DETERMINANTS OF ECONOMIC COMPLEXITY IN NIGERIA

https://doi.org/10.47743/jopafl-2024-31-1

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Abstract: The complexity of a country's economy is an important indicator of its level of development and competitiveness in the global economy. Economic complexity has received substantial attention in modern economics as a valuable instrument for analyzing an economic system's production capacity. It entails knowledge quantifying acquired by economic players and expressed in the production process (Hidalgo et al., 2007; Nguyen et al., 2021). Economic complexity explains how diverse and sophisticated an economy is in producing a wide range of goods and services. It measures the knowledge and capabilities of a country's businesses and workers to create various products, reflecting the level of advancement and competitiveness in the global economy. Economic complexity goes beyond typical economic measurements by diving into the productive knowledge contained in an economy, especially through an in-depth examination of the export structure of a country. Therefore, it provides a thorough picture of a country's economic capabilities and prospects for further development.

Introduction

Nigeria, Africa's largest economy, has immense potential and abundant resources. Nonetheless, the country has faced difficulties in reaching long-term economic complexity.

A variety of factors have contributed to this situation, including the country's heavy reliance on oil exports, limited economic diversification, inadequate infrastructure, institutional deficiencies, and a volatile business environment, all of which have hampered the country's progress toward greater economic sophistication. However, one defining features of Nigeria's economic landscape is its heavy reliance on oil exports. In 2020, oil exports accounted for approximately 90% of the nation's total export earnings (World Bank, 2021). This over-dependence on a single commodity renders Nigeria exceptionally vulnerable to unpredictable fluctuations in global oil prices, as evidenced by past volatility, thus endangering economic stability and overall growth.

By and large, the country aspirations for economic diversification have encountered obstacles, primarily stemming from the underdevelopment of its manufacturing sector. Data provided by the United Nations Industrial Development Organization (UNIDO, 2021) underscores the sector's limited contribution to the country's Gross Domestic Product (GDP), revealing the inherent challenges in expanding economic base. This lack of diversification exposes the nation to external shocks and restricts ability to produce a diverse array of goods and services. Furthermore, the development of human capital, a critical factor in achieving economic complexity, faces hurdles in Nigeria. The World Economic Forum's Human Capital Index (WEF, 2020) consistently ranks Nigeria lower compared to other countries in the region. In the 2020 index, Nigeria occupied the 116th position out of 174 countries, indicating significant challenges in education and healthcare. Inadequate investments in these pivotal areas hamper the cultivation of a skilled and innovative workforce, a prerequisite for economic diversification and technological advancement. Also, Global Innovation Index (GIK, 2021) ranked Nigeria 124th out of 131 countries that faces substantial challenges in technological advancement and innovation. This low ranking impedes Nigeria's global competitiveness in knowledge-intensive industries, thereby constraining economic diversification and technological progress. Indeed, income inequality remains deeply entrenched within Nigeria (World Bank, 2019). The Gini Index for the country stood at 35.1% in 2019, underscores significant income disparities within the country. A relatively small segment of the population commands a disproportionate share of the nation's wealth, while a substantial portion of the populace grapples with poverty and limited access to essential services.

Despite the growing body of literature, there remain notable gaps that warrant further exploration. These include measurement challenges related to quantifying economic complexity which is typically based on two related indices: the Economic Complexity Index (ECI) and the Product Complexity Index (PCI). The ECI captures the complexity of a country's export basket, while the PCI measures the complexity of a particular product or industry (Hidalgo & Hausmann, 2009; Hausmann et al., 2014). Although both the ECI and PCI contribute to our understanding of economic complexity, the ECI offers advantages in terms of providing a holistic perspective, enabling cross-country comparisons, serving as an aggregate measure, capturing country-specific factors, and linking to key economic outcomes but PCI can be useful for identifying strategic sectors, understanding global value chains, and informing targeted industrial policies or investment decisions. Therefore, the present study unravel the determinant of economic complexity in Nigeria by employing index of economic complexity (ECI) as against index of product complexity (PCI) to accounting for contextual factors and heterogeneity across countries, examining the dynamics and transition processes that enable countries to move towards more complex economic structures over time, and developing specific policy interventions and strategies to effectively promote economic complexity in different contexts (Mealy & Teytelboym, 2020; Albeaik et al., 2017; Hartmann et al., 2019).

Sequel to the above, literature have identified diverse factors that drives economic complexities and these factors could be classified as domestic and international factors. Subsequently, this study considered numerous essential elements such as gross domestic product per capita (Agosin et al.,2012; Elhiraika & Mbate, 2014), human capital development (Romer, 1990, Tebaldi, 2011), terms of trade (Agosin et al.,2011), institutional quality (Costinot, 2009, Strauss, 2015), foreign direct investment (see Iwamoto & Nabeshima, 2012; Javorcik et al. 2017; Kabaklarlı et al., 2017) and natural resources (Camargo & Gala, 2017) to completely analyze the determinants or drivers of economic complexity or sophistication in Nigeria and equally determine whether it is internal or external or hybrid factors that influences or could influence economic complexity in Nigeria. Inaddition, this study also try to evaluate Nigeria's economic complexity, which provides significant insights into the structure of its economy, the diversity of its productive activities, and its potential for future growth. This metric aid scholars in gaining a full grasp of Nigeria's economic intricacies and assessing its development over time.

The research also provide insight into connection between economic complexity, technical progress, economic development, human development, and income disparity. These links are crucial in determining Nigeria's economic landscape and societal well-being. The analysis of economic complexities in Nigeria holds paramount importance for the nation's development trajectory and global competitiveness. By unraveling the determinants, measuring economic complexity, and exploring the relationships with other vital factors, this study aims to contribute valuable insights that can guide policymakers, stakeholders, and institutions in formulating effective strategies to enhance Nigeria's economic sophistication, reduce income inequality, and foster long-term inclusive growth.

The other part of the study is tailored therein: Section 2 entails brief literature review. Section three focuses on methodological structure. Results are discussed in Section 4. Section five concludes the study.

Literature Review

Economic complexity presents a novel perspective for comprehending crucial societal challenges and issues. The fundamental premise revolves around the notion that economic growth and development, advancements in technology, income inequality, spatial differences, and resilience are the observable results of intricate systemic associations occurring beneath the surface. The economic complexity aims to unravel the association structure and their influence on various socioeconomic stages. Remarkably, evidence to date suggests that economies with higher complexity tend to exhibit lower income inequality level, improve levels of development, and enhanced resilience (Ferraz et al., 2018). Therefore, Erkan & Yildirimci (2015) analyzed the relationship between export competitiveness and the economic complexity index in the context of Turkey's export market. The study utilized data from the Global Competitiveness Report of 2012-2013 and conducted a regression analysis on 110 countries to forecast the indicators of the complexity index. The findings revealed that countries with the highest complexity rankings also exhibited significant development in their human development index.

Using time series analysis, Khan et al (2020) explored the two ways directional causal association allying economic complexity and foreign direct investment (FDI) in China. The research measured economic sophistication level of China using the improved Economic Complexity Index (ECI) spanning 1985 to 2017. The study employed the Auto-regressive Distributed Lag (ARDL) framework to estimate the long-run relationship between the variables. The findings revealed a mutual influence between economic complexity and FDI in the long run. Additionally, economic complexity was found to have a short-run impact on FDI. Manuel, Irving, and Fernando (2021) explored the connection between economic complexity and foreign direct investment (FDI) distribution among Mexican states. Using data from economic censuses conducted by Mexico's National Institute of Statistics and Geography, they found that the economic complexity of a state strongly correlated with its ability to attract FDI. The study also revealed that the complexity of an industry group was a critical determinant of the amount of FDI it received. Evidence of strong local spillover effects of economic complexity among Mexican states was observed, indicating that states with highly complex neighbours experienced increased FDI inflows. Yalta & Yalta (2021) explored the determinants of economic complexity in the MENA region, focusing on human capital's role. Utilizing a system GMM approach and data from 12 countries between 1970 and 2015, they found a positive association between human capital and economic complexity. Natural resource rents had a negative influence, but this adverse effect disappeared when interacting with human capital and democracy. The study highlighted economic complexity's potential in helping countries escape the middle-income trap. However, FDI and terms of trade did not significantly contribute to economic complexity, except for FDI in more democratic regimes. This research provides empirical insights into the drivers of economic complexity in the MENA region, emphasizing human capital's importance in driving economic complexity.

With the average economic growth rate from 1995 to 2010, Zhu & Li (2017) examined the economic complexity impact and human capital on economic growth in 210 countries. The research utilized a method of reflection (MR) to measure economic complexity using cross-country panel data. The findings indicated a positive interaction effect allying complexity and human capital on economic growth. The outcomes revealed a strong connection linking complexity and human capital significantly promotes domestic economic growth, with secondary education and complexity exhibiting a huge connection impact compared to higher education. However, the positive connection linking complexity and human capital on long-run growth was found to be very small. Furthermore, the complexity impact and human capital on growth, particularly over a long term, were found to be sensitive to the revealed comparative advantages (RCA) threshold and the regression sample used. Caous & Huarng (2020) explored the link between Human Development Index (HDI) and Economic Complexity Index (ECI) in emerging economies. Employing hierarchical linear modeling on data from 87 developing countries between 1990 and 2017, with income inequality as a mediating factor, they found that greater economic complexity was associated with higher human development, though this relationship was only partially mediated by income disparity. Sustainable development was also influenced by energy use and gender inequality. However, income inequalities diminished the positive economic complexity impact on human development in developing nations.

Ncanywa, et al (2021) examined linking connection allying economic complexity and income inequality in sub-Saharan African countries, including Nigeria. The study, which uses a panel data set covering eight countries from 1994 to 2017 and employs the ARDL model, reveals that economic complexity is associated with reduced income disparities. This underscores the significance of diversifying and upgrading the productive structure, moving beyond the primary sector, to contribute to narrowing the income gap within countries, including Nigeria. In simpler terms, when countries like Nigeria diversify their economy beyond primary sectors and work towards more complex and varied production, income inequality tends to decrease.

Utilizing data from middle- and high-income economies spanning 1995 to 2010, Mao & An (2021) conduct an empirical analysis employing OLS, fixed-effects, and system GMM methodologies to explore the nexus between the Economic Complexity Index (ECI) and levels of economic development across nations. Their study delves into the determinants shaping ECI, with a spotlight on globalization factors such as participation in global value chains (GVCs) and foreign direct investment (FDI) flows. The research unveils a positive correlation between ECI and per capita GDP, where a unit increase in ECI corresponds to approximately a 30% rise in per capita GDP for middle- and high-income economies. Furthermore, the authors identify key drivers that elevate ECI, including heightened GVC integration, a robust manufacturing sector contribution, robust human capital endowments, increased R&D expenditure, and substantial outward FDI stocks. Notably, for middle-income countries, fostering manufacturing industries that align with their comparative advantages emerges as a crucial strategy for bolstering ECI.

Ajide (2022) investigated how economic complexity affects entrepreneurship in selected African countries, using data from 18 nations spanning 2006-2017. The study utilized panel-spatial correlation consistent estimation, panel quantile regression, and instrumental variables estimation techniques. The findings showed that greater economic complexity positively impacts entrepreneurship in Africa, with no evidence of a nonlinear relationship. This positive influence persisted across all analyzed quantiles. Moreover, the research revealed that ethnic and religious diversity amplified the beneficial effect of African entrepreneurship, while weak political institutions diminished it. These results underscore the importance of productive knowledge, product mix, and exports in driving entrepreneurial activities across African nations.

While various measures of economic complexity have been proposed, such as Economic Complexity Index (ECI) along with Product Complexity Index (PCI), there is ongoing debate about the most appropriate way to quantify and operationalize the concept. The present study attempts to address this gap by employing the Economic Complexity Index (ECI) to measure Nigeria's economic complexity, as the ECI offers advantages in terms of providing a holistic perspective, enabling cross-country comparisons, serving as an aggregate measure, capturing country-specific factors, and linking to key economic outcomes. Also, much attention has been paid to cross-country comparisons of economic complexity levels, there is a need for more research on the dynamics and transition processes that enable countries to move towards more complex economic structures over time. The study contributes to this gap by examining the factors that influence Nigeria's transition towards greater economic complexity over the period from 1990 to 2022. By analyzing the determinants of economic complexity in Nigeria, the study aims to provide valuable insights and recommendations for policymakers to formulate strategic interventions to enhance Nigeria's economic sophistication and foster sustainable development in the long run by employing fully modified ordinary least square and for robustness outcome the canonical cointegration regression is used.

Methodology

The study employs a comprehensive econometric model to capture of effects of various factors on the economic complexity of Nigeria. Following the study conducted by Yalta & Yalta (2021) along with little modification. The baseline model to analyse the determinants of economic complexities in Nigeria is specified as:

$$\mathrm{ECI} = \mathrm{F}(\mathrm{FDI}, \mathrm{GDDPPC}, \mathrm{TECH}\ , \mathrm{NRR}, \mathrm{FDI}, \mathrm{TOT}, \mathrm{INSQ}) \quad (1)$$

In addition, another determinant of economic complexity is technological advancement and institutional quality. Therefore, equation 1 is re-specified as;

$$\mathrm{ECI} = \mathrm{F}(\mathrm{FDI}, \mathrm{GDDPPC}, \mathrm{TECH}, \mathrm{NRR}, \mathrm{TOT}, \mathrm{INSQ}) \quad (2)$$

The econometric model is structured as:

$$\mathrm{ECI} = \beta o\ + \beta_1\mathrm{FDI} + \beta_2\mathrm{GDPPC} + \beta_3\mathrm{TECH} + \beta_4\mathrm{NRR} + \beta_5\mathrm{TOT}\ + \beta_5\mathrm{HDI} + \varepsilon \quad (3)$$

Where: ECI represents Economic Complexity Index, GDPpc represents GDP per Capita, TECH represents Technological Advancement, NRR represents Natural Resource Rent, FDI represents Foreign Direct Investment, TOT represents Terms of Trade. HDI represent human capital development. Also, βo represents the intercept, indicating the baseline level of economic complexity while β_1 to β_6 represent the coefficients of the respective variables, signifying their impact on ECI and ε represents the error term, accounting for unobserved factors influencing ECI not included in the model. Also, Table 1 presents data measurement, description and sources for various variables employed in the study.

Table 1: Measurement, Description and Sources of Data

Variables	Description	Measurement	Sources
ECI	Economic Complexity	Economic Complexity Index	Observatory of Economic Complexity (OEC)
GDPPC	GDP Per Capita	GDP per capita (constant 2015 US$)	World Development Indicators (WDI) of the World Bank
TECH	Technological Advancement	High-technology exports (current US$)	World Development Indicators (WDI) of the World Bank
NRR	Natural Resource Rent	Total natural resources rents (% of GDP)	World Development Indicators (WDI) of the World Bank
FDI	Foreign Direct Investment	Percentage of gross domestic product(GDP)	World Development Indicators (WDI) of the World Bank
TOT	Terms of Trade	Terms of trade adjustment (constant LCU)	World Development Indicators (WDI) of the World Bank
INSQ	Institutional Quality	i. Control of corruption ii. Government effectiveness iii. Political stability iv. Rule of Law v. Regulatory Quality	The Worldwide Governance Indicators& International Country Risk Guide (ICRG)

Sources: Authors Compilation, (2024)

Econometric strategy

To achieved the long run cointegration of the economic complexities and its determinant in Nigeria as presented earlier in equation (3), recent analytical methods namely Canonical Cointegrating Regression (CCR) and Fully Modified Ordinary Least Squares (FMOLS) approach are employed for the period 1990 to 2022. As against ARDL methodology employed by Adegboyega et al (2022a & b); Adegboyega, Odusanya & Popoola (2017); Ahmed, Seikdear & Khatun (2022) and Shahbaz & Rahman (2010) argued that ARDL best analysed long run and short run effects with variables of either I(0) or I(1), as against these two approach of CCR and FMOLS that are designed specifically for estimating cointegrating association between I(1) variables and both are efficient when estimating multiple cointegrating vectors in one step as suggested by Johansen (1991) & Gonzalo (1994). FMOLS and CCR also account for endogeneity between the regressors that is often present in cointegrated association which ARDL does not explicitly control for endogeneity. Inaddition, both methods correct standard errors for serial correlation that is usually found in cointegrated series whereas for ARDL estimates, serial correlation robust standard errors may still be biased. CCR and FMOLS have asymptotic optimality properties in estimating the cointegrating vectors that ARDL does not share. However, FMOLS and CCR estimates of the long-run parameters are super consistent even in small samples.

Results and discussion

Table 2: Summary of descriptive statistics

	Mean	Median	Max.	Min.	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.
ECI	-1.611	-1.665	-1.3177	-1.828	0.157	0.605	2.113	1.407	0.494
FDI	4.59E+	3.45E	8.84E+	7.75E+	2.62E+	0.393	1.802	1.283	0.526
GDPpc	2477.25	2490.21	2679.5	2170.05	134.655	-0.574	3.25	0.864	0.649
HDI	9.356	9.399	10.127	8.356	0.647	-0.155	1.53	1.409	0.494
INSQ	6295.04	6322.72	6834.362	5607.505	449.37	-0.144	1.522	1.416	0.49243
NRR	10.343	9.798	17.590	4.554	4.242	0.341	2.162	0.729	0.694
TECH	1.15E+08	854246	4.95E+08	7388348	1.19E+08	2.278	8.017	28.712	1E-06
TOT	-7.48E+	-6.00E	4.98E+	-1.60E	6.44E+	0.296	1.954	0.902	0.636

Source: Authors Compilation, (2024)

Where: ECI represents the Economic Complexity Index, GDPPC represents GDP per Capita, TECH represents Technological Advancement, NRR represents Natural Resource Rent, FDI represents Foreign Direct Investment, TOT represents Terms of Trade. HDI represent human capital development and INSQ stands for institutional quality

The descriptive statistics presented in Table 2 shows that ECI (Economic Complexity Index) has a mean of -1.611 indicates a relatively low level of economic complexity on average with standard deviation of 0.157 that shows moderate variation in ECI values over time. FDI (Foreign Direct Investment) reveals a very high mean of 459,000 but also extremely high standard deviation of 2,620,000, indicating very volatile FDI inflows. GDP per capita average value of 2,477, with low standard deviation of 134, suggesting relatively stable income levels. Also, HDI (Human Development Index) averaging 9.36 out of 10, with low standard deviation of 0.647, implies fairly high and stable human development whereas INSQ (Institutional Quality) having mean value of 6295, with moderate standard deviation of 449. TECH (Technological Advancement) and TOT (Terms of Trade) having an extreme high mean value of 115, with and standard deviation of 119 million and 748,000 but extremely high standard deviation of 6.44 billion respectively. The Maximum/Minimum estimates show the highest and lowest values for each variable over the period. For instance, ECI ranges from -1.828 to -1.317, while FDI had a maximum value of 8.84 billion.

NRR (Natural Resource Rents) slightly positively skewed at 0.341, leaning towards higher resource dependence. Tech highly positively skewed at 2.278, with extreme positive values. However, TOT and INSQ both have an approximately symmetric distribution but HDI and GDPpc both also have negative skewness of -0.154 and -0.574 respectively

Above all, the summary stats show economic complexity was relatively low on average, with high volatility in FDI, tech advancement and trade patterns. Income, human development and institutions were relatively stable. Distributions were broadly symmetric except for tech which had extreme positive values.

Table 3: Correlation analysis

	ECI	FDI	GDPpc	HDI	INSQ	NRR	TECH	TOT
ECI	1.000							
FDI	-0.042	1.000						
GDPpc	0.581	-0.489	1.000					
HDI	0.044	-0.897	0.34	1.000				
INSQ	0.041	-0.897	0.337	0.799	1.000			
NRR	-0.447	0.741	-0.531	-0.668	-0.667	1.000		
TECH	0.316	-0.119	0.342	0.178	0.176	-0.124	1.000	
TOT	-0.096	0.852	-0.589	-0.821	-0.821	0.734	-0.051	1.000

Source: Authors Compilation, (2024)

Where: ECI represents the Economic Complexity Index, GDPPC represents GDP per Capita, TECH represents Technological Advancement, NRR represents Natural Resource Rent, FDI represents Foreign Direct Investment, TOT represents Terms of Trade. HDI represent human capital development and INSQ stands for institutional quality

The correlation matrix in Table 3 reveals that ECI (Economic Complexity Index) has a moderate positive correlation with GDP per capita (0.581) and technological advancement (0.316), suggesting higher economic complexity is associated with higher income levels and more technological progress but has a moderate negative correlation with natural resource rents (-0.447), indicating higher dependence on natural resources is linked to lower economic complexity. Also, has very low or near-zero correlations with FDI, human capital (HDI), institutional quality and terms of trade. However, FDI (Foreign Direct Investment) has a high negative correlation with GDP per capita (-0.489), HDI (-0.897) and institutional quality (-0.897), suggesting FDI inflows are higher when income levels, human capital and institutions are weaker, but has a high positive correlation with natural resource rents (0.741) and terms of trade (0.852), implying FDI is attracted to countries with abundant natural resources and favorable trade dynamics

Furthermore, GDP per capita has a moderate positive correlation with technological advancement (0.342) as expected, as well as having moderate negative correlations with natural resource rents (-0.531) and terms of trade (-0.589). As institutional quality and human capital are highly positively correlated (0.799), natural resource rents have a high negative correlation with human capital (-0.668) and institutions (-0.667) as well as Terms of trade has a high negative correlation with human capital (-0.821) and institutions (-0.821). Summarily, the correlation matrix shows the expected relationships allying economic complexity and factors like income, technology, human capital and institutional quality. It also highlights the linkages between FDI, natural resources and trade patterns and essentially do not have the problems of autocorrelation, if all the variables are estimated.

Table 4: Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1140.75	NA	8.37E+64	163.678	163.906	163.657
1	-1093.16	54.3872*	4.46e+63*	160.451*	161.820*	160.324*
* imply lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Table 4 shows the results of lag order selection criteria for the variables used in the analysis. It helps determine the optimal number of lags to include in the econometric model. The table presents several information criteria values (LR, FPE, AIC, SC, HQ) for different lag lengths from 0 (no lags) up to 1 lag. The idea was to select the lag length that lessen these information criteria.

In view of all the five criteria examined, length of optimal lag chosen for the econometric model estimating determinants of economic complexity is 1 lag. These criteria assist to capture dynamics and remove serial correlation in the errors as few lags can lead to specification errors, while too many lags reduce estimation efficiency.

Table 5: Augmented Dickey-Fuller unit root test

Variables	At Level	1st Difference	Integration Order
ECI	-2.4040	-4.7712**	I(1)
FDI	-1.6780	-5.3707**	I(1)
GDPpc	-2.4710	-3.6499**	I(1)
HDI	-1.3478	-3.2969 **	I(1)
INSQ	-1.2990	-3.2749**	I(1)
NRR	-2.0644	-6.8908**	I(1)
TECH	-3.4729	-5.0837**	I(1)
TOT	-0.8156	-4.5966**	I(1)

Source: Authors Compilation, (2024)

Where: ECI represents the Economic Complexity Index, GDPPC represents GDP per Capita, TECH represents Technological Advancement, NRR represents Natural Resource Rent, FDI represents Foreign

Direct Investment, TOT represents Terms of Trade. HDI represent human capital development and INSQ stands for institutional quality

Test critical values:	1% level	-3.752946
	5% level	-2.998064
	10% level	-2.638752

Table 5 presents the results of the Augmented Dickey-Fuller unit root (ADF) test, which is used to measure if the variables are stationary or have a unit root (non-stationary) plight. The void hypothesis of the ADF test is that the variable has a unit root (is non-stationary). The test statistics are compared against the critical values at 1%, 5%, and 10% significance levels but for this study critical value at 5% significance level is used. Based on the estimates presented in Table 4, all variables used were non-stationary at levels but become stationary succeding first difference, i.e., they are integrated of order 1, I(1). This justifies using cointegration techniques like FMOLS and CCR which are designed for variables integrated of the same order.

Empirical results

Table 6: Estimate of the determinant of economic complexities in Nigeria

Variable	Model 1				Model 2			
	FMOLS		CCR		FMOLS		CCR	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Constant	8.610	7.549**	-6.396	-4.817**	-9.405	-6.344**	-4.268	-1.403
FDI	0.172	4.996**	0.003	1.029	0.176	4.831**	-0.002	3.806**
GDPPC	0.001	6.639**	0.001	4.095**	0.001	5.980**	0.001	3.806**
HDI	0.128	2.951**	0.202	2.361**	2.007	0.699	-7.699	-1.347
NRR	-0.023	-5.386**	-0.028	-3.904**	-0.022	-4.804**	-0.030	-4.052**
TECH	-5.94E-11	-0.504	-4.39E-10	-1.033	-7.08E-11	-0.550	-0.005	-1.989***
TOT	0.012	3.343**	3.41E-14	2.256**	1.58E-14	2.933**	0.050	2.701**
INSQ					-0.002	-0.652	0.011	1.386
R-Squared	0.801		0.642		0.810		0.506	
Adjusted R-Squared	0.632		0.336		0.589		0.423	

Source: Authors Compilation (2024)

Note: * $P < 0.01$, ** $P < 0.05$ & *** $P < 0.10$ respectively

Where: ECI represents the Economic Complexity Index, GDPPC represents GDP per Capita, TECH represents Technological Advancement, NRR represents Natural Resource Rent, FDI represents Foreign Direct Investment, TOT represents Terms of Trade. HDI represent human capital development and INSQ stands for institutional quality

Table 6 presents the estimated outcome on the direct and indirect behaviour of economic complexities in Nigeria between 1998 to 2022 while the R-squared value for all the models estimated shows that 80.1%; 64.2 %; 81% and 50.6% respectively of total variation in the economic complexities index (ECI) is being explained by the expository variables. This suggests that the R-squared values indicate that the models explain 80-81% of variation in

ECI using FMOLS and 50-64% using CCR. Likewise, the Adjusted R-squared value of 63.2%; 33.6%; 58.9% and 42.3% respectively, which suggests that the variability in the dependent variable is explained while penalizing for inclusion of additional variables.

Furthermore, Table 6 presents the estimates of the determinants of economic complexity in Nigeria using two different econometric techniques - Fully Modified Ordinary Least Squares (FMOLS) as well as Canonical Cointegrating Regression (CCR). Table 6 shows results for two model specifications. Model 1 using FMOLS estimates shows that FDI, GDP per capita, HDI, and terms of trade (TOT) have a statistically significant positive impact on economic complexity (ECI), suggesting that a unit rise in these variables would result to equal rise in ECI by 0.172; 0.001; 0.128 and 0.012 respectively whereas natural resource rents (NRR) have a negative coefficient of 0.023 effect on ECI and were found statistically significant at 5 percent significance level. Similarly, estimate emanating from CCR, FDI, GDP per capita, HDI, NRR and TOT are significant determinants with the same sign as reported for FMOLS.

In another instances for which institutional quality was included in the model (Model 2). The estimates emanating from the use of FMOLS estimates shows the coefficients of FDI, GDP per capita, NRR and TOT remain significant with a positive association with economic complexities in Nigeria. But when CCR estimates also reveals that FDI, GDP per capita, NRR and TOT remain significant determinants of economic complexities in Nigeria while TECH has a significant negative coefficient and were found statistically significant at 5% significance level.

Summarily, focusing on the FMOLS estimates, several variables emerge as significant determinants of economic complexity in Nigeria. Foreign direct investment (FDI), GDP per capita, human capital development (HDI), and terms of trade (TOT) exhibit a direct and statistically significant impact on ECI in both models at 5 percent significance level. This suggests that higher inflows of FDI, greater income levels, improved human capital, and more favorable trade conditions contribute to enhancing the complexity and sophistication of Nigeria's economy. The submission is in support of the findings conducted by Mao & An (2021); Ajide (2021); Yalta & Yalta (2021)

In contrast, natural resource rents (NRR) display a negative and significant coefficient across both models, implying that an over-reliance on natural resource extraction hinders the development of economic complexity. This finsubmission corroborate the study conducted by Yalta & Yalta (2021). Interestingly, while technological advancement (TECH) has an insignificant negative coefficient in Model 1, it becomes insignificant in Model 2 when institutional quality is included. The role of institutions, proxied by INSQ, appears to be statistically insignificant in the FMOLS estimation.

The CCR estimates broadly reinforce the findings from FMOLS, with some minor variations in the significance of certain variables. Notably, TECH emerges as a significant negative determinant of ECI in the CCR estimation of Model 2, suggesting that technological progress may have an adverse impact on economic complexity when institutional factors are accounted for. Overall, the results highlight the complex interplay between various factors, such as FDI, income levels, human capital, trade patterns, natural resource dependence, technology, and institutions, in shaping Nigeria's economic complexity landscape.

By and large, FDI, higher income levels, human capital development, and trade openness are crucial drivers of economic complexity and diversification in Nigeria. This highlights the importance of creating an enabling environment to attract more FDI inflows, boosting income growth, investing in education and skills development, and promoting export diversification. The negative impact of natural resource rents (NRR) on economic complexity underscores the pitfalls of over-reliance on natural resource extraction, which can hinder the development of a more diverse and sophisticated economic structure. This is commonly referred to as the "resource curse" phenomenon. The ambiguous role of technological advancement (TECH) and institutional quality (INSQ) in fostering economic complexity suggests that these factors may not be optimally leveraged or complemented by other supportive policies in the Nigerian context.

Table 7: Post estimation test outcomes

Tests	Statistics Value	Probability
Normality Test	2.015	0.365
Ramsey RESET Test	0.445	0.671
Heteroskedaticity Test: Breusch-Pagan-Godfrey	0.598	0.743
Breusch-Godfrey Serial Correlation LM Test	2.804	0.152
Heteroskedaticity Test: ARCH	0.002	0.959

Source: Authors Compilation (2024)

Moreover, to actually ascertain the validity, reliability and robustness of the econometric model used to investigate economic complexity determinants in Nigeria, various post estimation tests were conducted and result presented in Table 7, figures 1 and 2 respectively. From Table 7 both tests shows that all were free from estimation problem since the probability figures were greater than 5 percent (i.e. $p > 0.05$). Specifically, serial correlation, heteroskedasticity amongst other as stated in Table 7 are free of either specification problems or non-connecting, residual free of heteroskedasticity and normally distributed problem since the p-values for all tests are greater than 0.05 ($p > 0.05$).
Furthermore, Figure 1 and Figure 2 show the plots of the CUSUM (Cumulative Sum of Recursive Residuals) and CUSUM of Squares tests, respectively. These tests are used to assess the stability of the coefficients in a regression model over the sample period. The CUSUM plot tests for parameter stability by plotting recursive residuals cumulative sum against a straight line with a zero mean. If the plotted CUSUM falls within the two critical lines (5% significance level), it indicates that the stability of the model coefficients over sample period and there is no evidence of structural breaks or parameter instability.

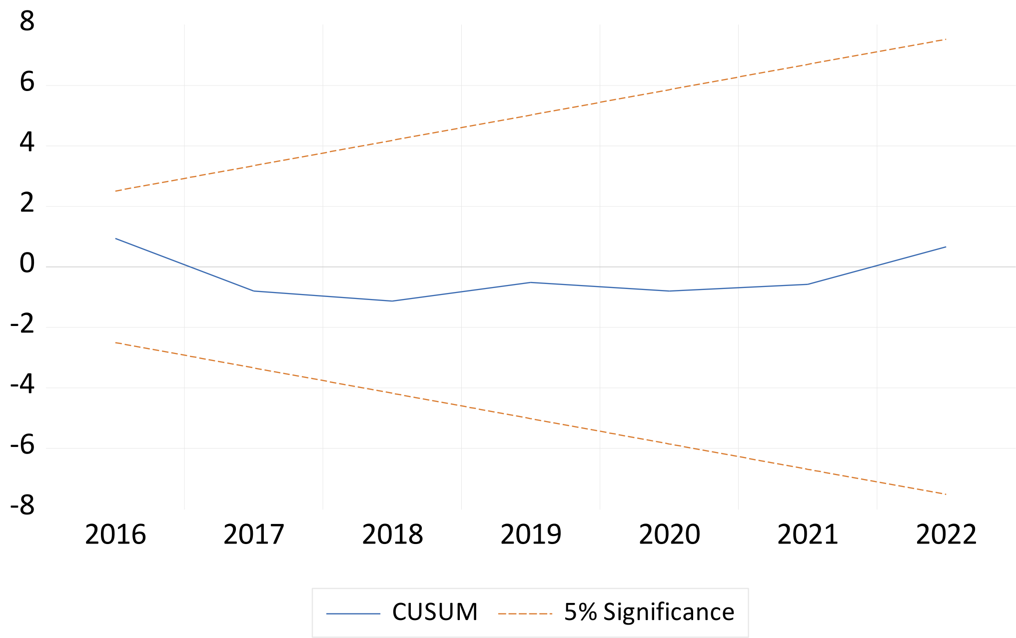

Figure 1: Plot of Cusum
Source: Authors Compilation (2024)

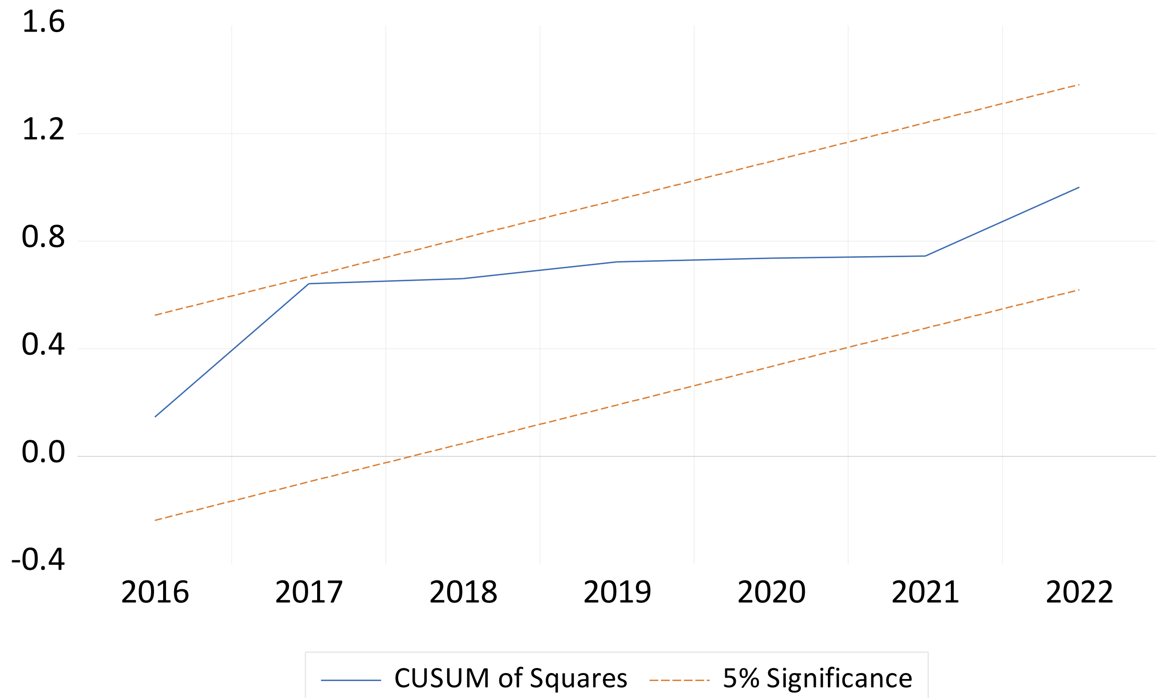

Figure 2: Plot of Cusum of Squares
Source: Authors Compilation (2024)

Also, the CUSUM of Squares plot tests for sudden changes in the coefficients of the regression model. Like the CUSUM plot, if the line representing the CUSUM of Squares falls within the two critical lines suggests that the coefficients are stable over the sample period, and further confirming the stability of the estimated model coefficients.

Overall, both the CUSUM and CUSUM of Squares plots indicate the model estimated coefficients for the determinants of economic complexity in Nigeria are stable over the sample period from 1990 to 2022. This stability in the coefficients suggests model is correctly specified and the relationships allying economic complexity and its determinants (FDI, GDP per capita, human capital, natural resource rents, trade openness, and institutional quality) are consistent and reliable over time.

Summary of findings and Policy recommendation

Economic complexity as discussed in the literature matters because it is seen as a key driver of economic growth and development. Countries with greater complexity in their economic activities tend to have higher income levels, faster economic growth, and greater prospects for further development. Hence the current study examines the determinants of economic complexities in Nigeria and established whether or either both direct and indirect factors matters for economic complexities while data spanning from 1990 to 2022 was put to use and achieve using two advanced analytical tools as guide by the augmented unit root test. The two analytical tools are fully modified ordinary least squares and canonical cointegration regression model and data were equally sourced from reliable sources such as WDI, ICRG, WGI among others.

The findings from the present study reveals that FDI, GDP per capita, human capital development (HDI), and trade openness (TOT) have a positive and significant impact on economic complexity in Nigeria. Also, natural resource rents (NRR) have a negative and significant effect on economic complexity, highlighting the "resource curse" phenomenon, but the roles of technological advancement (TECH) and institutional quality (INSQ) appear ambiguous or insignificant in driving economic complexity, Therefore, the outcome underscore the complex interplay between various domestic and international factors shaping Nigeria's economic complexity landscape.

Sequel to the findings, the study unravels the intricate association between economic complexity and a multitude of factors, including FDI, income levels, human capital, trade patterns, natural resource dependence, technology, and institutions. The findings provide valuable insights into the drivers and impediments to Nigeria's quest for greater economic sophistication and diversification. While factors like FDI, income growth, human capital development, and trade openness emerge as crucial catalysts, overdependence on natural resources poses a significant challenge. The roles of technological progress and institutional quality remain ambiguous, suggesting a need for complementary policies to harness their potential fully.

In view of the above submission, the government and policy make are implore to implement policies to attract more FDI inflows, particularly in non-resource sectors, by improving the business environment, strengthening regulatory frameworks, and developing infrastructure. This can help diversify the economy and enhance its complexity. Also, to invest heavily in human capital development through education reforms, vocational training programs, and initiatives to improve healthcare and nutrition. A skilled and healthy workforce is essential for building economic complexity and transitioning towards more knowledge-intensive industries. Inaddition, government should pursue export diversification strategies by identifying and supporting potential growth sectors with comparative advantages. This can involve targeted incentives, access to finance, and infrastructure development for promising industries. Moreover, gradually reduce the economy's dependence on natural resource extraction by reinvesting resource revenues into productive sectors, fostering entrepreneurship, and developing downstream industries. This can mitigate the inverse impact of resource dependence on economic complexity.

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