefficient (0.00) suggests that there is a positive relationship between the Poverty Index (PVI) and the Sustainable Development Index (SDI). However, the statistical tests (t-statistic and p-value) indicate that this relationship is not statistically significant at conventional levels (since the p-value is greater than 0.05). This is in line with the studies of Ounola, *et al.*, 2019; Nwozor, *et al*., 2019; Anigbolgu and Ndubuisi-Okolo, 2019; and Rabiu, *et al.*, 2022 in Nigeria. The discovery of a lack of statistical significance between the Poverty Index (PVI) and the Sustainable Development Index (SDI) implies that factors other than poverty strongly impact sustainable development outcomes. This highlights the insufficiency of solely addressing poverty to foster sustainable development, emphasizing the necessity for a holistic strategy encompassing various economic, social, and environmental elements. Policymakers and stakeholders should acknowledge the intricate nature of sustainable development and prioritize evidence-based interventions addressing multiple dimensions beyond poverty alleviation. In addition, the positive coefficient of the per capita income growth rate (PCGR) variable, at 2.74, suggests that an increase in per capita income growth rate is associated with a higher Sustainable Development Index (SDI). This implies that as the rate of per capita income growth accelerates, it positively impacts the overall level of sustainable development within a society. Furthermore, the unemployment rate (UNM) has a positive coefficient of 0.01, suggesting that higher unemployment rates are associated with higher SDI scores. Higher

SDI scores typically correlate with better standards of living, access to education, healthcare, and overall societal well-being. The positive association with unemployment rates may indicate that in certain contexts, factors such as social safety nets, education, or technological advancement may be mitigating the negative impacts of unemployment on overall development. Moreover, CO2 emission (GHE) also has a positive coefficient of 0.05, indicating that higher levels of CO2 emissions are associated with higher SDI scores. Higher SDI scores typically correlate with better standards of living and overall societal well-being. The positive association with CO2 emissions may suggest that, in some cases, industrialization and economic development contribute positively to overall societal progress. However, this interpretation should be approached with caution, as it may overlook the potential environmental costs and long-term sustainability concerns associated with high levels of CO2 emissions. The adjusted R-squared value of 0.98 suggests that approximately 98.2% of the variation in SDI can be explained by the independent variables in the model. The Durbin-Watson statistic of 1.55 indicates the absence of significant autocorrelation in the model residuals.

Table 6: Pairwise Granger Causality Tests

Null Hypothesis	**Obs**	**F Statistic**	**Prob**	**Granger Causality**
GINI does not Granger Cause SDI	31	5.75	0.02	GINI ⟷ SDI
SDI does not Granger Cause GINI		7.28	0.01	Bi-directional
PVI does not Granger Cause SDI	31	12.93	0.00	PVI ⟷ SDI
SDI does not Granger Cause PVI		16.49	0.00	Bi-directional
GHE does not Granger Cause SDI	31	8.36	0.01	GHE → SDI
SDI does not Granger Cause GHE		0.02	0.88	Uni-directional
PCGR does not Granger Cause SDI	31	17.18	0.00	PCGR ⟷ SDI
SDI does not Granger Cause PCGR		19.97	0.00	Bi-directional
UNM does not Granger Cause SDI	31	4.80	0.04	UNM ⟷ SDI
SDI does not Granger Cause UNM		11.79	0.00	Bi-directional
PVI does not Granger Cause GINI	31	3.29	0.08	PVI → GINI
GINI does not Granger Cause PVI		9.68	0.00	Uni-directional
PCGR does not Granger Cause GINI	31	3.54	0.07	PCGR → GINI
GINI does not Granger Cause PCGR		13.66	0.00	Uni-directional
GHE does not Granger Cause PVI	31	5.29	0.03	GHE ⟷ PVI
PVI does not Granger Cause GHE		4.98	0.03	Bi-directional
UNM does not Granger Cause PVI	31	8.29	0.01	UNM ⟷ PVI
PVI does not Granger Cause UNM		6.29	0.02	Bi-directional
PCGR does not Granger Cause GHE	31	4.36	0.05	PCGR →

GHE does not Granger Cause PCGR		1.46	0.24	GHE Uni-directional
UNM does not Granger Cause GHE GHE does not Granger Cause UNM	31	0.32 0.86	0.57 0.06	UNM ⟶ GHE Uni-directional
UNM does not Granger Cause PCGR PCGR does not Granger Cause UNM	31	5.74 6.68	0.02 0.02	UNM ⟷ PCGR Bi-directional

***Source*:** Researcher's Compilation, (2024).

Table 6 above shows the pairwise Granger causality tests, which indicate the potential causal relationships between the variables examined. Notably, SDI appears to Granger cause GINI, PVI, GHE, PCGR, and UNM, suggesting that changes in SDI precede changes in these variables. Conversely, there is no evidence to support the reverse causality, indicating that GINI, PVI, GHE, PCGR, and UNM do not Granger cause SDI. These findings can inform policymakers about the directionality of causal relationships between socioeconomic indicators and guide the formulation of targeted interventions to promote sustainable development. The economic implication of these Granger causality test results suggests a directional relationship between the Sustainable Development Index (SDI) and certain socioeconomic indicators. Specifically, the findings indicate that changes in SDI precede changes in variables such as income inequality (GINI), poverty index rate (PVI), CO2 emissions (GHE), per capita income growth rate (PCGR), and unemployment rate (UNM). This implies that improvements or deteriorations in sustainable development may drive subsequent changes in these socioeconomic factors. Understanding these causal relationships is crucial for policymakers as it allows for more targeted interventions to enhance sustainable development and address underlying socioeconomic challenges effectively.

4.0 Summary, Conclusion and Policy Recommendations

This study investigates the impact of inequality and poverty on sustainable development in Nigeria during the period 1991–2021. The literature review encompasses conceptual, theoretical, and empirical studies. Secondary data from the CBN Statistical Bulletin (2022) and the World Bank Development Indicator (2023) were utilized for analysis. The study employed Augmented Dickey Fuller (ADF), Johansen co-integration, and Fully Modify Ordinary Least Squares (FMOLS) approaches for data analysis. Descriptive statistics indicated that PVI has the highest central value among the variables, followed by PCGR, UNM, SDI, GINI, and GHE. Additionally, the median value suggests that PVI exhibits the highest skewness, followed by PCGR, UNM, GINI, SDI, and GHE. Furthermore, the analysis indicates that PVI has the highest value around the mean compared to the other variables. Importantly, the Jarque-Bera test statistics demonstrate that the residuals of SDI, GINI, PVI, GHE PCGR, and UNM are normally distributed at a 5% significance level. The FMOLS results indicate the relationship between various factors and the Sustainable Development Index (SDI) in Nigeria. The negative coefficient for the Gini coefficient (GINI) suggests that higher income inequality is associated with lower SDI, highlighting the challenge of achieving sustainable development in societies with unequal income distribution. Conversely, the positive coefficient for the Poverty Index (PVI) implies a positive relationship with SDI, although statistically insignificant, indicating that

addressing poverty alone may not suffice for sustainable development. Additionally, variables such as per capita income growth rate (PCGR), unemployment rate (UNM), and CO2 emissions (GHE) show positive associations with SDI, indicating potential drivers of societal progress, albeit with caveats regarding environmental sustainability and nuanced interpretations. The high adjusted R-squared value suggests a strong explanatory power of the model, while the Durbin-Watson statistic indicates no significant autocorrelation in the model residuals. These findings underscore the complex interplay of socio-economic factors in shaping sustainable development outcomes, urging policymakers to adopt holistic approaches informed by evidence-based interventions. Moreover, pairwise Granger causality tests reveal the directional relationships between variables examined. The findings indicate that Sustainable Development Index (SDI) Granger causes changes in income inequality (GINI), poverty index rate (PVI), CO_2 emissions (GHE), per capita income growth rate (PCGR), and unemployment rate (UNM), suggesting that alterations in SDI precede changes in these indicators. Conversely, there is no evidence of reverse causality, implying that these variables do not Granger cause SDI. These insights provide valuable guidance for policymakers, facilitating targeted interventions to promote sustainable development effectively by understanding the causal dynamics among socioeconomic indicators.

Recommendations

i. Policymakers should include progressive tax policies, social welfare programs, education and skills training investment, fair labour practices, targeted support for vulnerable groups, initiatives to enhance social mobility, and ensuring access to basic services, all aimed at reducing income disparities and fostering inclusive, sustainable development for societal well-being.

ii. The government should foster inclusive economic growth via infrastructure and entrepreneurship investment, implement targeted measures to tackle income disparities, and prioritize sustainable development goals like environmental conservation and renewable energy. These strategies aim to promote both economic prosperity and social equity, leading to enhanced well-being and poverty reduction. Also, the unexpected positive link between unemployment rates and SDI scores calls for nuanced policy responses. Prioritizing investments in social safety nets, job training, education, and healthcare can mitigate unemployment's adverse effects and promote sustainable development.

iii. Finally, policymakers should merge poverty reduction with initiatives in education, healthcare, environmental sustainability, and inclusive economic growth. Investing in human capital, environment, and inclusive economic policies is vital for sustainable development and poverty alleviation. Collaboration among government, civil society, academia, and the private sector is essential for effective evidence-based policies.

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