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Economic Complexity and Inclusive Growth in South Africa

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Abstract

For the past 29 years, South Africa has been characterised by high levels of unemployment, poverty, income inequality, educational disparities, corruption, and deteriorating infrastructure, among others. The Government of National Unity (GNU) came into power in 1994; it embarked on several policies to address these challenges. However, those policies were proven to be not effective in these challenges. In response to this, the present paper proposes an alternative approach known as economic complexity to the challenges of inclusive growth in South Africa. Thus, the present study examines the association between inclusive growth and the economic complexity index in South Africa for the period 1995-2021 using the ARDL model. The findings of the study reveal that economic complexity has a positive impact on inclusive

growth in the long run, but the impact is insignificant in the short run. The study's findings have important implications for South Africa's policymakers.

***Keywords**: Economic complexity; Inclusive growth; ARDL; South Africa*

1. Introduction

South Africa is home to 62 million people according to the census results published by Stats SA (2023). More than 30 per cent of South African households do not have any working adults and heavily rely on social welfare (i.e., social grants) programmes for survival, according to Shah (2022). Furthermore, Cillers and Aucoin (2016) concur with that view and reveal that the majority of South Africans still experience poverty, underdevelopment and inequality, the official figure from Stats SA (2023) reveals that approximately 10.2 million people lived in extreme poverty in 2011, and 28 million people are poor. Moreover, Morais (2013) reveals that in 2015 alone nearly 16.9 million South Africans were receiving social grants, even though social grants on their own are not an effective tool in fighting poverty. Ever since 1994 social grants have turned out to be the single most effective anti-poverty tool displayed. On the other hand, the country also grapples with the challenges of unemployment; as things stand, the youth unemployment rate (15-34 years) is 45.5 per cent, while the national average unemployment rate recorded 32.9 per cent in the first quarter of 2024, according to Stats SA (2024). To intensify matters, South Africa is considered one of the most unequal countries in the world, according to the recent data by UNU-WIDER https://www.wider.unu.edu/data South Africa has a Gini index of 0.67 points, which is among the highest income inequalities in the world.

The above developmental challenges signal a lack of inclusive economic growth in South Africa. Ali and Son (2007) define growth as inclusive if it increases the social opportunity function and depends on two factors, which are: (i) average opportunities available to the population; and (ii) how those opportunities are shared among the general population. However, if the growth process creates new economic opportunities that are unevenly distributed, then it does not meet these criteria. As the case may be, South Africa's growth does not meet the above criteria. Ever since post-apartheid period, South Africa's economic growth has remained sluggish and exclusive to the general population. Inclusive economic growth can be achieved through the

expansion of a regional scope of economic growth; according to Erkan and Yildirimci (2015), this can be done by fostering industrialisation, a main driver of structural change which is also a solid foundation for economic complexity or sophistication. Over the years South Africa has embarked on several economic policies to promote inclusive growth; these policies were the Reconstruction and Development Programme (RDP), Growth, Employment, and Redistribution (GEAR), Accelerated and Shared Growth Initiative for South Africa (ASGISA), and the New Growth Path (GNP) (SAHO, 2019). Despite the above policies, South Africa failed to achieve sustainable economic growth. Simply put, like many developing countries, South Africa has relied heavily on sectors (i.e., mining and agriculture) which do not create significant employment, as shown in Figure 1 below.

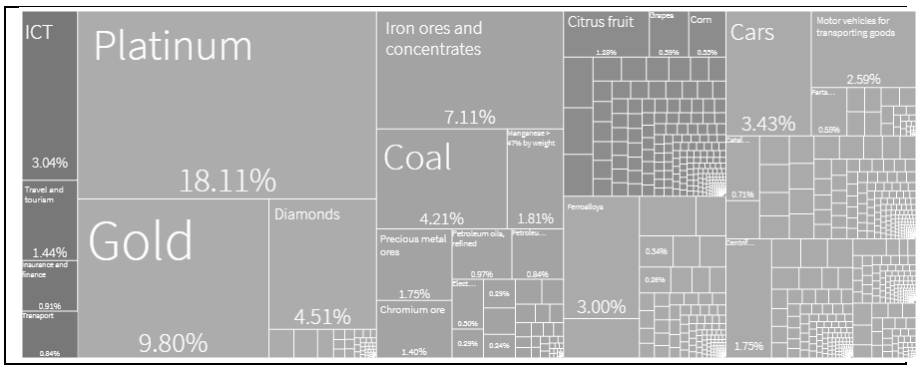


Figure 1: SA exports in 2021 Source: Atlas of Economic Complexity/Havard Growth Lab

The above figure shows the productive structure of South Africa for the year 2021; it summarises the economy of the country and reveal, which types of products (or commodities) were exported by South Africa in 2021. Most of the structure is accounted for by primary commodities like platinum, gold, coal, and agricultural products, while complex products like vehicles, machinery, electronics, and chemical products account for less. Hence, Bell, Goga, Mondliwa and Roberts (2018) are of the view that South Africa has made no significant improvement in transforming the productive structure of the economy, and by some measure the country has regressed because its manufacturing contribution to GDP has declined from 21 per cent in 1994 to 13 per cent in 2016. Consequently, Bhorat, Lilenstein, Oosthuizen, and Thornton (2020) postulate that even though the post-apartheid government of South

Africa has strengthened its pro-poor policies, the poverty levels, unemployment, and income inequality levels remain high in the country. To tackle these challenges Ncanywa, Mongale, Ralarala, Letsoalo, and Molele (2021) are of the view that, just like many African countries, South Africa will have to undergo a process of structural transformation, which is to shift resources from low-productivity activities to high-productivity activities. This practice can improve economic sophistication/complexity in South Africa. The term "economic complexity" according to Pietronero, Cristelli, and Tacchella (2013), refers to a set of intangibles, non-monetary and non-tradable assets, or productive capabilities which the national economy owns and which follow material production. According to Hidalgo (2009), who is the pioneer of the economic complexity approach, the concept of 'economic complexity' can be defined as an application of network science as well as machine learning techniques for the purposes of explaining and predicting changes in the economic structure of countries.

2 Literature Review

2.1 Theoretical Literature

In developmental literature there is no standard definition for inclusive growth; thus, there are many definitions of inclusive growth which do not link-up to a consensus on the concept, according to Ranieri and Ramos (2013). Ianchovichina and Lundstrom (2009) from World Bank (WB) define inclusive growth as growth that leads to a reduction of poverty, growth that will enable the general population to contribute to the economy and benefit from economic growth. However, for this growth to be sustainable in the long run, it must be broad-based across sectors and be inclusive of the larger part of the country's workforce. While Klasen (2010), from the Asian Development Bank (ADB) approaches it by defining inclusive growth as a process that ensures that everyone gets equal opportunities, as well as increasing access to those opportunities. On the other hand, the new theory known as *economic complexity* has emerged. Economic complexity and its potential impacts on countries and regions have received a great deal of attention in research since the seminal work of Hidalgo, Klinger, Barabási and Hausmann (2007), and Hidalgo and Hausmann (2009). The concept of economic complexity is relatively new in economics literature, and

according to Hausmann et al. (2014), it is used to refer to the magnitude of productive knowledge or capabilities embedded in society. The theory of economic complexity postulates economic sophistication is composed of a set of intangibles, non-monetary and non-tradable assets, or productive capabilities (i.e., technology, capital, institutions, and skill sets) which the national economy owns.

3 Empirical Literature

The present study aims to present empirical literature on the relationship between economic complexity and inclusive growth. The hypothesis of the study postulates that "economic complexity has a significantly positive impact on the inclusive growth index". Thus, the objective of the study will be to test the above research hypothesis that economic complexity promotes inclusive growth in South Africa. Literature uses poverty, inequality, and GDP per capita measures of inclusive growth, but the present study deviates from that. Hence the novelty of this study lies on creating a more socially inclusive growth index from various indicators (see Method section). Abdon and Felipe (2011) evaluate the method of Product Space, and what it says about the opportunities for growth and structural transformation in Sub-Saharan Africa. In the product space concept, there is a revelation that most countries in the SSA region are still trapped in the exportation of less sophisticated products, while highly standardised products are properly connected in the product space; therefore, because of that, the process of structural transformation becomes difficult. Gebrerufael (2017) used the linear LAS (Latin American Structuralist) technological intensity model to investigate the dynamics of product complexity of 23 countries in Africa and OECD countries for the period of 1996 to 2014. The study also employed fixed effects and random effects to examine the relationship between the economic complexity index of Africa (independent variable) using proxy technological intensity and GDP per capita and the time derivative of the economic complexity index of Africa (dependent variable). The results show a significant and positive relationship between Africa's economic complexity index and the time derivative of Africa's economic complexity index. The results imply that African countries have exerted poor efforts in diversifying their productive structures.

Yameogo et al. (2014) investigate diversification and sophistication as drivers of structural transformation on the African continent. To do that

they used the approach of Hidalgo et al. (2007) and that of Hidalgo and Hausmann (2009), known as the Product Space, and the results of their study indicate that African economies are not complex. Furthermore, their diversification is poor and less sophisticated than their western counterparts. Bhorat, Rooney and Steenkamp (2019) used fieldwork interviews in investigating the building of economic complexity in Africa. A common questionnaire was also adjusted according to country specific idiosyncrasies across the four case studies of four countries, which included Ghana, Kenya, Senegal and South Africa. Their study examines structural change through the lens of economic complexity and provides policy options through which these countries can achieve structural change that expands economic opportunities for disenfranchised women and youths. The implications are that there are country-specific constraints that restrict the process of building economic complexity in these countries. Ncanywa et al. (2021) investigate the relationship between economic complexity and income inequality in eight selected Sub-Saharan African countries for the period of 1994 to 2017. To examine the relationship, their study employed the ARDL model, and the main finding of the study was that economic complexity has the potential to reduce income disparities in Sub-Saharan African countries. Gnangnon (2021) employed fixed effects, FGLS and two-step system GMM to examine the effect of economic complexity on poverty in developing countries with a sample of 84 countries for the period of 1980 to 2017. The study's results reveal that greater economic complexity leads to lower poverty headcount rates. Lastly, Stojkoski and Kocarev (2017) employed panel dynamic ordinary least squares (DOLS) and generalised method of moments (GMM) to examine the effects of economic complexity on economic growth in south-eastern and central Europe. The study's results reveal that economic complexity is a statistically significant explanatory variable of economic growth in the long run, thereby creating economic implications. Contrarily, in the short run, productive knowledge has no effect on the changes in southeastern and central Europe.

The above studies attempted to examine the effect of economic complexity on inclusive growth, and it can be deduced that economic sophistication does have a positive impact on inclusive growth in African countries. However, it should be pointed out that South Africa and the African region have the lowest productive capabilities in comparison to other regions. This explains why the region is still grappling with

developmental challenges and still lags behind other regions. Furthermore, examined studies focus on isolated macroeconomic cases of inclusive growth; they do not examine inclusive growth as a composite index. Put simply, they do not look at inclusive growth holistically. Which is the knowledge gap that this study seeks to bridge. The following sections look into method, data and discussion of empirical results.

4 Method

4.1 Data

The present paper employs autoregressive distributed lag (ARDL) to examine the long-run and short-run relationship between inclusive growth and its determinant, economic complexity, in South Africa from the years 1995 to 2021, with annual data from the following electronic databases (it should be noted that data for the economic complexity index is only available for the years 1995-2021 on the *Atlas of Economic Complexity*). Nevertheless, the data for the economic complexity index (ECI) is retrieved from the Atlas of Economic Complexity database (https://atlas.cid.harvard.edu/rankings) for the measurement of the ECI. Hidalgo and Hausmann (2009) employed the Harmonised System (HS) data classification, which covers approximately 5000 products across 10 categories from the years 1995 to 2021, with HS categories containing six-digit detail levels. For the computation of the inclusive growth index, principal component analysis (PCA) has been employed to compute the index of inclusive growth. The present study follows the African Development Bank approach in computing the index (AfDB, 2016). Thus, the following indicators were employed in computing the inclusive growth index: GDP per capita growth, unemployment rate, life expectancy, infant mortality, expenditure on education, gini (Income inequality), female shares in parliament, female labour force participation rate, and governance (i.e., rule of law, and regulatory quality used). The African Development Bank (2012) approach views inclusive growth as a process of achieving economic growth that leads to a wider access of sustainable socio-economic opportunities for a broader population, and for that to be realised, Ianchovichina and Lundstrom (2009) document that this kind of growth must be broad-based across various sectors of the economy and be inclusive of the larger portion of the country's

workforce. Hence, the index of inclusive growth is composed of ten indicators, because it must encompass all societal factors, not only one factor (i.e., GDP per capita) as previous studies have done.

The data for GDP per capita growth, unemployment rate, life expectancy, infant mortality, expenditure on education, female shares in parliament and female labour force participation rate was retrieved from World Bank databases (https://data.worldbank.org/indicator). While the data for Gini income inequality was retrieved from UNU-WIDER databases (https://www.wider.unu.edu/data). The data for Rule of Law and Regulatory Quality were retrieved from Worldwide Governance Indicators (www.govindicators.org). The other control variables are inflation, tourism, natural resource rents, and population growth, and all their data was sourced from the World Bank database (https://data.worldbank.org/indicator).

Table 1: List of Variables

Variable	Notation	Data source	Unit
Economic complexity index	ECI	Harvard Growth lab	Index
Inclusive growth index	INCL	Author with World Bank data	Index
Natural resource rents	N-RES	World Bank	Percentage rate
Tourism	TOUR	World Bank	Percentage rate
Population growth	POP	World Bank	Percentage rate
Inflation	INFL	World Bank	Percentage rate

4.2 Autoregressive Distributed Lag Model

The present study employs the autoregressive distributive lag (ARDL) model to examine the effect of economic complexity on inclusive growth in South Africa for the years 1995 to 2021. The ARDL testing procedure was developed by Pesaran, Shin, and Smith (2001) to examine the cointegrating relationship between variables employed in a study. To examine the long-run relationship between inclusive growth and economic complexity, ARDL utilises a bounds test. According to Garidzirai and Muzindutsi (2020), the ARDL approach is useful because

it simultaneously provides estimates for both short-run and long-run dynamics, and it also accommodates for the integration of different orders (i.e., variables integrated at I(0), I(1) or a combination of I(0) and I(1), but none of the variables should be integrated at order I(2).The empirical model used in this paper to test the impact of economic complexity on inclusive economic growth in South Africa is in line with that of Nyasha and Odhiambo's (2015) approach. Therefore, ARDL representation is expressed by the following model:

$$INCL_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, INCL_{t-i} + \sum_{i=0}^{n} \alpha_{2i}\, ECI_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\, N\_RES_{t-i} + \sum_{i=0}^{n} \alpha_{4i}\, TOUR_{t-i} + \sum_{t=0}^{n} \alpha_{5i}\, POP_{t-i} + \sum_{t=0}^{n} \alpha_{6i}\, INFL_{t-i} + \sigma_1 INCL_{t-1} + \sigma_2 ECI_{t-1} + \sigma_3 N\_RES_{t-1} + \sigma_4 TOUR_{t-1} + \sigma_5 POP_{t-1} + \sigma_6 INFL_{t-1} + \varepsilon_{1t} \quad \text{……..(1)}$$

Where $INCL$ is the inclusive growth index; ECI is the economic complexity index; N_RES stands for natural resource rents; $TOUR$ stands for tourism, while POP stands for population growth, and lastly $INFL$ stands for inflation. Additionally, α_0 is a constant, while $\alpha_1 - \alpha_{5i}$ and $\sigma_1 - \sigma_5$ represent regression coefficients, n stands for lag length, and finally ε_t is the error term.

4.3 Empirical Results and Discussions

Table 2: Descriptive statistics

	INCL	ECI	N-RES	TOUR	POP	INFL
Mean	0.178879	0.117256	5.168980	9.777959	1.143900	5.173360
Maximum	3.693130	0.368016	11.99006	14.09239	2.074017	10.07458
Minimum	-4.436000	-0.176090	2.807948	2.887555	0.387278	-0.692030

Source: Author's own computations

Table 2 above shows mean, maximum and minimum values generated in South Africa between the years 1995 and 2021. The output describes the mean, the average of individual variables for 27 years in South Africa. From the year 1995 to 2021, inclusive growth in South Africa had an average share of 0.18 index points, a maximum share of 3.69 index points, and a minimum value of -4.44 index points, which is well below zero. These low figures are a sign that economic growth is not inclusive in South Africa. This could be attributed to the fact that after 2006-2007, after South Africa reached its peak, the country's GDP started to grow at a slower pace than other upper-middle-income countries, and after the

World Financial Crisis the country's growth remained sluggish. In fact, it grew at an average rate of 0.7 per cent in the five years prior to COVID-19 (Hausmann et al., 2023). On the other hand, the average share of ECI is 0.12 index, while the maximum value is sitting at 0.37 index, and the minimum is -0.18 index. These figures are significantly low, which shows that South Africa has poor productive structures or lower levels of economic complexity.

Table 3: Matrix correlation

Correlation Probability	INCL	ECI	N-RES	TOUR	POP	INFL
INCL	1.000000					

ECI	0.819919	1.000000				
	0.0000***	-----				
N-RES	0.242604	-0.042842	1.000000			
	0.3027	0.8577	-----			
TOUR	0.744866	0.749181	-0.096264	1.000000		
	0.0002***	0.0001***	0.6864	-----		
POP	-0.371891	-0.158582	0.012671	-0.265451	1.000000	
	0.1064	0.5043	0.9577	0.2580	-----	
INFL	0.027901	0.027167	0.391784	-0.145931	0.021387	1.000000
	0.9070	0.9095	0.0876*	0.5393	0.9287	-----

Source: Author's own computations

The study went on to test correlation analysis as shown in Table 3 above. According to Brooks (2014), when dependent and independent variables are found to be correlated, it means that they are being treated in a completely symmetrical way. It does not mean that changes in independent variables cause changes in the dependent variable or vice versa. However, it means changes in the two variables are to a certain degree related, given the correlation coefficient. As it can be seen from the results, the correlations among the variables in the study are significantly lowwhich implies variables employed in the study are independent, there are no influential factors in the model or other parts of the study. Furthermore, the inverse relationship between POP and INCL is noteworthy. This is because population growth is detrimental to the inclusive growth of South Africa, as it creates socio-economic problems and lowers development, since the economy is still subdued.

The study went further and tested stationarity [see Tables 4 and 5 below] to determine if the series contains a unit root or not. The Augmented Dickey-Fuller (ADF) and Dickey-Fuller Generalised Least Squares (DF-GLS) unit root tests show that all the variables employed in the study follow an I(0) and I(1) process, which is the main requirement for estimating the ARDL model. The ARDL approach produces reliable and consistent estimates of the long-run coefficients irrespective of whether the variables are I(0) or I(1). But none of those variables should be integrated at order 2 or I(2). Furthermore, the approach of ARDL allows the exploration of accurate dynamic structure, while other approaches do not allow for the distinction between long-run and short-run associations (Hasan and Nasir, 2008).

Table 4: Augmented Dickey-Fuller (ADF)

Augmented Dickey-Fuller at **Intercept**			Augmented Dickey-Fuller at **Trend and Intercept**	
Variable	Levels	1st Difference	Levels	1st Difference
INCL	-0.229610	-3.657293**	-2.544344	-3.292799*
ECI	-0.819644	-6.614516***	-3.443379*	-6.667950***
N-RES	-3.093549**	-7.182540***	-3.113392	-7.007887***
TOUR	-0.870027	-3.459633**	-1.232089	-3.954319**
POP	-3.262792**	-6.120292***	-3.711984**	0.926888
INFL	-3.852290***	-5.414041****	-4.005004**	-5.280939***

Source: Author's own computations with EViews

Table 5: Dickey-Fuller Generalised Least Squares (DF-GLS)

Dickey-Fuller GLS at **Intercept**			Dickey-Fuller GLS at **Trend and Intercept**	
Variable	Levels	1st Difference	Levels	1st Difference
INCL	-0.411506	-3.158006***	-1.557459	-3.649350**
ECI	-0.722459	-6.757880***	-3.529822**	-6.862530***
N-RES	-3.152435***	-6.941584***	-3.259482**	-7.202242***
TOUR	-1.064500	-3.635603***	-1.747826	-4.056594***
POP	-2.865344***	-5.911218***	-3.100710*	-6.257198***
INFL	-2.892698***	-5.123184***	-4.051169***	-5.263781***

Source: Author's own computations with EViews

For cointegration, the ARDL bounds test [see Table 6 below] was used to determine if cointegration exists between the inclusive growth index, economic complexity index, natural resource rents, tourism, population growth, and inflation.

Table 6: ARDL bounds test results.

F-Statistic value	k	Critical values	I0 Bound	I1 Bound
4.107532	5	10%	2.26	3.35
		5%	2.62	3.79
		1%	3.41	4.68

Source: Author's own computations

The ARDL bounds test reveals that the calculated F-statistic is above most I(0) and I(1) bound values at 5 per cent level of significance. The cointegration is significant at 5 per cent and not the 1 per cent level; according to Narayan (2005), this is because critical values (CV) are calculated based on the sample size. Thus, based on the relatively small sample size employed in the study (18 observations after adjustment), that is a CV of 5 per cent corresponds with 18 observations, it cannot correspond to a CV of 1 per cent as the sample size is small. Thus, the study rejects the null hypothesis of "no cointegration" implying there is a long-run association between the variables employed in the study.

Table 7: ARDL Model

Dependent variable: Inclusive Growth				
Short-Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ECI)	1.017195	1.778920	0.571805	0.5832
D(N_RES)	0.110393	0.061401	1.797900	0.1099
D(TOUR)	0.174997	0.090694	1.929525	0.0898*
D(POP)	-0.472521	0.302169	-1.563763	0.1565
D(INFL)	0.109051	0.060843	1.792335	0.1108
ECT (-1)	-0.457759	0.097463	-4.696763	0.0015***
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECI	15.620663	3.498217	4.465321	0.0021***
N_RES	0.241160	0.117552	2.051523	0.0743*
TOUR	0.382291	0.196551	1.945000	0.0877*
POP	-2.205299	0.759003	-2.905521	0.0197**
INFL	-0.044519	0.117860	-0.377729	0.7155
C	-4.560924	2.487138	-1.833804	0.1040

*, **, *** denotes significance at 10 %, 5 %, and 1 %, respectively

Table 7 presents the results of the ARDL model for inclusive economic growth and economic complexity in South Africa from 1995 to 2021.

The choice of the optimal lag for the ARDL model (1, 1, 0, 0, 1, 1) is based on the Akaike Information Criteria (AIC) value, which has the lowest value of 0.95 in comparison with other criteria such as the

Bayesian information criterion (BIC) and the Hannan-Quinn (HQ) criteria, which have the values 1.45 and 1.02, respectively. The coefficient of the error correction term (-1) is negative, less than 1, and statistically significant, which is a sign of a stable long-run relationship between the dependent variable and independent variables employed in the study. It also represents the speed of adjustment to restore equilibrium in the dynamic model following a disturbance. The error correction term coefficient is -0.46, which shows the speed of adjustment is approximately 46 per cent in returning to its equilibrium each year when disequilibrium occurs.

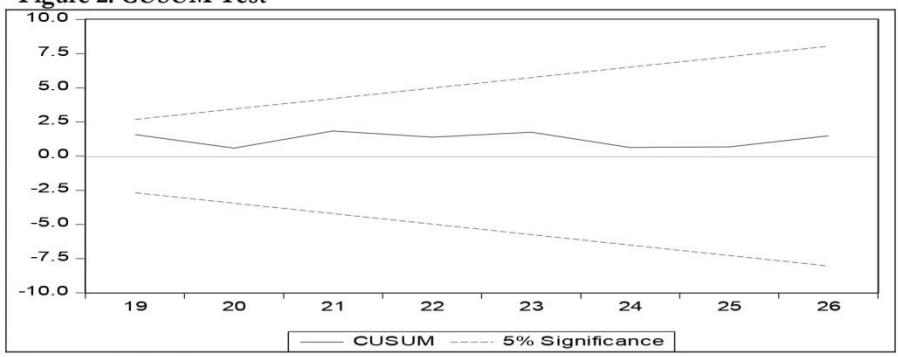
The results of the economic complexity index reveal a statistically significant and positive effect on inclusive growth in the long run, but are insignificant in the short run, which is in line with priori expectations of the study. These results indicate that a 1-unit increase in the economic complexity index in South Africa will increase inclusive growth by 15.62 points in the longrun. The effect is insignificant in the short-run because it takes time to develop industries (upstream/downstream companies), and it also takes more time to develop connections between these industries. Hence the effect is only significant in the long run. This result is consistent with that of Mohammadi and Zivari (2022), where it is shown that economic complexity has a positive and significant effect on economic growth, but in the short run the effect is insignificant, implying that changes in the production structure on growth are time sensitive.

The result implies a dire need for policy shifting from short-term based policies to long-term based policies in South Africa to tackle the challenges associated with economic growth. As demonstrated in the previous sections of the study, South Africa displays lower levels of economic complexity, but with its already existing productive capabilities (i.e., manufacturing sector), it has the potential to develop quicker than most African economies. However, to achieve this, more mechanised methods of mass production and capital formation, which are essential components of economic complexity, are needed. In essence, this means producing products that are closer to the existing productive capabilities of South Africa, and with that, the country will unlock more opportunities for further diversification of products. Moreover, producing such products will enable South Africa to increase economic growth; furthermore, these complex products are associated with higher wages, which is an opportunity gain that leads to an improvement in inclusive growth in South Africa.

Currently, the level of economic complexity in South Africa only targets major cities, which implies that a larger population of the country is left out from the benefits of economic growth, which explains why economic growth is not inclusive. A study conducted by Estmann, Sørensen, Ndulu, and Rand (2022) identifies key industries that are critical for diversifying the Tanzanian economy; thus, South African policymakers should look into the country's product space and identify niches which could be used to advance economic sophistication in South Africa. These results are also in line with the findings of Nguea and Kaguendo (2023), who show that economic complexity enhances inclusive growth through moderated renewable energy consumption and biomass energy consumption in Africa.

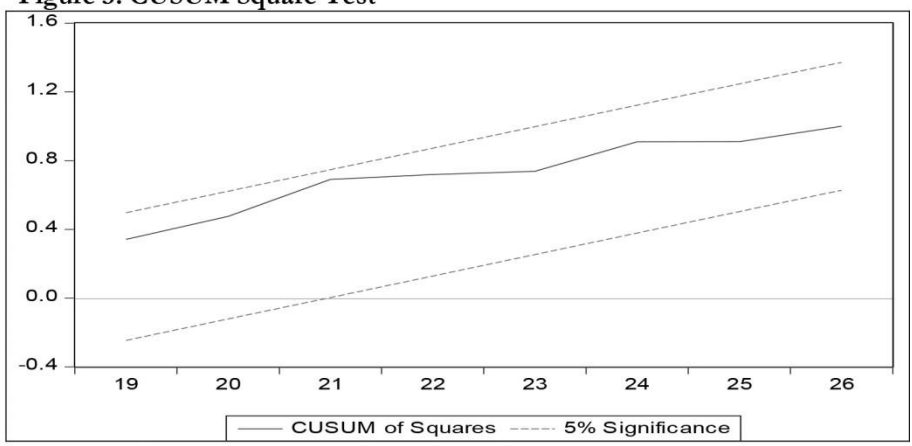
Natural resource rents display a positive and significant effect on inclusive growth in the long run. These are the incomes from natural resources, which are not in line with the priori expectations of the study. The results are in line with those of Mohamed (2020) where it shown that economic growth is positively impacted by natural resource rents in Sudan. The results also show that tourism has a positive and significant effect on inclusive growth in the short and long run, which is in line with the study's a priori expectations. This result is consistent with those of Osinubi and Osinubi (2020) where it is shown that tourism leads to inclusive growth in Nigeria.Population growth displays a negative and significant effect on inclusive growth in the longrun, this aligns with the priori expectation of the study. The effect of population is negative, because population growth coupled with low economic growth slows down development as it creates more socioeconomic problems. The result is consistent with the findings of Peterson (2017), where it is shown that in developing countries, rapid population growth is detrimental because it leads to an increase in the number of dependent children. Inclusive growth remains unresponsive to inflation in both the short and long run because the South African Reserve Bank uses an inflation-targeting framework to keep inflation in line with its target and minimise its impact on economic growth.

Figure 2: CUSUM Test



Source: Author's own computations with EViews

Figure 3: CUSUM Square Test



Source: Author's own computations with EViews

After the regression analysis, the present study conducted the following post-estimation tests: cumulative sum of recursive residuals (CUSUM) and cumulative sum of square (CUSUMQ) graphs, normality test (Jarque-Bera), heteroskedasticity, serial correlation, and Ramsey's reset. The results of the CUSUM and CUSUMQ tests [see Figures 2 and 3 above] show that all the coefficients of the error correction are stable, and the null hypothesis is not rejected, as the plots in CUSUM and CUSUMQ are within a 5 per cent range of significance. Thus, the ARDL model is stable.

Table 8: Post-Diagnostic Tests

Diagnostic Tests	P-Value
Normality test (Jarque-Bera)	0.7851
Heteroskedasticity	0.7158
Serial correlation	0.1047
Ramsey's reset	0.4798

Source: Author's own computations

Furthermore, the results for the normality test (Jarque-Bera), heteroskedasticity, serial correlation, and Ramsey's reset [see Table 8] reveal that the ARDL model passed all the diagnosis tests, as suggested by their P-values, which lie above a 5 per cent level of significance. Thus, residuals are normally distributed (i.e., there is normality), there is no heteroskedasticity in the ARDL model, and there is also no serial correlation in the ARDL model. Lastly, the functional form of the ARDL model is correct based on Ramsey's reset test. However, there might be limitations in some of these tests, as they are asymptotic tests, particularly Breusch-Godfrey tests (serial correlation, heteroskedasticity); that is, they may not be valid in small sample sizes such as the sample size of this paper.

5 Conclusion and Recommendations

For the past 29 years, South Africa has been characterised by high levels of unemployment, poverty, income inequality, educational disparities, corruption, and deteriorating infrastructure, among others. These are the challenges associated with a lack of inclusive growth, and when the Government of National Unity (GNU) came into power in 1994, it embarked on several policies to address these challenges. These policies were the Reconstruction and Development Programme (RDP), Growth, Employment, and Redistribution (GEAR), Accelerated and Shared Growth Initiative for South Africa (ASGISA), and the New Growth Path (GNP). However, the challenges listed above did not allow these policies to promote growth. To date South Africa still faces similar challenges. In response to this, the present paper proposes an alternative approach to the challenges of inclusive growth in South Africa. The new approach is economic complexity (product mix), and it has the ability to predict the next pattern of diversification and economic growth, as demonstrated in this study.

The present study went further and analysed economic complexity as a determinant of inclusive growth in South Africa for the years 1995 to 2021 with the ARDL model as a method of estimation. The findings of the study reveal that economic complexity has a positive impact on inclusive growth in the long run, but the impact is insignificant in the short run. The study has also made the following recommendations:

> To promote sophistication in the country in the short term, the government of South Africa will have to focus more on the Expanded Public Work Programmes (EPWP), which is basically aimed at equipping the general population with general skills. The government will also have to reinforce its revised Industrial Policy Action Plan (IPAP2). This policy will assist in advancing production sectors of the country, like producing value-added products for both local and international markets.

South Africa needs to transform its export structures, as these are dominated by primary products. The productive structures need to be transformed for economic complexity to have a meaningful impact on inclusive growth in South Africa. South African governments must invest more in innovation, research and development (R&D) to promote diversification in the productive structures in the country.

Furthermore, since there is a short supply of capital stock in the country, the government must adopt an *open-door policy* to attract more foreign direct investment (FDI). For this approach to work, the South African president must get a team of experts to visit the following industrialised countries: Japan, Germany, France, Italy, the United States of America, South Korea, Singapore, and China, among others. The team will have to visit high-tech states (provinces) in these countries; the goal will be to build relationships with foreign firms (multinational companies) and lure them to come and work with South African companies. The South African government in return will have to be generous on tax rates and exempt these foreign firms from paying certain duties. This is crucial for domestic firms, as they will benefit from foreign knowledge and technology.

Lastly, organisations like the development of Southern Africa (DBSA) and the Industrial Development Corporation (IDC) must play a role in assisting the South African government in addressing capability constraints; they should also advise the government on how to adopt good governance practices.

In closing, there were some limitations in the study, and these involved the lack of compatibility of certain control variables with the model; these variables were foreign direct investment (FDI), research and development (R&D), and agriculture value added (AGV). As a result, these control variables were omitted. Furthermore, at the time of data collection and writing, the data from the Atlas of Economic Complexity was only available for the years 1995 to 2021; there was no data for the years 2022, 2023, and 2024.

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