Hlongwane, Nyiko Worship; Daw, Olebogeng David

Article

Electricity trade and economic growth in South Africa

International Journal of Energy Economics and Policy

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2023, 13(5), 355-364.

Electricity Trade and Economic Growth in South Africa

Nyiko Worship Hlongwane*, Olebogeng David Daw

School of Economics, North-West University, South Africa. *Email: nyikowh@gmail.com

Received: 15 April 2023 **Accepted:** 13 August 2023 **DOI:** https://doi.org/10.32479/ijeep.14722

ABSTRACT

The study investigates the relationship between electricity trade and economic growth in South Africa. The study utilised time series data spanning from 1985 to 2022 collected from secondary sources like the Quantec. The study employed DF-GLS and KPSS unit root, ARDL Bounds cointegration test, ARDL ECM model, Granger causality and residual diagnostics tests. The study discovered the presence of short and long run negative relationships between electricity trade and economic growth in South Africa. The Granger causality revealed unidirectional causality running from economic growth to electricity generation in South Africa. The study recommends the reduction of electricity trade to boost economic growth in South Africa for the period understudy. The study further makes the following recommendations, in future the studies should consider investigating electricity infrastructure and economic growth in South Africa utilising either time series or panel data analysis.

Keywords: Electricity Trade, Economic Growth, ARDL Model, Granger Causality, South Africa
JEL Classifications: C1, C29, Q43, P18

1. INTRODUCTION

South Africa is one of the economies characterised by high imports and less exports since it is a developing country that lacks many skills and expertise to produce goods locally. This has led to South African economy relying much on trade up to an extent that it also involves the import and export of electricity with its neighbouring countries through the South African Power Pool (SAPP) created in August 1995 to facilitate energy in SADC region. Despite efforts to try balance the gap between electricity demand and supply by trade of electricity, South Africa is still suffering from loadshedding since 2007 that has negatively affected economic activities and led to economic growth declining.

Several scholars has conducted studies on the nexus of economic growth that include electricity generation, consumption and loadshedding in South Africa such as Lenoke (2017), Khobai et al. (2016), Khobai (2018a), Khobai (2018b), Khobai (2021), Hlongwane and Daw (2021a), Stungwa et al. (2022), Hlongwane and Daw (2021b) and Hlongwane and Daw (2022) but none of them has investigated the nexus between electricity trade and economic growth in South Africa. This study investigates the relationship between electricity trade and economic growth in South Africa. It is important to conduct this study as it will help policymakers, Eskom, and the South African government to discover how electricity trade affect the economy and formulate policies that can enable electricity trade to drive economic growth that is direly needed to reduce issues such as high unemployment, high level of inequality and poverty. This study covers the period from 1985 to 2022 due to the availability of data from Quantec that will help also understudy the effect loadshedding have on the entire electricity and economic growth nexus.

1.1. Overview of the Study

Energy is the lifeblood of the South African economy and is an important sector of the economy that creates jobs and value by extracting, transforming, and distributing energy goods and services throughout the economy (DMRE, 2022). The industrial sector contributed to 51%, transport sector 26%, commerce and public 11%, residential 7% and non-specified 3% of electricity consumed in South Africa in 2018 according to the Department of

Energy and Minerals. In analysing the sub-sectors of the industrial sector, chemical and petrochemical industries consumed 28%, iron and stell 13%, mining and quarrying 10%, non-ferrous metals 7%, non-metallic metals 3%, food and tobacco 1%, construction 1% and 37% from non-specified industries. In analysing the residential sector, the consumption of electricity amounted to 76% of the total energy consumed in the sector with 12% from renewables, 7% from geothermal and 5% from coal. This is a clear indication of how electricity is important for the growth of South African economy.

Hlongwane and Daw (2021a) notes the backlogs in and inadequate maintenance, low reserve levels, and insufficient coal supplies and frequent usage of substandard coal as major difficulties for Eskom's generation capabilities, the scholars also suggest retrofitting of coal-fired power stations to ensure the ongoing functioning of these old power plants. As Khobai (2018a) recommends that the South African government should make appropriate effort to select energy policies that do not negatively affect economic growth, this study will look further into analysing how electricity trade can improve economic growth in South Africa. Several studies in energy economics argues that electricity consumption and electricity generation leads to economic growth such as the studies of Hlongwane and Daw (2021b), Hlongwane and Daw (2021a), Stungwa et al. (2022), Hlongwane and Daw (2022), Hlongwane et al. (2023), Sarker and Alam (2010), Bayraktutan et al. (2011), Marques et al. (2014), Khobai (2018a), Oryani et al. (2020) and Azam et al. (2021). However, there are studies that found the detrimental effect of electricity generation and consumption on economic growth such as the studies of Maslyuk and Dharmaratna (2013), Hdom (2019), Lean and Smyth (2010), Ohler and Fetters (2014), Ha and Ngoc (2021), Bhattacharya et al. (2016) and Menyah and Wolde-Rufael (2010). The main objective of this study is to analyse electricity trade and economic growth in South Africa for the period from 1985 to 2022. The results of this study will add new insights in the field of energy economics by investigating electricity import and export's effects on the growth of the South African economy. Majority of the studies on trade focuses on trade in general, however this study narrows the focus to specifically electricity import and export in South Africa. The study continues to discuss literature review as shown in the section below.

2. LITERATURE REVIEW

This section consists of the theoretical and empirical literature of trade and economic growth in the context of various developed and developing country as well as in the context of South Africa. The theoretical review will focus on the theories of trade and economic growth. The empirical review will highlight the work of different scholars and their findings as their implications for trade and economic growth.

2.1. Theoretical Literature

The absolute advantage theory proposed by Adam Smith in 1776. According to Smith (1937), the theory says that countries should focus on producing such products that they can produce efficiently at lower cost as compared to other countries. Manufacturing a product in which a particular country specialises is quite advantageous for them. Countries should produce and export such goods which can produce efficiently and import those goods that the produce relatively less efficiently and this will allow mutual beneficial trade for both countries. David Ricardo in 1817 proposed a theory of comparative advantage. Ricardo (1817) argues that if a country cannot produce goods more efficiently than other countries then it should only produce such goods in which it is most efficient. Countries should specialize and export such products in which it has a less absolute disadvantage as compared to other products.

Heckscher-Ohlin theory of international trade was developed by Eli Heckscher and Bertil Ohlin and it is also referred to as the factors proportion theory and states that the country will produce and export those goods whose production require those factory which are in great supply in-country and have low manufacturing cost (Samuelson, 1981). Whereas it will import all such goods whose production requires nation's scarce and expensive factors and have high demand. Trade relations are identified by factor endowment rather than productivity, according to this idea. The cost of any commodity or resource is simply a function of supply and demand. Raymond Vernon established the Product Life Cycle Theory in 1970. It claims that initially, new products would be manufactured and exported from the nation of innovation. When demand for the product increases, the government will make foreign direct investments in other countries and build numerous production units to match the demand (Vernon, 1970). The sites of product manufacturing and sales fluctuate during its life cycle or as the product matures.

2.2. Empirical Literature

2.2.1. Studies that focused on electricity consumption and generation on economic growth

Can and Korkmaz (2019) investigates the relationship between renewable energy and economic growth in Bulgaria using annual data from 1990 to 2016. The results of ARDL revealed that renewable energy generation and consumption cause economic growth. Shahbaz and Feridun (2012) explore the effects of financial development, economic growth, coal consumption and trade openness in Pakistan from 1965 to 2008 utilising the ARDL and ECM models. The results revealed that electricity consumption causes environmental degradation. Marinaș et al. (2018) examines the correlation between economic growth and renewable energy consumption for ten EU member countries from 1990 to 2014 using the ARDL model. The results reveal positive relationship between electricity consumption and economic growth and bidirectional causality. Yildirim et al. (2012) investigates the relationship between renewable energy consumption and economic growth in USA using causality models and suggest that countries should focus on energy generation from waste as an alternative resource. Namahoro et al. (2021) examine the impact of total energy consumption and economic growth for 75 countries from 1980 to 2016 ARDL method and recommend that policy makers to put policies that attract investors in renewable energy projects to ensure that renewable energy positively affect economic growth.

Using threshold model, Chen et al. (2020) examine the relationship between renewable energy consumption and economic growth from 1995 to 2015 and found that there is no relationship between energy consumption and economic growth in the 103 countries. Fotourehchi (2017) using ECM model discovered positive relationship between energy consumption and economic growth in 42 developing countries from 1990 to 2012. Bernard and Obi (2016) found that positive relationship of energy consumption on economic growth in Nigeria and recommend the formulation of policies aimed at encouraging the industrial sector to enhance economic growth and encourage energy consumption by the industrial sector. Using the ARDL and VECM models on data from 1990 to 2018, Khobai (2021) suggest the importance of policies that promote the implementation of clean energy technology to alleviate poverty in South Africa. Utilising multivariate Granger causality model on data from 1970 to 2010 in Turkey, Alt and Kum (2013) found bidirectional causality running from economic growth to electricity generation and recommend the reduction of electricity generation as it is detrimental to economic growth. Marques et al. (2014) utilising panel ECM model from 2004 to 2013 in Greece, discovered positive relations of electricity generation on economic growth and recommend incorporation of Greek technology into renewable electricity generation to enhance economic growth. Utilising ARDL model from 2010 to 2014 in France, Marques et al. (2016) recommend the reduction in nuclear sources as it is detrimental to economic growth. Khobai (2018a) utilising VECM Granger causality model from 1997 to 2012 recommend that South African government should make appropriate effort to select energy policies that do not negatively affect economic growth. Azam et al. (2021) utilising PARDL and Granger causality model recommend the increase of investment in renewable electricity generation through tax credits, renewable energy portfolio standards and certification of renewable energy markets as it boost economic growth.

2.2.2. Studies that focused on trade and economic growth

Singh (2010) surveys the literature on the relationship between international trade and economic growth specifically focusing on the role of GATT/WTO in fostering free trade. The macroeconomic evidence provides a dominant support for the positive and significant effects of trade on output and growth, while microeconomic evidence lends larger support to the exogenous effects of productivity on trade, as compared to the effects of trade on productivity. The study notes that it is difficult to disentangle the effects of trade policies from those of other macroeconomic policies and unequivocally interpret the observed correlations between trade policies and economic growth. Busse and Königer (2012) investigate the relationship between trade and economic growth in 108 countries using panel data spanning from 1971 to 2005. The study adopted the OLS and the System GMM model and the results revealed the positive and highly significant impact on economic growth of trade. Omri et al. (2015) examines the relationship between financial development, CO_2 emissions, trade and economic growth using simultaneous-equation panel data models for a panel of 12 MENA countries over a period from 1990 to 2011. The results indicated bidirectional causality between trade openness and economic growth.

Tahir et al. (2014) surveys the available empirical literature on the relationship between trade openness and economic growth and the study concludes that there is a positive relationship between trade openness and economic growth. Shahbaz et al. (2013) examines the linkages among economic growth, energy consumption, financial development, trade openness and CO_2 emissions over the period of 1975Q1 to 2011Q4 in Indonesia. The study employed the VECM Granger causality model, and the results revealed that trade openness compact economic growth. Sebri and Ben-Salha (2014) investigates the causal relationship between economic growth and renewable energy consumption in the BRICS countries over the period from 1971 to 2010. The results of the ARDL and VECM-Granger causality reveals significant relationship between trade openness and electricity consumption on economic growth. Belloumi (2014) investigated the relationship between foreign direct investment, trade openness and economic growth in Tunisia from 1970 to 2008. The study employed the ARDL model, and the results revealed that there is no causal relationship between trade openness and economic growth. Shahbaz et al. (2013) investigates the relationship between energy use and economic growth by incorporating financial development, international trade, and capital in China for the period from 1971 to 2011. The study employed ARDL and Granger causality model and the results revealed that there is bidirectional causality between international trade and economic growth.

Tahir and Khan (2014) investigates trade openness and economic growth in the Asian region using panel estimation techniques and the results revealed that trade openness has contributed significantly to economic growth. Menyah et al. (2014) examines the causal relationship between financial development, trade openness and economic growth in African using panel causality approach and the results revealed that financial development and trade liberalization do not seem to have made a significant impact on growth. Kasman and Duman (2015) investigates the causal relationship between energy consumption, carbon dioxide emissions, economic growth, trade openness and urbanization utilising panel model for the period from 1992 to 2010. The empirical results revealed that there is statistically significant relationship between trade and economic growth. Zahonogo (2016) investigates how trade openness affects economic growth in developing countries of Sub-Saharan Africa using dynamic pooled group mean estimator for the period from 1980 to 2012. The results reveal non-linear relationship between the variables and recommend that SSA countries must have more effective trade openness particularly by controlling import levels to boost their economic growth through international trade. Rahman and Mamun (2016) investigates energy use, international trade and economic growth nexus in Australia utilising the ARDL model for the period from 1960 to 2012. The Granger causality results revealed that there is bidirectional causality between international trade and economic growth. Chen et al. (2022) investigates the trade openness, economic growth, and energy intensity in China from 2005 to 2018.

The empirical literature provided the literature on trade and economic growth as well as electricity generation and consumption on economic growth from different scholars. It can be seen from the literature that there is a gap in terms of investigation electricity trade and economic growth since the studies that focused on trade did not include electricity trade specifically and those that focused on generation and consumption of electricity did not incorporate electricity trade to stand on its own as a control variable. The significance of this study is to investigate the impact of electricity trade on economic growth in South Africa from 1985 to 2022.

3. METHODOLOGY

3.1. Model Specification

The study investigates the relationship between electricity trade and economic growth in South Africa. The study utilises electricity import, electricity export, electricity consumed in power stations, electricity generation and gross domestic product to formulate a multivariate model. The linear multivariate model used in this study is therefore specified as follows:

$$LGDP_t = \alpha + \alpha_{LEIMP} LEIMP_t + \alpha_{LEEXP} LEEXP_t + \alpha_{LECPS} LECPS_t + \alpha_{LGEN} LGEN_t + \varepsilon_t \quad (1)$$

Where LGDP is the natural logarithm of gross domestic product per capita representing economic growth, LEIMP is the logged electricity import, LEEXP is the logged electricity export, LECPS is the logged electricity consumed in power stations, LGEN is the logged electricity generation, a is the constant and ε_t is the error term.

3.2. Data Sources

The study utilises annual time series data from 1985 to 2022 collected from secondary sources such as World Bank and Quantec Easy-Data as shown in Table 1.

3.3. Data Analysis

3.3.1. Unit root test

The study employ the Dickey-Fuller Generalised Least Squares (DF-GLS) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root test proposed by Elliott et al. (1992) and Kwiatkowski et al. (1992) respectively. The KPSS stationarity test is for testing the null hypothesis (H_0) that observable time series is stationary around deterministic trend against the alternative hypothesis (H_1) of a unit root. The null hypothesis (H_0) is rejected at 1%, 5% and 10% level of significance if the KPSS LM statistic is greater than the LM critical statistics and conclude that the series is not stationary. For the DF-GLS unit root test, if the computed DF-GLS test statistic is greater than the critical values at 1%, 5% and 10% level of significance the null hypothesis (H_0) is rejected and conclude that the series is stationary. The study employs the VAR optimal lags model to determine the appropriate number of lags to use in the model as some relationship depend on previous periods.

Table 1: Data sources and description

Variable	Unit	Description	Source
LGDP	%	GDP per capita annual growth rate	World Bank
LEIMP	GWh	Logged electricity import	Quantec
LEEXP	GWh	Logged electricity export	Quantec
LECPS	GWh	Logged electricity consumed in power stations and auxiliary systems	Quantec
LGEN	GWh	Logged electricity generation	Quantec

Source: Author's compilation

3.3.2. Co-integration test

The study employs the ARDL Bounds test to check for cointegration relationship among the variables proposed by Pesaran et al. (2001). After the presence of cointegration relationships, the study will estimate both short run and long run relationships. The ARDL Bounds test is preferred more than other cointegration models such as of Engle and Granger (1987) and Johansen (1988) because it does not require the underlying variables to be integrated of the same order, it uses single reduced for of equation to examine long run relationships and it is possible to test for cointegration with small sample data. The ARDL models employed in this model are given below:

$$\begin{aligned}\Delta LGDP_t = {} & \alpha_1 + \alpha_T T + \alpha_{LGDP} LGDP_{t-1} + \alpha_{LEIMP} LEIMP_{t-1} \\ & + \alpha_{LEEXP} LEEXP_{t-1} + \alpha_{LECPS} LECPS_{t-1} \\ & + \alpha_{LGEN} LGEN_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta LGDP_{t-i} \\ & + \sum_{j=1}^{q} \alpha_j \Delta LEIMP_{t-j} + \sum_{k=1}^{r} \alpha_k \Delta LEEXP_{t-k} \\ & + \sum_{m=1}^{s} \alpha_m \sum_{m=0}^{s} \alpha_m \Delta LGEN_{t-m} + \varepsilon_{1t} \end{aligned} \quad (2)$$

$$\begin{aligned}\Delta LEIMP_t = {} & \alpha_1 + \alpha_T T + \alpha_{LEIMP} LEIMP_{t-1} + \alpha_{LGDP} LGDP_{t-1} \\ & + \alpha_{LEEXP} LEEXP_{t-1} + \alpha_{LECPS} LECPS_{t-1} \\ & + \alpha_{LGEN} LGEN_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta LGDP_{t-i} \\ & + \sum_{j=1}^{q} \alpha_j \Delta LEIMP_{t-j} + \sum_{k=1}^{r} \alpha_k \Delta LEEXP_{t-k} \\ & + \sum_{m=1}^{s} \alpha_m \Delta LGEN_{t-m} + \varepsilon_{2t} \end{aligned} \quad (3)$$

$$\begin{aligned}\Delta LEEXP_t = {} & \alpha_1 + \alpha_T T + \alpha_{LEEXP} LEEXP_{t-1} + \alpha_{LEIMP} LEIMP_{t-1} \\ & + \alpha_{LGDP} LGDP_{t-1} + \alpha_{LECPS} LECPS_{t-1} \\ & + \alpha_{LGEN} LGEN_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta LGDP_{t-i} \\ & + \sum_{j=0}^{q} \alpha_j \Delta LEIMP_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta LEEXP_{t-k} \\ & + \sum_{m=0}^{s} \alpha_m \Delta LGEN_{t-m} + \varepsilon_{3t} \end{aligned} \quad (4)$$

$$\begin{aligned}\Delta LECPS_t = {} & \alpha_1 + \alpha_T T + \alpha_{LECPS} LECPS_{t-1} + \alpha_{LEEXP} LEEXP_{t-1} \\ & + \alpha_{LEIMP} LEIMP_{t-1} + \alpha_{LGDP} LGDP_{t-1} \\ & + \alpha_{LGEN} LGEN_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta LGDP_{t-i} \\ & + \sum_{j=0}^{q} \alpha_j \Delta LEIMP_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta LEEXP_{t-k} \\ & + \sum_{m=0}^{s} \alpha_m \Delta LGEN_{t-m} + \varepsilon_{4t} \end{aligned} \quad (5)$$

$$\Delta LGEN_t = \alpha_1 + \alpha_T T + \alpha_{LGEN} LGEN_{t-1} + \alpha_{LECPS} LECPS_{t-1} + \alpha_{LEEXP} LEEXP_{t-1} + \alpha_{LEIMP} LEIMP_{t-1} + \alpha_{LGDP} LGDP_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta LGDP_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta LEIMP_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta LEEXP_{t-k} + \sum_{m=0}^{s} \alpha_m \Delta LGEN_{t-m} + \varepsilon_{5t} \quad (6)$$

LGDP is the natural logarithm of gross domestic product per capita. LEIMP is the logged electricity import. LEEXP is the logged electricity export. LECPS is the logged electricity consumed in power stations and auxiliary systems. LGEN is the logged electricity generation. T represents the period whereas Δ is the first difference operator. We assume that the residuals (ε_{1t}, ε_{2t}, ε_{3t}, ε_{4t}, ε_{5t}) are white noise and normally distributed. To assess the existence of co-integration among variables, the bounds test is based on the joint F-statistics and t-statistics. The null hypothesis for the absence of cointegration in equations 3.2 to 3.6 is as follows; H_0: $\alpha_{LGDP} = \alpha_{LEIMP} = \alpha_{LEEXP} = \alpha_{LECPS} = \alpha_{LGEN} = 0$ tested against the alternate hypothesis H_1: $\alpha_{LGDP} \neq \alpha_{LEIMP} \neq \alpha_{LEEXP} \neq \alpha_{LECPS} \neq \alpha_{LGEN} \neq 0$. Pesaran et al. (2001) provide the two sets of critical values for a particular significance. The first assumes that all the variables in the ARDL model are I(0), whereas the second assumes that the variables are I(1). If the estimated F-statistics surpass the upper critical bound value, H_0 is not accepted, and the results shows that there is cointegration. H_0 fails to be rejected if the F-statistics fall below the lower critical bound value. If the F-statistics is between the two boundaries, the cointegration test is inconclusive.

3.3.3. Granger causality

The presence of cointegration relationships does not show which variable cause one another between electricity trade and economic growth. The study will also perform granger causality test to check for causal relationships between the variables in the model. The Granger causality model helps to determine which variable causes the other between all the variables that are employed in the model. The VECM model help estimate both short and long run relationships between the variables and can detect sources of causation. The VECM-Granger model is then specified as given below in Eq3.7-3.11. In each equation, the response variable is explained by itself, the explanatory variables and error correction term.

$$\Delta LGDP_t = \alpha_{10} + \sum_{i=1}^{q} \alpha_{11} \Delta LGDP_{t-i} + \sum_{i=1}^{r} \alpha_{12} \Delta LEIMP_{t-i} + \sum_{i=1}^{s} \alpha_{13} \Delta LEEXP_{t-i} + \sum_{i=1}^{t} \alpha_{14} \Delta LECPS_{t-i} + \sum_{i=1}^{u} \alpha_{15} \Delta LGEN_{t-i} + \psi_1 ECT_{t-1} + \varepsilon_{1t} \quad (7)$$

$$\Delta LEIMP_t = \alpha_{20} + \sum_{i=1}^{q} \alpha_{21} \Delta LEIMP_{t-i} + \sum_{i=1}^{r} \alpha_{22} \Delta LGDP_{t-i} + \sum_{i=1}^{s} \alpha_{23} \Delta LEEXP_{t-i} + \sum_{i=1}^{t} \alpha_{24} \Delta LECPS_{t-i} + \sum_{i=1}^{u} \alpha_{25} \Delta LGEN_{t-i} + \psi_2 ECT_{t-1} + \varepsilon_{2t} \quad (8)$$

$$\Delta LEEXP_t = \alpha_{30} + \sum_{i=1}^{q} \alpha_{31} \Delta LEEXP_{t-i} + \sum_{i=1}^{r} \alpha_{32} \Delta LEIMP_{t-i} + \sum_{i=1}^{s} \alpha_{33} \Delta LGDP_{t-i} + \sum_{i=1}^{t} \alpha_{34} \Delta LECPS_{t-i} + \sum_{i=1}^{u} \alpha_{35} \Delta LGEN_{t-i} + \psi_3 ECT_{t-1} + \varepsilon_{3t} \quad (9)$$

$$\Delta LECPS_t = \alpha_{40} + \sum_{i=1}^{q} \alpha_{41} \Delta LECPS_{t-i} + \sum_{i=1}^{r} \alpha_{42} \Delta LEIMP_{t-i} + \sum_{i=1}^{s} \alpha_{43} \Delta LEEXP_{t-i} + \sum_{i=1}^{t} \alpha_{44} \Delta LGDP_{t-i} + \sum_{i=1}^{u} \alpha_{45} \Delta LGEN_{t-i} + \psi_4 ECT_{t-1} + \varepsilon_{4t} \quad (10)$$

$$\Delta LGEN_t = \alpha_{50} + \sum_{i=1}^{q} \alpha_{51} \Delta LGEN_{t-i} + \sum_{i=1}^{r} \alpha_{52} \Delta LECPS_{t-i} + \sum_{i=1}^{s} \alpha_{53} \Delta LEEXP_{t-i} + \sum_{i=1}^{t} \alpha_{54} \Delta LEIMP_{t-i} + \sum_{i=1}^{u} \alpha_{55} \Delta LGDP_{t-i} + \psi_5 ECT_{t-1} + \varepsilon_{5t} \quad (11)$$

Δ represents the difference operator, α_{it} is the constant term and ECT represents the error correction term derived from the long run cointegration relationships. The t-statistics is employed to test the significance of the speed of adjustment in ECT terms. The negative ECT validates long run convergence of the existence of causality among the variables. The short run causality is investigated through the Wald test on differenced lagged terms of explanatory variables.

3.3.4. Residual diagnostics test

Finally, the study will perform residual diagnostics test to check for validity of the results from the model. The study will perform the Breusch-Godfrey serial correlation test to check for any presence of serial correlation in the model. The study will perform Breusch-Pagan-Godfrey test to find out if the conditions of homoskedasticity is present or not in the model. The study will perform the Jarque-Bera test to check for normality of residuals in the model. The study will also perform stability test of CUSUM to check for stability of the residuals form the model.

4. RESULTS AND INTEPRETATION

The study conducted the unit root test through Dickey-Fuller GLS and KPSS Stationarity test as shown in Table 2. The results reveal that the variables are all stationary at first difference as shown by the result of Dickey-Fuller GLS and KPSS stationarity test. This means that the study will estimate the relationships between electricity trade and economic growth in South Africa with differenced variables at high order one I(1). This will help with avoiding spurious regressions. The study continues to perform the optimal lag length criterion as shown in Table 3 to determine the desired number of lags to utilise in the model.

The study performed the VAR optimal lag length criterion as shown in Table 3 by utilising the LogL, LR, FPE, AIC, SC, and HQ criterion. The results of the LR, FPE, and AIC reveals that the study should utilise 3 lags whilst the results of the SC and HQ reveals that the study should utilise zero lags in the model. This study, however, will rely on the automatic lags selected by

Table 2: Unit root test

Variables	Dickey-Fuller GLS unit				KPSS stationarity test			
	Constant		Trend and intercept		Constant		Trend and intercept	
	Level	Δ	Level	Δ	Level	Δ	Level	Δ
LGDP	−2.8964***	−7.5337***	−3.5156***	−5.3180***	0.3034***	0.4166***	0.1953***	0.5000
LEEXP	−0.4562	−4.4216***	−0.9365	−5.4198***	0.6658***	0.4015***	0.2069***	0.1586***
LEIMP	−1.4416	−5.7020***	−2.5132	−6.1001***	0.5543***	0.0560***	0.1052***	0.0565***
LECPS	0.5144	−4.5924***	−1.4906	−5.4518***	0.6898***	0.2421***	0.2035***	0.0585***
LGEN	−0.9056	−1.1976	−0.6515	−5.9839***	0.6435***	0.6785***	0.1943***	0.0938***

Source: Author's own computation

Table 3: Optimal lag length criterion

Lag	LogL	LR	FPE	AIC	SC	HQ
0	36.05925	NA	1.11e−07	−1.827015	−1.602550*	−1.750466*
1	59.71145	38.95656	1.22e−07	−1.747733	−0.400944	−1.288439
2	79.18978	26.35303	1.87e−07	−1.422928	1.046184	−0.580890
3	122.3432	45.69190*	8.52e−08*	−2.490779*	1.100658	−1.265996

Source: Author's computation

the ARDL model. The study therefore performs the cointegration relationships as shown in Table 4 to check for presence of long run relationships between electricity trade and economic growth in South Africa.

The results of the ARDL F-Bounds and t-Bounds test are given in Table 4. The F-Bounds has an F-statistic of 9.750444 that is greater than the critical values at 1%, 2.5%, 5% and 10% level of significance indicating that we fail to accept the null hypothesis (H_0) of no long run relationships. The t-Bounds test also has a t-statistic of −6.184655 which is smaller than the critical values at 1%, 2.5%, 5% and 10% level of significance indicating the fail to accept the null hypothesis (H_0) of no long run relationships between the variables in the model. Based on these bounds test results, the study will estimate both the short and long run relationship since it was found that there is cointegration relationships between electricity trade and economic growth in South Africa.

The study estimated the short run relationship between the variables as shown in Table 5. There is a negative statistically insignificant relationship between electricity exports and economic growth in South Africa. A 1% rise in electricity export in the short run in South Africa insignificantly result in economic growth declining by 1.52%, ceteris paribus. This implies that electricity export is not good for the growth of the South African economy though the impact is insignificant. This brings to the support of the view that electricity trade in terms of electricity export is not good for the growth of the South African economy. These results are consistent with the study of Shahbaz et al. (2013) that found trade to have a detrimental impact on economic growth.

Furthermore, there is a negative statistically significant short run relationship between electricity import and economic growth in South Africa. A 1% rise in electricity import in South Africa in the short run significantly result in economic growth declining by 0.54%, ceteris paribus. These results entail that electricity import plays a detrimental role on the growth of South African economy and calls for the government to review and revise its electricity import policies so it can boost economic growth. These results

Table 4: Cointegration tests

ARDL bounds test null hypothesis: No levels relationship				
F-Bounds test				
Test statistic	Value	Signif. (%)	I (0)	I (1)
F-statistic	9.750444	10	2.45	3.52
k	4	5	2.86	4.01
		2.5	3.25	4.49
		1	3.74	5.06
t-Bounds test				
t-statistic	−6.184655	10	−2.57	−3.66
		5	−2.86	−3.99
		2.5	−3.13	−4.26
		1	−3.43	−4.6

Source: Author's computation

also support the view that electricity trade in terms of electricity import is not good for the growth of the South African economy. These results are inconsistent with the results of Tahir and Khan (2014) that found trade to boost economic growth.

Moreover, there is a negative statistically significant relationship between electricity consumed in power stations and auxiliary systems. A 1% increase in electricity consumed in power stations and auxiliary systems significantly result in economic growth declining by 32.34%, ceteris paribus. These results entail that electricity consumed in power stations and auxiliary systems play a major negative impact on the growth of the economy. Eskom and the South African government, therefore, need to minimize on the electricity wasted in power stations and auxiliary systems to boost economic growth.

Moreso, there is a positive statistically significant short run relationship between electricity generation and economic growth in South Africa. A 1% rise in electricity generation in the short run significantly result in economic growth rising by 79.60%, ceteris paribus. This entails that, out of all the variables utilised in the model, electricity generation is the only variables playing a crucial role on the growth of South African economy. This means that the government must continue boosting electricity generation as it is positively impacting economic growth. These results are

Table 5: ARDL ECM and short run relationships

ARDL error correction regression				
Selected Model: ARDL (3, 1, 1, 0, 4)				
Sample: 1985 2022				
Case 3: Unrestricted Constant and No Trend				
Variable	Coefficient	Standard Error	t-Statistic	Probability
DLEEXP	−1.516410	1.447599	−1.047535	0.3080
DLEIMP	−0.539067	0.243482	−2.213994	0.0393
DLECPS	−32.33881	10.85963	−2.977891	0.0077
DLGEN	79.59504	20.55353	3.872573	0.0010
CointEq(−1)*	−2.763007	0.359665	−7.682177	0.0000
R-squared		0.927942		
Adjusted R-squared.		0.899746		
Durbin-Watson stat		2.217379		

Source: Author's computation

consistent with the study of Marques et al. (2014), Khobai (2018a) and Hlongwane and Daw (2021b).

The ECT term is negative and statistically significant and consistent with the prior expectations. This coefficient is -2.763007, meaning that 276% of the errors in economic growth in the short run are corrected towards long run equilibrium. Narayan and Smyth (2006) emphasizes that it is possible for the ECT term to be above the absolute value of one or two implying oscillatory convergence to long run equilibrium. The R-squared is 0.927942, meaning that 92.79% of variations in economic growth is explained by the model while the remaining 7.21% is explained by the stochastic error term. The study continues to explain the long run relationship as given in Table 6.

After the discovery of cointegration relationship through the ARDL Bounds tests, the study estimated long run relationships between the variables as shown in Table 6. There is a negative statistically significant long run relationship between electricity export and economic growth in South Africa. A 1% rise in electricity export in the long run significantly result in economic growth declining by 0.39%, ceteris paribus. This entail that electricity trade in terms of exports is not good for the growth of the South African economy as was the case with the short run period. This calls for the government to revise policies on electricity exports as it has not been able to positively lead to economic growth in both the short and long run periods.

Moreso, there is a negative statistically significant long run relationship between electricity import and economic growth in South Africa. A 1% rise in electricity import in the long run significantly result in economic growth declining by 3.63%, ceteris paribus. These results entail that electricity trade in terms of electricity import is not good for the growth of the South African economy as was the case with the short run period. The government should implement policies that limit electricity import as it is detrimental for the growth of the economy.

Furthermore, there is a negative statistically significant long run relationship between electricity consumed in power stations and auxiliary systems and economic growth in South Africa. A 1% rise in electricity consumed in power stations and auxiliary systems significantly result in economic growth declining by 11.70%, ceteris paribus. This calls for policymakers and Eskom to draft

Table 6: ARDL and long run relationships

ARDL long run form				
Selected model: ARDL (3, 1, 1, 0, 4)				
Sample: 1985 2022				
Case 3: Unrestricted constant and no trend				
Variable	Coefficient	Standard error	t-statistic	Probability
LEEXP	−0.392597	0.256444	−1.530928	0.1423
LEIMP	−3.627934	1.757829	−2.063872	0.0530
LECPS	−11.70421	4.027529	−2.906051	0.0091
LGEN	34.94316	11.18087	3.125263	0.0056

Source: Author's computation

and implement policies that will help reduce electricity wastage in power stations and auxiliary systems to boost economic growth. These results entail that electricity consumed in power stations and auxiliary systems plays an unfavourable impact.

Moreover, there is a positive statistically significant long run relationship between electricity generation and economic growth in South Africa. A 1% rise in electricity generation in the long run significantly result in economic growth rising by 34.94%, ceteris paribus. These results entail that economic growth plays a crucial role on boosting economic growth both in the short and long run period though the magnitude of impact is smaller in the long run than that of the short run period. The governments need to boost electricity generation as it is the most important determinant of economic growth in both periods. The results are consistent with the study of Khobai (2018a).

The study performed the Granger causality test to check for causality relationships between the variables. The results have revealed unidirectional causality running from economic growth to electricity generation at 10% level of significance (Table 7). This supports the idea that it is economic growth that has a causal effect on electricity generation, entailing that policies that reduce economic growth will have a detrimental effect on electricity generation and visa versa. These results are consistent with the study of Alt and Kum (2013) that found unidirectional causality running from economic growth to electricity generation.

The study performed the residual diagnostics tests as shown in Table 8 to validate reliability of the results from the study. The

Table 7: Granger causality

Pairwise granger causality test		
Null hypothesis	**F-statistic**	**Probability**
DLEIMP does not granger cause DLGDP	0.60443	0.4424
DLGDP does not granger cause DLEIMP	0.51861	0.4765
DLEEXP does not granger cause DLGDP	0.02392	0.8780
DLGDP does not granger cause DLEEXP	0.04383	0.8355
DLECPS does not granger cause DLGDP	0.96313	0.3335
DLGDP does not granger cause DLECPS	1.21390	0.2785
DLEGEN does not granger cause DLGDP	1.70213	0.2010
DLGDP does not granger cause DLEGEN	2.99091	0.0931

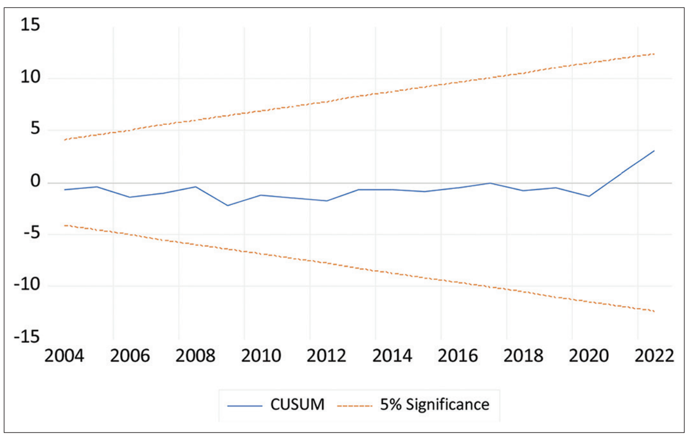
Source: Author's computation

Table 8: Residual diagnostics

Test	Probability	Decision
Breusch-Godfrey-Pagan Heteroskedasticity	0.6825	Fail to reject H_0
Breusch-Godfrey Serial Corelation	0.2564	Fail to reject H_0
Jarque-Bera Normality	0.6106	Fail to reject H_0

Source: Author's computation

Figure 1: CUSUM test



Source: Author's computation

results of Breusch-Godfrey-Pagan heteroskedasticity tests indicate that there is no heteroskedasticity in the residuals form the model and we can conclude that the residuals are homoscedastic. The results of Breusch-Godfrey serial correlation test indicate the absence of serial correlation between the variables in the model. The results of the Jarque-Bera normality test indicate that the residuals are normally distributed. The conclude that the results of this study are reliable for policy recommendations between electricity trade and economic growth in South Africa.

The results of the CUSM squares are given in Figure 1. The blue line drifts upwards and down without overshooting the 5% critical region (red lines) implying that the model is stable throughout the period from 1985 to 2022. The study continues to offer the conclusion and recommendation as given in section 5 below.

5. CONCLUSION AND RECOMMENDATION

The study's main objective was to investigate the relationship between electricity trade and economic growth in South Africa. This goal was achieved by employing the time series data spanning from 1985 to 2022 and the negative relationship between electricity import, electricity export, and economic growth in both the short and long run period. The goal was assured by employing the techniques of stationarity tests (DF-GLS and KPSS), cointegration tests (ARDL F-bound and t-bound), long run relationships (Unrestricted ARDL Levels equation), short run relationships (Unrestricted ARDL Error Correction Regression) and diagnostics test (residual and stability). The unit root test confirmed that the residuals are stationary, and the diagnostics test confirmed that the model does not suffer from any irregularities. To validate these results, the study performed the Granger causality test and found unidirectional causality running from economic growth to electricity generation only in South Africa meaning economic growth is the one that causes electricity generation.

Based on the empirical results from the study, this study therefore makes the following policy recommendations: Firstly, there is negative relationship between electricity import, electricity export and economic growth in both the short and long run periods. This means that electricity trade has a detrimental effect on the growth of South African economy. This calls for the department of trade, Eskom, policymakers, and the South African government at large to review and revise policies on electricity trade so they can boost economic growth. This can be achieved through reducing the amount of electricity exported and imported into South Africa. South Africa has been battling loadshedding since 2007 so this can bring a relief to the power cuts and blackouts currently being experienced in South Africa.

Secondly, there is a negative relationship between electricity consumed in power stations and auxiliary systems in both the short and long run period. This means that electricity waste is never good for the growth of the South African economy. This calls for the South Africa government, Eskom, policy makers and the department of energy to improve their electricity infrastructure to reduce electricity wasted in power stations and auxiliary systems. This can be done through increased investment in electricity infrastructure to guarantee that the South African electricity infrastructure is at par with the electricity demand and supply passing through its grid.

Thirdly, there is a positive relationship between electricity generation and economic growth in South Africa in both the short and long run period. This calls for the government to increase both public and private investment in electricity generation infrastructure as this will boost the South African economic growth. The most practical way of achieving this policy recommendation is making funds available to complete the newly constructed Kusile and Medupi Power Plants so they can generate electricity at full capacity. This will enable the grid to obtain full feed of electricity and avoid grid collapse.

In conclusion, the study investigated the relationship between electricity trade and economic growth in South Africa. This was achieved with the aid of the ARDL and Granger causality model on time series model spanning from 1985 to 2022. The results of the ARDL model revealed both negative relationships between electricity trade and economic growth in the short and long run period in South Africa. The Granger causality model validated these results through the discovery of unidirectional causality running from economic growth to electricity generation. The study recommends that in future, scholars should consider investigating the relationship between electricity infrastructure and economic growth in South Africa either through time series or panel data analysis.

REFERENCES

Alt, H., Kum, M. (2013), Multivariate granger causality between electricity generation, exports, prices and economic growth in Turkey. International Journal of Energy Economics and Policy, 3, 41.

Azam, A., Rafiq, M., Shafique, M., Yuan, J. (2021), Renewable electricity generation and economic growth nexus in developing countries: An ARDL approach. Economic Research-Ekonomska Istraživanja, 34(1), 2423-2446.

Bayraktutan, Y., Yılgör, M., Uçak, S. (2011), Renewable electricity generation and economic growth: Panel-data analysis for OECD members. International Research Journal of Finance and Economics, 66, 59-66.

Belloumi, M. (2014), The relationship between trade, FDI and economic growth in Tunisia: An application of the autoregressive distributed lag model. Economic Systems, 38(2), 269-287.

Bernard, O.A., Obi, K. (2016), Sectoral consumption of non-renewable energy and economic growth in Nigeria. International Journal of Research in Management, Economics and Commerce, 6(7), 15-22.

Bhattacharya, M., Paramati, S.R., Ozturk, I., Bhattacharya, S. (2016), The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. Applied Energy, 162, 733-741.

Busse, M., Königer, J. (2012), Trade and Economic Growth: A Re-examination of the Empirical Evidence. Available from: https://www.ssrn2009939

Can, H., Korkmaz, Ö. (2019), The relationship between renewable energy consumption and economic growth: The case of Bulgaria. International Journal of Energy Sector Management, 13(3), 573-589.

Chen, C., Pinar, M., Stengos, T. (2020), Renewable energy consumption and economic growth nexus: Evidence from a threshold model. Energy Policy, 139, 111295.

Chen, S., Zhang, H., Wang, S. (2022), Trade openness, economic growth, and energy intensity in China. Technological Forecasting and Social Change, 179, 121608.

DMRE. (2022), The South African Energy Sector Report 2021. Pretoria: Department of Mineral Resources and Energy. p1-36.

Elliott, G., Rothenberg, T.J., Stock, J.H. (1992), Efficient Tests for an Autoregressive Unit Root. Cambridge, Mass., USA: National Bureau of Economic Research.

Fotourehchi, Z. (2017), Clean energy consumption and economic growth: A case study for developing countries. International Journal of Energy Economics and Policy, 7(2), 61-64.

Ha, N.M., Ngoc, B.H. (2021), Revisiting the relationship between energy consumption and economic growth nexus in Vietnam: New evidence by asymmetric ARDL cointegration. Applied Economics Letters, 28(12), 978-984.

Hdom, H.A. (2019), Examining carbon dioxide emissions, fossil and renewable electricity generation and economic growth: Evidence from a panel of South American countries. Renewable Energy, 139, 186-197.

Hlongwane, N.W., Daw, O.D. (2021a), The challenges and opportunities of electricity generation on economic growth in South Africa: An ARDL approach. International Journal of Energy Economics and Policy, 12, 164-174.

Hlongwane, N.W., Daw, O.D. (2021b), An Increase of Electricity Generation can Lead to Economic Growth in South Africa. In: MPRA Paper 111018. Germany: University Library of Munich.

Hlongwane, N.W., Daw, O.D. (2022), Renewable electricity consumption and economic growth: A comparative study of South Africa and Zimbabwe. International Journal of Energy Economics and Policy, 13, 197-206.

Hlongwane, N.W., Daw, O.D., Sithole, M.S. (2023), Renewable Electricity Generation and Government Expenditure on Economic Growth of South Africa and Botswana. Germany: Munich Personal RePEc Archive.

Kasman, A., Duman, Y.S. (2015), CO_2 emissions, economic growth, energy consumption, trade and urbanization in new EU member and candidate countries: A panel data analysis. Economic Modelling, 44, 97-103.

Khobai, H. (2018a), The Causal Linkages between Renewable Electricity Generation and Economic Growth in South Africa. In: MPRA Paper 86485. Germany: University Library of Munich.

Khobai, H. (2018b), Electricity consumption and economic growth: A panel data approach for Brazil, Russia, India, China and South Africa countries. International Journal of Energy Economics and Policy, 8(3), 283.

Khobai, H. (2021), Renewable energy consumption, poverty alleviation and economic growth nexus in South Africa: ARDL bounds test approach. International Journal of Energy Economics and Policy, 11, 450-459.

Khobai, H., Sanderson, A., Le Roux, P. (2016), Co-integration between electricity supply and economic growth in South Africa. International Journal of Energy Economics and Policy, 6(3), 637-645.

Kwiatkowski, D., Phillips, P.C., Schmidt, P., Shin, Y. (1992), Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? Journal of Econometrics, 54(1-3), 159-178.

Lean, H.H., Smyth, R. (2010), Multivariate Granger causality between electricity generation, exports, prices and GDP in Malaysia. Energy, 35(9), 3640-3648.

Lenoke, M. (2017), The Impact of Load Shedding on the Economic Growth of South Africa. South Africa: North-West University.

Marinaș, M.C., Dinu, M., Socol, A.G., Socol, C. (2018), Renewable energy consumption and economic growth. Causality relationship in Central and Eastern European countries. PLoS One, 13(10), e0202951.

Marques, A.C., Fuinhas, J.A., Menegaki, A.N. (2014), Interactions between electricity generation sources and economic activity in Greece: A VECM approach. Applied Energy, 132, 34-46.

Marques, A.C., Fuinhas, J.A., Nunes, A.R. (2016), Electricity generation mix and economic growth: What role is being played by nuclear sources and carbon dioxide emissions in France? Energy Policy, 92, 7-19.

Maslyuk, S., Dharmaratna, D. (2013), Renewable electricity generation, CO_2 emissions and economic growth: Evidence from middle-income countries in Asia. Revista de Economía Aplicada, 31(1), 217-244.

Menyah, K., Nazlioglu, S., Wolde-Rufael, Y. (2014), Financial development, trade openness and economic growth in African countries: New insights from a panel causality approach. Economic Modelling, 37, 386-394.

Menyah, K., Wolde-Rufael, Y. (2010), Energy consumption, pollutant emissions and economic growth in South Africa. Energy Economics, 32(6), 1374-1382.

Namahoro, J., Nzabanita, J., Wu, Q. (2021), The impact of total and renewable energy consumption on economic growth in lower and middle-and upper-middle-income groups: Evidence from CS-DL

and CCEMG analysis. Energy, 237, 121536.
Narayan, P.K., Smyth, R. (2006), Do governments lead or lag in fighting crime? Applied Economics Letters, 13(1), 11-15.
Ohler, A., Fetters, I. (2014), The causal relationship between renewable electricity generation and GDP growth: A study of energy sources. Energy Economics, 43, 125-139.
Omri, A., Daly, S., Rault, C., Chaibi, A. (2015), Financial development, environmental quality, trade and economic growth: What causes what in MENA countries. Energy Economics, 48, 242-252.
Oryani, B., Koo, Y., Rezania, S. (2020), Structural vector autoregressive approach to evaluate the impact of electricity generation mix on economic growth and CO_2 emissions in Iran. Energies, 13(16), 4268.
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., Mamun, S.A.K. (2016), Energy use, international trade and economic growth nexus in Australia: New evidence from an extended growth model. Renewable and Sustainable Energy Reviews, 64, 806-816.
Ricardo, D. (1817), On the Principles of Political Economy and Taxation. London: John Murray.
Samuelson, P.A. (1981), Bertil Ohlin (1899-1979). Journal of International Economics, 11(2), 147-163.
Sarker, A.R., Alam, K. (2010), Nexus between electricity generation and economic growth in Bangladesh. Asian Social Science, 6(12), 16-22.
Sebri, M., Ben-Salha, O. (2014), On the causal dynamics between economic growth, renewable energy consumption, CO_2 emissions and trade openness: Fresh evidence from BRICS countries. Renewable and Sustainable Energy Reviews, 39, 14-23.
Shahbaz, M., Feridun, M. (2012), Electricity consumption and economic growth empirical evidence from Pakistan. Quality and Quantity, 46(5), 1583-1599.
Shahbaz, M., Hye, Q.M.A., Tiwari, A.K., Leitão, N.C. (2013), Economic growth, energy consumption, financial development, international trade and CO_2 emissions in Indonesia. Renewable and Sustainable Energy Reviews, 25, 109-121.
Shahbaz, M., Khan, S., Tahir, M.I. (2013), The dynamic links between energy consumption, economic growth, financial development and trade in China: Fresh evidence from multivariate framework analysis. Energy Economics, 40, 8-21.
Singh, T. (2010), Does international trade cause economic growth? A survey. The World Economy, 33(11), 1517-1564.
Smith, A. (1937), The Wealth of Nations [1776]. Vol. 11937. Na.
Stungwa, S., Hlongwane, N.W., Daw, O.D. (2022), Consumption and supply of electricity on economic growth in South Africa: An econometric approach. International Journal of Energy Economics and Policy, 12(1), 266-274.
Tahir, M., Haji, D.H.N.B.P., Ali, O. (2014), Trade openness and economic growth: A review of the literature. Asian Social Science, 10(9), 137.
Tahir, M., Khan, I. (2014), Trade openness and economic growth in the Asian region. Journal of Chinese Economic and Foreign Trade Studies, 7, 136-152.
Vernon, R. (1970), Front Matter, The Technology Factor in International Trade. Cambridge: NBER. p10.
Yildirim, E., Saraç, Ş., Aslan, A. (2012), Energy consumption and economic growth in the USA: Evidence from renewable energy. Renewable and Sustainable Energy Reviews, 16(9), 6770-6774.
Zahonogo, P. (2016), Trade and economic growth in developing countries: Evidence from sub-Saharan Africa. Journal of African Trade, 3(1-2), 41-56.