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Article

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Energy Consumption and Economic Growth: Empirical Evidence for Sudan

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ABSTRACT

This paper examines the dynamic relationship between energy consumption and economic growth in Sudan covering period 1984-2014. Using the autoregressive distributed lag model cointegration approach. Gross fixed capital formation (K), trade openness (OP), and Urban population (URP) were included as control variables. The cointegration results provide evidence on the existence of long-run equilibrium relationship among the variables. In the long run energy consumption has negative impact on economic growth. In contrast, in the short run energy consumption shows different impacts at the level and first difference on economic growth this attributed to fluctuations in oil production and Secession of southern Sudan, which is consider the main source of petroleum resources. The implications of the study is that, energy conservation policy regarding oil and gas would lead to improve in economic growth in Sudan, the short run and long run plans of low-priced energy generation domestically to meet increasing energy demand is highly needed policy as well.

Keywords: Energy Consumption, Economic Growth, Autoregressive Distributed Lag Model
JEL Classifications: Q43, F43, C19

1. INTRODUCTION

The impact of energy consumption on economic growth has attracted the interests of economists and policy makers in recent times. According to Erbaykal (2008) the petroleum crisis in 1970s displayed the importance of energy as a production factor. Since then, energy comes up as a production factor in addition to labor and capital. The world population is rising rapidly, notably in the developing countries. Historical trends suggest that increased annual energy use per capita is a good surrogate for the standard of living factors, which promote a decrease in population growth rate. If these trends continue, the stabilisation of the world's population will require the increased use of all sources of energy as cheap oil and gas are depleted. The improved efficiency of energy use and renewable energy sources will be essential to stabilising population, while providing a decent standard all over the world (Omer, 2007).

Akinlo (2008) using autoregressive distributed lag (ARDL) bounds test to examine the causal relationship between energy consumption and economic growth for eleven countries in sub-Saharan Africa. Using, the study finds that energy consumption is cointegrated with economic growth in Cameroon, Cote d'Ivoire, Gambia, Ghana, Senegal, Sudan and Zimbabwe. Moreover, this test suggests that energy consumption has a significant positive long run impact on economic growth in Ghana, Kenya, Senegal and Sudan, granger causality test based on vector error correction model (VECM) shows bi-directional relationship between energy consumption and economic growth for Gambia, Ghana and Senegal. However, Granger causality test shows that economic growth Granger causes energy consumption in Sudan and Zimbabwe. The neutrality hypothesis is confirmed in respect of Cameroon and Cote D'Ivoire. The same result of no causality was found for Nigeria, Kenya and Togo. The result shows that each country should formulate appropriate energy conservation policies taking into cognizance of her peculiar condition.

Energy is an essential factor in development movement since it stimulates, and supports the economic growth; and the development. After the energy crisis in 1973, it has been realized that fossil fuels, especially oil and natural gas, are finite in extent, and should be regards as depleting assets, and since that time the efforts are oriented to search for new sources of energy. Sudan like most of the oil importing countries suffered a lot from sharp increase of oil prices in the last decade. Spending most of its hard currency earnings in importing oil, but could not meet the increasing demand for energy. Despite the fact that the oil bill consumes more than 50% of the income earnings but oil represent only about 17% of total energy consumption (Omer, 1998).

Recent increasing energy demand can be covered partially through renewable energy. According to Omer (2015) "Sudan's renewable energy strategy is well integrated in the National Energy Plan and "clearly spelled out" in the National Energy Policy, more is yet to be done.

Mishra et al. (2009) found the energy- gross domestic product (GDP) nexus for the panel of pacific island countries. The Granger causality test shows that there is bidirectional causality between energy consumption and GDP. Energy consumption and GDP have positive effects on each other for the whole panel. Ozturk et al. (2010) examined the causality relationship between energy consumption and economic growth by using the panel data of energy consumption (EC) and economic growth (GDP) for 51 countries from 1971 to 2005. These countries are divided into three income groups: Low income group, middle income group and upper middle income group. The causality test is applied to reveal the way of causality between EC and GDP. The result reveals that there is long term Granger causality running from GDP to EC for low income countries and bidirectional causality between EC and GDP for lower and upper middle income group.

The innovative of this paper is to contribute in literature related to energy studies in Sudan. Thus, the remainder of this paper is organised as follows. Section 2 briefly reviews the literature related to the relationship between energy consumption and economic growth. Section 3 presents the econometric method and data. Section 4 illustrates the empirical results and discusses. Section 5 provides conclusions and policy implications.

2. LITERATURE REVIEW

The relationship between energy consumption and economic growth has received great attention of the academic researchers, international organizations, and institutions particularly in last two decades. Ajlouni (2015) investigates the causation link direction between energy consumption and economic growth in Jordan using annual data over the period 1980-2012. The ARDL bound testing approach to co-integration was employed to estimate the elasticities of traditional neoclassical aggregated production function. Empirical findings showed positive long-run and short-run elasticity of output with respect to energy. Granger-Causality supports the feedback hypothesis. The causal relationship of energy consumption and economic growth was investigated by Abid and Sebri (2011) for the time frame of 1980-2007 using VECM approach in Tunisia. The empirical finding shows that in overall economic perspective energy consumption lead to higher economic performance, while in sectoral level energy uses negatively affect economic growth.

Hong (2010) examined the long- and short-term relationship between GDP and energy consumption. Co-integration, ECM, and Granger causality approaches were employed, and the results indicated a long-term equilibrium relationship between energy consumption and real GDP. In the short run, the total energy consumption and production Granger cause GDP during the period 1953-2007 in China. The same results were supported by Peng and Sun (2010) who posited that bi-directional causalities exist between GDP and energy consumption in the short and long run in China. Zhongmin and Bingshi (2010) focused only on Shaanxi Province. They used simple regression and found a linear relationship between economic growth and energy consumption from 1985 to 2008.

Ozturk and Acaravci (2010) using ARDL model and ECM method investigated the causal relationship between energy consumption and economic growth in Albania, Bulgaria, Hungary and Romania over the period 1980-2006. Granger causality test results revealed bidirectional causality only for Hungary.

Hye and Riaz (2008) use Pakistan data and examined the nexus between economic growth and energy consumption for the period of 1971-2007 based on ARDL form of Granger-causality. In the short-run the causality test shows bi-directional relationship between the variables, and one way causality running from economic growth to energy consumption in the long-run. Energy consumption do not influence economic growth in the long-run because higher prices of energy may induce the cost doing business to upsurge which will lead energy uses to affect economic growth negatively.

Chaudhry et al. (2012) investigate the relationship between energy consumption and economic growth for Pakistan based on annual data for the period of 1972-2012. They argued that, the demand for energy is increasing rapidly in the globalizing world. Most of the countries are facing shortage of energy and consequently it is severely affecting the economic growth. In Pakistan, there is insufficient investment in the energy sector to the extent that majority of commercial energy infrastructure is still underdeveloped. There are many flaws in the demand side and supply side especially relating to payments. Consequently a huge amount is disbursed on account of circular debit in Pakistan. Their empirical results state that, the consumption of electricity is significantly stimulating economic growth among other sources of energy. The oil consumption is also affecting economic growth adversely because of its high volume of import. The variable of trade openness has also positive impact on economic growth in the period. The study has important policy implication for Pakistan's economy that there should be shift from expensive imported fuel (oil) to indigenously available alternative fuel (gas or coal) in order to reduce import burden and consequently current account balance. The government should make short run as well as long run plans of low-priced energy generation domestically to meet the needs of high energy consumption.

The nexus between renewable and non-renewable energy and performance of the economy was analysed by Uçan et al. (2014) across fifteen members of EU economies over the period of 1990-2011. The panel cointegration shows that variables were cointegrated. However, Granger-causality test reveal unidirectional causality running from non-renewable energy uses to economic growth.

Solarin et al. (2016) investigate the urbanization, EC and growth relationships for Angola. They find that growth, urbanization and trade variables are causing the EC in the long run. Further, growth is also caused by the EC, urbanization and trade variables.

Furthermore, this might be connected with the level of financial exclusion in Nigeria, in the sense that majority of those that consumes fossil fuel are financially excluded therefore their consumption may not influence financial intermediation. Economic growth is also negative but significant at 1% which means that increase in the consumption of energy by 1% leads to a decline of economic growth by 0.5 that means more consumption of energy is a detriment to the growth of the Nigerian economy in the long-run (Ali et al., 2015). This finding also substantiated the results of Hye and Riaz (2008); Abid and Sebri (2011); Chaudhry et al. (2012) and Uçan et al. (2014) that energy consumption adversely affected economic growth. For example Chaudhry et al. (2012) argues that oil is highly imported in Pakistan which may increase other prices and hence increase the cost of doing businesses, this may negatively affect growth (Hye and Riaz, 2008).

Chien and Hu (2008) used the structural equation modeling approach to show the effects of renewable energy on the GDP of 116 countries. They determined that renewable energy has a positive and significant effect on capital formation and that there are relationships between renewable energy and GDP through the increase in capital formation.

Bildirici (2016) analyzed the relationship between economic growth and hydropower energy consumption. According to the results of the short run causality, there is evidence to support the growth hypothesis in OECD countries with high incomes. There is evidence to support the conservation hypothesis for Brazil, Finland, France, Mexico, the U.S. and Turkey. The unidirectional causality goes from economic growth to energy consumption and suggests that the policy of conserving hydropower energy consumption may be implemented with little or no adverse effects on economic growth in less energy-dependent economies.

Fatai (2014) reassessed the causal relationships between energy consumption and economic growth in 18 Sub-Saharan Africa countries over the period 1980-2011. The results of panel co-integration tests show that energy consumption and economic growth do have a stable long-run equilibrium relationship. There is unidirectional causality from energy consumption to economic growth in East and the Southern Africa Sub-region, which supports the growth hypothesis. As a result, the related authorities in the regions should take a special interest in different sources of energy and invest more in this sector, make suitable policies in this regard and find new alternative and cheap sources of energy. But, there is no causality between energy consumption and economic growth in Central and the West Africa Sub-region, which is in line with the neutrality hypothesis. In other words, both energy consumption and economic growth are neutral with respect to each other. Our results confirm the inconclusive nature of a causality relationship between energy consumption and economic growth.

Odhiambo (2009) using ARDL bounce test and granger causality test examined the relationship between energy consumption and economic growth in Tanzania from 1971 to 2006. The result revealed a long run relationship between energy consumption and economic growth which the granger causality sowed a unidirectional causality running from energy consumption to economic growth as well as EC to economic growth. The results imply that energy conservation policies would have damaging repercussions on economic growth for Tanzania. In similar vein, Odhiambo (2010) reassessed the causal relationship between energy consumption and economic growth in three SSA countries. He added the prices as an additional variable because of its effects on both energy consumption and economic growth. He discovered that the causality between energy consumption and economic growth varies significantly across the three countries. The results indicated that for South Africa and Kenya thereis a unidirectional causal relationship from energy consumption to economic growth, while for Congo (DRC) it is economic growth that drives energy consumption.

3. METHODOLOGY AND DATA

3.1. Data

This study used annual data covered the period from 1984 to 2013 for Sudan. The variables incorporated are GDP used as a proxy for economic growth, energy consumption (EC), Gross fixed capital formation (K), Trade (OP), and Urban population URP). Data of (GDP) per capita measured in constant 2005 US dollars, energy consumption measured as Energy use (kg of oil equivalent per capita), Gross fixed capital formation (% of GDP), trade openness (OP) measured as sum of exports and imports as percentage of GDP, and Urban population measured as percentage of total population. All the data obtained from World Bank World Development Indicators (WDI). All the variables are transformed to their natural logarithms to avoid the heteroscedasticity.

3.2. Model Specification

In this study the ARDL bounds test developed by Pesaran et al. (2001) were used to examine the long run and short run relationship between energy consumption and economic growth, The ARDL cointegration approach have been used for many advantages in comparison with other cointegration methods. Unlike other cointegration techniques, the ARDL bounds test approach can be applied regardless of whether the underlying regressors are integrated of order one I(1) or order zero I(0). Secondly, the ARDL test is suitable in case of small sample size. Thirdly, the ARDL generally provides unbiased estimates of the long-run model and valid t-statistics, along the same line the Augmented Dickey-Fuller (ADF) test will be used to investigate if the variables are stationary or not.

The ARDL model to the variables incorporated in the study is expressed below.

$$\Delta LnGDP_t = \alpha_0 + \sum_{t=0}^{n} \varnothing_1 \Delta LnGDP_{t-1} + \sum_{t=0}^{n} \varnothing_2 \Delta LnEC_{t-i} + \sum_{t=0}^{n} \varnothing_3 \Delta LnK_{t-i} + \sum_{t=0}^{n} \varnothing_4 \Delta LnOP_{t-i} + \sum_{t=0}^{n} \varnothing_5 \Delta LnURP_{t-i} + \partial_1 LnGDP_{t-1} + \partial_2 LnEC_{t-1} + \partial_3 LnK_{t-1} + \partial_4 LnOP_{t-1} + \partial_5 LnURP_{t-1} + \varepsilon_t \quad (1)$$

Where: Ln GDP is the log of per capita real GDP; LnEC log of energy consumption; LnK the log of Gross fixed capital formation; LnOP log of Trade Openness; LnURP log of Urban population; Δ is the first difference operator; ε_t is the white noise error term; n appropriate lag length of the first difference selected based on Akaike information criterion (AIC).

The bounds test procedure going through joint F-statistic (or Wald statistic) for cointegration analysis. F-statistics distributed under the null hypothesis of no cointegration between examined variables. The null hypothesis of no cointegration among the variables in Eq. (1) is H_0: $\partial_1=\partial_2=\partial_3=\partial_4=\partial_5=0$ against the alternative hypothesis H_1: $\partial_1\neq\partial_2\neq\partial_3\neq\partial_4\neq\partial_5\neq0$ which assert the existence of long-run relationship among the variables.

The estimated F-statistics will compare with tabulated critical value of Pesaran et al. (2001), if the value of F-statistics is above the upper critical value the null hypothesis of no cointegration is rejected which implies that variables were cointegrated. However, if F-statistics is less than the lower critical value the null hypothesis cannot be rejected which suggests no long-run relationship. After establishing the existence of long-run cointegration relationship among the variables under consideration the next step is to test the long-run effects and the short-run dynamics using the ECM. Where, ECM used to find out the speed of adjustment towards the long-run equilibrium path if any divergence occurred in the short-run. Thus, the long run coefficients of selected ARDL given in equation (2) below:

$$\Delta \mathrm{LnGDP_t} = \pm_0 + \partial_1 \mathrm{LnGDP_{t-1}} + \partial_2 \mathrm{LnEC_{t-1}} + \partial_3 \mathrm{LnELECTI_{t-1}} + \partial_4 \mathrm{LnOP_{t-1}} + \partial_5 \mathrm{LnURP_{t-1}} + \varepsilon_t \quad (2)$$

Following the bounds testing approach the ECM were applied to determine the dynamics of the variables in the short-run as follows:

$$\Delta LnGDP_t = \alpha_0 + \sum_{t=0}^{n} \varnothing_1 \Delta LnGDP_{t-i} + \sum_{t=0}^{n} \varnothing_2 \Delta LnEC_{t-i} + \sum_{t=0}^{n} \varnothing_3 \Delta LnK_{t-i} + \sum_{t=0}^{n} \varnothing_4 \Delta LnOP_{t-i} + \sum_{t=0}^{n} \varnothing_5 \Delta LnURP_{t-i} + \delta ECM_{t-1} + \varepsilon_t \quad (3)$$

Where: ECM_{t-1}; the error correction term, δ; is the speed of adjustment parameter and must have a statistically significant coefficient with a negative sign. A negative coefficient of the error correction term assures the convergence of system, it also indicates the long-run relationship among the variables.

The stability of the long-run and short run coefficients were tested using cumulative sum (CUSUM) of recursive residuals and cumulative sum of squares (CUSUMSQ) of recursive residuals as proposed by Brown et al. (1975).

4. EMPIRICAL RESULTS AND DISCUSSION

To ensure that no variable is found to be stationary at I(2) the Augmented Dickey-Fuller (ADF) unit roots test is applied to examine the order of integration among the variables the results illustrate in Table 1.

The result of unit root test in Table 1 indicate that energy consumption and urban population are stationary at level this implies that they are I(0), while economic growth, gross fixed capital formation, and trade are non-stationary at level but stationary at first difference means they are I(1). Since the unit root result shows that one variable is I(0) and the other three are I(1). Thus, ARDL is suitable method to apply (Pesaran et al., 2001) in order to identify the existence of long-run relationship between the variables using ARDL bound test procedure.

The ARDL bounds testing approach to cointegration tests the existence of long run relationship between the variables. The appropriate lag order selection is based on Akaike information criterion (AIC) to precede the ARDL bounds testing approach to cointegration. Lag length helps in capturing the dynamic relationships to select the best ARDL model to estimate. Table 2 reports the results of bounds test to cointegration.

Null hypothesis: No long-run relationships exist follow Table 2 title as ARDL-cointegration test results.

Table 2 illustrates the result of bounds test approach to Co-integration. This result revealed that there is an existence of co-integration among the variables as indicated by f-statistics value of (6.821185) which is greater than the lower and upper bound values at 1% level of significance. Therefore, this is a sufficient proof of the existence of a long-run equilibrium relationship between energy consumption and economic growth in Sudan between 1984 and 2014. Based on the result null hypothesis of no cointegration was rejected H_0: $\partial_1=\partial_2=\partial_3=\partial_4=0$ and accepted the alternative hypothesis H_1: $\partial_1\neq\partial_2\neq\partial_3\neq\partial_4\neq0$ at 1% significance level. Since the variables were cointegrated, the next is to estimate our Equation (2) to obtain the long-run coefficients; the result is reported in Table 3.

The long run coefficients in Table 3 are the elasticities, based on the ARDL model the long run elasticities are statistically significant at 1% level for the energy consumption with negative sign related to economic growth, gross fixed capital formation and trade openness are statistically significant at 5% level, while urban population is statistically significant at 10% level. This implies that a 1% increase in energy consumption lead to decreases in real GDP per capita by 4.129%. This finding also substantiated the results of Hye and Riaz (2008); Abid and Sebri (2011); Chaudhry et al. (2012) and Uçan et al. (2014) that energy consumption adversely affected economic growth. For example Chaudhry et al. (2012)

Table 1: ADF unit root tests results

Constant/Trend		Statistics At Level			
		GDP	EC	ELECT	OP
With Constant	t-Statistic	-0.1132 no	-1.7643 no	4.3491 no	-1.5774 no
	Prob.	0.9398	0.3917	1.0000	0.4844
With Constant & Trend	t-Statistic	0.1120 no	-4.8899***	2.6847 no	-1.7347 no
	Prob.	0.9962	0.0017	1.0000	0.7154
Without Constant & Trend	t-Statistic	1.8339 n0	-2.1497**	5.1634 no	-0.9562 no
	Prob.	***0.9818***	***0.0321***	***1.0000***	***0.2968***
		At First Difference			
		d (GDP)	**d (EC)**	**d (ELECT)**	**d (OP)**
With Constant	t-Statistic	-0.6494 n0	-5.2969***	-0.3776 no	-3.4345**
	Prob.	0.8457	0.0001	0.9023	0.0159
With Constant & Trend	t-Statistic	-8.260***	-5.3308***	-5.4831***	-3.3512*
	Prob.	0.0000	0.0006	0.0003	0.0739
Without Constant & Trend	t-Statistic	0.4662 no	-6.4789***	1.3967 no	-3.4838***
	Prob.	0.8100	0.0000	0.9564	0.0010

Significant at the 10%; **significant at the 5%; ***significant at the 1%; lag length based on AIC this result is the out-put of program has developed by Dr. Imadeddin AlMosabbeh, College of Business and Economics, Qassim University-KSA. ADF: Augmented Dickey-Fuller

Table 2: ARDL-cointegration test results

Test statistic	Value	k
F-statistic	6.821185	4
Critical value bounds		
Significance	**I0 bound**	**I1 bound**
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

ARDL: Autoregressive distributed lag

Table 3: Long run coefficients estimation based on AIC

Variable	Coefficient	Std. Error	t-Statistic	P
LOG (EC)	−4.129814	0.592361	−6.971782	0.0001
LOG (K)	0.239542	0.093831	2.552896	0.0310
LOG (OP)	0.276228	0.122273	2.259104	0.0503
LOG (URP)	0.668822	0.325900	2.052231	0.0704
C	44.593552	4.251838	10.488065	0.0000

AIC: Akaike information criterion

argues that oil is highly imported in Pakistan which may increase other prices and hence increase the cost of doing businesses, this may negatively affect growth (Hye and Riaz, 2008). In contrast, a 1% increase in gross fixed capital formation, trade openness, and urban population will increase the real GDP per capita by 0.239%, 0.276%, and 0.668% respectively. This result provides an evidence for the heavy dependence on imported of energy resources, fluctuation of energy production and Secession of southern Sudan which provided about 70% of the energy resources.

After analyzing long run relationship between the variables we move to estimate the short-run coefficients the result presented in Table 4.

The result in Table 4 indicates that energy consumption has significant positive impact on real per capita GDP implies that increase in energy consumption lead to increase in the real GDP and overall economic performance in Sudan in the short-run. However, trade openness and urban population have significant positive impact on real GDP. This implies that an increase in trade openness and urban population could upsurge the real GDP which is consistent with the theory of trade lead growth. The error correction term is negative and statistically significant at 1% level reported that the ECM value confirms the integrity of long-run relationship. The ECM coefficient revealed that once there is disequilibrium in the system, can be adjusted back towards long-run equilibrium level at the average speed of 0.56%. This finding was collaborate by Banerjee et al. (1998) who asserted that a highly significant lagged error correction terms proves the existence of long-run relationship between the variables and its ability to adjust from disequilibrium.

The stability of ARDL long run model parameters were examined using the cumulative sum of the recursive residuals (CUSUM) and the cumulative sum of the squares of recursive residuals (CUSUMSQ) tests), the graphical results presented in Figures 1 and 2 respectively. Illustrate that, residuals were within the critical bounds at 5% level of significance. This signifies that the ARDL estimates are dynamically and structurally stable, consistent and reliable.

5. CONCLUSIONS AND POLICY IMPLICATIONS

The present study investigates the long run relationship between energy consumption and economic growth in Sudan 1984-2014. The ARDL model bounds testing approaches to cointegration were applied to test the existence of long run relationship between energy consumption, gross fixed capital formation, trade openness, urban population and economic growth.

The empirical results confirm the existence of long run relationship between energy consumption, gross fixed capital formation, trade openness, urban population and economic growth. The long run estimated parameters (elasticities) based on the ARDL model the long run elasticities are statistically significant at 1% level for the energy consumption with negative sign related to economic growth, gross fixed capital formation and trade openness are statistically significant at 5% level, while urban population is

Table 4: Short run analysis

Variable	Coefficient	Standard error	t-Statistic	P
DLOG (GDP(-1))	0.367920	0.236670	1.554569	0.1545
DLOG (EC)	−0.376175	0.164649	−2.284712	0.0482
DLOG (EC(-1))	1.046200	0.273504	3.825169	0.0041
DLOG (EC(-2))	0.487794	0.232099	2.101670	0.0649
DLOG (K)	0.004706	0.038262	0.122988	0.9048
DLOG (K(-1))	0.073812	0.041442	1.781086	0.1086
DLOG (K(-2))	−0.052605	0.028047	−1.875585	0.0935
DLOG (OP)	0.096890	0.035201	2.752499	0.0224
DLOG (OP(-1))	−0.136416	0.044768	−3.047190	0.0139
DLOG (URP)	6.698300	1.901843	3.522005	0.0065
DLOG (URP(-1))	−2.400068	4.380425	−0.547908	0.5971
DLOG (URP(-2))	−2.562981	2.141707	−1.196700	0.2620
ECM(-1)	−0.561115	0.099482	−5.640386	0.0003

ECM=LOG (GDP)-(−4.1298*LOG (EC)+0.2395*LOG (K)+0.2762*LOG (OP)+0.6688*LOG (URP)+44.5936)

Figure 1: Plot of CUSUM test with 95% confidence intervals

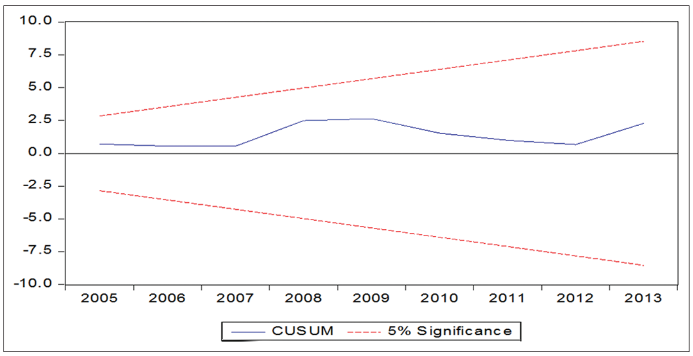
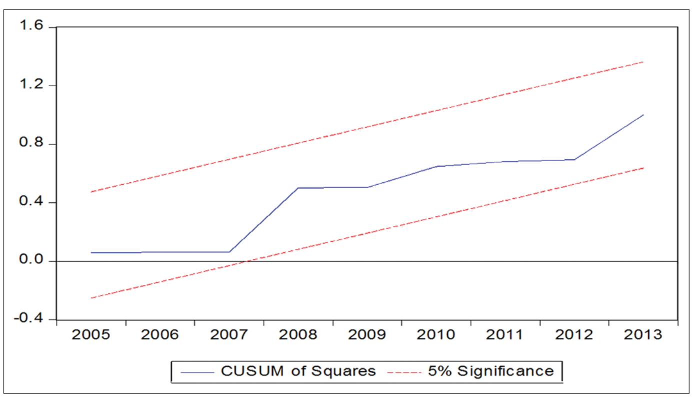


Figure 2: Plot of CUSUM of squares test with 95% confidence intervals



statistically significant at 10% level. This implies that a 1% increase in energy consumption lead to decreases in real GDP per capita by 4.129%. In contrast, a 1% increase in gross fixed capital formation, trade openness, and urban population will increase the real GDP per capita by 0.239%, 0.276%, and 0.668% respectively. This result provides an evidence for the energy consumption is heavily depending on imported resources in Sudan, while gross fixed capital formation, trade openness and urban population showed positive impact. This can be attributed to the importance of gross fixed capital formation, trade openness and urban population as the main sources to supports production. The error correction term ECM is negative and statistically significant at 1% level reported that the ECM value confirms the integrity of long-run relationship. The ECM coefficient revealed that once there is disequilibrium in the system, it takes an average (slow) speed of 0.56% to adjusted back towards long-run equilibrium level. Thus, availability of energy uses from domestic sources green and renewable energy seems to provide effective policy to promote economic growth, along the same line, gross fixed capital formation, trade openness and urban population considered as important factors to support economic growth.

Furthermore, policy that reduces the consumption of imported oil and gas would stabilize economic growth. Therefore, to achieve growth and sustainable development this study recommends development of green and renewable energy sources that would compensate for the reduction in petrol and gas consumption in industrial sector. The study has important policy implication that the economy should be shift from expensive imported fuel (oil) to available alternative fuel (gas or coal) to reduce import burden and consequently current account balance. The government should make short run as well as long run plans of low-priced energy generation domestically to meet the needs of high energy consumption.

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