Transforming Africa's Productive Economy: Case Studies of Three Selected African Countries

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ABSTRACT

Economic transformation refers to the process of changing the structure and composition of an economy. Africa's economic transformation is essential for sustainable development and global competitiveness. This study investigates the productive economy of three selected African countries, highlighting key strategies, challenges, and policy interventions that have influenced their economic progress. The study employs secondary data on the gross domestic product (GDP) of each country (proxy for economic transformation) as dependent variable while using industrialization, technological advancement, and human capital development as independent variables. The study employed panel data analysis and comparative analysis approach. The research identifies best practices and lessons learned in fostering industrialization, technological advancement, and human capital development. The findings underscore the importance of innovation, infrastructure, and policy coherence in driving Africa's economic transformation.

Keywords: Gross domestic product (GDP), economic transformation, industrialization, technological advancement, and human capital development.

JEL Classification: 01,02,05,014,055

INTRODUCTION

Background to the study

A productive economy is typically defined as an economic system that efficiently utilizes its resources—such as labor, capital, land, and technology—to generate goods and services at a high output level relative to input. Productivity, in this context, generally refers to economic productivity, particularly labor productivity and total factor productivity, which are key indicators of how effectively an economy transforms inputs into outputs. A productive economy is one that uses its resources efficiently to maximize output and improve the well-being of its population, typically measured by indicators such as GDP per capita, labor productivity, and total factor productivity." (OECD, 2021). According to Krugman (1994) "Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker." Solow (1957) introduced the concept of total factor productivity (TFP) as a measure of an economy's long-run productivity performance beyond capital and labor inputs. In 2025,

Statement of the problem

Africa's real growth is projected at 4.0%, outpacing Latin America and the Caribbean (2.5%) and close behind developing Asia (4.8%). And yet the continent's economic growth continues to generate too few quality jobs, for the growth does not translate into sufficient productivity gains (AUC/OECD, 2019); AUC/OECD, 2018). Skill gaps are one central reason. Partly because of shortages in skilled labour – notably in sectors such as agrifood and renewable energies –private investment remains below the continent's potential (AUC/OECD, 2023). Africa

has a higher share of informal employment than any other world region, as a result of slow productive transformation; an estimated 82% of all the continent's workers are in informal employment, compared to 56% in Latin America and the Caribbean and 73% in developing Asia. In South Africa, a country with a low share of informality, 76% of employers report difficulty finding the talent they need. Skilled workers are necessary to strengthen Africa's fledgling productive transformation and to deliver quality jobs at scale. Workers lack the specific skill sets required for existing jobs (limited supply), while not enough quality jobs are available to further build their skills (limited demand). In a survey of six African countries, many secondary school graduates did not meet employers' expectations in terms of technical skills (almost 50%), digital, business and managerial skills (25%) and soft skills (10-40%) (ACET, 2022). In Ghana, about 14% of surveyed companies reported recruiting employees with digital skills internationally, because they could not find skilled local talent. Over 80% of African youth in school aspire to work in high-skilled occupations, but only 8% find such jobs (OECD, 2017).

Having identified various transformational potentials and problems in African countries, this study therefore attempts to investigate the productive economy of three selected African countries, highlighting key strategies, challenges, and policy interventions that have influenced their economic progress. The study employs secondary data on the gross domestic product (GDP) of each country (proxy for economic transformation) as dependent variable while using Manufacturing value added (proxy for industrialization), ICT Index (proxy for technological advancement), and Human capital index (proxy for human capital development) as independent variables.

Objectives of the study

The broad objective of this study is to investigate the productive economic transformational process and strategies of the three selected African countries. Specifically, the study:

examine the effect of industrialization on productive economic transformation of the three selected African countries; ii. determine the relationship between technological advancement and productive economic transformation of the three selected African countries; and evaluate the impacts of human capital development on productive economic transformation of the three selected African countries.

Research questions

i. How does industrialization affect productive economic transformation in the three selected African countries?

ii. What is the relationship between technological advancement and productive economic transformation in the three selected African countries?

iii. To what extent does human capital development impacts productive economic transformation in the three selected African countries?

Statement of hypotheses:

Ho (1): Industrialization has no significant effect on productive economic transformation in the three selected African countries

Ho (2): There is no relationship between technological advancement and productive economic transformation in the three selected African countries

Ho (3): Human capital development has no significant impacts on productive economic transformation in the three selected African countries.

Scope of the study

This study examines economic transformation of the three selected countries: Nigeria, Rwanda, and South Africa through the identified economy transformation variables from 1990 to 2024.

Significance of the study

This study will be useful for the decisions and policies makers so as to serve as a guide for their countries' economies transformation. In addition, the output of this study shall contribute immensely to the body of knowledge in economics, finance and public management.

LITERATURE REVIEW

Conceptual review

Industrialisation

Induistrialisation has stood for the rapid transformation of the manufacturing sector compared to other economic sectors. It lies at the heart of structural change and the accompanying economic growth and development (World Bank, 2021). The empirical evidence shows that countries whose manufacturing sectors grow the fastest among all sectors can industrialise and boost their incomes. Several explanations exist for the linkages between industrialisation and economic growth. According to conventional structural change theory, industrialisation is commonly associated with redistributing capital and labour from low to high-productivity sectors, given the right technology (Rodrik, 2013). As labour and other resources shift from agriculture to advanced industries, employment and overall productivity rise. As a result, industrialisation has unparalleled connections to other sectors.

Manufacturing value added (MVA)

Manufacturing value added (MVA) generally has a positive effect on economic growth. Studies suggest that increased manufacturing output can lead to higher GDP growth through increased demand for manufactured goods, investments, and exports. However, the relationship can be complex and influenced by various factors, including the specific context of the country or region. The idea that Africa should industrialize is not new. The continent's post-independence leaders—like those in many developing countries in the 1960s and 1970s—looked to state-led, import-substituting industrialization as the key to rapid economic growth. Though African manufacturing grew in the immediate post-independence period, largely shaped by state-led and protectionist policies, by the mid- 1980s, a series of external shocks—including oil price increases, commodity price decreases, real interest rate rises, withering public coffers, and the limitations of domestic markets— were major factors in industrial decline in the region (Signe,2018).

Gross domestic product

Gross Domestic Product (GDP) and industrialisation are closely linked in economic development. GDP represents the total value of goods and services produced in a country over a specific period. Industrialisation is the process through which an economy transforms from primarily agricultural to one based on manufacturing and industry (Todaro and Smith, 2020). As GDP increases, it often reflects higher national income, which can lead to more savings and investment. Higher GDP provides the government with more revenue through taxes. This allows for increased public investment in roads, power supply, water, and transport systems—essential for industrial growth. (UNIDO, 2022).

Technological advancement

Technological advancement refers to the process of developing new and improved technologies or the refinement of existing ones, leading to increased efficiency, productivity, and capabilities across various fields. This advancement is a continuous cycle of innovation, improvement, and integration of new tools, techniques, and systems. It plays a crucial role in societal and economic development by enhancing infrastructure, communication, and overall quality of life. Technology can be a source of tremendous optimism. It can help overcome some of the greatest challenges our society faces, including climate change, famine, and disease. For those who believe in the power of innovation and the promise of creative destruction to advance economic development and lead to better quality of life, technology is a vital economic driver (Schumpeter,1942).

High technology exports

High-technology exports refer to products that are heavily based on research and development (R&D) and involve advanced scientific and engineering knowledge. These exports are typically innovative, complex, and often drive industrial and economic competitiveness on a global scale. Major characteristics of high-technology exports include: require significant investment in R&D incorporate advanced technologies (e.g., AI, biotech, electronics); often protected by patents or intellectual property rights; require highly skilled labor to produce and manage; and have high value-to-weight ratio, making them valuable in trade. (World Bank, 2020).

Human capital development

Human capital refers to the knowledge, skills, abilities, and attributes acquired by individuals through education, training, and experience. It represents the productive capacity and potential of individuals in the labor force. Human capital is an intangible form of capital that is distinct from physical capital (e.g., machinery, buildings) but plays a crucial role in economic development and growth. In Ghana and Tanzania, on-the-job management training using the Kaizen approach, which enhances firm-level productivity by gradually applying tools such as production management and quality control, had substantial benefits. The two countries increased the value added of small businesses in a garment production cluster by 50% and raised the resilience of small firms in the metal industry by 20% (ILO, 2018).

Human Development Index

The Human Development Index (HDI) is a composite index developed by the United Nations Development Programme (UNDP) to measure and rank countries' levels of social and economic development. Human development index ranges from 0 to 1. The value 0.000 – 0.549 indicates low human development, while 0.550 – 0.699 indicates medium human development, 0.7000-0.799 indicates high human development and finally, 0.800-1.000 indicates very high human development. (UNDP, 2024).

Theoretical review

Kaldor Growth Theory

Nicholas Kaldor's paper was published in 1966, on the reasons for the United Kingdom's poor economic progress in that particular period Kaldor carried out a structural, empirical and comparative study, concentrating on the part the manufacturing sector plays roles in economic development (Kaldor, 1966). This 1966 paper of Kaldor came to be an important reference as it contains the basis of the hypothetical formulation which was later acknowledged as Kaldor's growth laws. Kaldor's growth laws acclaim vital significance to the manufacturing industry for economic growth. He further posited that the growth passage of advanced nations in the post-war era (over the period 1952-54 to 1963-64) displayed the association between industrial development and the entire economic performance of a nation. This statement formed the basis for the first law of Kaldor which says that a close association exists between increasing in manufacturing output and increasing in gross domestic product (GDP). This first law can be expressed briefly as the manufacturing industry is the engine of economic growth. The linear specification of the first law of Kaldor is as follow:

"$\mathbf{gGDP = a0 + a1\ gMAN}$"

Where:

gGDP: The growth of total output.

gMAN: The growth of the manufacturing output.

Empirical review

Manufacturing and Growth

Abdulrazaq (2024) examined the critical role of manufacturing value-added to the economic growth of the GCC countries. Also, gross fixed capital formation, total labor force, and technology with economic growth were also

examined. This research evaluates the data of six Gulf Cooperation Council (GCC) countries that includes Kuwait, Qatar, Oman, Saudi Arabia, United Arab Emirates, and Bahrain which started from 1980 to 2020 and used well know econometric panel framework. Methods: The study employed econometric methods included panel unit root testing based on Im-Pesaran-Shin and Fisher. The long-run association was extracted based on the fixed effect econometric model followed by residual diagnostic testing that include Pesaran test for cross sectional independence to validate outcomes. The outcomes of panel unit roots suggest all variables are integrated at order and hence provide a platform to move on to check long run association between variable. The overall outcomes of this study revealed that manufacturing value-added, gross fixed capital formation, labor force, and technology are a positive and significant relationship with economic growth in the long run.

Bokosi (2022) drawing on balanced panel data of 6 Southern African countries in 1978–2019, this paper examines the impact of industrialisation on economic growth using several econometrics methods: pooled mean group, mean group, dynamic fixed effects and takes account of common correlated effects. Estimation is conducted using manufacturing value added as the proxy for industrialisation. Empirical results reveal that an increase in industrialisation is positively associated with economic growth in both the short and long-run and the positive relationship is more significant when we use common correlated factors to address the issue of crosssectional dependence. Karami, Elahinia and Karami (2019) examined the impact of manufacturing on economic growth in European economies during the period of deindustrialization. Moreover, the associations between capital, labor force, and technology with economic growth have been investigated. Econometric tests are performed based on a panel data for twenty-five of most competitive European economies for the period 1995 - 2016. To quantify the relationship between explanatory variables and economic growth, an eclectic model consists of both the Kaldor's first law of growth and the neoclassical growth model was estimated. The result of this study revealed that the economic growth has a significantly positive association with manufacturing, labor force, and technology. The unexpected interesting result is that the association between economic growth and investment is significantly negative

The study of Szirmai and Verspagen (2015) examined the relationship between manufacturing value- added (NVAG) and the gross domestic product in 92 economies from 1950 to 2005 and analyzed through panel estimation methods Fixed Effect, Random Effect and Hausman Test). Their findings suggest that the manufacturing sector role plays a vital role in developing low and middle-income economies. Mercan et al. (2015) found positive causal relation between the growth of manufacturing output and the growth of GDP in

South Africa, Mexico, Brazil, China, India, Indonesia, Malaysia, Philippines, Thailand, and Turkey using panel cointegration method for the 1965-2012 data. This positive relationship was also evidence in panel data analysis of 7 Latin countries for the period 1985-2001

Technology and growth

Yusuf and Biala (2021) investigate the effect of ICT on economic growth, examine whether real per capita income influences the effect of ICT on income level and economic growth and whether the effect of ICT on economic growth differs among the sub-regions of African countries. While a panel regression analysis was carried out, Hausman, Probability and Breusch-Pagan LM tests were employed to choose the appropriate estimator between the fixed-effect and random-effect estimators. Data were obtained from the World Bank's World Development Indicators and International Monetary Fund classification of Africa countries. Results were evaluated at 0.05 level of significance. The results of the study showed that ICT did not have significant effect on economic growth, and that the effect of ICT on economic growth did not differ among the sub-regions of African countries. However, we found that real income per capita influenced the effect of only mobile cellular subscription (an indicator of ICT) on economic growth. Therefore, policymakers should not rely on ICT for sustained output growth because it can only lead to only one-shot, unsustainable change in income level. Gani (2009) examined the association between per capita economic growth in nations with advanced levels of technological success and high-tech exports. The panel regression results for 45 countries in the period of 19962004 shown that high-tech exports have a positive significant impact on the development of the technical leader category of nations and a statistically insignificant but positive impact on the potential leader category of nations. Falk (2009) investigated the effect of the high-tech export on economic development. He calculated a growth model on panel data for 22 OECD nations in the period of 1980–2004. Employing the system GMM panel estimator that adjusts in case of simultaneity, he discovered that the share of high-tech exports and the intensity of R and D for business are positively and significantly linked to the GDP.

Human capital development and growth

Woldemichael and Shimeles (2019) revisit the role of investment in human capital in closing the productivity gap, boosting labor productivity growth, speeding the rate of structural transformation, and ultimately creating high-quality jobs in Africa. Analysis of detailed sector-level historical data on employment, value added, and human capital shows that investment in human capital is significantly and positively associated with the rate at which countries close the labor productivity gap between agriculture and the rest of the economy. Investment in human capital also significantly increases labor productivity within sectors and the speed at which labor is reallocated from low-productivity to high-productivity employment. In line with other research on this topic, the findings from this study underscore that Africa is ready to benefit significantly from improving human capital through investments in education, health care, and nutrition. Jellilov, Aleshinloye and Onde (2016) analyze the impact of education on economic growth of Nigeria using ordinary test squares (OLS) to determine the relationship between education as human capital and Real Gross Domestic Product (GDP). The result of the study shows that there is statistically significant relationship between GDP and all the variables used in the study with the exception of primary school enrolment (PRYE). The negative coefficient of the PRYE is also an indicator that there are problems at this level of education in Nigeria. The variables used are Real Gross Domestic Product, Capital Expenditure on Education, Recurrent Expenditure on Education, Primary School Enrolment and Secondary School Enrolment from 1970 to 2006 which is latest data for Nigerian education sector by Central Bank of Nigeria. Shobowale, Olopade, and Oladeji (2022) assessed the direct effects of human capital development and selected total factor productivity components (technology and infrastructure) on economic growth in selected Sub-Saharan African Countries during the period 1981-2020 using the panel least square method. The study employed the augmented Solow growth model. The variables used were the growth rate of Real Gross Domestic Product (RGDP) as the dependent variable; while the explanatory variables are Human Capital Development proxy by the Human Development Index (HDI); Physical Infrastructure Index (PII) as a proxy for Physical Infrastructure; Research and Development (R&D) to proxy technology; Labour force growth; Share of Private Investment in GDP, Trade Openness, Financial Openness and Share of Total Government Expenditure (SGE). The study established that human capital development on its own is not sufficient to bring about the needed growth in an economy, enhance, there is a need for complementary factors such as technology and infrastructure for human capital to actualise its full potential. The results of the direct effect of human capital development, physical infrastructure and technology on economic growth in selected Sub-Saharan African countries indicated that Human Capital exhibited a positive relationship with economic growth, which implies that the economy grows when the human capital is strengthened. Physical Infrastructure also exerted a positive impact on the country's economic growth process. Physical Infrastructure positively induces the country's growth. The study recommended that government spending should be centered on the infrastructural development which serves as the framework for industrial growth and export promotion.

Contribution to the study/gaps

Having reviewed the previous works of the scholars related to this study, we found that many of them examined the effect of each of the stated explanatory variables separately on the economic transformation, while this study investigates the effect of the three variables collectively namely: industrialization, information communication technology and human capital on economy transformation. In addition, reviewed works of some scholars employed panel regression only, this study involves a comparative analysis of the three selected countries in conjunction with panel analysis.

METHODOLOGY

Research Design

The study adopted the Ex-post facto research design to examine the effects of independent variables: industrialization, technological advancement, and human capital development on dependent variable: economy transformation of three selected African countries. Ex-post facto study or after the-fact research is a category of research design in which the investigation starts after the fact has occurred without interference from the researcher.

Model Specification

This model specification was based on the combination of Kaldor Growth Theory and modification of the work of Bokosi (2022), which examined the impact of industrialisation on economic growth in selected countries. Mathematical Model:

GDPG = f(MVA, HTX, HDI) ----------eq 1

GDPG = Gross Domestic Product Growth (Annual % - proxied economy transformation)

MVA = Manufacturing Value Added (% of GDP - proxied industrialization)

HTX = High Technology Export ($USD million - proxied technology advancement)

HDI = Human Development Index (Ranges 0-1 proxied human capital development)

For the purpose of the estimation, it is necessary to re-write the model in the form of econometric equation:

$GDPGit = \beta 0 + \beta 1 MVAit + \beta 2 HTXit + \beta 3 HDIit + \mu it$ ----------eq 2

$\beta 0$ = Constant term, $\beta 1$, $\beta 2$, $\beta 3$ = the coefficient of manufacturing value added, high technology export, and human development index to be determined.

μ = error or stochastic term; i = number of countries and t = years of study

Apriori expectation: $\beta 1 > 0$, $\beta 2 < 0$, $\beta 3 > 0$; Null Hypotheses (Ho): $\beta 1 = \beta 2 = \beta 3 = 0$

Source of data

This study used the secondary data source of data from World Development Indicators produced by World Bank, UNDP, IMF. The secondary data represent the existing data upon which the statistical inferences can be computed. The author used moving-average method to compute unavailable data.

Data analysis techniques and estimation methods

This study employed descriptive statistics, panel unit root tests, cointegration and panel Auto Regressive Distributed Lags (ARDL) of the data from three selected African countries under the study. The ARDL model distinguishes between short- and long-run coefficients.

DATA ANALYSIS, RESULTS AND DISCUSSION

Descriptive statistics

Table 1: Descriptive Statistics of the Economy Transformation Variables

	GDPG	HDI	HTX	MVA
Mean	4.041218	0.527013	732.6179	12.98793
Median	4.195924	0.520000	51.43719	12.36678
Maximum	35.22408	0.741000	2860.700	23.74351
Minimum	-50.24807	0.192000	1.100000	6.552817
Std. Dev.	7.430395	0.132113	1002.798	4.553402

Skewness	-3.028398	-0.489231	0.834624	0.535641
Kurtosis	31.00850	2.928373	1.917081	2.136530
Jarque-Bera	3592.580	4.211011	17.32108	8.282866
Probability	0.000000	0.121784	0.000173	0.015900
Sum	424.3279	55.33633	76924.88	1363.733
Sum Sq. Dev.	5741.920	1.815207	1.05E+08	2156.281
Observations	105	105	105	105

Source: Author's Computation using E-view 10.

Table 1 provides the descriptive statistics of the variables employed in the study. The annual average growth rate of GDP across the selected African countries was 4.04% in real terms. The highest growth rate of 35.2% in 1995 and the lowest growth rate of -50.2% in 1994 were recorded respectively in Rwanda. The average mean value for HDI, HTX, and MVA are 0.527, 732.6179 and 12.98793 respectively. The skewness of GDPG and HDI are negative while the skewness of HTX and MVA are positive. The kurtosis of all the variables except GDPG are less than 3 and they are platykurtic, while GDPG with kurtosis greater than 3 is leptokurtic. The normality test based on Jarque-Bera test with probability values showed that all the variables except HDI were not normally distributed because their probabilities value were less than 5% level of significance.

Panel Unit Root Tests

Table 2: Panel Unit Root Test (Levin, Lin & Chu)

Null Hypothesis: Series has a unit root (non-stationary) Alternative: Series is stationary

Variable	Level Statistic (p-value)	**Conclusion**	First Diff (p-value)	**Conclusion**
GDPG	-2.28 (0.0114)	Stationary at Level	—	—
Variable	Level Statistic (p-value)	**Conclusion**	First Diff (p-value)	**Conclusion**
HDI	0.645 (0.7407)	Non-stationary	-2.02 (0.0217)	Stationary at 1st Diff
HTX	-3.04 (0.0012)	Stationary at Level	—	—
MVA	1.35 (0.9123)	Non-stationary	-2.74 (0.0031)	Stationary at 1st Diff

Source: Author's Computation using E-view 10.

Table 2 indicates the panel unit root of the variables under the period of study. The GDPG and HTX are stationary at level while, HDI and MVA are integrated of order 1, i.e., stationary after first difference. Thus, the foregoing suggests the use of Panel Autoregressive Distributed Lag technique for the model estimation due to the fact that all variables were stationary between levels and first difference.

Panel cointegration test

Table 3: Panel Cointegration Test of the model

Pedroni Residual Cointegration Test					
Series: GDPG HDI HTX MVA					
Alternative hypothesis: common AR coefs. (within-dimension)					
				Weighted	
		Statistic	Prob.	Statistic	Prob.
Panel v-Statistic		1.985013	0.0236	0.966449	0.1669
Panel rho-Statistic		-2.940314	0.0016	-1.899957	0.0287
Panel PP-Statistic		-5.468612	0.0000	-4.744610	0.0000
Panel ADF-Statistic		-1.970649	0.0244	-1.160576	0.1229
Alternative hypothesis: individual AR coefs. (between-dimension)					
		Statistic	Prob.		
Group rho-Statistic		-1.429905	0.0764		
Group PP-Statistic		-5.680873	0.0000		
Group ADF-Statistic		-1.454079	0.0730		
Cross section specific results					
Phillips-Peron results (non-parametric)					
Cross ID	AR(1)	Variance	HAC	Bandwidth	Obs
Nigeria	0.296	8.300101	8.300101	0.00	34
Rwanda	0.018	92.50283	92.50283	0.00	34
South Africa	-0.031	3.847608	1.796002	6.00	34
Augmented Dickey-Fuller results (parametric)					
Cross ID	AR(1)	Variance	Lag	Max lag	Obs
Nigeria	0.491	7.504216		--	33
Rwanda	-0.005	94.81236		--	33
South Africa	-0.146	3.787725		--	33

Source: Author's Computation using E-view 10.

Table 3 indicates several within-dimension statistics (rho, PP, ADF) and between-dimension stats are significant at 1%-5% level. Thus, there is cointegration among GDPG, HDI, HTX, and MVA and therefore long-run relationship exists.

Estimation of Panel ARDL Model (Pooled Level)

Table 4: Panel ARDL Model (Pooled Level)

Dependent Variable: D(GDPG)				
Selected Model: ARDL (1, 1, 1, 1)				
Note: final equation sample is larger than selection sample				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
	Long Run Equation			
HDI	27.89836	13.64024	2.045298	0.0438
HTX	-0.009285	0.004596	-2.020282	0.0464
MVA	-0.296337	0.153006	-1.936768	0.0560

	Short Run Equation			
COINTEQ01	-0.547622	0.103671	-5.282324	0.0000
D(HDI)	82.05972	98.27944	0.834963	0.4060
D(HTX)	0.020947	0.014840	1.411536	0.1617
D(MVA)	-1.849746	1.513049	-1.222529	0.2248
C	-2.050412	2.370309	-0.865040	0.3894
Root MSE	3.938689	Mean dependent var		0.056868
S.D. dependent var	10.59662	S.E. of regression		4.326998
Akaike info criterion	5.423848	Sum squared resid		1628.894
Schwarz criterion	5.878813	Log likelihood		-266.7520
Hannan-Quinn criter.	5.608209			
*Note: p-values and any subsequent tests do not account for model selection.				

Source: Author's Computation using E-view 10.

Long run analysis

From table 4, the Long-run coefficient for human development index is 27.89836 and significant at 5% probability level. Thus, 1% increase in human development index will lead on average to 27.9% increase in the gross domestic product growth of the three selected African countries (Nigeria, Rwanda and South Africa). There exists a positive relationship between human development index (proxy human capital development) and gross domestic product growth (proxy productive economic transformation). Thus, the foregoing result indicates that human capital development has a positive effect on productive economic transformation of the selected African countries (Nigeria, Rwanda and South Africa) under this study.

Similarly, the Long-run coefficient for high-technology export is (-0.009285) and significant at 5% probability level. Thus, 1% increase in high-technology export will lead on average to 0.009% decrease in the gross domestic product growth of the three selected African countries (Nigeria, Rwanda and South Africa). There exists a negative relationship between high-technology export (proxy information communication technology) and gross domestic product growth (proxy productive economic transformation). Thus, the foregoing result indicates that technological advancement has a negative effect on productive economic transformation of the selected African countries (Nigeria, Rwanda and South Africa) under this study.

In addition, the Long-run coefficient for manufacturing value added is (-0.296337) and significant at 5% probability level. Thus, 1% increase in manufacturing value added will lead on average to 0.30% decrease in the gross domestic product growth of the three selected African countries (Nigeria, Rwanda and South Africa). There exists a negative relationship between manufacturing value added (proxy industrialization) and gross domestic product growth (proxy productive economic transformation). Thus, the foregoing result indicates that industrialization has a negative effect on productive economic transformation of the selected African countries (Nigeria, Rwanda and South Africa) under this study.

Short run analysis

From the short-run model in table 4, the Error correction term (EC) is significant, indicating adjustment towards long-run equilibrium. It affirms apriori expectation as its coefficient is negative. Its value of – 0.547622 implies that an impulse to GDP growth in the current period will be restored at a speed of adjustment of about 55% in the next period. The short-run coefficient for human development index is 82.05972 and insignificant. Thus, 1% increase in human development index will lead on average to 82% increase in the gross domestic product growth of the three selected African countries (Nigeria, Rwanda and South Africa). There exists a positive relationship between human development index (proxy human capital development) and gross domestic product growth (proxy productive economic transformation). Thus, the foregoing result indicates that human capital development has a positive effect on productive economic transformation of the selected African countries (Nigeria, Rwanda and South Africa) under this study. Moreso, the short-run coefficient for high-technology export is 0.020947 and insignificant. Thus, 1% increase in high-technology export will lead on average to 0.02% increase in the gross domestic product growth of the three selected African countries (Nigeria, Rwanda and South Africa). There exists a positive relationship between high-technology export (proxy information communication technology) and gross domestic product growth (proxy productive economic transformation). Thus, the foregoing result indicates that technological advancement has a positive effect on productive economic transformation of the selected African countries (Nigeria, Rwanda and South Africa) under this study. In addition, the short-run coefficient for manufacturing value added is (-1.849746) and insignificant. Thus, 1% increase in manufacturing value added will lead on average to 1.85% decrease in the gross domestic product growth of the three selected African countries (Nigeria, Rwanda and South Africa). There exists a negative relationship between manufacturing value added (proxy industrialization) and gross domestic product growth (proxy productive economic transformation). Thus, the foregoing result indicates that industrialization has a negative effect on productive economic transformation of the selected African countries (Nigeria, Rwanda and South Africa) under this study.

Country-specific short-run estimates:

Table 5: Cross section short run co-efficient (Country level)

NIGERIA

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.683115	0.014650	-46.62931	0.0000
D(HDI)	-86.43971	5619.466	-0.015382	0.9887
D(HTX)	0.008116	2.02E-05	402.2405	0.0000
D(MVA)	-1.269185	0.132484	-9.579898	0.0024
C	-3.547166	25.80659	-0.137452	0.8994

RWANDA

Variable	Coefficient	Std. Error	t-Statistic	Prob. *

COINTEQ01	-0.615795	0.012861	-47.88242	0.0000
D(HDI)	253.9593	4863.329	0.052219	0.9616
D(HTX)	0.050539	0.060343	0.837521	0.4638
D(MVA)	-4.712022	0.473264	-9.956426	0.0022
C	-5.197531	16.55918	-0.313876	0.7742

SOUTH AFRICA

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.343956	0.017394	-19.77465	0.0003
D(HDI)	78.65954	3496.423	0.022497	0.9835
D(HTX)	0.004185	3.03E-06	1383.368	0.0000
D(MVA)	0.431970	0.713970	0.605025	0.5879
C	2.593460	19.04967	0.136142	0.9003

Source: Author's Computation using E-view 10.

Nigeria

Table 5 indicates country specific short run estimates. In Nigeria, the error correction term (EC) is significant, indicating adjustment towards long-run equilibrium. It affirms a priori expectation as its coefficient is negative. Its value of – 0.683115 implies that an impulse to GDP growth in the current period will be restored at a speed of adjustment of about 68% in the next period. HTX has strong positive short-run effect (very significant), while MVA has negative short-run effect (significant). Thus, in the short run, technology advancement has a strong positive and significant (at 1% level of probability level) effect on productive economy transformation in Nigeria. While in contrary industrialization has a strong negative effect on productive economy transformation in Nigeria. Finally, in Nigeria the human capital development has a negative and insignificant relations with productive economy transformation.

Rwanda

Table 5 shows that in Rwanda, the error correction term (EC) is significant, indicating adjustment towards longrun equilibrium. It affirms a priori expectation as its coefficient is negative. Its value of – 0.615795 implies that an impulse to GDP growth in the current period will be restored at a speed of adjustment of about 62% in the next period. MVA has strong negative effect (significant) while HDI and HTX not significant short-run drivers. Thus, in the short run, industrialization has a strong negative effect on productive economy transformation in Rwanda, while human capital development and technology advancement have positive and insignificant relationship with productive economy transformation Rwanda.

South Africa

Table 5 provides that in South Africa the error correction term (EC) is significant, indicating adjustment towards long-run equilibrium. It affirms a priori expectation as its coefficient is negative. Its value of – 0.343956 implies that an impulse to GDP growth in the current period will be restored at a speed of adjustment of about 34% in the next period. HTX has highly significant positive effect, while MVA and HDI not significant in the short run. Thus, technology advancement has strong positive effect on productive economy transformation in South Africa.

Table 6: Correlation Analysis

	GDPG	HDI	HTX	MVA
GDPG	1	-0.0509	-0.189	-0.337
HDI	-0.050	1	0.797	0.245
HTX	-0.189	0.797	1	0.457
MVA	-0.337	0.245	0.457	1

Source: Author's Computation using E-view 10.

Table 6 shows that gross domestic product growth (GDPG) is negatively correlated with all other variables within the study. While, human development index (HDI) and high-technology exports (HTX) are strongly correlated (0.80), which is an indication of multicollinearity. Finally, HTX and manufacturing value added (MVA) are moderately correlated (0.46).

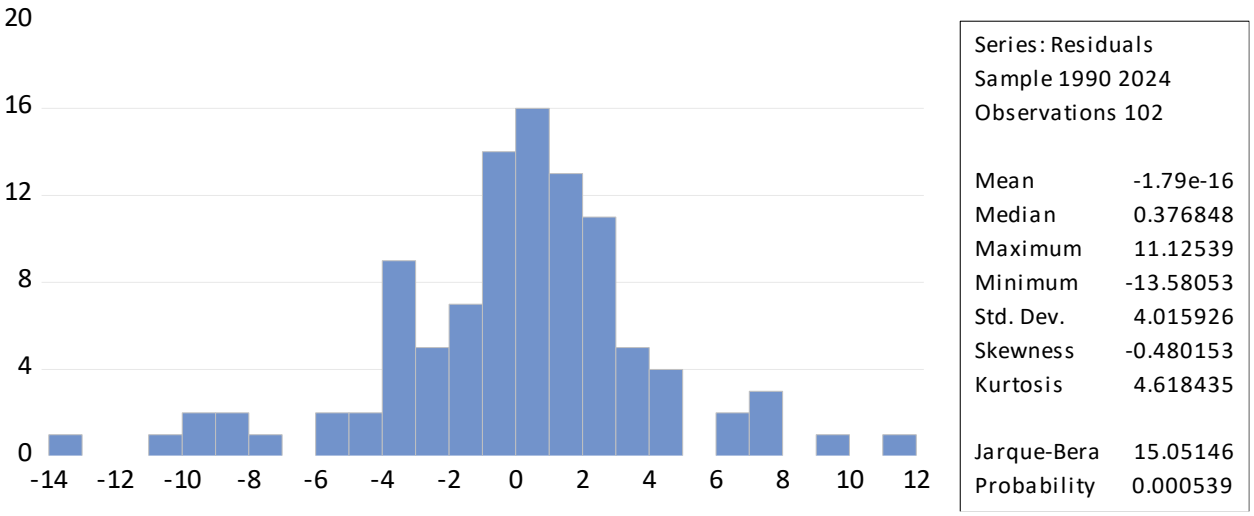

Figure 1: Test for Normality

Source: Author's computation from E-view 10

The residuals from the ARDL model show some degree of skewness and high kurtosis, indicating potential outliers or deviations from a normal distribution. This can affect the reliability of the model's predictions. The Skewness value of -0.480153 indicates negative skewness, meaning a longer tail on the left side of the distribution). The Kurtosis = 4.6184-35 indicates high tails and the Jarque-Bera statistics of 15.05146 with a probability of 0.000539 suggests non-normal distribution.

DISCUSSION

In line with the work of Jelliloy et-al (2016), and shobowale et-al (2022), this study found that human development index (proxy for human capital development) improves gross domestic product growth (proxy for economy transformation) in the selected African countries. Thus, this study confirmed that human capital development has positive relationship with economy transformation in Africa. In agreement with the works of Yusuf and Biala (2021) and contrary to the works of Gani (2009) and Falk (2009), the study posits that high technology exports (proxy for technology advancement) reduce gross domestic product growth (proxy for economy transformation). Thus, technology advancement has a negative relationship with economy transformation in the selected African countries under this study.In contrary to the works of Abdulrazaq (2024), Bokosi (2022), as well as Karami, Elahinia and Karami (2019), the study indicated that manufacturing value added (proxy for industrialization) reduces gross domestic products growth (proxy for economy transformation).

Thus, industrialization has negative relationship with economy transformation in the selected African countries under this study.

SUMMARY OF FINDINGS, CONCLUSION AND POLICY RECOMMENDATIONS

Summary of findings

Aspect	Finding
Data Properties	GDPG and HTX are stationary at level. HDI and MVA become stationary after differencing.
Cointegration	Long-run relationship exists among GDPG, HDI, HTX, and MVA.
Long-run Impact	HDI improves GDPG; HTX and MVA reduce GDPG.
Short-run Impact	HTX positively affects GDPG in Nigeria and South Africa; MVA negatively affects GDPG in Nigeria and Rwanda.
Adjustment Speed	Fastest in Nigeria, slowest in South Africa.
Correlations	HDI & HTX are highly correlated; GDPG negatively correlates with all variables.

Conclusion

In an attempt to investigate the impacts of human capital development, technological advancement and industrialization on productive economic transformation in selected African countries – Nigeria, Rwanda and South Africa, the following objectives were stated: examine the effect of industrialization on productive economic transformation of the three selected African countries; determine the relationship between technological advancement and productive economic transformation of the three selected African countries; and evaluate the impacts of human capital development on productive economic transformation of the three selected African countries. We therefore found that in the long run: human capital development has a positive effect on productive economic transformation of the selected African countries; technological advancement has a negative effect on productive economic transformation of the selected African countries; and industrialization has a negative effect on productive economic transformation of the selected African countries. While in the short run: human capital development has a positive effect on productive economic transformation of the selected African countries; technological advancement has a positive effect on productive economic transformation of the selected African countries; and industrialization has a negative effect on productive economic transformation of the selected African countries. African countries are therefore advised to use the examined variables to structure their productive economy transformation.

Policy Recommendations

Based on the findings of this study from the three selected African countries, the following policy recommendations are therefore suggested.

- Having established that human development index (HDI) proxy for human capital development has longrun positive effect on GDP growth, governments of the three selected countries are therefore advised to invest in education, health**,** and social services. Thus, improved human capital boosts long-term economic growth. Nigeria/Rwanda should intensify SDG-aligned policies and improve human development indicators for sustainable growth.

- High-Technology Exports (HTX) proxy for technological advancement has long-run negative effect on GDPG (possibly due to low scale or poor returns), but positive short-run effect in Nigeria and South Africa. The policy implication of the foregoing result include: develop value-added tech ecosystems (e.g., ICT hubs, local content laws); enhance IP protection, access to venture capital, and export diversification; and governments should promote R&D and link it to production and export chains.

- Manufacturing Value Added (MVA) proxy for industrialization has negative effect in both long and short run, except weakly positive in South Africa. The Policy Implication include: focus on reviving competitive

manufacturing; provide industrial credit, improve power supply, and infrastructure; and finally, encourage industrial clusters and local sourcing.

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