Journal of Studies in Social Sciences and Humanities
http://www.jssshonline.com/
Volume 8, No. 3, 2022, 332-347
ISSN: 2413-9270

Effects of Economic Complexity as A Development Index on Economic Performance: A Sub-Saharan Africa and BRICS Comparative Analysis

Sehludi Brian Molele, PhD*
University of Limpopo, Limpopo Province, South Africa.
E-mail: sehludi.molele@ul.ac.za

Thobeka Ncanywa, PhD
E-mail: ncntho73@gmail.com
University of Limpopo, South Africa.

Corresponding author

Abstract
The study provides a comparative analysis of the effects of economic complexity on the economic performance of selected Sub-Saharan Africa (SSA) and the BRICS group. The wellness of a nation depends on how inclusive the development progression of an economy is towards its people as seen through economic complexity. Economic performance is measured by gross domestic product per capita. Panel autoregressive distributive lag methodology is employed in the data spanning from 1994 to 2018 to estimate the long and short-run estimates. Results showed a positive relationship between economic complexity and economic performance for both SSA and BRICS at 5% and 10% significance respectively in the long run. In the short run, ECI was an insignificant predictor for both SSA and BRICS. In the long run, it can be recommended that countries should invest in their people, mostly youth, to improve human capabilities that can enhance their economic complexity. This is in the case of the SSA region with an average negative ECI. As shown in the BRICS countries more improved ECI might encourage GDP per capita. The SSA countries may form part of economic integrations with developed countries that offer mutual beneficiation that fast-tracks the development, following in the footsteps of South Africa in the BRICS formation.

Keywords: GDP per capita, economic complexity, Sub-Sahara Africa, BRICS, Panel Autoregressive Distributive Lag

Introduction

Some economic debates confirmed significant differences between developed and developing countries, particularly in economic performance (Hidalgo, 2021; Adebayo et al, 2022). As such, the study investigates the effects of economic complexity on the economic performance of Sub-Saharan Africa (SSA) and the BRICS formation through their GDP per capita, as a measure of economic performance. GDP per capita measures the living standards of a nation's population embracing economic activity as a catalyst for a country's wellness (Adebayo et al, 2022). To this effect, given the openness of economies, and emergences of the country's economic formation such as BRICS and regional groups such as SSA, it became imperative to measure aspects such as exports market sophistication if it has the capabilities of improving economies well enough to address the income imbalance brought on by the respective economies. An interesting fact is that South Africa is found in both groups, and it would be interesting to see which group can enhance its performance.

The analysis of properties of the global trade network has generated new insights into the patterns of economic performance across countries (Mealy et al, 2018). This is a new field of research that provides a framework to investigate macroeconomic competitiveness and economic performance as measured in GDP per capita (Zaccaria et al, 2018). The first attempt to apply this framework to macroeconomics was proposed in a series of papers that used a network of products to investigate the development of countries (Hidalgo et al. 2009; Hidalgo & Hausmann, 2009; Zaccaria, et al. 2018). An economy that produces and exports sophisticated goods accelerates economic efficiency, suggesting that development is associated with an increase in the number of activities and with the complexity that emerges from the interactions between them. Therefore, countries with complex economic structures experience a privileged source of comparative advantage, a form of spatial–technological monopoly from which they extract rents (Balland & Rigby, 2017; Butler, 2011). Consequently, it goes to reason that a more sophisticated production output may improve the developmental state of nations leading to improved economic performance as the export basket develops in sophistication. Figure 1 looks to draw a comparison of the two classes of countries about their GPD per capita.

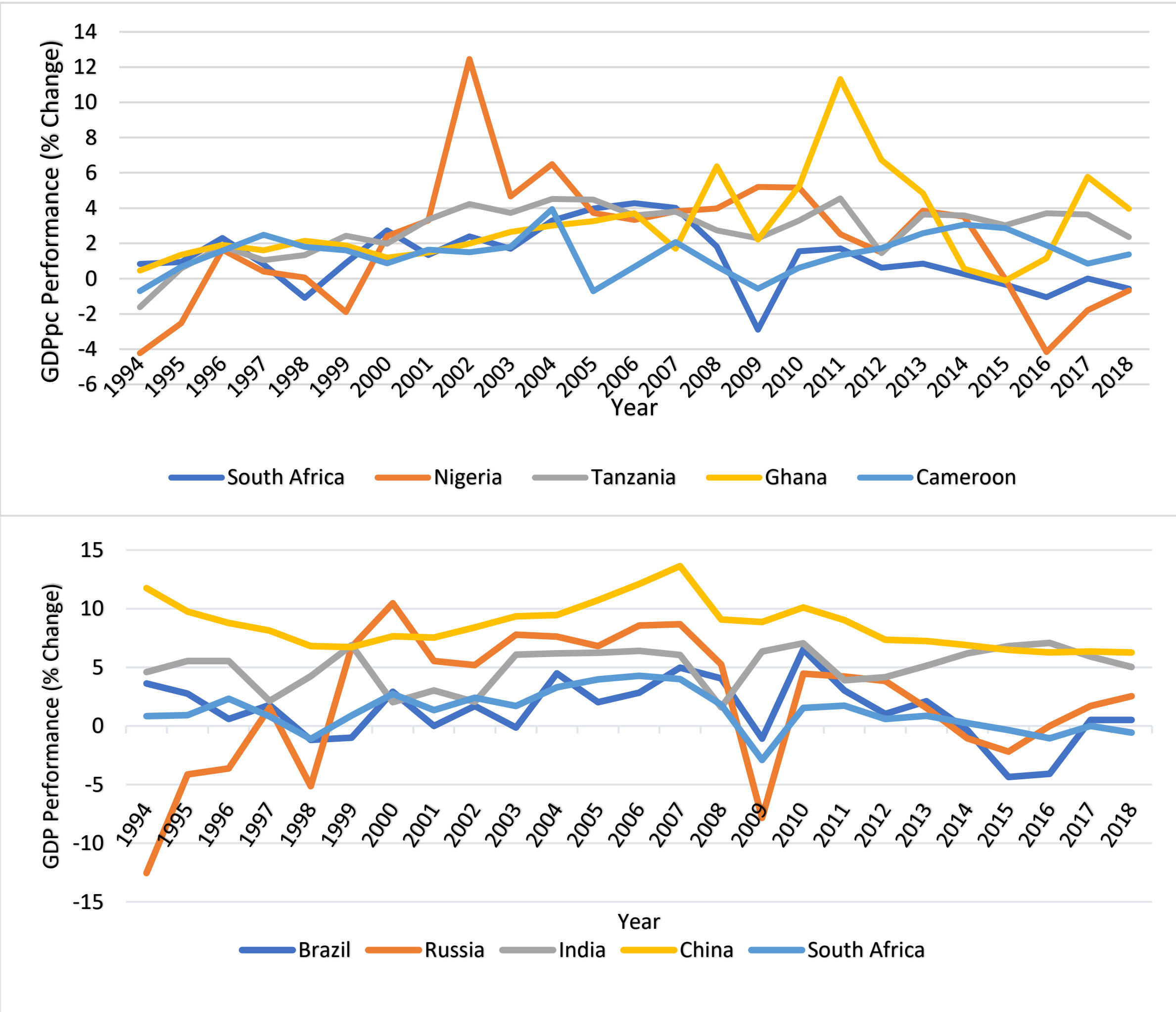

Figure 1: *SSA and BRICS GDP per capita percentage change (World Bank Data)*

Figure 1 reflects the performance of both group's countries, the selected SSA countries and their per capita income trends in percentage change. Nigeria and Ghana had the highest percentage yearly increase in 2002 and 2012 at around 12% and 10% respectively in the SSA. While, China had a consistent yearly percentage change and the highest in the BRICS countries, and reaching the highest peak of around 13.5% in 2007. India, on the otherside, have caught up to China in percentage change in 2017. In real monetary terms, using the purchasing power approach, the countries in the SSA range, on average, around $4000 for SSA and $5000 for BRICS. As opposed to the SSA countries, the BRICS nation shows a visible upwards trajectory of GDP per capita, except for India. The most performing

SSA country was South Africa peaking at just over $12 000 which is also a BRICS member, and in the BRICS group, Russia had the highest performance at over $25 000 per capita at the end of 2018 (World Bank, 2020).

The above analysis boats well to investigate the Sub-Saharan African (SSA) countries given that Africa is still seen much relying on raw unprocessed products though some countries like South Africa and Tanzania have improved compared to their African peers. As such, it is expected that an improved growth path for developing countries will have an improved GDP per capita. Gala et al (2018) state that structuralism is a dynamic process of industrialisation, a necessary condition for increasing employment, productivity, and income per capita and, consequently, reducing the problem of poverty, especially in the African continent. Henceforth, the main idea behind complexity is that the higher the economic complexity of a country, the better are its conditions to promote faster growth rates (Gala et al, 2018; Mealy et al, 2018). Hence, the study holds many contributions, perhaps economic complexity can advocate for the advancement of the total knowledge content of an economy and subsequently improve the economic performance. It is also interesting to compare the nature of the relationship between ECI and GDP per capita in two different groups, with BRICS ranked high and SSA ranked low in the complexity index as revealed through the descriptive statistics.

Research Objectives

The following objectives arise from the aim of the study in the two groups of economies (SSA & BRICS):

1. To determine the long and short run relationship between economic growth per capita (economic performance) and economic complexity.
2. To compare estimates in the nexus between economic growth per capita and economic complexity between the two groups.
3. To propose strategies that can be used to enhance economic performance through the concept of economic complexity.

Hypotheses

$\boldsymbol{H_{1i}}$**:** There is no significant statistical relationship between economic growth per capita and economic complexity.

$\boldsymbol{H_{1a}}$**:** There is a significant statistical relationship between economic growth per capita and economic complexity

$\boldsymbol{H_{2i}}$**:** SSA/BRICS group does not yield best estimates on the nexus between economic growth per capita and economic complexity.

$\boldsymbol{H_{2a}}$**:** SSA/BRICS group does yield best estimates on the nexus between economic growth per capita and economic complexity.

Literature Review

Literature pertaining to the hypothesis that there exists/ does not exist a relationship between GDP per capita and economic complexity index (ECI) is discussed. An evaluation of theoretical and empirical works on GDP per capita and ECI reflects the approval that indeed there exists a connection where economic complexity is an important feature in most economies' performance (Hildago & Haussman, 2009; Erkan & Vildirimci, 2015; Hartman et al, 2017; Ivanova et al, 2017). It is thus argued that sustained growth for decades involves the continual introduction of new goods, not merely continual learning on a fixed set of goods. To this effect, the theoretical perspective is emphasized by Romer's (2018) Knowledge-based Endogenous Growth Model in which the impact of economic complexity is imbued in it the idea of knowledge and innovation leading to the progress of an economy, and indeed its people.

The endogenous growth model is a significant theoretical adoption because it states clearly what sophistication and knowledge thereof lead to the progression of economies. This clearly states a positive relation between ECI and GDP per capita. The work of Romer (2018) stems from his past works (1983; 1986; 1990; 1994) and advocates for improving economies concerning absolute and comparative trade advantages. Hausmann and Hidalgo (2011) capture other economists' views that say that a successful theory of development has to involve more than aggregative modelling.

The ECI thus provides the cardinal measure of knowledge and sophistication embedded in countries as measured in their exports. Therefore, providing a measure of how countries may be classified accordingly in respect of the knowledge in society as expressed in the products makes and compete in international markets. This index provides solutions to Steedman and Steedman's (2001) question that "Even if 'knowledge' either is or can be rendered homogeneous – and that is a very big 'if' – the question arises whether there exists any cardinal measure of the single stock of knowledge". This intertwines with Romer's (1994) argument that technological advance comes from things that people do; the aggregate rate of discovery is still determined by things that people do. This notion is at the heart of ECI as reflected by Revealed Comparative Advantage (RCA), a direct link to endogenous growth. The endogenous growth theory is therefore relevant as revealed by Romer (2018). It contrasts with neoclassical growth theories that argue that factors affecting growth are exogenous. Hence, this means that factors affecting economic growth are rather endogenous factors through the exploitation of knowledge. Romer (2018) mentions that knowledge is non-rival. This means that the fact that ECI uses exports as measures for respective indexes does not render any other irrelevant. But rather, it is equally important a measure sophistication leading to improved product sophistication and economic valuations using export data.

In this study, the second hypothesis compares estimates in the nexus between economic growth per capita and economic complexity between SSA countries and the BRICS groups. The idea is to relate work done that also answers the question on why some countries are more developed in ECI terms. One other novelty is that studies relating to SSA and BRICS are found lacking. Lee and Yoon (2015), undertook a comparative study that meant to identify different patterns of latecomers' technological learning in developing complex product systems (CoPS). The study incorporated two BRICS countries, China and Brazil including South Korea in military aircraft development to explain the learning process in attaining indigenous technological capability. The method of study was the development of military technological learning by comparing differences in technological patterns in the military aircraft industries and projects of 1945 to 1999 in Brazil, of 1969 to 2012 in Korea, and of 1952 to 1999 in China. The findings indicated that in the case of Brazil, the important role played by universities and government research institutes in developing CoPS with a focus on design capability was beneficial. It was also explained that the phenomenon was similar to the catching-up of Korea and Taiwan in mass-produced goods, that of semi-conductor or electric products, that fostered the spin-offs and commercialisation of the research outcomes from their universities and government research institutes. In the case of China, the following were findings since the early 1950s. The country established more than 400 research units to strategically focus on reverse engineering were highly skilled Chinese scientists and engineers returned from the United States of America (USA). Finally, the acquisition of foreign companies enabled China to access foreign technology and link up with global R&D. On the overall, the findings were also that the role of foreign partners is crucial in acquiring highly sophisticated technology through coproduction, co-development and reverse engineering.

Naudé et al (2013), provide an industrial comparative study on the BRICS countries by analysing the manufacturing sector for the period 1980 to 2010 to address and contribute to the gap and patterns of structural change. The findings indicated that three of the BRICS experienced a de-industrialisation, that is, Brazil, Russia and South Africa. China was the only country where an expanding manufacturing sector accounted for a substantial part of total growth. The differences between the member economies was drawn down to differences in industrial policy where China industrial policy supported both foreign and domestic investment for technological catch-up. China was the only country where domestic investment started becoming increasingly important compared to FDI from 1995 onwards. China and India's rapid growth of per capita is said to have been complemented by structural changes away from agriculture, and into manufacturing and services, respectively. It was also summed up with regards to technological progress, that China had the most significant progress, followed by India, and to a minor extent Brazil, Russia and South Africa. The latter two remain economies that are essentially dominated by natural resource extraction and services, and by difficulties in their political and social transition processes.

Rubbo et al. (2021), provide a comparative analysis among the BRICS members in respect to their innovation index and economic complexity index. The findings indicated that India and Brazil weakened the most in the innovation status or ranking, while Russia realised the worst descent in the

ECI ranking. Moreover, China ascended seven places in the ECI position, but stagnated in innovation. Of interest was that in SSA Africa, South Africa showed the most similarities in comparison, rising up in both innovation and ECI rankings. However, the resulting conclusion was that economic complexity and the innovation ranking are not equivalent. They display discrepancies regarding the rises and declines among BRICS economies. These are important results because they reflect on the industry or manufacturing development of these countries. In the African context, a trend report on the prospective of manufacturing and industrialisation, opportunities, and strategies by the Brookings Institute submits some recent trends (Signé & Johnson, 2018). Current industry setting contributes meaningfully to the build-up of physical and human capital. Of significance, the manufacturing sector offers fairly well-paid jobs for large numbers of unskilled or under-educated workers, particularly those who are not integrated in the formal economy. To this effect, increases household income and subsequently domestic demand. The concern however, was that in terms of two indicators of industrial development, manufacturing value added (MVA) and manufacturing exports, Africa lags far behind the rest of the world and even in comparison to developing countries. Bhorat et al. (2019), also gave a comparative among some of the SSA (South Africa, Kenya, Senegal and Ghana) countries, and the following summation on a report on building economic complexity in Africa. There was indication of a minor shift concerning manufacturing in Senegal and Kenya, although economic activity was said to have shifted away from manufacturing in South Africa and Ghana. The general conclusion was that the scale of manufacturing-led structural change across the African continent was insufficient to drive immense job growth.

Upon providing and reflecting on the above literature on the stated hypothesis, additional literature is included in reflection of all economies. Some studies focused on the relationship between economic complexity and income issues. For instance, Hidalgo and Hausmann (2009), presented a technique that uses available economic data to develop measures of countries product complexity and showed strong correlation between income per capita and complexity. The relationship between ECI and economic growth data was explored on 16 countries from South Eastern and Central Europe for the period 1995 to 2013 (Stojkoski & Kocarev, 2017). The results were summed up as that change in economic complexity has no effect on short run changes in the income of South Eastern and Central Europe. On the other hand, change in investment and GDP per capita were significant explanatory variables of short-run income changes. Contrary to short-run, ECI was seen as a positive contributor to the elasticity of income per capita. It was found that on average there were increases of GDP per capita by 45%. Gao & Zhou (2018) quantified economic complexity of China's provinces by analysing firm data against some selected macroeconomic indicators from 1990 to 2015. Their findings where that economic complexity was a positive and significant indicator of economic development, as suggested by the high correlation between ECI and GDP per capita.

Felipe, et al (2012), ranked 5,107 products and 124 countries in measuring whether product complexity has an impact on economic development. Estimation results show that, out of the 5107 products, 2554 have statistically significant positive elasticities; 680 have statistically significant negative elasticities; and there are 1873 products with statistically insignificant elasticities. For example, self-propelled railway cars and external electric power showed the estimated share elasticity of 1.55, which means that as income per capita increases by 10%, the share of this product in total exports increases by 15%. Gala et al (2018) analysed the relationship between ECI and GDP per capita by employing heterogeneous regressions for a sample of 147 countries and covers the period 1979-2011. The results where that GDP per capita and ECI is negative and statistically different from zero with GDP per capita. This was analysed as indicating that countries with high export complexity are more capable of reducing the income gap to developed countries than countries with low export complexity. Additionally, Yalta and Yalta (2021) shed light on the trade competitiveness and ECI connection through term-of –trade in MENA (Middle East and North Africa). This study extends this on the actual current account outlook and ECI connection through diverse technique application. Yalta and Yalta (2021) also explored the domestic investment–ECI analysis in the said countries. Likewise, this study further adds to literature in a comparative setting. The study is in essence exploring the concept of economic diversification and development to the wellbeing of relevant macroeconomic indicators.

Methodology

Data and Model Specification

The article employed secondary yearly data spanning the period 1994 to 2018. Data for ECI was obtained from Massachusetts Institute of Technology (MIT) Atlas of Economic complexity observatory lab and data for GDP per capita was obtained from the World Bank. Additionally, all the variables included in respective SSA and BRICS models were also sourced from World Bank. However, real effective exchange rate of Tanzania was sourced from Federal Reserve Bank of ST. Louis.

The selected SSA countries are South Africa, Nigeria, Tanzania, Ghana and Cameroon. While BRICS is an acronym of countries who amalgamated for economic integration of Brazil, Russia, India, China and South Africa. South Africa is in both set of the group settings. The selected SSA countries were chosen due to the availability of data, the strength of economies in respect of GDP and the population size following the work of Muhammad et al. (2010). A multivariate model is used in this study to examine the relationship between economic complexity and GDP per capita adopting and improving on earlier studies (Stojkoski & Kocare, 2017; Hartmann et al, 2016). For a comparative setting, there exists two models, the selected SSA and BRICS model. Each model is infused with control variables to indeed make the frameworks multivariate and to have better estimates following the above stated authors. The adopted models across the two groups of economies are (SSA and BRICS) modelled as such:

$$GDPPC_{SSA} = f(ECI, INF, \ HHE, IMPI, GOVEX, REER) \quad (1)$$
$$GDPPC_{BRICS} = f(ECI, INF, HHE, IMPI, IND, EMPL) \quad (2)$$

Wherein model 1 (the SSA), GDPPC is gross domestic product per capita, ECI is economic complexity index, REER is the real effective exchange rate, INF denotes inflation measured in GDP deflator, GOVEX is government expenditure, HHE is household consumption expenditure, and IMPI is import index. In model 2 (BRICS) GDPPC, ECI, INF, HHE, and IMPI denotes same as SSA model, while IND relates to industrial production, and EMPL stands for employment.

The resulting linear model from the functions is identified as follows:

$$\Delta GDPPC_{itSSA} = ECI_{it} + INF_{it} + LHHE_{it} + LIMPI_{it} + LGOVEX_{it} + REER_{it} + \varepsilon_{it} \quad (3)$$
$$\Delta GDPPC_{itBRICS} = ECI_{it} + INF_{it} + HHE_{-it} + LIMPI_{it} + LIND_{it} + LEMPL_{it} + \epsilon_{it}] \quad (4)$$

In both models (SSA & BRICS), the percentage change in GDP per capita ($\Delta GDPPC_{it}$) is annual percentage growth rate of GDP per capita based on constant local currency. GDP per capita is gross domestic product divided by midyear population (World Bank, 2020). This form of dependant variable transformation is followed based on other works where the goal was to follow an endogenous theory and the effect of ECI on GDP per capita (Stojkoski & Kocarev, 2017). Economic complexity (ECI_{it}) is the complexity of a nation's productive assembly by merging information on the variety of a country's exports, and the ubiquity of its products, that is, the volume of nations that export the merchandise or service (Hidalgo & Haussmann, 2009). Inflation at GDP deflator (INF_{it}) as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency (World Bank, 2020). The log of household consumption expenditure ($LHHE_{it}$) provides values for households and NPISHs (Non-profit institutions serving households) final consumption expenditure expressed in current international dollars converted by purchasing power parity (PPP) conversion factor. Log of imports value index ($LIMPI_{it}$) is the current value of imports converted to U.S. dollars and expressed as a percentage of the average for the base period (2000) (World Bank, 2020). Log of general government final consumption expenditure ($LGOVEX_{it}$) includes all government current expenditures for purchases of goods and services (including compensation of employees). Real effective exchange rate ($REER_{it}$) is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs (World Bank, 2020; Federal Reserve Bank of ST. Louis, 2021). Log of Industry as a percentage of GDP ($LIND_{it}$) also includes construction. The log of employment ($LEMPL_{it}$) relates to population ratio, from the age of 15+ as total percentage

Estimation Technique

In attaining the set objective, the panel Autoregressive Distribution Lag (ARDL) approach is utilised for both the SSA and BRICS models. This allows to reflect on the significance of ECI on GDP per capita, while also reflecting on which coefficient estimates are higher between SSA and BRICS. As revealed that South Africa, a SSA country is also a BRICS member, the country is included in both models. A panel ARDL approach hold significance for several reasons. Firstly, ARDL method can be applied on variables integrating at different orders that is order I (0) and order I (1), but not order I (2). Secondly, panel ARDL captures the long run and short run estimates simultaneously. Thirdly, the approach is applicable on small number of observations. Fourthly, the approach can accommodate the structural breaks in time series data (Pesaran et al. 2001). Despite the advantages of ARDL over other panel methodologies, the model is employed because variables employed in the study integrate at different orders, and the method is applicable to small sample size time series.

However, prior to estimating panel ARDL estimates, two tests are of paramount importance, testing for unit root and the need to have evidence of cointegration. Panel unit root tests are helpful in choosing which model is suitable for the data used in the study before testing for cointegration. Recent literature suggests that panel-based unit root tests have higher power than unit root tests based on individual time series. The study makes use of the Im, Pesaran and Shin (IPS, 2003) and the Fisher-type tests using augmented Dickey-Fuller and Phillips Perron unit roots. The two-unit root techniques, IPS and Fisher tests are chosen on the basis that they allow heterogeneous coefficients and persistent parameters to move freely across sections (Bidirici & Bohur 2015).

The general tests used in panel cointegration are the Pedroni test, Kao test and the Johansen-Fisher test. Pedroni and Kao tests are based on Engle-Granger (1987) two-step (residual-based) cointegration tests. The Fisher test is a combined Johansen test. Several additional issues are of potential importance and these include: heterogeneity in the parameters of the cointegration relationships; heterogeneity in the number of cointegration relationships across countries; and the possibility of cointegration between the series from different countries (Verbeek, 2004).

The study starts with the descriptive statistics analysis, which is also meant to distinguish between the variables concerned that they are not actually similar. Additionally, a descriptive statistics analysis shows and explains the characteristics of each variable in the models as they relate to each group to engage a comparative analysis. Lastly, diagnostic tests are not carried out because of the characteristics of panel data. Blackburne & Frank (2007) alludes to the fact that the use of panel data increases the total number of observations and their variation, and reduces the noise coming from individual time series, therefore, heteroskedasticity is not an issue in panel data analysis. Additionally, there is evidence of heterogeneity, that's the difference among units under study (Lee and Wang, 2015). This is so because the models are not a run through a Vector Autoregressive setting.

Results and discussion

Table 1 shows both economies, SSA and BRICS nation's descriptive analysis. The yearly GDP per capita changes are unique across the two groups with an average (mean) change of 2.11% for SSA and a 3.68% in BRICS. The standard deviation for SSA stands at 2.365558 and 4.178092 for BRICS, a slight difference. But the slight variation is expected as GDP per capita is expressed in percentage change as opposed to real monetary GDP per capita values.

Table 1:

Descriptive Statistics for SSA and BRICS

Panel A: SSA							
Statistical Tests	**GDPpc**	**ECI**	**INF**	**LIMPI**	**REER**	**LHHE**	**LGOVEX**
Mean	2.116479	-1.136619	12.62298	5.397150	99.97627	25.01228	22.25509
Median	1.873828	-1.216820	8.418683	5.518979	98.03009	24.93718	21.99191
Maximum	12.45747	0.284770	80.75458	6.676647	275.2927	27.43414	25.13861

Minimum	-4.232816	-2.764250	-1.119766	4.161017	64.66765	22.80403	19.95845
Std. Dev.	2.365558	0.751240	13.73607	0.749928	28.16128	1.258474	1.556939
Observations	125	125	125	125	125	125	125
Panel B: BRICS							
Statistical Tests	**GDPpc**	**ECI**	**INF**	**LIMPI**	**LIND**	**HHE**	**EMPL**
Mean	3.685504	0.341492	31.00486	5.467647	3.408253	5.174354	4.000155
Median	3.982017	0.266418	7.431225	5.580020	3.374823	5.470858	4.032256
Maximum	13.63582	1.163790	2302.841	6.906270	3.861962	15.46467	4.338571
Minimum	-12.53979	-0.304549	-1.268410	3.938909	2.897521	-9.326956	3.603076
Std. Dev.	4.178092	0.279746	207.2090	0.856078	0.243707	4.300405	0.194341
Observations	125	125	125	125	125	125	125

Source: Author's Computation

Comparatively, this implies that the BRICS economies' performance was highly varied across the sampled period. This is expected as the five countries are from various continents, some from Asia, one from Africa, and one from South America. The SSA GDP per capita is also high, this too is expected given individual distinctiveness of the SSA countries. For the remainder of the other variables, the control variables, the standard deviation is most critical to reflect whether indeed the variables are unique. As indicated by their respective deviations they are proven to have a set of varied data sets, and as such inferences may be drawn between them.

Following on the estimation procedure above, table 2 provides the unit root tests results for selected SSA (Panel A) and BRICS (Panel B). The log of GDP per capita unit root estimates and across all the tests, SSA and BRICS are all stationary at first level. However, for SSA group, the I (1) stationarity was conclusive, while for the BRICS formation stationarity is concluded as I (1) on the basis that five of the eight tests across all the methods maintained the I (1) order. The significance level is at different levels, but unanimously at I (1) across LLC, IPS and Fisher-ADF.

Table 2

Stationarity Tests for SSA and BRICS

Variable	**Test Method**	**Test equation**	**Panel A: selected SSA**		**Panel B: BRICS**	
			Level	**1st Difference**	**Level**	**1st Difference**
GDPPC	LLC	Intercept	-2.60112***	-	-4.38148***	-
		Intercept and trend	-2.46307***	-	-3.96672***	-
	Fisher-ADF	Intercept	25.7660***	-	22.7382**	-
		Intercept and trend	14.6037	54.0622***	17.5867*	-
	Fisher - PP	Intercept	37.7353***	-	35.3485***	-
		Intercept and trend	22.9299**	-	29.9664***	-
ECI	LLC	Intercept	-1.137437 *	-	-0.02687	-4.52622 ***
		Intercept and trend	1.2456	-4.16096 ***	2.05574	-3.27607 ***

	Fisher-ADF	Intercept	35.6590	121.678 ***	11.6328	39.3655 ***
		Intercept and trend	26.4328	91.2575 ***	5.25662	26.7375***
	Fisher - PP	Intercept	16.3667*	-	14.1218	77.2954***
		Intercept and trend	17.3310*	-	6.63532	60.7126***
INF	LLC	Intercept	-1.49286 *		201.268	213.555
		Intercept and trend	1.56082	-2.27990 **	224.266	243.499
	Fisher-ADF	Intercept	-7.49552 ***	-	43.8744***	-
		Intercept and trend	-6.46289 ***	-	39.7492***	-
	Fisher - PP	Intercept	55.9612***	-	60.2596***	-
		Intercept and trend	54.0687***	-	548.539	-
LHHE (SSA)	LLC	Intercept	-1.24125	-4.48407***	-3.27935***	-
&		Intercept and trend	0.55743	-4.00989***	-2.20430**	-
HHE(%) (BRICS)	Fisher-ADF	Intercept	3.63830	43.0475***	24.3555***	-
		Intercept and trend	7.68255	33.2352***	17.8452*	-
	Fisher - PP	Intercept	5.03124	77.0133***	37.1685***	-
		Intercept and trend	11.0426	71.8165***	30.7646***	-
LIMPI	LLC	Intercept	-1.22098	-4.04410 ***	-0.83004	-4.66337***
		Intercept and trend	2.8278	-2.03614 **	0.97100	-3.86447***
	Fisher-ADF	Intercept	6.30399	53.2680***	2.62576	28.5753**
		Intercept and trend	3.61005	36.0795***	3.28354	17.6301*
	Fisher - PP	Intercept	3.37980	57.6195***	3.88911	47.7973***
		Intercept and trend	1.97059	42.8808***	1.94311	32.3061***
LGOVEX (SSA)	LLC	Intercept	0.31638	-4.41871 ***	1.41921	-0.82671
&		Intercept and trend	0.05947	-3.97245 ***	2.16839	0.24831
LIND(BRIC)	Fisher-ADF	Intercept	17.8782	76.7105***	5.90164	34.2006***
		Intercept and trend	15.8296	55.6063***	5.78853	27.6361***
	Fisher - PP	Intercept	1.91885	75.0894***	24.0267***	-

		Intercept and trend	5.90303	63.6762***	16.6950*	-
REER (SSA)	LLC	Intercept	-0.42932	-4.50368 ***	-0.91486	-2.00914**
&		Intercept and trend	1.46622	-2.59011 ***	-0.95548	-1.09560
LEMPL (BRICS)	Fisher-ADF	Intercept	20.8335	80.8096 ***	5.65375	28.2112***
		Intercept and trend	19.8894	53.1013 ***	14.5762	19.5463**
	Fisher - PP	Intercept	17.5513	72.3334***	3.37330	33.7253***
		Intercept and trend	16.7607*	-	7.45849	21.8880**

Source: *Author's computation*
Note: **, **, *** represents significance at 10%, 5% and 1% respectively.*

With respect to ECI, the BRICS ECI had a definite stationarity level of I(1) with all the tests proving the 1st difference criteria. The selected SSA ECI had an indefinite conclusion with four of the eight test proving a I(0) and the other four showing an I(1). It is then concluded that ECI in the selected SSA is stationary at I(1) because the confidence level was higher at 1% as seen at LLC, Fisher-ADF and IPS methods at the intercept and trend specification. While the remainder had significance at the weaker level of significance (10%). The remainder of the variables stationarity levels are provided below in reflection of table 2 results.

$$\Delta GDPPC_{itSSA} = ECI_{it} + INF_{it} + LHHE_{it} + LIMPI_{it} + LGOVEX_{it} + REER_{it} + \varepsilon_{it}$$

[I(0)] [I(1)] [I(0)] [I(0) [I(1)] [I(1)] [I(1)]

$$\Delta GDPPC_{itBRICS} = ECI_{it} + INF_{it} + HHE_{\_it} + LIMPI_{it} + LIND_{it} + LEMPL_{it} + \epsilon_{it}]$$

[I(0)] [I(1)] [I(0)] [I(0)] [I(1)] [I(1)] [I(1)]

Table 3 relays the Pedroni panel cointegration results for both set of economies. The Pedroni cointegration test results are categorised into three sections, the no deterministic trends, the deterministic intercept and trend, and the no deterministic intercept or trend scenarios. The null hypothesis is that there is no cointegration between the variables. The SSA model in panel A and the BRICS model in panel B were demarcated, reflecting the seven test equations of within dimension or panel statistics and between dimensions or group mean statistics on both the weighted statistics and the normal test statistics.

Table 3:
Pedroni Panel Cointegration for SSA and BRICS

Equation	**Statistical method**	**Panel A: Selected SSA Model**		**Panel B: BRICS Model**	
		Test Statistic (P-value)	**Weighted Statistic (P-value)**	**Test Statistic (P-value)**	**Weighted Statistic (P-value)**
No deterministic trends					
Within Dimension	Panel v-Statistic (+)	-0.613510	-0.911716	-0.597738	-1.893057
/ Panel	Panel rho-Statistic	1.292346	0.881193	0.749532	0.834924
Statistic	Panel PP-Statistic	-1.049247	-2.277214**	-2.731101***	-3.147150***

	Panel ADF-Statistic	0.437094	-0.103801	-2.779114***	-3.141453***
Between Dimensions / Group Mean Statistic	Group rho-Statistic	1.793944		1.516829	
	Group PP-Statistic	-1.698360		-1.438903***	
	Group ADF-Statistic	0.892715		-4.074792***	
Deterministic intercept and trend					
Within Dimension / Panel Statistic	Panel v-Statistic (+)	-0.310014	-1.335988	-1.488327	-3.085099
	Panel rho-Statistic	1.910911	1.217663	2.110724	1.922205
	Panel PP-Statistic	-1.351391***	-3.311757***	-13.30655***	-7.881133***
	Panel ADF-Statistic	-2.846002***	-4.101147***	-6.041966***	-5.623757***
Between Dimensions / Group Mean Statistic	Group rho-Statistic	2.239311		2.369951	
	Group PP-Statistic	-2.190070**		-19.03516 ***	
	Group ADF-Statistic	-3.602405***		-6.574810***	
No deterministic intercept or trend.					
Within Dimension / Panel Statistic	Panel v-Statistic (+)	-0.177390	-0.605167	-0.16471	-1.526331
	Panel rho-Statistic	0.843612	0.705850	0.398908	0.36827
	Panel PP-Statistic	-1.584078	-2.534714***	-2.758381***	-3.235984***
	Panel ADF-Statistic	-0.351017	-1.042354	-2.881648***	-3.322323***
Between Dimensions / Group Mean Statistic	Group rho-Statistic	1.596497		1.450761	
	Group PP-Statistic	-2.368227***		-5.428704***	
	Group ADF-Statistic	-0.448772		-3.576117***	

Source: *Author's computation*
Note: **, **, *** represents significance at 10%, 5% and 1% respectively.*

Analysing the no deterministic trend scenario first, the results maintain the null hypothesis with no co-integration across the seven equations in both weights. While the BRICS models reject the null hypothesis with the majority of equations advocating for co-integration with six of the eleven equations rejecting the null hypothesis. Two of the three between dimension equations reject the null hypothesis, and four of the eight within-dimension equations rejected the null hypothesis.

When incorporating the deterministic intercept and trend, both the selected SSA model and the BRICS model are observed to follow the same pattern of results. With seven of the 11 equations reflecting estimates suggesting cointegration, that is, four of the within dimension having p values lower than 5%, the Panel PP-Statistic and Panel ADF-Statistic on both weights are significant. Additionally, the Group PP-Statistic and Group ADF-Statistic also reflected to be statistically significant of a co-movement in the SSA GDP per capita model. Similarly, the BRICS GDP per capita model also has the same tests reflecting cointegration. Thus, four of the seven statistics method approve a long-run co-movement for the SSA and BRICS models. When incorporating the no deterministic intercept or trend

equation, only the BRICS equation produces co-integration results, rejecting the null hypothesis on the same basis as the no deterministic trend. The selected SSA maintains the null hypothesis.
In summary, it is confirmed that the Pedroni test advocates for the presence of cointegration in the BRICS model were most of the test methods reject the null hypothesis. However, the selected SSA could not prove the presence of long-run co-movement in the estimated model. Hence, even more imperative to test further techniques.

Table 4

Kao and Johansen-Fisher Panel Cointegration Test for SSA and BRICS Country Groups

Panel A: Kao ADF Test	**A1: Selected SSA Model**	**A2: BRICS Model**
	Test Statistic (P-value)	**Test Statistic (P-value)**
Method	-4.410024 (0.0000)	-2.967474 (0.0015)
Residual variance	4.551008	5.560897
HAC variance	2.204551	4.279451

Panel B: Johansen-Fisher Cointegration

Hypothesised No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
B1: Selected SSA				
None	240.7	0.0000	217.7	0.0000
At most 1	134.6	0.0000	95.36	0.0000
At most 2	53.38	0.0000	36.71	0.0001
At most 3	24.76	0.0058	15.25	0.1232
B2: BRICS				
None	282.3	0.0000	335.1	0.0000
At most 1	239.5	0.0000	139.8	0.0000
At most 2	135.6	0.0000	95.42	0.0000
At most 3	60.66	0.0000	49.23	0.0000
At most 4	22.49	0.0128	20.04	0.0289
At most 5	11.05	0.3535	6.551	0.7670
At most 6	20.42	0.0256	20.42	0.0256

Source: *Author's computation using*
Note: **, **, *** represents significance at 1%, 5% and 10% respectively.*

The results in Table 4 show panel A (Kao tests) and panel B (Johansen-Fisher) cointegration tests. The results were that cointegration exists in the SSA and BRICS models as seen by the ADF t-statistics of -4.410024, and a probability of 0.0000 for the SSA, which is less than 5%. While the BRICS models also confirm cointegration with the ADF t-statistic of -2.967474 and a probability of 0.0015. The results, therefore, provide the existence of a long-run co-movement among the variables in respective models. In addition, the Johansen-Fisher panel cointegration reveals that both the Fisher trace statistics and max-eigenvalue revealed three cointegration vectors in the selected SSA models and four in the BRICS model at 1% level of significance in both models and 5% (at the 4th cointegration level in BRCS). These results then show that there exists a long-run co-movement in GDP per capita and economic complexity model for both sets of economies.

The macroeconomic variable, the GDP per capita, estimated against economic complexity and the five predictors in the two groups of economies, the selected SSA model and BRICS model. The two models were estimated using the Akaike selection criteria, and two lags were used under the constant trend specification for the selected SSA models, while the BRICS model adopted the linear trend specification.

Table 6:
Panel ARDL Long-run Estimate

Panel A: SSA					Panel B: BRICS				
Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***	**Variables**	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
ECI	0.605474	0.296392	2.042817	0.0471	ECI	0.623318	0.329825	1.889841	0.0662
INF	-0.160115	0.016074	-9.960854	0.0000	INF	0.008970	0.029609	0.302933	0.7636
LHHE	0.842013	0.494218	1.703730	0.0955	HHE (%)	0.392926	0.041640	9.436345	0.0000
LIMPI	0.034114	0.368436	0.092592	0.9266	LIMPI	-0.029025	0.228752	-0.126884	0.8997
LGOVEX	-1.025375	0.630513	-1.626255	0.1110	LIND	8.120936	1.780731	4.560451	0.0000
REER	0.010563	0.008708	1.213112	0.2316	LEMPL	0.008970	0.029609	0.302933	0.7636

Source: *Author's computation*

Table 6 provides the long-run estimates in answering the objective about whether economic complexity affects the GDP per capita desirably, and other predictors for both the selected SSA and BRICS. Panel A of the table is the selected SSA results, while panel B is for the BRICS. For the selected SSA estimates, in the long-run there exists a positive association between economic complexity and GDP per capita, significant at a 5% level. Therefore, any 1% upward change in economic complexity is associated with a 0.605% increase on GDP per capita. Likewise, in the BRICS nations, the same empirical stand holds in that there is a positive association between economic complexity and GDP per capita, however, significant at 10% level. A 1% upward change economic complexity is associated with a 0.623% increase GDP per capita. These sets of economies affirm the endogenous growth model as a catalyst to economic and the people's well-being in the long-run. Both economies findings are in line with argument by Hausmann et al. (2014), which assured a strong positive relationship between GDP per capita and economic complexity. As such, Romer's (2019) observations that a sophisticated society or a technologically advanced production in countries is a prerequisite for development holds. Additionally, these results uphold the work of Ncanywa et al. (2021), on ECI improving the income inequality outlook in the selected SSA context. What this also suggests in a developmental scenario is that a local value chain in the production line that leads to manufacturing for the export market is an important facet of the economy that primes the wellness of the citizens of these two groups of economies. More so, for the less developed region of SSA in that this may aid the improvement in the standard of living and alleviate the prevalence of poverty.

The remainder of the predictors are summarily outlined as such. Firstly, inflation has a negative and significant association on GDP per capita at 1% level for the selected SSA, while in the BRICS case an insignificant positive association was observed. Secondly, the log of household expenditure in the selected SSA had a positive and 10% significant relationship on GDP per capita, while the BRICS case household expenditure as a percentage of GDP also had a positive and significant relationship at 1%. Thirdly, the log of imports index for both economies was seen as an insignificant predictor of GDP per capita. Fourthly, the log of government expenditure was seen as an insignificant negative predictor of GDP per capita in the selected SSA countries, while in BRICS the log of industrial production it was seen that there exists a positive association which is significant at the 1% level. Lastly, real effective exchange rate and the log of employment were insignificant predictors of GDP per capita for selected SSA and BRICS, respectively.

Table 7
GDPPC Short-run and ECM Estimates

Panel A: SSA					Panel B: BRICS				
Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***	**Variables**	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
COINTEQ01	-0.096541	0.290451	-3.775308	0.0005	COINTEQ01	-0.484128	0.292499	-5.073966	0.0000
D(GDPPCC(-1))	0.042527	0.142859	0.297688	0.7673	(GDPPCC(-1))	0.339126	0.247269	1.371485	0.1781
D(ECI)	-0.409964	1.543881	-0.265541	0.7918	D(ECI)	1.667073	1.589785	1.048615	0.3008
D(ECI(-1))	-1.533568	1.078108	-1.422462	0.1619	D(ECI(-1))	0.160092	1.178763	0.135813	0.8927
D(REER)	-0.011333	0.026002	-0.435857	0.6651	D(INF)	0.198016	0.057109	3.467337	0.0013
D(REER(-1))	-0.016450	0.020911	-0.786676	0.4357	D(INF(-1))	0.112919	0.117215	0.963351	0.3413

D(INF)	0.080030	0.052101	1.536046	0.1317	D(LIMPI)	-0.250412	3.478282	-0.071993	0.9430
D(INF(-1))	0.004023	0.051765	0.077725	0.9384	D(LIMPI(-1))	1.697663	1.046582	1.622103	0.1128
D(LGOVEX)	2.569577	1.358900	1.890925	0.0652	D(LIND)	-7.809979	10.81057	-0.722439	0.4743
D(LGOVEX(-1))	0.643978	0.672213	0.957997	0.3433	D(LIND(-1))	7.912508	6.153824	1.285787	0.2061
D(LHHE)	19.17227	6.985070	2.744750	0.0087	D(HHE%)	-0.202496	0.178708	-1.133114	0.2641
D(LHHE(-1))	13.60647	8.138724	1.671819	0.1017	D(HHE%(-1))	-0.163336	0.161337	-1.012388	0.3176
D(LIMPI)	0.745866	1.258707	0.592565	0.5565	D(LEMPL)	-6.189081	32.42616	-0.190867	0.8496
D(LIMPI(-1))	1.291119	1.133453	1.139103	0.2608	D(LEMPL(-1))	49.34770	73.36690	0.672615	0.5052
C	2.490436	1.146652	2.171921	0.0353	C	5.666372	1.989952	2.847491	0.0070

Source: *Author's computation*

Table 7 presents the short-run and ECM estimates for the selected SSA model in panel A and the BRICS model in panel B. For both models, the short-run estimates reveal that economic complexity is not a significant predictor of GDP per capita. This shows that economic complexity is not an immediate contributor to the economic progress of the respective group of economies' people's well-being. Moreover, the most significant results are that of the error correction model, which indicates that, in the selected SSA countries, the speed of adjustment is both negative and significant at 1%. This tells us that any short-run disequilibrium will adjust back to equilibrium, however at a much slower pace of 9.65% of the disequilibrium corrected within the first period. However, in the BRICS case, the adjustment path to equilibrium given the prevalence of disequilibrium is much faster. The error correction term shows that the BRICS model will correct any disequilibrium by 48.41% in the first period.

The two groups of economies seem to have a similar stand in the short-run but differ in the adjustment path with the BRICS model adjusting much faster. The BRICS model adjusts 96% of the disequilibrium within two years. The statistical insignificance of the short-run results suggests that Romer's (2018) endogenous theory does not hold in the short-run. Additionally, the results also confirm the findings of Felipe et al. (2012), who found statistically insignificant estimates between complexity and income. To this end, the ECI and income nexus may not be seen as a short-run driven process, but rather, a long-run driven process. This was also evident in that previous observations indicating that ECI does not influence income inequality in the short-term but meaningfully reduced income inequality in the long run for developing countries (Caous & Huarng, 2020).

Conclusion and recommendations

Interrogating the GDP per capita and economic complexity association, the following results were found. Applying the PARDL in both the selected SSA and BRICS settings, the endogenous growth theory was seen to hold. It was seen that economic complexity had a positive and significant association with GDP per capita in both the selected SSA and BRICS formation. This then reasons that economic complexity as a measure of economic development is necessary through the export of complex products to bring about the well-being of the people of the selected SSA and BRICS countries.

On the well-being of the selected SSA nations, the SSA GDP per capita is still lacking behind some major economies, with the exception of South Africa. Even more concerning, the ECI is still much less than zero which means the selected SSA are less developed. This means socioeconomic problems are still prevalent in the SSA region, including South Africa. The SSA region needs to learn from the leading BRICS countries by creating a conducive environment for a better development of innovation that improves the domestic value chain that produces knowledge-based products for the export market; as it stands, and additionally, the SSA region is still well behind on the industrial revolution compared to the BRICS countries, including the 3rd industrial revolution. As such, the region needs to take cognisance and speed up industrial-economic disruption that promotes the creation of new technologies such as artificial intelligence, 3D printing, the internet of things, robotics, cloud computing, biotechnology, and/or advanced wireless technologies; It is highly recommended that the SSA region promotes and invest vastly on innovation or knowledge building in science and technology from foundation phase education to the universities. There needs to be cohesion between university academia, the private sector and respective governments to address the technical lack in the region. This will aid the knowledge build that addresses the needs of the region and provides the required technical and domestic products and services meant to drive-up value exchange across industries. The best lessons are in the BRICS economies as science and technology is infused at an early stage in the education process. This will help the selected SSA to address the socio-economic problems by improving on the knowledge and technical know-how of its citizens. Moreover, it will stimulate the much-needed country development that will be seen by improvement in economic complexity, realising a more acceptable positive index as opposed to the current negative ECI's that engulf the SSA region. As shown in the BRIC countries more improved ECI might encourage economic growth. The rest of the selected SSA region may also form part of the economic integrations with the more developed countries that offer mutual beneficiation that fast-tracks the development, following in the footsteps of South Africa in the BRICS formation.

References

Adebayo, T. S., Rjoub, H., Akadiri, S. S., Oladipupo, S. D., Sharif, A., & Adeshola, I. (2022). The role of economic complexity in the environmental Kuznets curve of MINT economies: evidence from method of moments quantile regression. *Environmental Science and Pollution Research*, *29*(16), 24248-24260.

AfDB, OECD, UNDP. (2016). African Economic Outlook: Sustainable Cities And Structural Transformation. *African Economic Outlook*, 15th edition. DOI: http://dx.doi.org/10.1787/aeo-2016-en.

Bidirici, M. and Bohur, E. (2015). Design and economic growth: Panel cointegration and causality analysis. *Social and Behavioral Sciences*, 210, 1–94. https://doi.org/10.1016/j.sbspro.2015.11.359.

Blackburne, E. F. and Frank, M. W. (2007). Estimation of Nonstationary Heterogeneous Panels. *Stata Journal*, 7 (2), 197 – 208. DOI: 10.1177/1536867X0700700204.

Engle, R, F. and Granger, C, W, J. (1987). Co-integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, 55, 251–276.

Erkan, B. and Yildirimci, E. (2015). Economic Complexity and Export Competitiveness: The Case of Turkey. Procedia - *Social and Behavioral Sciences* Elsevier, 195, 524–533. doi: 10.1016/j.sbspro.2015.06.262.

Felipe, J, Kumar, U, Abdon, A. and Bacate, M. (2012). Product complexity and economic development, *Structural Change and Economic Dynamics*. Elsevier B.V., 23(1), 36–68. doi: 10.1016/j.strueco.2011.08.003.

Gala, P. Rocha, I. and Magacho, G. (2018). The structuralist revenge: economic complexity as an important dimension to evaluate growth and development. *Brazilian Journal of Political Economy*, 38 (2). 219-236. doi:

Hartmann, D. (2014). Economic Complexity and Human Development: How Economic Diversification and Social Networks Affect Human Agency and Welfare. New York: Routledge.

Hartmann, D, Guevara M.R, Jara-Figueroaa, C, Aristara´ M and Hidalgo, C. A. (2016). Linking Economic Complexity, Institutions, and Income Inequality. *World Development*, 93, 75–93. http://dx.doi.org/10.1016/j.worlddev.2016.12.020.

Hausmann, R. and Hidalgo, C. A. (2011).The network structure of economic output. *Journal of Economic Growth*, 16(4), 309–342. doi: 10.1007/s10887-011-9071-4.

Hausmann, R., Hidalgo, C. A., Bustos, S., Coscia, M., Simoes, A., & Yildirim, M. A. (2014). The atlas of economic complexity: Mapping paths to prosperity. MIT Press.

Hidalgo, C and Hausmann, R. (2009). The building blocks of quality. *The Health service journal*, 119(6166), p. 15. doi: 10.2307/1312923.

Hidalgo, C., Klinger, B., Barabasi, L. and Hausmann, R. (2007). The Product Space Conditions the *Development of Nations, Science*, 317, 482-487.

Hidalgo, C. A. (2009). The Dynamics of Economic Complexity and the Product Space over a 42 year period. Working Papers, 189.

Hidalgo, C. A. (2021). Economic complexity theory and applications. *Nature Reviews Physics*, *3*(2), 92-113.

Im, K.S., Pesaran, M.H. and Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115 (revised version of 1997's work), 53–74.

International Trade Centre. (2017). *BRICS countries: Emerging players in global services trade*. ITC, Geneva.

Kao, C. (1999). Spurious regression and Residual-based Tests for cointegration in Panel Data. *Journal of Econometrics*, 90, 1–44. https://doi.org/10.1016/S0304-4076(98)00023-2.

Koirala, S., (2018). An Analysis of the Impact of Real Effective Exchange Rate on Economic Growth of Nepal. *Pravaha Journal*, 206-216.

Klinger, B. and Hausmann, R. (2006). Structural Transformation and Patterns of Comparative Advantages. CID Working Paper No. 128, Harvard Center for International Development.

Lee, Y and Wang, K. (2015). Dynamic heterogenous panel analysis of the correlation between stock prices and exchange rate. Economic research – Ekonomska istrazivanja, 28 (1), 749 – 772.

Levin, A., Lin, C. F., and Chu, C. (2002). Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties. *Journal of Econometrics*, 108, 1–24.

Lucas, R., (1988). On the mechanics of development. *Journal of Monetary Economics*, 22(1), 3-4.

Mealy, P., Farmer, J. D., & Teytelboym, A. (2018). A new interpretation of the economic complexity index. *Alexander, A New Interpretation of the Economic Complexity Index (February 4, 2018)*.

Muhammad A, Muhammad S, F, Hafiz K, A, Ishrat B and Quddus M. A. (2010). Relationship Between School Education and Economic Growth In Pakistan: ARDL Bounds Testing Approach to Cointegration. *Pakistan Economic and Social Review*, 48 (1), 39-60. Doi: https://www.jstor.org/stable/41762413.

Neubert, D. (2019). What we can learn from the fading myth of the (African) middle class. Global-e, 12 (40).

Pedroni, P. (1999). Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors. *Oxford Bulletin of Economics and Statistics*, 61, 653–70.

Pedroni, P. (2004). Panel Cointegration; Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis. *Econometric Theor*y, 20, 597–625.

Pesaran, M. H., Shin, Y. and Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289–326.

Pérez-Balsalobre, S., Llano-Verduras, C., Díaz-Lanchas, J. (2019). Measuring subnational economic complexity: An application with Spanish data. JRC Working Papers on Territorial Modelling and Analysis No 05/2019.

Raschen, M. (2014). The Problem of Balance of Payment Imbalances. *KfW Economic Research*, 4, 1 - 7.

Romer, P. (1986). Increasing returns and long run growth. *Journal of Political Economy*, 94 (1), 1002–1037.

Romer, P. (1990). Endogenous Technological Change. *The Journal of Political Economy*, 98(5), S71-S102.

Romer, P. (1994). The Origins of Endogenous Growth. *Journal of Economic Perspectives*, 8(1), 3–22.

Steedman, I. and Steedman, I. (2001). On Measuring Knowledge in New (Endogenous) Growth Theory. Growth Theory Conference, Pisa, Italy, October 5-7', (0).

Stojkoski, V. and Kocare, L. (2017). The Relationship between Growth and Economic Complexity: Evidence from South eastern and Central Europe. Online at https://mpra.ub.uni-muenchen.de/77837/ MPRA Paper No. 77837, posted 23 Mar 2017 11:02 UTC

Stojkoski, V., Utkovski, Z. and Kocarev, L. (2016). The impact of services on economic complexity: Service sophistication as route for economic growth', *PLoS ONE*, 11(8), 1–29. doi: 10.1371/journal.pone.0161633.

Verbeek, M. (2004). *A guide to Modern Econometrics*. 2nd Edition. Erasmus University Rotterdam : John Wiley and Sons.

World Bank, (2019). World Bank Open Data. Available https://data.worldbank.org/.

World Bank, (2021). https://www.worldbank.org/

Yalta, A. Y., & Yalta, T. (2021). Determinants of economic complexity in MENA Countries. *JOEEP: Journal of Emerging Economies and Policy*, *6*(1), 5-16.

Yellapragada, K. K. (2016). Economic Diversification in Sub-Saharan African countries. International Monetary Fund. https://www.researchgate.net/publication/328265710.

Zaccaria, A., Mishra, S., Cader, M. and Pietronero, L. (2018*). Integrating Services in the Economic Fitness Approach.* World Bank Group, International Finance Corporation: Policy Res. (arch Working Paper, 8485.