

Hussein, Hassan Abdikadir; Warsame, Abdimalik Ali; Ahmed, Mohamed Yusuf et al.

## Periodical Part

# Unveiling the drivers of economic growth in Somalia : the role of energy consumption, environmental pollution, and globalization

International Journal of Energy Economics and Policy

## Provided in Cooperation with:

International Journal of Energy Economics and Policy (IJEEP)

*Reference:* In: International Journal of Energy Economics and Policy Unveiling the drivers of economic growth in Somalia : the role of energy consumption, environmental pollution, and globalization 15 (2025).

<https://www.econjournals.com/index.php/ijEEP/article/download/16040/8489/41089>.

doi:10.32479/ijEEP.16040.

This Version is available at:

<http://hdl.handle.net/11159/708441>

## Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics  
Düsternbrooker Weg 120  
24105 Kiel (Germany)  
E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)  
<https://www.zbw.eu/>

## Standard-Nutzungsbedingungen:

Dieses Dokument darf zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden. Sie dürfen dieses Dokument nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen. Sofern für das Dokument eine Open-Content-Lizenz verwendet wurde, so gelten abweichend von diesen Nutzungsbedingungen die in der Lizenz gewährten Nutzungsrechte. Alle auf diesem Vorblatt angegebenen Informationen einschließlich der Rechteinformationen (z.B. Nennung einer Creative Commons Lizenz) wurden automatisch generiert und müssen durch Nutzer:innen vor einer Nachnutzung sorgfältig überprüft werden. Die Lizenzangaben stammen aus Publikationsmetadaten und können Fehler oder Ungenauigkeiten enthalten.

## Terms of use:

*This document may be saved and copied for your personal and scholarly purposes. You are not to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public. If the document is made available under a Creative Commons Licence you may exercise further usage rights as specified in the licence. All information provided on this publication cover sheet, including copyright details (e.g. indication of a Creative Commons licence), was automatically generated and must be carefully reviewed by users prior to reuse. The licence information is derived from publication metadata and may contain errors or inaccuracies.*



<https://savearchive.zbw.eu/terms-of-use>



# Unveiling the Drivers of Economic Growth in Somalia: The Role of Energy Consumption, Environmental Pollution, and Globalization

Hassan Abdikadir Hussein<sup>1\*</sup>, Abdimalik Ali Warsame<sup>2</sup>, Mohamed Yusuf Ahmed<sup>3</sup>,  
Mohamed Ahmed Salad<sup>2</sup>

<sup>1</sup>Faculty of Management Science, SIMAD University, Mogadishu, Somalia, <sup>2</sup>Faculty of Economics, SIMAD University, Mogadishu, Somalia, <sup>3</sup>Faculty of Social Science, SIMAD University, Mogadishu, Somalia. \*Email: [amalow499@simad.edu.so](mailto:amalow499@simad.edu.so)

Received: 20 April 2024

Accepted: 23 September 2024

DOI: <https://doi.org/10.32479/ijeeep.16040>

## ABSTRACT

The fundamental goal of economic policy in most countries around the world is to achieve sustainable economic growth. Energy serves a crucial role in fostering sustainable economic growth in both developing and developed nations. Hence, the study aims to explore the impact of energy consumption, environmental pollution, and globalization on economic growth in Somalia using data from 1990 to 2020 for all variables. The study employs the autoregressive distributed lag (ARDL) bound test. The empirical results of the bound test indicate that energy consumption and globalization are statistically significant and have a positive effect on economic growth. In addition, environmental pollution has a negative impact on economic growth in Somalia. Moreover, the findings revealed that energy consumption and globalization promote economic growth, while environmental pollution harms economic growth in Somalia. Based on the empirical evidence, the study provides several policy implications.

**Keywords:** Economic Growth, Energy Consumption, Environmental Pollution, Globalization

**JEL Classifications:** O44, Q43, O55, F23

## 1. INTRODUCTION

The fundamental goal of economic policy in most countries around the world is to achieve sustainable economic growth. Nevertheless, the expansion of the economy can affect the phenomenon of global warming and the rise of climate change which are significant worldwide issues and topics of concern (Warsame and Sarkodie, 2022). The process of economic development and civilization resulted in an increase in the level of carbon dioxide (CO<sub>2</sub>) and other greenhouse gases (GHGs) in the atmosphere of the planet (Yurtkuran, 2021; Hussein et al., 2023). In the literature, there is a widely accepted relationship between GHG emissions, energy use, globalization, and economic output. Energy is an essential factor in promoting sustainable economic growth in both emerging and developed countries. It is regarded as an essential component in the production process, especially in industrial sectors that rely largely on energy for production (Hussein et al., 2023).

Despite energy scarcity being a significant issue for many Sub-Saharan African nations, including Somalia, it is crucial for economic development and alleviating poverty. In the context of Somali, a country that is grappling with energy shortages most urban and traditional households rely on traditional biomass, specifically charcoal and firewood, for their energy needs. This accounts for around 82% of the total energy use (Warsame et al., 2024). The significant dependence on traditional biomass not only impedes socio-economic development but also leads to environmental damage and health risks.

In addition, the utilization of traditional biomass for cooking and heating in Somalia has numerous adverse consequences. The unsustainable utilization of forests to produce charcoal results in deforestation and the loss of the environment, hence disrupting ecosystems and biodiversity. Inefficient burning of biomass fuels results in the emission of significant quantities of dangerous

pollutants. This, in turn, contributes to both interior and outdoor air pollution. The pollution issue exacerbates health diseases, particularly among women and children who are most susceptible to the fumes emitted within their homes (Warsame et al., 2024). Moreover, the shortage of energy resources limits industrial efficiency and hampers entrepreneurial endeavors, thus impeding economic growth (Ghazouani et al., 2020). The scarcity of adequate accessibility to reliable and cost-effective energy sources hampers the progress of manufacturing industries, hence restricting the generation of employment opportunities and the expansion of the economy (Raza et al., 2020). The lack of energy resources also impedes the use of contemporary technologies and green practices, obstructing the country's path toward a more environmentally friendly and healthy economy (Raza et al., 2020; Pata & Caglar, 2021).

Furthermore, The importance of globalization resides in its ability to enable the transfer of technology and foster collaboration among nations in addressing the challenge of climate change (Ansari et al., 2021). Considering the close link between the utilization of non-renewable energy sources and the rate of economic growth, the escalating worldwide need for goods and services has led to an upsurge in energy consumption (Khan et al., 2022; Abdi 2023). It is significant to point out that environmental rules implemented in developing countries frequently serve as a magnet for pollution-intensive enterprises originating from developed nations, so resulting in environmental degradation within the host regions (Wenlong et al., 2023; Shahbaz et al., 2015). The effect plays a role in the generation of emissions, as changes in manufacturing sites caused by divergent environmental regulations lead to the transfer of emissions from one nation to another. The impact of globalization on economic growth is a subject of significant consideration and academic study. Empirical studies suggest that globalization has a variety of effects on the economic growth depending on the channel via which it enters. Studies indicate that globalization promotes economic growth by enabling efficiency, innovation, and specialization (Santiago et al., 2020; Hassan et al., 2019). On the other hand, others argue that it exacerbates inequality, undermines local industry, and fosters dependence on global markets.

The economic path of Somalia is greatly impacted by globalization, which refers to the increasing interconnectedness of economies and societies. Globalization presents opportunities for trade, investment, and technological progress, but it also poses challenges in the shape of market volatility, competition, and vulnerability to external factors. Despite facing political instability and institutional inefficiencies, Somalia's integration into the global economy greatly influences its economic policies, trade relations, and investment prospects, ultimately determining its overall economic performance (Hussein et al., 2023).

The current study examines the connection between energy consumption, globalization, CO<sub>2</sub> emissions and economic growth in Somalia by using time-series data from 1990 to 2020. To the best of the authors' knowledge, there is no previous effort to analyze the connection between these variables within a single framework in the context of Somalia. Furthermore, the study utilizes advanced estimation methods, including the autoregressive distributed lag

(ARDL). This technique is applied to derive more thorough policy suggestions based on the linkage between energy consumption, globalization, environmental pollution, and economic growth of Somalia. The structure of this paper is outlined as follows. Section two represents a review of the literature. Section three delineates the econometric methods employed and the data sources utilized. The findings and discussions are presented in section four, while the concluding section offers a summary and outlines the pertinent policy implications.

## 2. LITERATURE REVIEW

### 2.1. The Impact of Energy Consumption on Economic Growth

Studies examine the relationship between energy and economic growth using four theories. First, the growth hypothesis states that a rise in energy consumption has a positive impact on economic growth, hence emphasizing the significance of energy as a crucial input for output. second hypothesis posits that A unidirectional causal relationship exists between economic growth and energy consumption, suggesting that implementing a policy aimed at reducing energy use may not harm economic growth. The third hypothesis, the feedback hypothesis posits that there is a mutual dependence between energy consumption and economic growth, with a bidirectional causal relationship between the two variables. The fourth hypothesis, the neutrality hypothesis posits that there is no causal relationship between energy consumption and economic growth, and any policy implemented on one variable will not have an impact on the other (Shahbaz et al., 2020).

Numerous studies investigate the impact of energy consumption on economic expansion. Several studies confirm that the use of energy enhances economic growth. Ivanovski et al. (2021) assessed the impact of renewable and nonrenewable energy consumption on economic growth in both OECD and non-OECD nations. By conducting cross-country analysis. They reported renewable and nonrenewable energy consumption has a positive impact on economic growth in both nations. Salari et al. (2021) conducted a study employing static and dynamic panel analysis to assess the influence of renewable and nonrenewable energy sources on economic growth within the states of the United States. The findings demonstrated that both renewable and nonrenewable energy sources contribute to the enhancement of economic growth. The study conducted by Kasperowicz (2015) examined the enduring relationship between energy consumption and economic growth in a sample of 18 European Union (EU) nations by using FMOLS and DOLS from 1995 to 2012. The results indicate a positive correlation between energy consumption and economic growth. A study conducted by Muhammad and Khan (2019), explored the relationship between energy consumption in 35 Asian host nations and 118 source countries, by employing the OLS method they revealed that energy usage promotes the economic growth of these host countries. Rahman and Velayutham, (2020) conducted a study utilizing FMOLS and DOLS methodologies to examine the impact of renewable and non-renewable energy consumption on economic growth in south Asia. They found that renewable energy and non-renewable energy stimulate economic growth. Zhang et al. (2021) conducted a study in Bangladesh using the

ARDL technique and found that both gas and household electrical energies contribute to long-term economic growth. Shastri et al. (2020) conducted a study to analyze the influence of renewable and non-renewable energy consumption on the economic growth of India. They employed the NARDL model for their analysis. The findings indicate that an increase in non-renewable energy consumption has a favorable impact on economic growth, whereas a decrease in non-renewable energy utilization has a significant negative influence on long-term economic growth.

## 2.2. The Impact of Environmental Pollution on Economic Growth

Climate change and environmental deterioration have garnered significant attention in both academic research and policy debates. Although the ample studies on the relationship between economic activity and the environment, there is a lack of empirical research investigating the reciprocal relationship, specifically if environmental deterioration has an impact on economic growth (Acheampong and Opoku, 2023). There are various mechanisms by which environmental degradation might impact economic growth. According to Ricci (2007), the impact of environmental degradation on economic growth is significant when it is viewed as both an input and a by-product of production. Ricci (2007) argues that implementing measures to regulate environmental pollution may impede economic growth by imposing additional costs or restrictions on production.

A recent study by Acheampong and Opoku, (2023). Explored the impact of Environmental degradation on economic growth in a global panel consisting of 140 countries spanning the years 1980-2021. The study employed the two-step dynamic system-generalized method of moment technique to address the issue of endogeneity. The findings of the study demonstrated that environmental deterioration declines in economic growth.

In a similar vein, Albrizio et al. (2016) contend that strict environmental regulations might place an extra cost on companies, leading them to redirect resources from profitable industries to pollution mitigation sectors. This, in turn, hinders economic growth. Moreover, considering the significance of health in enhancing economic activity. In a similar vein, Soytaş and Sari (2009) suggest that the correlation between environmental degradation and economic growth can be observed, as the implementation of policies aimed at mitigating environmental degradation can foster technological advances and enhance factor productivity.

The study conducted by Rehman et al. (2021) examined the effect of environmental pollution on economic growth in Pakistan by using the ARDL approach and analyzed data spanning from 1971 to 2017. The study revealed a positive relationship between carbon dioxide emissions in the transportation sector and economic growth in Pakistan. The study conducted by Zhai and Song (2013) revealed a positive correlation between carbon dioxide emissions and economic growth, both in the short-term and long-term.

## 2.3. The Impact of Globalization on Economic Growth

The influence of globalization on economic growth is a subject of interest among economists and academics hailing from developing

as well as developed nations. Numerous academic studies have been conducted to examine the linkages among globalization, economic freedom, and economic growth. The relationship between openness and foreign direct investment is commonly associated with economic growth, as evidenced by studies conducted by Kheng et al. (2017) and Liu and Nishijima (2013). While these two factors are often considered synonymous with globalization, it is important to acknowledge that a comprehensive understanding of globalization requires considering factors beyond its economic aspects. Globalization is believed to have three primary characteristics: Economic, political, and social. These dimensions should be considered. A study conducted by Santiago et al. (2020) examined the impact of globalization on economic growth in a group of 24 developing countries from Latin America and the Caribbean over a period ranging from 1995 to 2015. They reported that globalization has a positive effect on the long-term economic growth, as well as the economic and social aspects, of these countries. However, it was found that the political aspect of globalization did not exhibit any statistically significant impact on economic growth. Moreover, (Hassan et al. 2019) assessed the linkage between globalization and economic growth in Pakistan from 1970 to 2014 by employing the ARDL method. The study reveals that globalization increases economic growth in Pakistan. Shahbaz et al. (2016) assert that globalization produces a substantial influence on economic growth and has the potential to foster enduring economic efficiency. In contrast, Twerefou (2017) argued that globalization has a negative influence on the process of economic growth.

## 3. MATERIALS AND METHODS

### 3.1. Data Sources and Descriptions

The current study examines the impact of energy consumption, globalization, and environmental degradation on economic growth in Somalia using data from 1990 to 2020 for all variables.

Table 1 presents a detailed overview of the data, comprising its definition, source, and unit of measurement. The sample period is determined by the accessibility of the data. The World Bank, KOF, and SESRIC are the sources of all the data. The study variables includes such as environmental pollution, energy consumption, globalization, foreign direct investment, and economic growth. Heteroskedasticity was addressed by applying natural logarithm adjustments to all variables. Foreign Direct Investment (FDI) is widely recognized as playing a crucial role in driving economic

**Table 1: Data sources and description**

Variable	Code	Description	Source
Carbon dioxide emission	InCO <sub>2</sub>	Carbon dioxide emission kilotons	World Bank
Gross domestic product per capita	InRGDPC	Real gross domestic product per capita	SESRIC
Foreign direct investment	InFDI	Foreign direct investment	SESRIC world bank
Energy consumption	InEC	Total energy consumption	Our world data
Globalization	InGL	Kof Globalization index	KOF



growth. (Bermejo Carbonell and Werner, 2018; Lall and Narula, 2004) have demonstrated that foreign direct investment (FDI) has a positive impact on economic growth. Hence, foreign direct investment (FDI) is included as a control variable to account for the effects on economic growth. Natural logarithms were constructed using all variables. The data and its sources are shown in Table 1, while Figure 1 illustrates the patterns seen in the sampled variables.

### 3.2. Econometric Methodology

The study employs the ARDL technique to achieve its objective. In numerous aspects, the ARDL methodology exhibits superior performance compared to alternative cointegration strategies. The ARDL model can be effectively employed with limited sample sizes and does not require extensive time-series data. Additionally, if the variables are not integrated at the second difference I. (2), the ARDL can be employed to do a regression analysis. More importantly, when compared to previous methodologies. It does a simultaneous regression analysis of the short- and long-term cointegration of the variables (Pesaran et al., 2001).

The Following efforts of Rehman et al. (2021) Warsame and Sarkodie, (2022) Hussein et al. (2023). The ARDL co-integrating equation is written as shown in:

$$\ln GDPC_t = \beta_0 + \beta_1 \ln EC_t + \beta_2 \ln CO_{2t} + \beta_3 \ln GL_t + \beta_4 \ln FDI_t + \varepsilon_t \quad (1)$$

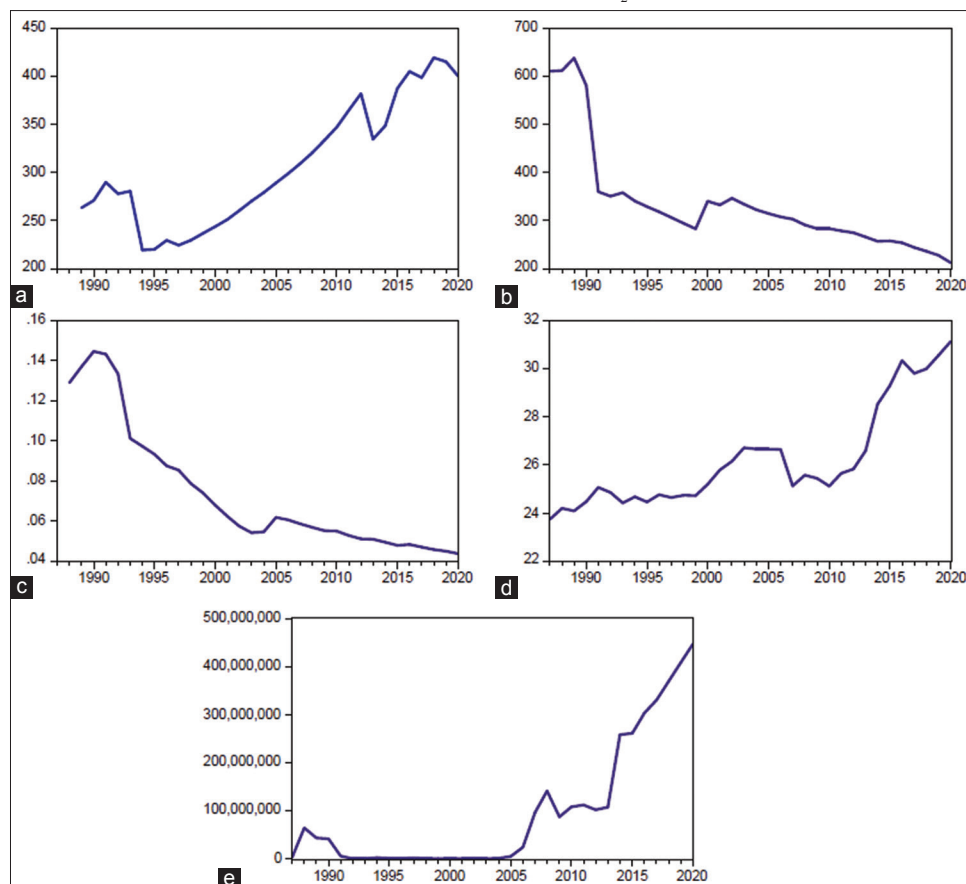
$\ln CO_{2t}$  is the log of carbon dioxide emission in year t,  $\ln EC_t$  is log of energy consumption in year t,  $\ln FDI_t$  is the log of Foreign direct

investment in year t,  $\ln GL_t$  is log of Globalization in year t,  $\ln GDP_t$  is Gross domestic product per capita and  $\varepsilon_t$  is the disturbance term in time t. Model 2 employs the similar ARDL method of cointegration, which is denoted by:

$$\begin{aligned} \Delta \ln RGDP C_t = & +\alpha_0 + \sum_{i=0}^p \Delta \alpha_1 \ln CO_{2t-k} + \sum_{i=0}^p \Delta \alpha_2 \ln EC_{t-k} + \\ & \sum_{i=0}^p \Delta \alpha_3 \ln FDI_{t-k} + \sum_{i=0}^p \Delta \alpha_4 \ln GL_{t-k} + \beta_1 \ln RGDP C_{t-1} + \\ & \beta_2 \ln EC_{t-1} + \beta_3 \ln FDI_{t-1} + \beta_4 \ln GL_{t-1} + \beta_1 \ln CO_{2t-1} \varnothing ECT_{t-1} + \Delta_t \end{aligned} \quad (2)$$

Whereas  $\alpha_{1-4}$  is the coefficient of short-run, and  $\alpha_0$  is the intercept  $\beta_{1-4}$  denote the coefficient of long-run variables,  $\Delta$  is the operator of first difference, p represents the number of lags and the ECT is the error correction term and  $\varepsilon_t$  is the error term. The significance of determining the long-term cointegration of the dependent and independent variables cannot be overestimated. Thus, the equation (2) is regressed utilizing the ordinary least squares (OLS) technique. In Somalia, the Wald F-statistic is employed to assess the alternative hypothesis, which posits the presence of cointegration between the variables, in comparison to the null hypothesis, which suggests the absence of cointegration among the variables. The hypothesis is formulated as follows:

**Figure 1:** Trend of variables: (a) RGDP. (b) Energy consumption. (c)  $CO_2$ . (d) Globalization (e) Foreign direct investment



$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5$  | The null hypothesis ( $H_0$ ): the indicators are not cointegrated.

$H_a: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$  | The alternative hypothesis ( $H_a$ ): the indicators are cointegrated.

## 4. EMPIRICAL RESULTS AND DISCUSSION

Summary statistics of the study is reported in Table 2. The mean, median, maximum, and minimum values of the sampled variables are reported. Mean values of the economic growth, FDI, energy consumption, environmental pollution, and globalization are 5.7, 16, 5.7, -2.74, and 3 respectively. FDI has the highest standard deviation value of 3.12. Moreover, all the interested variables have positive skewness except FDI which has a negative skewness. Most of the interested variables are normally and identically distributed except energy consumption. Besides, the correlations of the variables are also presented in Table 2. Energy consumption and environmental pollution are negatively related to economic growth whereas FDI and globalization are positively correlated with the economic growth.

### 4.1. Unit Root

The main objective of time series analysis is to verify the stationarity of the variables. The presence of a unit root issue in the variables may lead to the produce of inaccurate results. The Augmented Dickey-Fuller (ADF) and Philips Perron (PP) tests are employed to determine whether the variables may be affected by this problem. The null hypothesis of ADF and PP

provides evidence for the presence of a unit root issue, whereas the alternative hypothesis confirms the absence of a unit root issue. If the t-statistic of the variable exceeds the critical t-value assigned to it, we reject the null hypothesis that the data are non-stationary and do not reject the alternative hypothesis that the data are stationary. Based on the results shown in Table 3, it can be observed that all variables examined exhibit stationarity at the first difference level I (1). However, both the partial probability PP and ADF unit root tests indicate that the all variables indicate stationarity at the first difference, hence failing to reject the alternative hypothesis of stationarity. The lack of unit root problems in our data, as evidenced by the ADF and PP tests, suggests that the ARDL bound test is suitable for the data's attributes.

The result of the ARDL bound test is presented in Table 4. The bound F-statistics is 9.35 which are greater than the upper bound critical value of 4.37 at the 1% significance level. Hence, we conclude that FDI, energy consumption, environmental pollution, and globalization are cointegrated to economic growth in Somalia in the long run.

Further, the long- and short-run cointegration coefficients are reported in Table 5. It was observed that all the explanatory variables are statistically and have a positive effect on economic growth except environmental pollution that a negative coefficient. A 1% increase in FDI is translated to a 0.042% increase in economic growth in the long run. Similarly, energy consumption substantially improves economic growth. A 1% increase in energy

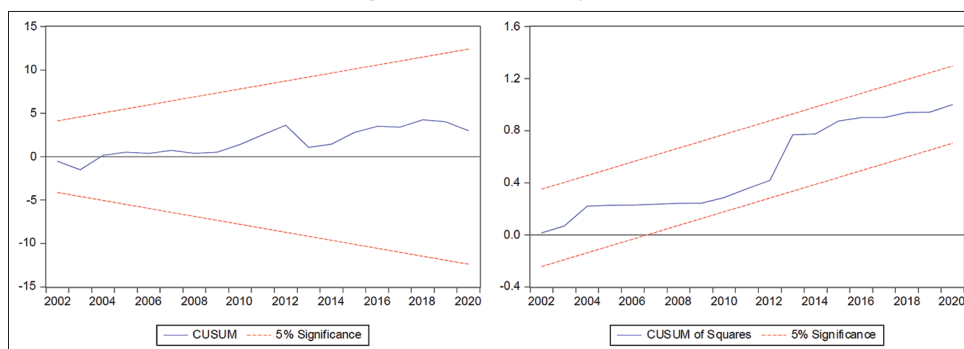
**Table 2: Summary statistics**

Statistic	lnRGDPC	lnFDI	lnENERGY	lnCO <sub>2</sub>	lnGLO
Mean	5.703590	16.11372	5.729237	-2.740276	3.269082
Median	5.668206	17.26327	5.719302	-2.862965	3.243020
Maximum	6.039016	19.91807	6.458678	-1.933093	3.438375
Minimum	5.390349	10.59663	5.357038	-3.158251	3.181449
Std. Dev.	0.207646	3.121612	0.225907	0.349700	0.076582
Skewness	0.127274	-0.366497	1.489080	0.998635	0.998273
Kurtosis	1.776961	1.698207	6.242806	2.983274	2.652209
Jarque-Bera	2.080825	2.975927	25.84698	5.319155	5.476208
Probability	0.353309	0.225832	0.000002	0.069978	0.064693
Correlation					
lnRGDPC	1				
lnFDI	0.808	1			
lnENERGY	-0.589	-0.387	1		
lnCO <sub>2</sub>	-0.650	-0.432	0.851	1	
lnGLO	0.785	0.584	-0.685	-0.718	1

**Table 3: Unit root tests**

Variable	ADF level intercept	Intercept and trend	PP level intercept	Intercept and trend
LCO <sub>2</sub>	-1.2996	-1.9378	-1.2660	-1.3698
LEC	-1.9611	-2.3998	-2.1099	-2.2369
LGDPC	-0.3637	-2.0932	-0.3637	-2.0058
LGLO	0.4071	-1.0228	0.0566	-1.4468
LFDI	-1.2215	-1.9831	-1.2871	-2.0311
	First difference intercept	Intercept and trend	First difference intercept	Intercept and trend
LCO <sub>2</sub>	-3.6436***	-4.3714***	-4.1045***	-4.6555***
LEC	-7.003***	-3.9041***	-4.9593***	-4.9950***
LGDPC	-3.8091***	-4.0935***	-5.1501***	-5.1921***
LGLO	-4.6512***	-4.8241***	-4.7357***	-4.8465***
LFDI	-5.7193***	-5.8373***	-5.7152***	-5.8388***

\*\*\*, \*\*, and \* show significance level at 10%, 5%, and 1%, respectively

**Figure 2:** Model stability tests**Table 4: ARDL bounds test**

F-statistic	9.355267	K (4)
<b>Critical value bounds</b>		
<b>Significance</b>	<b>10 Bound</b>	<b>11 Bound</b>
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

K: Number of independent variables

**Table 5: Long- and short-run results**

Variable	Coefficient	Std. error	t-Statistic	Prob.
<b>Long run result</b>				
lnFDI	0.0426	0.0051	8.3342	0.0000
lnENERGY	0.6295	0.1584	3.9723	0.0008
lnCO <sub>2</sub>	-0.6084	0.1188	-5.1178	0.0001
lnGLO	0.5882	0.2458	2.3924	0.027
Constant	-2.1942	1.4020	-1.5649	0.134
<b>Short-run result</b>				
Δ (LFDI)	-0.0007	0.0051	-0.1527	0.8803
Δ (LFDI(-1))	-0.0116	0.0057	-2.0515	0.0543
Δ (LENERGY)	0.0159	0.0723	0.2207	0.8277
Δ (LENERGY(-1))	-0.3427	0.1001	-3.4248	0.0028
Δ (LENERGY(-2))	-0.3815	0.0814	-4.6886	0.0002
Δ (LCO <sub>2</sub> )	0.016665	0.139748	0.119249	0.9063
Δ (LGLO)	0.172260	0.306571	0.561892	0.5808
ECT(-1)	-0.670258	0.083523	-8.024825	0.0000

**Table 6: Diagnostic tests**

Reset test	0.017 [0.895]
Adjusted R-square	0.965
Heteroskedasticity test	0.837 [0.519]
Serial correlation test	1.635 [0.082]
Normality	2.398 (0.302)

T-statistics values are in (.) parenthesis. P-values are in [.]

consumption is associated with 0.62% increase in economic growth in the long run. Notably, energy consumption has the highest coefficient elasticity compared to other independent variables. Moreover, globalization is a greasing wheel for economic growth in Somalia. A 1% increase in globalization leads to 0.58% increase in economic growth in the long run. On the contrary, environmental pollution, measured for CO<sub>2</sub> emissions, impedes economic growth in Somalia in the long run. A 1% increase in environmental pollution results in 0.60% decrease in economic growth in the long run.

The short run result of the study is also reported in Table 3. Most of the independent variables are statistically insignificant in the short run. But the previous value of FDI has a mitigating effect on economic growth in the short run. A 1% increase in the previous value of FDI reduces economic growth by about 0.011% in the short run. Similarly, the previous year value of energy consumption reduces economic growth by about 0.34% in the short run. More importantly, the error correction term (ECT) is significant and has a negative coefficient as expected. Any shock deviation occur in economic growth in the short run is adjusted 67% in the long run by the sampled independent variables annually.

To find out robust results, we perform several diagnostic tests such as serial correlation, heteroskedasticity, normality, model misspecification, and model stability tests. Hence, the result model of the study has passed all the diagnostic problems as reported in Table 6. It is also stable as shown in Figure 2 – CUSUM and CUSUM square tests.

This result aligns with the study conducted by Ivanovski et al. (2021), and Kasperowicz (2015), Salari et al. (2021) which concluded that energy consumption enhances economic growth in OECD and non-OECD nations, 18 European Union (EU) nations. And United States respectively. Moreover, This study is in line with Santiago et al. (2020) and Hassan et al. (2019) who revealed that globalization enhances economic growth. In contrast, Wabena (2017) stated that globalization hinders the process of economic growth. Furthermore, This study is supported by Acheampong and Opoku, (2023), and Albrizio et al. (2016) who demonstrated that environmental deterioration declines economic growth., in contrast, the study by Rehman et al. (2021) and Zhai and Song (2013) reported that environmental d pollution in economic promotes growth.

## 5. CONCLUSION

Sustainable economic growth is the main goal of economic policy in most countries worldwide. Energy plays an essential part in facilitating sustainable economic growth in both emerging and developed countries. Hence, the study aims to explore the impact of energy consumption, environmental pollution, and globalization on economic growth in Somalia using data from 1990 to 2020 for all variables. The study employs the autoregressive distributed lag (ARDL) bound test. The empirical results of the bound test

indicate that energy consumption and globalization are statistically significant and have a positive effect on economic growth. However, environmental pollution harms economic growth in Somalia.

Based on the empirical evidence, the study offers several policy implications. To optimize the potential positive effects of energy consumption on economic growth, the government and pertinent stakeholders need to provide precedence to policies and initiatives that foster the advancement of energy infrastructure, renewable energy sources, and efficient energy systems. This encompasses the strategies of attracting both domestic and foreign investments, establishing legislative frameworks that are conducive to growth, fostering collaborations between public and private entities, and improving technical and vocational training programs to cultivate a proficient workforce within the energy industry. Somalia can unlock economic growth potentials, raise productivity across industries, stimulate job creation, and improve overall socio-economic development by addressing energy availability and supporting sustainable energy usage. In addition, Globalization offers several opportunities for countries such as Somalia to broaden their market reach, allure global capital inflows, and get entry to novel technology and expertise. To leverage the advantages of globalization, policymakers must give priority to strategies that involve the reduction of trade barriers, the enhancement of infrastructure and logistics, the improvement of connectivity, and the cultivation of a conducive business environment. This includes the execution of trade agreements, the optimization of customs procedures, the allocation of resources towards transportation and communication networks, and the provision of assistance to domestic firms to enhance their competitiveness in global markets. Moreover, allocating resources towards education and enhancing skills can facilitate the workforce's ability to adjust to the requirements of the global market, thereby promoting creativity and productivity. Through the adoption of globalization and the implementation of supportive policies, Somalia has the potential to foster economic growth, generate employment prospects, and enhance the quality of life for its populace.

Furthermore, To address the negative impacts of environmental pollution on economic growth, policymakers must give emphasis to policies that effectively enforce environmental standards, foster the adoption of clean technologies, and provide incentives for sustainable behaviors across many sectors. These measures encompass the enforcement of more stringent rules for emissions and waste management, allocation of resources towards renewable energy sources, advocacy for sustainable agricultural and fisheries practices, and the dissemination of information to enhance public consciousness regarding the significance of environmental preservation. Somalia can safeguard its natural resources, enhance public health, attract environmentally conscious investments, and promote resilient and environmentally responsible long-term economic growth by tackling environmental pollution and adopting sustainable practices.

## 6. ACKNOWLEDGMENT

This study is supported by Simad university.

## REFERENCES

- Abdi, A.H. (2023), Toward a sustainable development in sub-Saharan Africa: Do economic complexity and renewable energy improve environmental quality? *Environmental Science and Pollution Research*, 30(19), 55782-55798.
- Acheampong, A.O., Opoku, E.E.O. (2023), Environmental degradation and economic growth: Investigating linkages and potential pathways. *Energy Economics*, 123, 106734.
- Albrizio, S., Koźluk, T., Zipperer, V. (2016), Environmental policies and productivity growth: Evidence across industries and firms. *Journal of Environmental Economics and Management*, 81, 209-226.
- Ansari, M.A., Haider, S., Masood, T. (2021), Do renewable energy and globalization enhance ecological footprint: An analysis of top renewable energy countries? *Environmental Science and Pollution Research*, 28(6), 6719-6732.
- Bermejo Carbonell, J., Werner, R.A. (2018), Does foreign direct investment generate economic growth? A new empirical approach applied to Spain. *Economic Geography*, 94(4), 425-456.
- Ghazouani, T., Boukhatem, J., Yan Sam, C. (2020), Causal interactions between trade openness, renewable electricity consumption, and economic growth in Asia-Pacific countries: Fresh evidence from a bootstrap ARDL approach. *Renewable and Sustainable Energy Reviews*, 133, 110094.
- Hassan, S.T., Xia, E., Huang, J., Khan, N.H., Iqbal, K. (2019), Natural resources, globalization, and economic growth: Evidence from Pakistan. *Environmental Science and Pollution Research*, 26, 15527-15534.
- Hussein, H.A., Khalif, M.A., Warsame, A.A., Barre, G.M. (2023), The impact of trade openness on economic growth in Somalia. *International Journal of Sustainable Development and Planning*, 18(1), 327-333.
- Hussein, H.A., Warsame, A.A., Barre, G.M., Salad, M.A. (2023), The Nexus between economic growth, energy consumption, and environmental degradation in Kenya. *International Journal of Energy Economics and Policy*, 13(6), 220-226.
- Ivanovski, K., Hailemariam, A., Smyth, R. (2021), The effect of renewable and non-renewable energy consumption on economic growth: Non-parametric evidence. *Journal of Cleaner Production*, 286, 124956.
- Kasperowicz, R. (2015), Economic growth and CO<sub>2</sub> emissions: The ECM analysis. *Journal of International Studies*, 8(3), 91-98.
- Khan, H., Weili, L., Khan, I. (2022), Environmental innovation, trade openness and quality institutions: An integrated investigation about environmental sustainability. *Environment, Development and Sustainability*, 24, 3832-3862.
- Lall, S., Narula, R. (2004), Foreign direct investment and its role in economic development: Do we need a new agenda? *The European Journal of Development Research*, 16, 447-464.
- Pata, U.K., Caglar, A.E. (2021), Investigating the EKC hypothesis with renewable energy consumption, human capital, globalization and trade openness for China: Evidence from augmented ARDL approach with a structural break. *Energy*, 216, 119220.
- Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289-326.
- Rahman, M.M., Velayutham, E. (2020), Renewable and non-renewable energy consumption-economic growth nexus: New evidence from South Asia. *Renewable Energy*, 147, 399-408.
- Raza, M.Y., Wasim, M., Sarwar, M.S. (2020), Development of renewable energy technologies in rural areas of Pakistan. *Energy Sources, Part A: Recovery, Utilization and Environmental Effects*, 42(6), 740-760.
- Rehman, A., Ma, H., Ozturk, I., Murshed, M., Dagar, V. (2021),



- The dynamic impacts of CO<sub>2</sub> emissions from different sources on Pakistan's economic progress: A roadmap to sustainable development. *Environment, Development and Sustainability*, 23(12), 17857-17880.
- Ricci, F. (2007), Channels of transmission of environmental policy to economic growth: A survey of the theory. *Ecological Economics*, 60, 688-699.
- Salari, M., Kelly, I., Doytch, N., Javid, R.J. (2021), Economic growth and renewable and non-renewable energy consumption: Evidence from the U.S. States. *Renewable Energy*, 178, 50-65.
- Santiago, R., Fuinhas, J.A., Marques, A.C. (2020), The impact of globalization and economic freedom on economic growth: The case of the Latin America and Caribbean countries. *Economic Change and Restructuring*, 53(1), 61-85.
- Shahbaz, M., Mallick, H., Mahalik, M.K., Loganathan, N. (2015), Does globalization impede environmental quality in India? *Ecological Indicators*, 52, 379-393.
- Shahbaz, M., Raghutla, C., Chittedi, K.R., Jiao, Z., Vo, X.V. (2020), The effect of renewable energy consumption on economic growth: Evidence from the renewable energy country attractive index. *Energy*, 207, 118162.
- Shastri, S., Mohapatra, G., Giri, A.K. (2020), Economic growth, renewable and nonrenewable energy consumption nexus in India: Evidences from nonlinear ARDL approach and asymmetric causality analysis. *International Journal of Energy Sector Management*, 14(4), 777-792.
- Warsame, A.A., Alasow, A.A., Salad, M.A. (2024), Energy consumption and economic growth nexus in Somalia: An empirical evidence from nonlinear ARDL technique. *International Journal of Sustainable Energy*, 43(1), 2287780.
- Warsame, A.A., Sarkodie, S.A. (2022), Asymmetric impact of energy utilization and economic development on environmental degradation in Somalia. *Environmental Science and Pollution Research*, 29, 23361-23373.
- Wenlong, Z., Tien, N.H., Sibghatullah, A., Asih, D., Soelton, M., Ramli, Y. (2023), Impact of energy efficiency, technology innovation, institutional quality, and trade openness on greenhouse gas emissions in ten Asian economies. *Environmental Science and Pollution Research*, 30(15), 43024-43039.
- Yurtkuran, S. (2021), The effect of agriculture, renewable energy production, and globalization on CO<sub>2</sub> emissions in Turkey: A bootstrap ARDL approach. *Renewable Energy*, 171, 1236-1245.
- Zhang, G., Nuruzzaman, M., Su, B. (2021), Nexus between household energy consumption and economic growth in Bangladesh (1975-2018). *Energy Policy*, 156, 112420.