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New Insight into the Causal Linkage between Economic Expansion, FDI, Coal consumption, Pollutant emissions and Urbanization in South Africa

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Abstract

This study examines the relationship between foreign direct investment inflow and economic growth by incorporating the role of urbanization, coal consumption and CO_2 emissions as additional variables to avoid omitted variable bias. The different order of integration from the unit root test suggested the adoption of dynamic autoregressive distributed lag bounds testing procedure. The results show that the long-run equilibrium relationship between the outlined series and foreign direct investment exerts positive and significant influence on economic growth. The Granger causality test indicates a bidirectional causal effect between urbanization and foreign direct investment. This suggests that urban development in South Africa stimulates foreign direct investment. The findings reveal a one-way link from GDP to coal consumption, suggesting that economic prosperity is a promoter of coal consumption. Coal consumption was found to escalate carbon emissions. The study implies that economic development in South Africa, is in part, dependent on the conservative policy, development of urban centres through infrastructural improvement, establishing industrial zones, among others would attract more economic investments.

Keywords: South Africa; coal consumption; CO_2 emissions; climate change; urbanization

1. Introduction

Foreign direct investment (FDI hereafter) is seen by most scholars as a panacea for economic growth through its spillover effect especially to the developing economies. However, a consensus is yet to be established as to whether the impact of FDI inflow is gainful to the economic progress of the host countries. Some studies (Flora & Agrawal 2014; Mehic *et al.* 2017 Kalai & Zghidi, 2019; Pradhan *et al.* 2019) identify FDI inflow as a driving force for economic advancement. These studies label FDI inflow as a promoter of productivity, research and development, civilization, and improvement of skill and technical knowhow. According to Gungor and Katircioglu (2010), FDI inflow drives economic growth positively in the case of Turkey. This is similar to the work of Gungor and Rigim (2017) for the case of Nigeria. Other extant literature (Sunde, 2017, Tshepo, 2014, Abbes *et al.* 2015, Nistor 2014, Almfraji and Almsafir, 2014, Omr and Kahoulib, 2013, Shahbaz and Rahman, 2013) subscribe to the FDI-economic growth nexus. The spillover effect of FDI inflow is argued to drive economic progress faster than domestic investment (Borensztein *et al.* 1998), whereas others (Nair-Reichert and Weinhold 2001) argue that FDI could influence future growth in an open economy more than a closed economy. The impact of FDI inflow on economic progress though positive but was insignificant in the case of Nigeria (Ayanwale, 2007), however, FDI inflow to India exerts a transitory effect on the service sector output (Chakraborty and Nunnenkamp, 2008). Azman-Saini *et al.* (2010) submit that the impact of FDI inflow on economic advancement is not in view without attaining the minimum financial market development. Wang (2009) reveals that FDI inflow in the manufacturing industry promotes economic growth positive in a significant way for 12 Asian economies understudied, confirming the work of Yao (2006) in the case of China. Omri *et al.* (2014) find a two-way interaction between FDI inflow and economic growth for three regions studied, but, the impact of FDI inflow could only be triggered by a strong financial improvement of the host country (Hermes and Lensink, 2003). Fedderke and Romm (2006) confirm the complementary role of FDI inflow in the long-run in South Africa.

In contrast, some studies believe that FDI inflow is anti-economic progress. These include Bezuidenhou (2009) who reveals that FDI is rather harmful to the economic progress of the host country, thus, FDI inflow is an engine of retardation to the host economy. This confirms the work of Abdouli and Hammami (2017) in the case of Egypt and Lebanon. Adams, (2009) confirms the negative impact exhibited by FDI inflow on economic growth. Fedderke and Romm (2006) assert that FDI inflow causes capital flight in the short-run. Belloumi (2003) shows that FDI inflow does not

significantly influence economic progress in Tunisia. Alfaro *et al.* (2004) assert that the influence of FDI inflow on economic expansion without complementary role from other factors like the improved financial market is uncertain.

The linkage between coal consumption and economic expansion remains inconclusive. Some empirical findings from previous studies (Bekun *et al.* 2018; Bekun *et al.* 2019; Apergis and Payne 2010; Ziramba 2009; World-Rufael 2010, 2009, 2007, 2004; Yuan *et al.* 2007; Shui and Lam 2004) support the coal consumption-led economic expansion nexus, whereas others believe the nexus works the opposite way (see: Govindaraju and Tang 2013; Zhang and Xu 2012; Jinke *et al.* 2008; Reynolds and Kolodziej 2008; Soytas and Sari, 2003). Other studies reveal that coal consumption and economic advancement exhibit a mutual benefit (see: Belke *et al.* 2011; Fuinhas and Marques 2011; World-Rufael 2010; Paul and Bhattacharya 2004; Yuan *et al.* 2008). On the concluding note, the outcome of some studies remains neutral regarding the impact of coal consumption on economic advancement (see: Ziramba 2009; Jinke *et al.* 2008; Lee and Chang 2005; Sari and Soytas 2004; Yang 2000).

South African is one of the very few largest and fastest emerging economies in Africa and the global level. This economy demonstrates peculiar characteristics different from other emerging economies in Africa. These distinctive features include an economy that is the largest emitter of CO_2 emissions in Africa (~45% of the continental total) and 7th in the world (WEC 2016). In addition, the share of energy generated from coal is about 77% of the total energy generation capacity in South Africa and remains the largest consumer of the coal in the continent (EIA, 2010; Nasr *et al.* 2015; WEC 2016). South Africa is the largest producer of certain natural resources such as gold, iron ore, and platinum (World Bank economic indicators, 2018). However, the country has witnessed up and down in its quest to achieve both economic growth and FDI inflow. Despite this instability, the economy remains one of the leading economies in Africa especially after the takeoff of democracy in the country in 1994. For instance, in 2001 and 2002, the South African domestic currency weakened against the US dollar by 37%. This resulted in capital flight as investors discontinued their investment for fear of losing capital. Consequently, the rate of growth of GDP dropped significantly in the preceding year from 3% to 1.9% between 2002 and 2003. In 2005, GDP stood at $6729.827 billion in absolute values. This rose to $7432.117 billion in 2008 with a further increase in 2013 to 7563.993. In 2017, the GDP growth rate was estimated to be 0.7%, while unemployment accounted for 27% of the workforce. On the other hand, South Africa stands as a leader of FDI inflows to the Southern region and second-largest in Africa after Nigeria (UNCTAD 2012 $ 2018). The report further indicates that South African received the second largest proportion of the FDI inflows to the continent in 2011,

accounting for about 13.6% share of the total. In 2013, South Africa received FDI inflows of about $8300.1 million, followed by Mozambique which received $6175.1 million. In 2017, the FDI inflows to South Africa stood at $2.0 billion UNCTAD (2018). In 2018, the FDI inflow to the southern region experienced an increase by 13% to $32 billion out of which South Africa received the largest share of about $5.3 billion, a sharp increase compared to 2017. It is estimated that about 87% of the total FDI inflows to South Africa come from the UK, while the rest of the world account for the remaining percentage (UNCTAD 2013).

These distinctive characteristics informed this study with the intention of adopting the TY Granger causality test using one functional model to achieve the following objectives: first, carry out a country-specific study on the FDI-led growth hypothesis because of no consensus in the empirical literature (Guimaraes *et al.* 2000; Fedderke & Romm 2006; Sunde 2017; Khobai *et al.* 2017), especially for South Africa. Second, Nielsen *et al.* (2017) argued that industrialization, infrastructure improvement and the seat of power (government) that characterizes the urban centre could serve as a catalyst for attracting FDI. The study opines that urban conglomeration with improved infrastructures is an agent for attracting FDI inflow into the host country, that is, urban centres are attractive sights for the inflow of new investors into the host country. Thus, this study intends to investigate this claim by incorporating urbanization, coal usage, and CO_2 emissions in the FDI-growth hypothesis as control variables. Finally, this study investigates the growth hypothesis which posits that coal consumption is a key driver of economic expansion. Thus, this study is well articulated and will serve as a pioneer work in future research, especially in the case of South Africa.

2. Theoretical framework

This study is develpoed based on the modernization and dependency theories. The modernization theory argues that FDI inflow is an advantage for the host country especially the emerging economies because of its spillover effect in the form of, *inter alia*, technological advancement, and human capital development (Li & Liu 2005; Pradhan & Kumar 2002 and Borensztein *et al.* 1998). The school of thought believes in economic openness which facilitates the inflow of FDI, hence, FDI inflow is a key player in the economic expansion of the host country, especially developing economies. They conclude that though FDI inflows may not be totally free from negative impact, but its benefits out weigh the costs. In contrast, FDI inflow is labeled by the dependency theory as an engine for capital flight (see Adams 2009 and Chan & Clark 1996). The propagators of dependency theory argue that FDI is capable to undo the course of development through its crowding out effect, especially on the

domestic investment. Thus, profits of the foreign firm is sent back to the head office in their home country, which facilitates capital transfer from the host country. In a related development, four hypotheses have been advanced as a premise to explain the coal consumption-led growth nexus. First, the growth hypothesis asserts that economic progress is driven by coal consumption (see: Bekun *et al.* 2018; Bekun *et al.* 2019; Apergis and Payne 2010; Ziramba 2009; World-Rufael 2010, 2009, 2007, 2004; Yuan *et al.* 2007; Shui and Lam 2004). Conservative hypothesis, on the other hand, posits that demand for coal is a derivative of economic growth (see: Govindaraju and Tang 2013; Zhang and Xu 2012; Jinke *et al.* 2008; Reynolds and Kolodziej 2008; Soytas and Sari 2003). Third, the feedback hypothesis is of the view that the interaction between coal consumption and economic development is a mutual relationship (see: Belke *et al.* 2011; Fuinhas and Marques 2011; World-Rufael 2010; Paul and Bhattacharya 2004; Yuan *et al.* 2008). The neutrality hypothesis asserts that the impact of coal consumption on economic development is a fallacy (see: Ziramba 2009; Jinke *et al.* 2008; Lee and Chang 2005; Sari and Soytas 2004; Yang 2000). Thus, from a policy perspective, hypotheses one and four support the conservation policy which encourages a reduction in coal consumption, whereas hypotheses three and two assert that conservation policy is harmful to economic growth.

3. Data and Methods of Analysis

This study to investigates the causal relationship between the series by leveraging on the time series data from World Bank database ranging from 1970 to 2017. The series includes real GDP as a proxy for economic expansion, FDI net inflow (% of GDP), urbanization (URB) represent the urban population as % of the total, and coal consumption which represents the value of coal in tonnes, and carbon emission (CO_2). All series are converted to their log form to ascertain the growth rates of the series. The econometric procedure of this study consists of first, the unit root test for which the order of integration is determined in other to avoid estimation of a regression line that is spurious. Second, the estimation of cointegration to determine if a disturbance in the short is corrected in the long-run using ARDL bound testing procedure. Finally, we use the dynamic T-Y Granger causality test to determine the causal interaction between the variables of interest. The procedures of all the sections are skipped as a result of space except for the bounds test to cointegration followed briefly after the model specification.

3.1 Model Specification

The relationship establishes that carbon emission is a function of economic expansion (GDP), foreign direct investment (FDI), coal usage and industrialization. Thus, the functional form of the model for this study is expressed as:

$$CO_2 = f(GDP, FDI, COAL, URB) \quad (1)$$

$$LnCO_2 = \beta_0 + \beta_1 LnGDP + \beta_2 LnFDI + \beta_3 LnCOAL + \beta_4 LnURB + \mu_t \quad (2)$$

Where, β_0 is the model intercept, while $\beta_1, \beta_2, \beta_3$ and β_4 connote the coefficient of RGDP, FDI, Coal consumption and Industrialization.

ARDL Bounds Testing to Cointegration

This study adopts the ARDL bound testing to cointegration developed by Pesaran *et al.* (2001) due to its dynamic nature. The ARDL procedure remains indifferent irrespective of the order of integration of the series under investigation. This implies that either the order of integration is I(1), I(0), or a mixture of both, the adoption of ARDL still remain valid for the purpose of analysis. Thus, the formula is presented as:

$$\Delta Z = \mu_0 + \mu_1 t + \lambda_1 \delta_{t-1} + \sum_{i-1}^{k} \delta_1 \nu_{it-1} + \sum_{j-1}^{n} \varphi_j \Delta Z_{t-j} + \sum_{i-1}^{k} \sum_{j-1}^{n} \phi_{ij} \Delta V_{it-j} + \Upsilon D_t + \mu_t \quad (3)$$

Where v_t estimate vector and D account for an exogenous variable which is the structural break within the study scope. The empirical hypothesis of the bound using f-statistic is stated below:

$$H_0 : \lambda_1 = \lambda_2 = \ldots. = \lambda_{K+2} = 0$$
$$H_1 : \lambda_1 \neq \lambda_2 \neq \ldots. \neq \lambda_{K+2} \neq 0$$

Thus, the rejection of H_0 indicates evidence of long-run convergence between the series and vice versa.

4. Preliminary

The preliminary analysis begins with a graphical technique to show the trend of the series as presented in Figure 1. This is closely followed by the summary statistic which shows that GDP relatively exhibits the highest average. The probability of the Jargue-Bera test for three of five variables is significant,

concluding that the variables are not normally distributed. The Pearson coefficient correlation matrix (see Table 2) on the other hand reveals the outcome in line with empirical intuitions. For instance, there is a very strong interaction between CO_2 and coal consumption, which is not far from the empirical assertion that the latter is a major emitter of the former. Another significant relationship exists between urbanization and GDP indicating that the former is a driver of the later and vice versa. The results further show that coal consumption strongly correlates with GDP which confirms the growth hypothesis. Thus, on the overall, the result shows a strong positive link between the series. The stationarity test from Augmented Dickey-Fuller (ADF) test as presented in Table 3 shows that all variables are stationary at level at different statistical significance except for GDP. The same is applicable to the Phillips-Perron (PP) test. However, for ADF and PP unit root test, it is established at first difference that all series turn out to be stationary at 1% significance level except urbanization. The exceptional revelation here is that urbanization was stationary at level form but turned out to non-stationary at first difference. This could be due to variation or drift characteristic of time series data as noted by Gujarati (2009). In addition, only GDP failed to be stationary at level but turned to be stationary at first difference. The result shows a different order of integration which suggest the adoption of the autorgressive distributed lag (ARDL) bound test as the most suitable method.

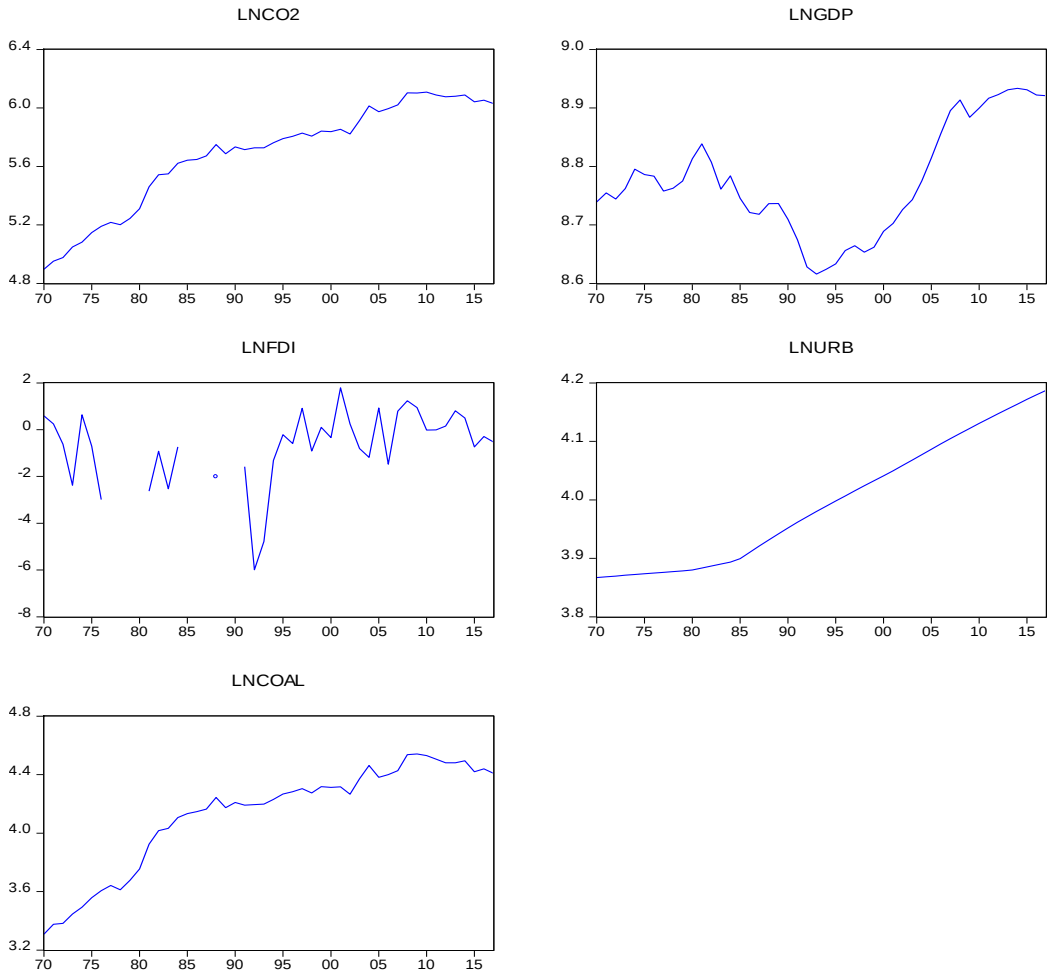

Figure 1: Visual graph of the variables

Table 1: Summary Statistics

	LNCO2	LNGDP	LNFDI	LNURB	LNCOAL
Mean	5.728704	8.781534	-0.676924	4.016755	4.167526
Median	5.821883	8.775257	-0.526894	4.024101	4.282794
Maximum	6.107774	8.933624	1.788230	4.187379	4.541417
Minimum	4.896834	8.615685	-5.993135	3.867214	3.308790
Std. Dev.	0.368005	0.103445	1.585520	0.108153	0.370087
Skewness	-1.024367	0.057322	-1.364664	-0.055998	-1.205243
Kurtosis	2.846857	1.755786	5.297031	1.644816	3.122840
Jarque-Bera	6.858735	2.536968	20.67908	3.004735	9.466494

Probability	0.032407	0.281258	0.000032	0.222603	0.008798
Sum	223.4195	342.4798	-26.40005	156.6534	162.5335
Sum Sq. Dev.	5.146245	0.406631	95.52715	0.444486	5.204650
Observations	39	39	39	39	39

Note: Natural logarithm of variables are presented

Table 2: Pairwise correlation matrix analysis

Observations	CO2	GDP	FDI	URB	COAL
CO2	1.000000				
t-Statistic	-----				
Probability	-----				
No. of obs.	48				
GDP	0.456030	1.000000			
t-Statistic	3.475360	-----			
Probability	0.0011	-----			
No. of obs.	48	48			
FDI	0.364679	0.228995	1.000000		
t-Statistic	2.656305	1.595514	-----		
Probability	0.0108	0.1174	-----		
No. of obs.	48	48	48		
URB	0.932540	0.578416	0.425519	1.000000	
t-Statistic	17.51691	4.809126	3.189141	-----	
Probability	0.0000	0.0000	0.0026	-----	
No. of obs.	48	48	48	48	
COAL	0.992918	0.368745	0.348250	0.889777	1.000000
t-Statistic	56.68603	2.690554	2.519677	13.22265	-----
Probability	0.0000	0.0099	0.0153	0.0000	-----
No. of obs.	48	48	48	48	48

Note: Series are in their level form

Table 3: Non-stationarity test (ADF and PP)

Statistics (Level)	$LNCO_2$	LNGDP	LNFDI	LNURB	LNCOAL
τ_T (ADF)	-1.142	-1.384	-3.901**	-3.759**	-1.039
τ_μ (ADF)	-3.159**	-0.874	-3.575**	-0.129	-3.165**
τ (ADF)	3.690	0.599	-3.303***	2.009	2.871
τ_T (PP)	-1.075	-1.073	-3.781**	-3.455*	-0.9439

τ_μ (PP)	-3.320**	-0.605	-3.475**	2.252	-3.321**
τ (PP)	3.186	0.855	-3.100***	6.357	2.551

Statistics (FirstDifferc)	LNGDP	LNFDI	LNFDI	LNURB	LNCOAL
τ_T (ADF)	-6.961***	-4.355***	-4.524***	-0.921	-6.867***
τ_μ (ADF)	-6.008***	-4.265***	-8.182***	-1.873	-5.934***
τ (ADF)	-4.895***	-4.253***	-8.305***	-0.129	-5.185***
τ_T (PP)	-6.975***	-4.301***	-8.458***	-0.921	-6.903***
τ_μ (PP)	-6.004***	-4.258***	-8.606***	-1.653	-5.934***
τ (PP)	-4.951***	-4.243***	-8.706***	0.097	-5.205***

Note: significance at ***0.01 and **0.05

Table 4: Lag Length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	137.6040	NA	3.52e-10	-7.577374	-7.355182	-7.500673
1	448.7944	515.6868*	2.83e-17*	-23.93111*	-22.59795*	-23.47090*

Source: Author's computation were significant at ***0.01 and **0.05

The lag length in this study is selected because all the Sequential Modified Likelihood Ratio test statistic (LR, FPE, AIC, SC & HQ) unanimously generated lag length one. Thus, lag length one is deemed most appropriate for this study since there is no conflicting interest among Sequential Modified Likelihood Ratio test statistic.

5. Empirical Analysis

Table 5 presents the empirical findings from the ARDL long-run and short-run test. The result reveals that economic expansion emits CO_2 significantly both in the long and short-run. That is about 26% of carbon emission in the short-run is a consequence of the growth process in South Africa. The same is true of 18% for the long-run. This implies that economic expansion produces emission as its consequences. The impact of FDI inflows on CO_2 emission is found to be significantly negative in both periods suggesting that FDI inflow rather slow down carbon emission by about 0.002% and 0.005% in the two separate terms. The result further indicates that the contribution of urbanization to CO_2 is positively insignificant in the short-run but turn out to be significant in the long-run. Urbanization significantly contributes to carbon emission by 35% in the long-run which is has policy implications for South Africa, pointing out that economic activities in the urban centres are in part

responsible for carbon emission. This is not far-fetched as activities in urban centres' such as industrial operation are major producers of air pollution, water pollution and generally carbon emission. Thus, the government and stakeholders must partner to devise means of curtailing and efficiently managing the emission produced from economic and commercial activities in the urban centres. A channel for proper disposal of the waste from the sources of emission must be put in place. In a related development, coal consumption contributes significantly positive to carbon emission both in the short and long-run. About 77% of carbon emission in South Africa is attributed to the operation of the coal sector in the short term, while in the distance term coal accounts for about 86% carbon emission in the economy. The revelation from this test shows that coal consumption proves to be the highest emitter of CO_2 in South Africa. The implication is that the government must implement a conservation policy to lessen carbon emission or risk pending danger of environmental degradation through carbon emission. On the other hand, after the rejection of the null hypothesis at 10, 5 and 1 percent, the cointegration bound test as presented in Table 6 reveals that the series converge in the long-run quickly with a high speed of adjustment of about 51%, as established by the error correction (ECT) term. This implies that the short-run disturbance between the series could be corrected in the nearest future. The diagnostic test as presented in part B of Table 5 reveals that the functional model of the study is free from model specification errors. The CUSUM and CUSUMSQ presented in Figure 2 and 3 indicate that the model is stable as the blue line is properly fitted into the critical boundary Okunola (2016).

Table 5: ARDL result CO_2=f(GDP,FDI,URB, COAL)

Variables	Coefficient	SE	t-statistic	P-Value
Short-run				
LNGDP	0.269***	0.062	4.339	0.000
LNFDI	-0.002**	0.001	-2.646	0.013
LNURB	0.934	1.260	0.741	0.465
LNCOAL	0.771***	0.027	28.616	0.000
ECT	-0.512***	0.085	-5.998	0.000
Long run				
LNGDP	0.187***	0.044	4.299	0.0002
LNFDI	-0.005**	0.002	-2.596	0.0147
LNURB	0.357***	0.068	5.232	0.0000
LNCOAL	0.865***	0.022	40.003	0.0000
Diagnostic Tests				
Tests	F-statistic	Prob. Value		
χ^2 *SERIAL*	1.189	0.320	F(2,27)	
χ^2 *WHITE*	1.406	0.236	F(8,29)	

χ^2 *RAMSEY*	0.027	0.974	F(2,27)

Note: ***,** and * represent 1, 5 and 10 percent respectively.

Table 6: ARDL Bounds test

Test stat.	Value	K
F-stat	5.114	4
Critical Value Bounds		
significance	I(0) Bounds	I(1) Bounds
10%	2.427	3.395
5%	2.893	4.000
1%	3.967	5.455

Source**:** Author computation

The results from the TY granger causality test in Table 7 reveal a one-way link only from GDP to CO_2 emission as supported by Govindaraju and Tang (2013) in the case of China. This implies that along the path of economic expansion in South Africa there drop the consequences of carbon emission which in turn may be harmful to the economy in the near future through environmental degradation. As a matter of urgency, the government must review the consumption of carbon emitters such as coal which are a critical factor in its growth equation to device means of effective and efficient management, otherwise, the growth process may turn out to mar the economy, particularly in the long-run. The findings uncovered a one-way link running from FDI inflow to CO_2 implying that the major types of FDI flowing to South Africa are carbon emission inherent. The government in its quest to attract new investors into the economy must as a matter of necessity put in place the necessary measures that will checkmate any expected harmful discharge emanating from FDI which is capable to pose a greater threat to economic prosperity. Furthermore, the empirical evidence proves a one-way interaction flowing from urbanization to CO_2. This is intuitively valid because urbanization connotes explosion of population and commercial activities. Commercial activities which include high industrial productivity are most at time energy-intensive, hence are not free from carbon emissions. Another outcome from the findings also shows that a bidirectional link exists only from economic prosperity to FDI inflows. It signifies that the market size (economic expansion) in South Africa to a greater extent is responsible for the attraction of FDI inflows into the economy. This empirical evidence reflects the true nature of the South African economy which is known to be among the fast-emerging economy in Africa. Thus, the policymakers and the stakeholders need to do more on

promoting the course of economic advancement, as well as, a stable macroeconomic environment to accommodate more FDI inflow and to provide a large market for their finished products. In addition, a peaceful environment in South Africa is not negotiable if the government is determined to give priority to the attraction of new investor into the economy because no successful investor will risk its resources in an unstable economic or political environment. Similarly, a bidirectional interaction exists between coal consumption and CO_2, while only one-way drive connects from GDP to coal usage. This means that coal usage in South Africa contributes significantly to carbon emission but not economic progress, contradicting the work of Bekun *et al.* 2018 and Bekun *et al.* 2019 for South Africa but supports the conservation hypothesis and other empirical studies (see: Zhang & Xu 2012; World-Rufael 2010). The implication is that conservation policy will be suitable for the South African economy without any side effect. A bidirectional relationship between GDP and urbanization implies that infrastructure and the general development of urban centres will be a thing of the past in the face of economic prosperity and vice versa. Another mutual benefit exists between urbanization and coal consumption. Notably, urbanization implies population explosion coupled with the expansion of productive economic activities which will, in turn, generate higher demand for energy for power supply. Thus, the reality of improving urban centres through infrastructural development will lead to an increased derived demand for coal consumption through energy generation for power supply. The opposite holds when more energy is demanded. This is so because energy consumption is a critical factor that drives every segment of the economy. Adequate energy supply will not just boost industrial productivity but will increase the efficiency of the national economic productivity which transcends to improving lives and wellbeing. Finally, the findings further reveal a two-way interaction between FDI inflow and urbanization confirming the economic intuition that urbanization is an active player in attracting FDI inflow as validated by Nielsen *et al.* 2017 and Guimaraes *et al.* 2000. From both business and economic perspective, it can be deduced that functional urban centres with well-developed infrastructure are undoubtedly sight attraction for investors and vice versa, consistent with our *apriori* expectation.

Table 7. Granger block exogeneity results.

Excluded	Chi-sq	df	Prob.
Dependent variable: LNCO2			
LNGDP	170.455***	3	0.0000
LNFDI	161.444***	3	0.0000
LNURB	131.633***	3	0.0000
LNCOAL	25.905***		0.0000

All	776.994***	12	0.0000
Dependent variable: LNGDP			
LNCO2	2.732	3	0.434
LNFDI	5.762	3	0.124
LNURB	36.109***	3	0.000
LNCOAL	2.837	3	0.418
All	126.107***	12	0.000
Dependent variable: LNFDI			
LNCO2	3.967	3	0.265
LNGDP	9.588**	3	0.022
LNURB	7.759**	3	0.051
LNCOAL	4.546	3	0.208
All	49.526***	12	0.000
Dependent variable: LNURB			
LNCO2	1.394	3	0.7070
LNGDP	10.462**	3	0.0150
LNFDI	7.784**	3	0.0507
LNCOAL	3.992	3	0.2624
All	249.016***	12	0.0000
Dependent variable: LNCOAL			
LNCO2	17.437***	3	0.000
LNGDP	74.545***	3	0.000
LNFDI	79.077***	3	0.000
LNURB	58.793***	3	0.000
All	283.716***	12	0.000

Note: significance at ***0.01 and **0.05

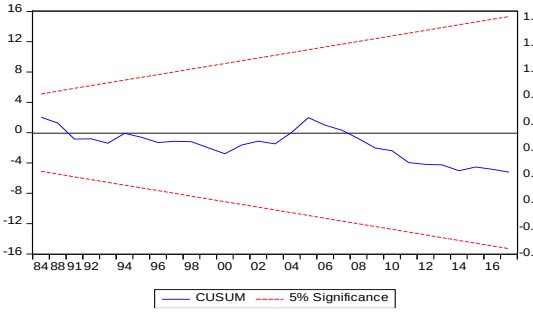

Figure 2: CUSUM

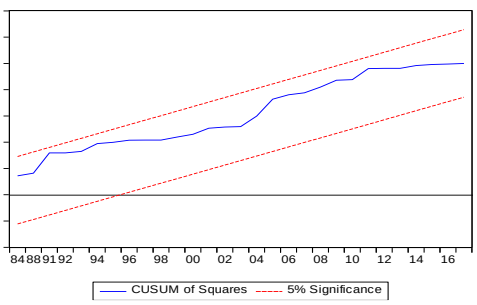

Figure 3: CUSUMSQ

6. Conclusion

This study estimated the causal relationship between FDI inflow and economic advancement in South African by incorporating urbanization, coal consumption carbon emission as additional variables, with specific emphasis on the role of urbanization. The results from the findings show that FDI exerts a

positive influence on economic advancement in South Africa in the short and long run. Similarly, the findings from the granger causality shows a two-way drive between urbanization and FDI inflow, implying that urban development in South Africa plays a vital role in promoting the course of FDI inflow into the economy, which through its spillover effect will transcend to promoting economic growth. The government of South Africa must be guided by this evidence in placing priority in terms of resource allocation. Both attention and adequate resources must be shifted to promote the course of urban development to attract significant FDI into the economy. The government of the day must embark on strategic policies such as sitting of the industrial zone and embarking on infrastructure improvement as a matter of necessity. When these are achieved, the inflows of FDI and the realization of its full potential in South Africa will naturally occur. On the other hand, a one-way link running from GDP to coal usage is consistent with the conservative hypothesis. Similarly, the bidirectional link between coal usage and CO_2 suggests that the former is an emitter of carbon emission. Thus, the empirical reality from this study speaks volume, showing that coal consumption promotes CO_2 emissions but not economic growth. Thus, embarking on effective conservation policy is not optional in the quest of South Africa to achieve economic prosperity and maintain a dynamically healthy economy. Urgent priority must be given to conservative policy to avoid the reality of the impending environmental degradation through incessant carbon emission. This is instructive enough, however, care must be taken to manage the usage of the carbon emitters such as coal, FDI, urban development and economic prosperity. Because economic growth itself is an emitter, attention must be drawn to the necessary measures that will efficiently and effectively manage the path of economic prosperity, otherwise, in the long-run economic advancement itself will turn out to be a curse rather than blessing through environmental degradation caused by emission.

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