THE IMPACT OF FOREIGN DIRECT INVESTMENT (FDI) ON THE RELATIONSHIP BETWEEN ELECTRICITY ENERGY CONSUMPTION (EEC) AND GROSS DOMESTIC PRODUCT (GDP) IN KENYA

Joyce Khasacha Omina
Unicaf University
And
Ali Saleh Alarussi
American University of Malta, Malta
Sana'a University, Yemen

Abstract

The consumption of energy plays a pivotal role in the economic growth globally. In a developing economy such as Kenya, where there are still policy frameworks under development, it is importance to understand this relationship to set up correct procedures and policies. This paper used the Vector Error Correction Model to test the short-run and long-run relationships of these variables; foreign direct investment (FDI), gross domestic product (GDP) and electricity energy consumption (EEC). A secondary data of Kenya was used was secondary for Kenya for the period 2002 to 2021. The vector error correction (VEC) Model was run, and post-estimation tests were conducted on the data. The results concluded that there is a short-run bidirectional relationship between FDI & EEC. Moreso, there are long- run unidirectional relationships running from GDP to FDI. The findings support the neoclassical theory and encourage the Kenyan government to develop the petroleum and electricity sector, at the same time work towards developing alternative sources of energy in the renewable energy space.

Keywords: foreign direct investment (FDI), gross domestic product (GDP), electricity energy consumption (EEC) and Vector Error Correction Model (VECM).

1. Introduction

The Bureau of Economic Analysis (BEA) gives a clear definition for Gross domestic product (GDP) as the value of the goods and services produced by the nation's economy less the value of the goods and services used up in production. GDP is also equal to the sum of personal consumption expenditures, gross private domestic investment, net exports of goods and services, and government consumption expenditures and gross investment. It is also the most closely-watched aggregate economic indicator and one which is so often used as a measure of the standard of living. Callen (2020) stated that GDP is important measurement because it gives information about the size of the economy and how an economy is performing. The growth rate of real GDP is often used as an indicator of the general health of the economy. In broad terms, an increase in real GDP is interpreted as a sign that the economy is doing well. When real GDP is growing strongly, employment is likely to be increasing as companies hire more workers for the industries and the population has a lot of money to pocket. When GDP shrinks, as it has done in most economies in 2020, employment rate decreases.

On the other side, climate change and environment, sustainability, and governance (ESG) are now discussion topics in all forums. Funding to developing nations for curbing effects of climate changes requires that governments formulate policies which will safeguard these funds and utilize them in the most efficient way. Different scholars have looked at the relationship between energy consumption and economic growth and found different results across different economies. Many of these studies tried to examine the causal relationship between energy consumption and revenue. For example, an earlier study by Kraft and Kraft (1978) found evidence in favor of causality relationship between income and energy consumption in the United States, after analyzed data for period 1947–1974. The findings show that energy conservation policies may be initiated without affecting the economy. Other empirical studies were later extended to focus on many developing countries to aid the execution of proper energy policies; Asafu-Adjaye (2000) presented a different review of recent studies examined the relationship between energy consumption and income for developing countries, using co-integration and error-correction techniques. The findings of these studies have been mixed and contradicted. Soytas and Sari (2003) likewise estimated the causal relationships for number of emerging markets for the period 1950–1992 and concluded that there is a bi-directional causality between energy consumption and economic growth or Argentina, but for the countries Indonesia and Poland there was no co-integration, meaning that economic growth and energy consumption were not moving together towards a long-term equilibrium. In addition, Oh and Lee (2004) computed an energy aggregate and substituted it for a simple model of energy aggregate for South Korea, which indicates the existence of a long-run bi-directional causal relationship between energy and GDP as well as a short-run unidirectional causality running from energy to GDP.

Kenya is a country that is considered among one of the fastest growing economies in Africa and first in Eastern Africa. According to the Kenya National bureau of Statistics (2020) the country has averaged about 4.9% annual GDP growth in the first quarter of 2020 {compared to 5.5% in 2019 and 6.2% in 2018 for the first quarters). The year 2020 is not a very good comparator due to the effects of COVID-19 which hit hard globally, and negatively affects investments including foreign direct investment. Moosa (2002) defined Foreign direct investment (FDI) as the process where the population of a host country acquire the ownership of assets in another country known as the host country with an intention to control the production, distribute and perform other activities. Different scholars such as Lee (2013); Batten & Vo (2009) and Mallampally & Sauvant (1999 stated that FDI plays a vital role in the economic growth of developing economies especially for those do not have sufficient capital for investing. FDIs contribute to the economic growth of developing countries not only with capital financing, but it also helps those countries to increase their productivity by transferring advanced production technology, managerial skills, and know-how to modernize the economy and encourage innovation. FDI creates new job alternatives and encourages entrepreneurship and competitiveness, which are the most important tools for the rapid growth of developing countries. Gökmenoğlu & Taspinar (2016) concluded that there is a relationship between economic growth and FDI in Turkey. The finding implies that, in Turkey, FDI is economic growth-driven, which means stable economic growth creates a safe investment environment for foreign investors. Jensen (1996) revealed that having a well-developed financial sector

facilitates in attracting FDI and may encourage economic growth, however, it increases industrial pollution and reduces environmental quality. He further described the key functions of FDI to include transfer of new technology, improving managerial skills and knowledge, increasing productivity, international production network, creating connections to foreign markets and decreasing unemployment.

This paper, however, intends to examine the impact of foreign direct investment on the association between the energy consumption and the GDP of Kenya. This study is important to enable the Kenyan government to enforce friendlier regulations for foreigners to invest. According to the report of the African Development Bank (2020) the GDP in Kenya grew by an estimated 5.9% in 2019, driven by household consumption and investment on the demand side and services on the supply side including public administration, information technology, finance & insurance, and transport and storage. GDP was down from 6.5% in 2018, caused mainly by unfavorable weather and reduced government investments in 2019. Public debt rose to 58% of GDP in 2019, up from 41% in 2013, and became more non-concessional (67%) than concessional (33%).

Zhang (2001) and Nyamwenga (2009) opined that an increase in FDI specifically in the energy sector has led to industrialization, increase in employment levels, improved living standards especially in the rural areas and reduction in poverty levels. Nyamwenga (2007) further observed that FDI inflows to Kenya is important since it acts as capital source, given the fact that foreign assistance has been declining in the past years. The study concluded that FDI promotes investments in the local country, generates employment opportunities and boosts economic growth. In addition, he found out that FDI does not only grants capital to African countries for domestic investment, but it also assists in transferring managerial & technical skills and avails employment chances, all these factors are a contribution to economic development. With the recognition that FDI contributes immensely to economic development, then all governments in Africa inclusive Kenya would want to attract it. In the other side, Semboja (1994) stated that the Kenyan Government can implement energy-efficient policies which would lead to a reduction on the dependence on foreign energy purchases, advancement of reliable local energy purchasing and the conservation of different energy sources, hence saving of foreign currency and boosting good environmental practices. So far, there is a lack of studies that empirically examine the association between FDI and both EEC and GDP. This study, however, aims to fill this gap and exams the role of FDI on the relationship between the energy generation and the economic growth in terms of GDP in Kenya. In other words, this study intends to answer the following questions:

1. What is the relationship between electricity energy consumption (EEC) and Economic Growth (GDP)?
2. What is the relationship between foreign direct investments (FDI), electricity energy consumption (EEC) and economic growth (GDP)?
3. Is there a bi-directional relationship between electricity energy consumption (EEC) and economic growth (GDP) in Kenya?

The remaining of this study is as follows; the literature review and hypotheses developments are presented in the following section. The methods of study and data collection process are explained in Section 3. The results discussion is reported in Section 4, and finally Section 5 which presents the conclusion of this study.

2. Literature Review

2.1. Previous Empirical Studies

Dunne and Aslay (2005), described Kenya as a nation in Africa to the eastern part of the continent, which has endeavored to work for the stability of its economy from when it got its independence from Britain in 1964. Despite several efforts by the central bank and the government of Kenya to grow the economy, the country has remained in a pattern of domestic deficits and huge external debts with a slow-moving GDP growth rate. The GDP for Kenya in 2003 was at 1.04 trillion Kenya shillings translated as 13.8 billion USD. In the year 2003, Kenya experiences a very slow and varying growth from one year to the next. In the 60's and 70's, the GDP in Kenya fluctuated uncontrollably from 23% to minus 5%, due to a number of factors, which included; shortages in the World oil in the 70's, gaining political independence from the British, an increase in the global coffee demand– being a dominant export for the country in the years 1976 and 1977 as well as the fall of the East African Community which occurred in 1977. Onuonga (2012) probed the sources of energy in Kenya which encompass non-commercial and commercial usage. The non-commercial alternatives are mostly biomass and to a small extent there is biogas, solar energy, and wind energy while commercial energy sources include electricity and petroleum products. Petroleum fuel is the leading source of modern energy for Kenya with a proportion of about 20% of the total consumed energy. Petroleum consumption in 2006 was 3038.2 thousand tones and went up to 3121.8 thousand tones in the year 2007.

Duce and España (2003) investigate the methodological aspect of FDI in relation to International Investment Position (IIP) and the Balance of Payments (BoP). The financial system is a focal point because of its importance both as a sender (domestic perspective) and a receiver (host perspective) of direct foreign investment. Hassen and Anis (2012) reported that the world economy has become extremely complex during the past few decades. Given the free trade, free circulation of goods and capital mechanism, the investment landscape has become increasingly complex, and it is imperative that emerging countries attract foreign investment. Specifically for the case of Tunisia, it is important to investigate how FDI affects the development of the country's economy with the help of modern time series analysis methods applied to data from 1975-2009. effect on a subset of growth-promoting factors, particularly human capital, and financial development. Denisia (2010) notices that there was a significant increase in FDI's relevance in the global economy following the Second World War. Understanding the economic process and the actions of economic agents, on both the micro and macro levels, has been made possible by theoretical research into FDI, which in turn has opened new fields of study in economics. The fundamental reasons why a company would choose to invest abroad as opposed to exporting its goods or outsourcing to domestic

enterprises are the starting point for any analysis of FDI. On the other side, Sriyana (2019) investigated how changing the effects of consumption of energy has on increasing the economy of a developing country. By using, investments, consumption of renewable energy & electric power, supply of money, government expenditure and labor participation proportion. He established that consumption of electric power and participation of labor impact the economy in a positive direction. Consuming electrical and renewable energies were seen to have asymmetrical impacts in both the long and short runs. They opined that labor force and energy consumption are the primary sources of economic growth in Indonesia. These findings were in line with the neoclassical theory. Squalli (2006) applied the bound tests for all the member states in the Organization of the Petroleum Exporting Countries noted that there is a long-run linkage between consumption of electricity and growth in the economies of all the OPEC countries.

Lise and Montfort, (2006) stated that until 2025, Turkey's GDP and energy consumption are predicted to yearly increase by 7% and 5.9% respectively. The study used annual data for Turkey (1970-2003) and a cointegration approach to unravel the relationship between energy use and GDP. The study demonstrated the cointegration between GDP and energy use in a potentially bidirectional manner. The findings also showed that energy savings would not damage economic growth in Turkey by establishing a unidirectional causality between GDP and energy consumption. Meanwhile, as long Turkey's economy expands, the energy consumption will continue to rise. However, this study focus on the association between electricity energy consumption and Gross domestic product and the impact of Foreign direct investment in this relationship in Kenya.

2.2. Hypothesis Development

2.2.1. Electricity Energy Consumption

Bildrici (2013) delved into the relationship between consumption of electricity and growth in the economies from the year 1970 to 2010 for different African countries including Kenya, Ethiopia, Togo, Congo, Cameroon, Ghana, Senegal, Gabon, Guatemala, Zambia and Cote D'Ivoire. By applying the autoregressive distributed lag model, 10 out of the 11 countries in the sample showed that there is a linkage between economic growth and consumption of electricity. For Guatemala and Gabon, it was established that electricity consumption falls under leisure goods. For Senegal, electricity consumption falls under Engel goods and for Zambia it is an inferior good. Growth hypothesis was found for The Republic of Congo, Kenya, Mozambique, Cameroon, and Ethiopia. Aljebrin (2014) examined the relationship between prices of electricity, consumption of electricity and GDP for Saudi Arabia. He observed that the prices of electricity and consumption of electricity have a negative linkage in both the long and short terms. Whilst consumption of electricity has a positive link with GDP for the long term but is immaterial for the short run. Alkhathlan and Javid, (2013) explored at both disaggregated and aggregated levels, the linkages between carbon discharges, consumption of energy and economic growth for Saudi Arabia. They observed that in the long run, there are positive relationships between carbon dioxide discharges & electricity consumption and GDP

in per capita & carbon discharges. Nonetheless there was no causation recognized between consumption of electricity in per capita and GDP per capita. Karekezi (2002) who sought to have a summarized view of the energy spectrum in the whole continent of Africa and in brief look at the relationship between energy in Africa and poverty levels, concluded that policy makers should ensure issues to do with energy must be resolved to meet both the current and the future technology.

According to Muhammad and Majeed (2015) the growth in the economy, financial & commerce openness, and consumption of energy linkages in South Asia. Results show that trade, FDI and energy have a positive impact on the growth in the economy, there is a bidirectional linkage in the long term between energy and growth and a unidirectional relationship from commerce and financial advancement to economic growth for five South Asian countries for a period between 1980 to 2010. Kahia, Ben and Belloumi (2019) examined effects of the consumption of renewable energy consumption, inflows of FDI & trade, growth in the economy and carbon dioxide discharges and for twelve North African and Middle Eastern countries for years 1980 to 2012. Results of analyses show that the variables are all inter-related, supporting the feedback hypotheses. Based on the above discussion, the hypotheses for this study can be formulated as follows:

H1. There is a positive association between EEC and GDP.

H2. There is a positive association between FDI and the association between EEC and GDP.

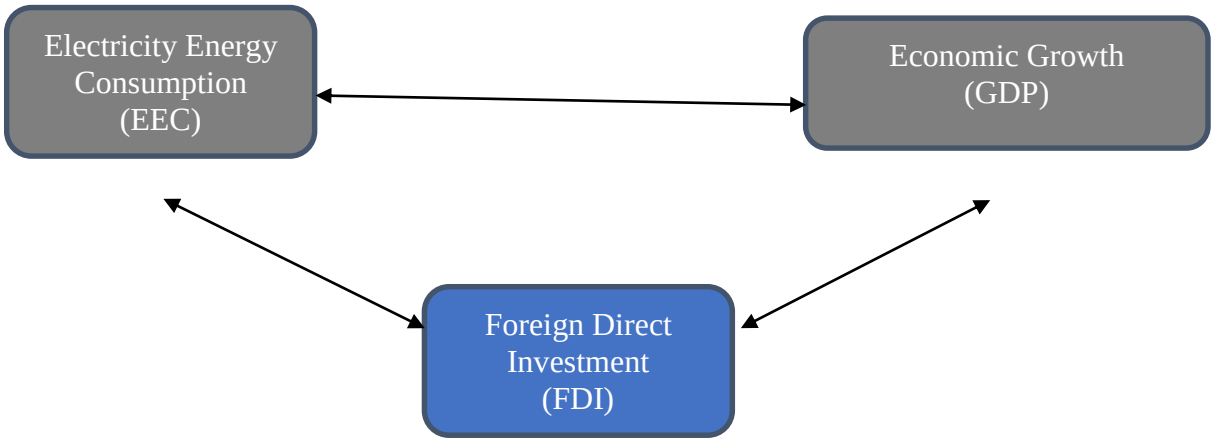

Figure 1: Conceptual Framework, Source: Author (2020)

3. Data, Sample and Model specifications

3.1. Data Description

This study considered 80 time series observations for all the variables that is, these are 20 quarters from January 2002 up to December 2021. Data was collected from the Kenya National Bureau of statistics (KNBS). A summary of their basic characteristics is as per the representation in the below table. The data measurements were different; gross domestic product is measured in Trillions Kenya shillings; electricity energy consumption is measured in Million Kilowatt Hours while foreign direct investment is measured in Millions Kenya shillings. The data for this study was enormous and normalized to fit analysing in STATA.
Table 1 shows the descriptive results indicate all the data values lie within the acceptable limits. George & Mallery (2010) explained that the values for kurtosis and asymmetry should lie between positive 2 and negative 2 to have a normal univariate distribution, which is the case for all the variables below.

Table 1 Descriptive Analysis

	GDP	**FDI**	**EEC**
Mean	1215.66	1554.17	1567.35
Median (p50)	1012.53	1577.59	1561.91
Minimum	233.46	17.85	580.20
Maximum	3178.57	4784.46	2441.10
Standard Deviation	909.47	1135.53	552.94
Skewness	0.0353	0.1283	0.4801
Kurtosis	0.0006	0.8689	0.0000
Observations	**80**	**80**	**80**

The GDP has a mean of 1215.66 and a median of 1012.53, the minimum value of the GDP is 233.46 while the maximum value is 3178.57. The FDI has a mean of 1554.17 and a median of 1577.59, the minimum value of the FDI is 17.85 while the maximum value is 4784.46. As for the EEC, its mean is 125.66 and a median of 1561.91, the minimum value of the EEC is 580.20 while the maximum value is 2441.10. All the medians are means are close and this indicates that the data set has a symmetrical distribution. A skewness value greater than 1 or less than -1 indicates a highly skewed distribution which is not the case for any of the variables.

3.2 Correlation Analysis

Daoud (2017) made 3 conclusions; Multicollinearity causes severe problems in data analysis and must be remediated before data modelling is done, there is a great recommendation that all assumptions of a regression analysis must be adhered to since they contribute to the accuracy of the conclusions and would assist in inferring to the population and a scholar should dismiss and ignore the whole model if multicollinearity is discovered this is due to the fact that the model will not be able to be interpreted. In this study, table 2 shows the correlation coefficients run on stata (using the command; correlate gdp fdi eec)

Table 2 Correlation Matrix

Variables	GDP	FDI	EEC
Type of Variable	Dependent Variable	Moderating Variable	Independent Variable
GDP	1.0000		
FDI	0.3221	1.0000	
EEC	*0.8589	0.4716	1.0000

There is a weak positive relationship between gross domestic product and foreign direct investments (0.3221). This indicates that when gross domestic product increases, foreign direct investment increases and when gross domestic product decreases, foreign direct investment also decreases. On the other hand, there is a strong positive relationship between electricity energy consumption and gross domestic product (0.8589). Electricity energy consumption and foreign direct investment are weakly associated to each other (0.4716). There is no inverse relationship between any of the variables in the study. The results of this correlation test are aligned to those of Moolio and GuechHeang (2013) who claimed that FDI affects GDP in a positive manner.

3.3 Stationarity Tests

Stationarity was assessed. For the stationarity test in this study, the null hypothesis (H_o) was non-stationarity whereas the alternative hypothesis (H_a) was for stationarity. Majority of macro-economic data is assumed to be integrated of order one I (1). There is need to confirm this before proceeding to fit the appropriate multivariate model. Stationarity test was used by Abid and Sebrri (2011) in their study of "Energy Consumption-Economic Growth Nexus: Does the level of aggregation matter?" The Null hypothesis (Ho) is non-stationarity while our alternative hypothesis (HA) is stationarity. Table 4.3 presents the results of the Dickey Fuller test run on Stata for both the variables and their first differences; the critical values at the different levels of significance (1%, 5% & 10%) are also displayed at the bottom of the table. The p-values at level for GDP, FDI and EEC are; 1.0000, 0.0257 and 0.0540 respectively. Only FDI is stationary at level. The The p-values at first difference for GDP, FDI and EEC are all 0.0000, showing that they are stationary at 1st difference.

Table 2 Dickey Fuller Test

variables	Level		First Difference	
	Test statistic	p-value for Z(t)	Test statistic	p-value for Z(t)
GDP	3.088	1.0000	-8.541	0.0000
FDI	-3.111	0.0257	-11.323	0.0000
EEC	-2.831	0.0540	-15.165	0.0000
	Critical values		Critical values	

1%	5%	10%	1%	5%	10%
-3.539	-2.907	-2.588	-3.541	-2.908	-2.589

The Dickey-Fuller has the null hypothesis (H_0) for data having a unit root (non-stationarity) against an alternative hypothesis (H_A) of no unit root (stationarity). The null hypothesis is accepted because in the Dickey fuller test, the test statistic is less than the critical values at the different levels of significance. The alternative hypothesis stating that there is stationarity is rejected. The test implies that the variables are non-stationary at level and stationary when differenced to order 1.

3.4. Lag selection

Table 5 below shows the results of the number of lags to be included in the model from the different information criteria methodologies.

Table 3 Lag Selection Criteria

Selection-order criteria
Sample: 6 - 66 Number of obs = 61

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-2580.96				6.1e+23	68.9591	69.0207*	69.1136*
1	-2546.5	68.921	25	0.000	4.8e+23	68.7068	69.0769	69.6338
2	-2509.64	73.733	25	0.000	3.5e+23	68.3903	69.0689	70.0898
3	-2493.41	32.449	25	0.145	4.5e+23	68.6244	69.6114	71.0964
4	-2454.87	77.084*	25	0.000	3.3e+23*	68.2632*	69.5587	71.5077

Endogenous: D2.gdp D2.fdi D2.eec
Exogenous: _cons
FPE: Final Prediction Error
AIC: Akaike Information Criterion
SBIC: Schwarz Bayesian Information Criterion
HQIC: Hannan-Quinn Information Criterion

The results in Table 5 above indicate that the Hannan-Quinn Information Criterion and the Schwarz Bayesian Information Criterion have chosen no lag for the model (lag zero with the asterisks); while the likelihood ration (LR), the Final Prediction Error and the Akaike Information Criterion have proposed that four lags be included in the model. The decision criterion is normally to choose and use the number of lags preferred by most criteria. As seen in the above results, four lags will be used in the model.

3.5. Co-integration test

Time series are said to be co-integrated if they co-move towards long run equilibrium. The Johansens methodology was utilized to determine if there is co-integration in the series and therefore fit the appropriate model. In the case for this study, the appropriate model would be the vector autoregressive (VAR) model if no co-integration exists or the vector error correction model (VECM) if co-integration exists. The use of either VAR or VECM was well demonstrated by Pramesti, Aziza and Suharsono (2017) in their comparison of vector autoregressive (VAR) and vector error correction models (VECM) for index of the Association of Southeast Asian Nations (ASEAN) stock price. In order to find out the existence of both short-run and long-run equilibrium relationships among the variables in this study, the Johansen co-integration test was performed as per Table 6 below in Stata V.12.0 and utilizing four lags as determined in the lag selection information criteria. The null hypothesis (H_o) is that there is no co-integration while the alternative hypothesis (H_A) is that there is co-integration. From the first table below, the trace statistics for maximum ranks 0, 1, 2 and 4 are all more than the critical values at 5% and therefore we reject the null hypothesis (which states that there is no co-integration) and accept the alternative hypothesis which states that there is co-integration.

Table 4 Johansen co-integrating Test

Trend: constant Number of obs = 75
Sample: 6 - 80 Lags = 4

Maximum rank	parms	LL	eigenvalue	Trace statistic	5% Critical value
0	80	-2548.4268	.	187.1107	68.52
1	89	-2501.3295	0.71519	92.9161	47.21
2	96	-2483.4624	0.37902	57.1818	29.68
3	101	-2466.3853	0.36580	23.0275	15.41
4	104	-2458.3342	0.19321	6.9255	3.76
5	105	-2454.8715	0.08820		

Maximum rank	parms	LL	eigenvalue	SBIC	HQIC	AIC
0	80	-2548.4268		72.56337	71.07842	70.09138
1	89	-2501.3295	0.71519	71.82554	70.17353	69.07545
2	96	-2483.4624	0.37902	71.75205	69.97011	68.78566
3	101	-2466.3853	0.36580	71.58449	69.70974	68.46361
4	104	-2458.3342	0.19321	**71.5425***	**69.61206***	68.32891
5	105	-2454.8715	0.08820	71.50772	69.61206*	68.26324

3.6. VEC Model

Table 5 Model Fitness

Sample: 6 - 80		No. of obs	= 75
		AIC	= 69.07545
Log likelihood = -2501.33		HQIC	= 70.17353
Det (Sigma_ml) = 6.40e+22		SBIC	= 71.82554

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D2_gdp	17	54.9279	0.6496	107.5448	0.0000
D2_fdi	17	763.011	0.6702	117.8803	0.0000
D2_eec	17	300.783	0.7862	213.2525	0.0000

From Table 7 above, the Parms show the number of parameters which for this study is 17. The RMSE is the root mean square error which shows the standard deviation. The R-sq is the R squared that explains the proportions; gross domestic product for the current quarter, is explained by 64.96% of its own lags and the lags of foreign direct investment and electricity energy consumption. Foreign Direct Investment for the current quarter is explained by 67.02% of its own lags and the lags of Gross Domestic Product and electricity energy consumption. Electricity energy consumption in the current quarter is explained by 78.62% of its own lags and the lags of gross domestic product and foreign direct investments. All the 3 model variables; gross domestic product, foreign direct investment and electricity energy consumption are significant 1% since the P>chi2 = 0.0000 which is less than 0.05.

Table 6 Speed of Adjustment

_Cel L1

	Coef.	Std. Err	z	p>|z|	[95% Conf. Interval]	
D2_gdp	-.0075635	.0685165	-0.11	0.912	-.1418534	.1267264
D2_fdi	3.539889	.9517714	3.72	0.000	1.674451	5.405326
D2_eec	-.7550408	.375194	-2.01	0.044	-1.490408	-.0196741

Model specification

Definition of the terms;

$\Delta gdp_t, \Delta fdi_t, \Delta eec_t$ are first differences i.e. $\Delta gdp_t = gdp_t - gdp_{t-1}, \Delta fdi_t = fdi_t - fdi_{t-1}, \Delta eec_t = eec_t - eec_{t-1}$,

μ, €, ¥ - These are the coefficients of the variables, they define the short-run relationship between the variables

$\beta_{11}, \beta_{21}, \beta_{31}$ -This are the coefficients for the long-run correlation/relationship between variables

ϱ_{1t} , $\varrho_{2t,}$ ϱ_{3t} – These are the white noise/shock terms

α_{10}, $\alpha_{20,}$ α_{30} - These are constants

$\{\infty + gdp_{t-1} - \alpha_{12}fdi_{t-1} + \alpha_{13}eec_{t-1}\}$-This is the error correction term per variable and corrects values for the previous period. This term corrects the previous errors and ensures differences are not zero.

We fit the Vector Error Correction Model with the 3 variables of the study. These are represented as below;

$\Delta gdp_t = \alpha_{10} + €_{11}\Delta gdp_{t-1} + \mu_{11}\Delta fdi_{t-1} + ¥_{11}\Delta eec_{t-1} + \beta_{11}\{\infty + gdp_{t-1} - \alpha_{12}fdi_{t-1} + \alpha_{13}eec_{t-1}\} + \varrho_{1t}$…….. (a)

$\Delta fdi_t = \alpha_{20} + \mu_{21}\Delta fdi_{t-1} + €_{21}\Delta gdp_{t-1} + ¥_{21}\Delta eec_{t-1} + \beta_{21}\{\infty + gdp_{t-1} - \alpha_{12}fdi_{t-1} + \alpha_{13}eec_{t-1}\} + \varrho_{2t}$…..... (b)

$\Delta eec_t = \alpha_{30} + ¥_{31}\Delta eec_{t-1} + €_{31}\Delta gdp_{t-1} + \mu_{31}\Delta fdi_{t-1} + \beta_{31}\{\infty + gdp_{t-1} - \beta_{12}fdi_{t-1} + \beta_{13}eec_{t-1}\} + \varrho_{3t}$…… (c)

The summary of the results for values is as below;

Table 9 Vector Error Correction Model Values

		Coef.	Std.Err.	z	p>|z|	[95% Conf.	Interval]
	Table 9.1						
D2_gdp	gdp						
	LD2.	-.6582988	.1239411	-5.31	0.000	-.9012189	-.4153786
	fdi						
	LD2.	.0016041	.0141068	0.11	0.909	-.0260448	.029253
	eec						
	LD2.	.0244765	.0242543	1.01	0.313	-.0230611	.072014
	Table 9.2						
D2_fdi	gdp						
	LD2.	-1.868778	1.721681	-1.09	0.278	-5.243211	1.505656
	fdi						
	LD2.	-.3658799	.1959597	-1.87	0.062	-.7499539	.018194
	eec						
	LD2.	-.7508375	.3369195	-2.23	0.026	-1.411188	-.0904874

Table 9.3

D2_eec	gdp					
	LD2.	-.2879948	.6786972	-0.42	0.671	-1.618217	1.042227
	fdi						
	LD2.	-.2235616	.0772485	-2.89	0.004	-.3749659	-.0721573
	eec						
	LD2.	-1.223729	.1328157	-9.21	0.000	-1.484043	-.9634151

The shock of one variable affects another variable in the long-term.

Table 10 Orthogonalized Impulse Response Functions

gross domestic product IRFs – Table 10.1

step	(1-gdp) oirf	(2-fdi) oirf	(3-eec) oirf
0	54.9279	212.775	13.0619
1	16.0911	113.387	-86.181
2	38.4541	163.367	16.8809
3	18.8214	181.138	17.3231
4	27.9585	59.5594	-54.4298
5	24.8274	174.425	2.17403
6	32.5188	168.879	-17.1738
7	26.1288	133.465	-16.7305
8	26.8828	96.0307	-12.8236
9	23.3511	180.329	-4.12483
10	30.6895	144.097	-31.13
11	28.1212	140.709	-9.99329
12	26.9429	113.56	-7.46822

foreign direct investment IRFs -Table 10.2

step	(6-gdp) oirf	(7-fdi) oirf	(8-eec) oirf
0	0	732.743	-17.197
1	-2.71149	-10.6822	-55.7288
2	4.67464	144.365	18.236
3	8.83169	297.726	-2.82429
4	-7.0933	289.758	-52.7731
5	5.77849	187.583	-8.64694
6	-.203276	193.03	13.5553

7	4.52267	236.541	-43.0844
8	-.36359	289.168	-16.5311
9	3.07811	168.956	-5.97337
10	.605171	239.766	-12.7706
11	3.29902	233.025	-28.6424
12	.009269	237.338	-9.29081

electricity energy consumption IRFs Table 10.3

step	(11-gdp) oirf	(12-fdi) oirf	(13-eec) oirf
0	0	0	300.007
1	6.78129	38.1177	-123.159
2	9.49278	139.109	96.6021
3	1.35486	-119.476	121.143
4	.035046	117.412	70.2235
5	9.14689	31.063	6.28955
6	.62462	19.1598	117.978
7	8.04812	23.5741	67.2244
8	1.25572	47.5022	56.4784
9	5.30285	26.5938	62.0047
10	2.28424	39.8385	93.4883
11	7.23378	16.6111	49.1814
12	2.65666	58.0567	72.5896

4. Discussion of results

4.1. Electricity energy consumption and gross domestic product

Table 9.3 indicates the short-run relationship, if the electricity energy consumption in the previous quarter hiked by one unit (1%), the Gross Domestic Product will reduce by 28.8% but it is not statistically significant. Table 9.1 shows that if the gross domestic product increased by one unit (1%) in the last quarter, then electricity energy consumption will increase by 2% but is not statistically significant. Table 10.3 shows that at the point when there is a shock in electricity energy consumption, there is a permanent positive effect on gross domestic product over the next 12 periods/quarters. This finding upholds the growth hypothesis from Payne (2010) which posits that there exists a unidirectional causality emerging from energy consumption to economic growth. In these circumstances, policies should be aimed at conserving electricity because its consumption is vital for the growth in the economy. The findings of this study opine that, in the long term, electricity energy consumption disturbances

have a long-lasting effect on gross domestic product. The conclusion of this relationship is in line with the growth hypothesis which was defined by Apergis and Payne (2012) as a result showing a unidirectional causal linkage from consumption of energy to the growth of the economy. They explained that in economies where the growth hypothesis exists, conservation measures have a hindering effect on the gross domestic product since consumption of energy consumption is vital for the economy to grow either indirectly or directly.

Onuonga (2012) who reviewed how consumption of commercial energy influences the gross domestic income in Kenya, stated that policies concerning energy conservation and most especially on fossil fuels which are imported will not have negative effects on the growth in the economy. A huge amount of foreign exchange will be saved, and these can be used for other productive sectors which would lead to an even higher growth in the economy amongst other advantages such as employment opportunities. Another policy implication that he observed, is that the growth in the Kenyan economy leads to the growth in commercial energy when all other factors are held constant. He insisted on the need for Kenya to do more investments in renewable energy which are more beneficial than energy derived from fossils to conserve the environment. According to Gumerman et al. (2003), Kenya Power Company needs to work to expand its residential, commercial, and industrial client base. To avoid discouraging customers, Kenya Power's pricing guide should be as user-friendly as possible, with reasonable rates for things like FX adjustments, ERC fees, and REP assessments. To increase both supply and demand, the Kenyan government's Energy and Petroleum Ministry should institute more favorable regulatory frameworks for the electrical sector. The boards of directors of these firms must keep an eye on electricity wastage (power losses) and make sure that cutting-edge strategies for producing and using electricity are consistently implemented.

4.2. Electricity energy consumption and foreign direct investment

Table 9.2 shows that, at the short-term stage, if the foreign direct investment went up by one unit (1%) in the past quarter; then electricity energy consumption will go down by seventy five percent in the current quarter. This is statistically significant with the P Value being less than 5%. Table 9.3 shows that if the electricity energy consumption in the previous quarter hiked by one unit (1%), foreign direct investment will go down by 22.4% units and is statistically significant. This result is in line with previous studies, for example, Alam (2013) performed an empirical analysis for Pakistan and India, between the year 1975 to the year 2008. His results indicated that there is a long-run causality from consumption of electric power to foreign direct investment which boosts economic growth for India. As for Pakistan, there was causality discovered for FDI and GDP which induces the electric power consumption at the long run. This study opined that, in Kenya there is a bi-directional linkage between FDI and EEC in the short run. Alam (2013) explained that boosting foreign direct investment inflows in Pakistan has contributed to an increase in the consumption of electric power. He opined that it is a fact that foreign direct investment through skill transfers and technology contribute to economic growth. The conclusion is that foreign direct investment, directly and by its synergies with economic growth in the Pakistan economy, boosts the consumption of electric power. Findings of this study show that in the short-run, foreign direct investment and electricity

energy consumption have a bi-directional relationship. Othman and Bekhet (2011) analyzed causality amongst consumption of electricity, consumer expenditure, GDP and FDI in Malaysia. They employed time series data from year 1971 to year 2009. They used the VECM (vector error correction model) for estimate these causal relationships between electricity consumption and the independent variables. The analysis showed that there was long run causality from electricity consumption to FDI which was significant. They opined that consumption of electricity is a vital component in the growth of the economy in Malaysia and a dominant tool in the execution of government policies for energy-saving.

Policy makers should be aware of how important stable supply of electricity supply is to even gain the confidence of foreign investors to put in their investments. The Ministry of energy in Kenya and the Kenya Electricity Generating Company (KenGen) should make sure that the supply of electricity grows at a much faster rate than the consumption of electricity. From the findings, Kenya is an energy dependent country. Electricity consumption being the largest in size from the data gathered. Going forward, the energy policy framework should target to expand the generation of electricity and concurrently explore possible methods of renewing the generation of electricity. The Kenyan Government through the Kenya Revenue Authority should ensure favorable tax regulations for foreign investors to attract them into investing. The foreign investors must also be assured of good management of energy growth policies to ensure that there is value for their money and the return on investment will be achieved faster.

4.3. Foreign direct investment and gross domestic product

Tables 9.1 and 9.2, imply that, when the foreign direct investment escalates by a unit in the current quarter, GDP will go down by 18.69% in the next quarter insignificantly. A unit increase in GDP, makes FDI increase by 0.2% but not significantly. The finding from this study matched that of Mavrotas and Chowdhury (2005) who examined the causality between economic growth and foreign direct investment by applying the Toda-Yamamoto test for 3 economies that are developing and found that GDP impacts FDI but not vice versa. These findings however go against Hansen and Rand (2006), who found out that foreign direct investment has a perpetual effect on the gross domestic product of the thirty-one countries while the gross domestic product has no long-lasting effect on the foreign direct investment of these economies. Table 10.1 demonstrates that an impact in GDP has a permanent impact on foreign direct investment. Mavrotas and Chowdhury (2006) sought to find out if it is FDI that causes GDP or the vice versa from years 1969 to 2000. They concluded that special attention must be accorded to both the quality and overall role of economic growth as this is a vital component of foreign direct investment. In the same breath, for Kenya, the human labour quality, infrastructure, financial institutions, tax regime, governance, ICT and legal framework among other factors must be enhanced to expand the GDP and consequently increase the foreign direct investment. Rand and Hansen (2005) hypothesized Granger causality between foreign direct investment (FDI) and GDP for thirty-one developing countries over a period of thirty-one years. They noted that foreign direct investment has a long-run significant effect on gross domestic product regardless of the level of development in a country. This is the opposite

for this study as GDP is the one with a long-run effect to FDI. Soric and Cicak (2015) who also researched on the relationship between FDI and GDP in European economies and made use of the VAR models, surmised that for Slovenia and Latvia there was evidence that GDP causes FDI. This finding corroborated the Macroeconomic stability theory that states that investors are attracted to more stable macroeconomic environments.

5. Conclusion

This paper empirically examined the impact of foreign direct investment on the relationship between usage of electric energy and the growth of the Kenyan economy. In measuring the economic growth of the country, the gross domestic product (GDP) was considered as the significant measure. The study looked at the electricity sector in Kenya. The utilized variables were electricity energy consumption (EEC) as an independent variable. The study used GDP as a dependent variable and foreign direct investment as a moderating variable. This study derived secondary data from the Kenya National bureau of statistics from year 2002 to the year 2021 for 20 years.

The findings indicated that foreign direct investment plays a crucial role in moderating between the relationship between electricity energy consumption and the gross domestic product. Foreign direct investment has a unidirectional relationship with electricity energy consumption for the short period. Gross domestic product (GDP) affects foreign direct investment permanently in the long period. Shocks on electricity energy consumption have permanent effects on the economic growth of Kenya. FDI is a vital moderating variable, and the Kenyan Government should ensure that foreign investors are encouraged to invest as much as possible and that the barriers of entry are less stringent.

References

Abid, M., and Sebri, M. (2012). Energy consumption-economic growth nexus: does the level of aggregation matter? *International Journal of Energy Economics and Policy*, 2(2), 55–62.

AfDB/OECD (2020). *African Economic Outlook 2020.* Retrieved from https://www.afdb.org/sites/default/files/documents/publications/afdb20-04_aeo_supplement_full_report_for_web_0705.pdf

Alam, A. (2013). Electric power consumption, foreign direct investment and economic growth. *World Journal of Science, Technology and Sustainable Development*, 10 (1), 55 – 65.

Aljebrin M. (2014). Revisiting electricity consumption function: the case of Saudi Arabia. *Business Economic Journal*, 5(4).

Alkhathlan K., and Javid, M. (2013). Energy consumption, carbon emissions and economic growth in Saudi Arabia: an aggregate and disaggregate analysis. *Energy Policy*, 62, 1525–32.

Allouhi, A., El Fouih, Y., Kousksou, T., Jamil, A., Zeraouli, Y. and Mourad, Y. (2015). Energy consumption and efficiency in buildings: Current status and future trends. *Journal of cleaner Production*, 109, 118–130.

Apergis, N., Payne, J.E., Menyah, K., and Wolde-Rufael, Y. (2010). On the causal dynamics between emissions, nuclear energy, renewable energy, and economic growth. *Ecological Economics*, 69, 2255–2260.

Arouri, M.E.H., Youssef, A.B., M'henni, H. and Rault, C. (2012). Energy Consumption, Economic Growth and CO2 Emissions in Middle East and North African Countries. *IZA Discussion Paper No. 6412*

Arusha, C, V. (2009). Government Expenditure, Governance and Economic Growth. *Comparative Economic Studies*, 51(3), 401-418.

Asafu-Adjaye, J. (2000). The relationship between energy consumption, energy prices and economic growth: time series evidence from Asian developing countries. *Energy economics*, 22(6), 615-625.

Asiedu E. (2002). On the Determinants of Foreign Direct Investment to Developing Countries: Is Africa Different? *World Development*, 30(1), 107-118.

Ayanwale, A. B. (2007). FDI and economic Growth: Evidence from Nigeria. *African Economic Research Consortium Paper, 165. Nairobi.*

Batten, J.A. and X.V. Vo. (2009). An Analysis of the Relationship Between Foreign Direct Investment and Economic Growth. *Applied Economics*, 41 (13), 1621–1641.

Bekhet, H. A., and Othman, N. S. (2011). Causality analysis among electricity consumption, consumer expenditure, gross domestic product (GDP) and foreign direct investment (FDI): Case study of Malaysia. *Journal of Economics and International Finance*, 3 (4), 228-235

Bildrici, M.E., Bakirtas, T. and Kayikci, F. (2012). Economic growth and electricity consumption: Auto regressive distributed lag analysis. *Journal of Energy in Southern Africa*, 23 (4), 29 -45.

Callen, T. (2020). Gross Domestic Product: An Economy's All. Retrieved from https://www.imf.org/external/pubs/ft/fandd/basics/gdp.htm.

Chowdhury, A., and Mavrotas, G. (2006). FDI and Growth: What Causes what? *The World Economy*, 29 (1), 9-19.

Cicak, K., and Soric, P., (2015). The Interrelationship of FDI and GDP in European Transition Countries. *International Journal of Management Science and Business Administration*, 1(4), 41-58

Daoud, J.I. (2017). Multicollinearity and regression analysis. *Journal of Physics: Conference Series.* doi:10. 1088/1742-6596/949/1/012009

Denisia, V. (2010). Foreign direct investment theories: an overview of the main FDI theories. *European Journal of Interdisciplinary Studies*, 3(2), 53-59.

Duce, M. (2003). Definitions of Foreign Direct Investment (FDI). A Methodological Note. Banco de Espana. doi: https://www.bis.org/publ/cgfs22bde3.pdf

Dunne, R. and Asaly, R., 2005. Country Report: Kenya. [Online]. doi: /http:// www-personal.umich.edu/kathrynd/kenya.2005.pdfS [assessed: 12/01/07].

Fung, H.K. (2009). Financial development and economic growth: convergence or divergence? *Journal of International Money Finance*, 28 (1), 56–78.

George, D., and Mallery, P. (2016). *IBM SPSS Statistics 23 Step by Step: A Simple Guide and Reference* (13th ed.). New York: Routledge.

Gokmenoglu, K. and Taspinar, N. (2016). The relationship between CO2 emissions, energy consumption, economic growth and FDI: the case of Turkey. Journal of International Trade Economics Development, 25(5), 706–723.

GuechHeang, L., and Moolio, P. (2013). The relationship between gross domestic product and foreign direct investment: The case of cambodia. *KASBIT Business Journal*, 6 (1), 87–99.

Gumerman, E.Z., Bharvirkar, R.R., LaCommare, K.H. and Marnay, C. (2003). Evaluation framework and tools for distributed energy resources. *Technical report, Lawrence Berkeley National Lab. (LBNL), Berkeley, CA (United States)*

Hansen, H., and Rand, J. (2006). On the causal links between FDI and growth in developing countries. *The World Economy*, 29 (1), 21─41.

Hassen, S. and Anis, O. (2012). Foreign direct investment (FDI) and economic growth: An approach in terms of cointegration for the case of Tunisia. *Journal of Applied Finance and Banking*, 2, 193.

Jensen, V. (1996). The pollution haven hypothesis and the industrial flight hypothesis: Some perspectives on theory and empirics. *Working Paper No.5, Centre for Development and the Environment, University of Oslo.*

Kahia, M., Jebli, M., and Belloumi, M., (2019). Analysis of the impact of renewable energy consumption and economic growth on carbon dioxide emissions in 12 MENA countries. *Clean Technologies and Environmental Policy*, 21(4), 871–885.

Kraft, J. and Kraft, A. (1978). On the relationship between energy and GNP. *The Journal of Energy and Development*, 3 (2), 401-403.

Lise, W. and Van, M, K. (2007). Energy consumption and GDP in Turkey: is there a co-integration relationship? *Energy Economics*. 29, 1166–1178.

Mallampally, P. and Sauvant, K.P. (1999). Foreign Direct Investment in Developing Countries. *Finance and Development*, 36, 34–37.

Moosa, I.A. (2002). *Foreign Direct Investment: Theory, Evidence and Practice*. London: Palgrave.

Muramalla, V. S.S.R., and Gawad, G.M.A. (2013). Foreign Direct Investment (FDI) and Its Effects on Oil, Gas and Refinery Production and Their Exports: An Applied Study. *Journal of Economics and Sustainable Development*, 4(1), 21-35.

Nyamwenga, M. (2007). Foreign Direct Investment in Kenya: A case study in Kenya, Nairobi.

Oh, W. and Lee, K. (2004). Energy consumption and economic growth in Korea: testing the causality relation. *Journal of Policy Modeling*, 26 (8-9), 973-981.

Onuonga, S. (2012), The Relationship Between Commercial Energy Consumption and Gross Domestic Income in Kenya. *The Journal of Developing Areas*, 46 (1), 305-314 doi: 10.1353/jda.2012.0022

Ozturk, I., and Acaravci, A. (2011). Electricity consumption and real GDP causality nexus: evidence from ARDL bounds testing approach for 11 MENA countries. *Applied Energy*, 88, 2885–92.

Apergis, N., and Payne, J.E., (2012). Renewable and non-renewable energy consumption-growth 17 nexus: Evidence from a panel error correction model. *Energy Economics*, 34(3), 733-738.

Payne, J.E. (2010). A survey of the electricity consumption-growth literature. *Applied Energy*, 87, 723 - 731.

Semboja, H. H. H. (1994). The effects of an increase in energy efficiency on the Kenyan economy. *Energy policy*, 218 – 225.

Siddique, H. M. A., and Majeed, M. T. (2015). Energy Consumption, Economic Growth, Trade and Financial Development Nexus in South Asia. *Pakistan Journal of Commerce and Social Sciences*, 9(2), 658-682.

Soytas, U. and Sari, R. (2003). Energy consumption and GDP: causality relationship in G-7 countries and emerging markets. *Energy economics*, 25 (1), 33-37.

Suharsono, A., Aziza, A. and Pramesti, W. (2017). Comparison of Vector Autoregressive (VAR) and Vector Error Correction Models (VECM) for Index of ASEAN Stock Price. In AIP Conference Proceedings; AIP Publishing LLC: New York, NY, USA.

Squalli, J., and Wilson, K. A. (2006). Bound analysis of electricity consumption and economic growth in the GCC. EPRU, Zayed University; WP-06–09.

Sriyana, J. (2019). Dynamic effects of energy consumption on economic growth in an emerging economy. *International Journal of Energy Economics and Policy*, 9(4), 283-290.

Vo, D. H., and Le, Q. T. T. (2019). CO2 emissions, energy consumption, and economic growth: New evidence in the ASEAN countries. *Journal of Risk and Financial Management*, 12(3), 145-159.

Zhang, K. H. (2001). Does Foreign Direct Investment Promote Economic Growth? Evidence from East Asia and Latin America. *Contemporary Economic Policy*, 19, 2, 175–85.