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Electricity Consumption and Exports Growth: Revisiting the Feedback Hypothesis

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Abstract
The dynamic relationship between exports and energy has been an interesting area of research in macroeconomics. This paper contributes to the extant literature by examining the relationship between electricity consumption and exports revenue for forty different economies as from 1980-2012. The study commences by examining the time series for unit roots using the Augmented Dickey-Fuller (ADF) test. The results of the Johansen cointegration test reveal that twenty-one economies under investigation exhibit statistically long run affiliations between exports income and electricity consumption. Comparatively, the Saikkonen and Lütkepohl test proved that exports and electricity consumption are statistically cointegrated in the long run for all economies. The Granger causality test showed that exports income promote an increase in electricity consumption. However, exports in some economies were induced by electricity consumption. Most importantly, the validity of the feedback hypothesis is affirmed as bidirectional causal relationships between exports and electricity consumption surface in multiple economies.
Keywords: exports, energy demand, electricity consumption, economic growth, Feedback hypothesis.

1. Introduction

In the manufacturing sector, human capital is still essential for most factories to carry out a variety of manual operations in spite of the rapid advancement of automation technology and robotics. In macroeconomics, the dynamic relationship between energy and exports has been debatable. Generally, economists argue that exports, representing economic growth trend positively with energy consumption. It is therefore reasonable to expect exports to drive the demand of energy sources such as electricity, oil, or wind energy. On this backdrop, the claims of Chang et al (2013) that greater energy-exports accelerate high economic growth rate are conceivable. Most studies generally focused on the dynamic relationship between exports and oil without considering other forms of energy. Oil and several factors affecting its sales and consumption such as exchange rates and prices have been studied in depth while other energy forms have been side-lined. This paper contributes to the literature in two ways. Firstly, this paper examines the relationship between exports and electricity consumption for forty countries as from 1980-2012. The Johansen cointegration test is used to test the long run associations between electricity consumption and exports revenue. A recent cointegration methodology proposed by Saikkonen and Lütkepohl is used for further empirical analyses. Secondly, this paper provides Granger causality test results between exports and electricity consumption for all economies under examination. Therefore this paper also tests the validity of the feedback hypothesis which stipulates that exports and energy consumption are jointly determined. Next is a review of previous studies.

Considering the extant literature, the relationship between exports and energy has been a debatable subject over time. Chang et al (2013) aimed to examine the effects of energy, exports and globalization on economic growth using the bias corrected Least Square Dummy Variable (LSDV) model in a panel of five South Caucasus economies (Azerbaijan; Armenia; Georgia; Russia and Turkey) for the period 1990-2009. Evidence brought forward showed that higher energy exports and globalization tend to propel economic growth. Moreover, the study revealed that higher economic, political and social integration are associated with high economic growth rate. Thus by implication, greater energy exports were found to contribute to higher growth rates in the course of globalization. Conclusively, Chang et al (2013) emphasised that energy exports are important determinants of economic growth in the South Caucasus region. In contribution to the literature, Amador (2012) aimed to compare the energy content in manufacturing exports in a set of thirty advanced and emerging economies and examined its evolution from 1995-2005. The author proposed a model that disentangles exports structure and sectoral energy efficiency. The results of the study led to the conclusion that Brazil, India and China present high energy content in manufacturing exports. However, it was found out that European and North American economies reinforce their position as exports with relatively lower energy usage. Economists have generally argued that China is an export-led economy. Kahrl and Roland-Hurst (2008) in particular noted that exports have been a primary driver of China's economic growth over the last decade and notably since the country's accession to the World Trade Organization in 2001. On this backdrop, the authors aimed to examine the linkages between China's exports and domestic energy consumption. The study revealed that exports are the largest source of energy demand growth in China. The dynamic relationship between exports and energy was further examined by Dedeoglu and Kaya (2013). The study employed a panel cointegration technique and Granger theorems to evaluate the presence of long-run relationships and causal relations. The study revealed a two-way Granger causality relationship between energy use and GDP; energy use and exports and energy use and imports. Above all, the variables were found to be cointegrated in the long run.

Urperlainen (2011) postulated that export-oriented economies have strong incentives to invest in energy efficiency and innovation as they are in a position to export technology innovations to global markets. It is important to investigate the impact of exports on national income. Sharma (2003) argued that exports growth in India has been much faster than GDP growth over the past few decades. The study examined the determinants of India's performance in a simultaneous equation framework. Sharma (2003) argued that the real appreciation of the Rupee adversely affects India's exports performance. This is because as the currency appreciates, this elevates the cost of trade on the purchasers therefore hindering exports growth and prosperity. Exports supply was found to be positively related to the domestic price of exports. Other factors such as Foreign Domestic Investment (FDI) appeared to have no significant impact on exports performance. In addition to the extant literature, Zheng et al (2011), aimed to investigate the impact of exports on industrial energy intensity to explore the possibility of reducing energy through greater exports. The study was brought forward by China's commitment to achieve a 40-45% reduction in CO_2 emission intensity by 2020. Using a panel varying coefficient regression model which covered China's twenty industrial sectors for the period 1997-2007, the study suggested that in general, greater exports aggravate energy intensity of the industrial sector and disparities exist in the impact of exports on energy intensity. Tekin (2012) aimed to investigate potential Granger causality among the real GDP, real exports and inwards Foreign Direct Investment (FDI) in the least developed countries for the period 1970 to 2009. Tekin (2012) indicated that there was unidirectional causality from exports to GDP in Haiti, Rwanda and Sierra Leone and from GDP to exports in Angola; Chad and Zambia. Considering the FDI-GDP relations there was evidence of FDI Granger causing GDP in Benin and Togo and GDP Granger causing FDI in Burkina Faso. Wind power has not been a subject of lively debate in previous studies. Comparatively, net exports in Western Denmark were found to confirm good correlation with wind power production however, it was found out that they were more statistically highly correlated with power production from the local Combined Heat and Power (CHP) plants (Mignard et al 2007).

Most studies on energy and exports focused intently on oil and its influence on exports. Riggi and Venditti (2015) aimed to provide novel evidence on changes in the relationship between the real price of oil and real exports in the Euro area. The duo used impulse response technique obtained from a theoretical model to identify oil supply and foreign productivity shocks in a time varying VAR with stochastic volatility. The study revealed that from the 1980's onwards the relationship between oil prices and Euro-area exports has become less negative conditional on oil supply short falls. Korsakiene et al (2014) substantiated the literature by testing if increasing prices of gas and electricity hinders the development of the Lithuanian industrial sector. Using correlation analysis, the results led to the conclusion than an increase of energy prices does not have any major impact on the industrial sector development. In contribution Faria et al (2009) aimed to develop a theoretical model that explains the positive correlation between Chinese exports and oil price. The empirical results revealed that Chinese economic growth can lead to an increase in oil prices. A summary of the reviewed studies is that energy consumption is positively related with exports and economic growth (Chang et al 2013; Amador; 2012; Kahrl and Roland-Hurst, 2013; Deoglu and Kaya, 2013; Zheng et al, 2011; Tekin, 2012). It is worth noting that the extant literature tends to focus intently on the relationship between oil and exports while overlooking other forms of energy such as nuclear energy; electrical energy; wind energy; hydroelectric power or solar energy. Even though oil is important, it is still necessary to investigate the relationship between exports and other forms of energy. This paper investigates the effects of electricity consumption on exports growth. This paper uses data from forty countries and covers the period 1980 to 2012 for diverse economies. This study contributes to the literature by proposing two cointegration tests and the Granger causality test. The Johansen cointegration test is used as well as the recent cointegration methodology proposed by Saikkonen and Lütkepohl. The distinct testing procedure of the two cointegration methodology will be used to provide comparative analysis in the long run relationship between the variables. This paper is structured as follows. Next is material and methods. This will be followed by the results of the empirical study and finally a discussion.

2. Materials and Methods

The data was obtained from Global economy (http://www.theglobaleconomy.com/) and covers the period 1980 to 2012 (annual) for several economies. Two variables were significant to this study: total revenue from exports of goods and services (in billion US dollars) and electricity consumption in billion kilowatt-hours. The analysis of the time series begins with examining the data for unit roots using the Augmented Dickey Fuller test (ADF). The Augmented Dickey-Fuller test is carried out in first difference which includes the trend and intercept. Table 1 shows results of the Augmented Dickey Fuller test.

Table 1: Electricity Consumption Stationarity- Augmented Dickey Fuller Test Results

Country	ADF Test Statistics		
Argentina	$-1.9722_{-[4.2733]}$	$-1.9722_{-[3.5577]}$	$-1.9722_{-[3.2124]}$
Barbados	$-2.1694_{-[4.2733]}$	$-2.1694_{-[3.5577]}$	$-2.1694_{-[3.2124]}$
Bolivia	$-0.3177_{-[4.2733]}$	$-0.3177_{-[3.5577]}$	$-0.3177_{-[3.2124]}$
Canada	$-0.0972_{-[4.2733]}$	$-0.0972_{-[3.5577]}$	$-0.0972_{-[3.2124]}$
Chile	$-2.1383_{-[4.2733]}$	$-2.1383_{-[3.5577]}$	$-2.1383_{-[3.2124]}$
Colombia	$-2.5363_{-[4.2733]}$	$-2.5363_{-[3.5577]}$	$-2.5363_{-[3.2124]}$
Dominica	$-2.2764_{-[4.2733]}$	$-2.2764_{-[3.5577]}$	$-2.2764_{-[3.2124]}$
El Salvador	$-2.4873_{-[4.2733]}$	$-2.4873_{-[3.5577]}$	$-2.4873_{-[3.2124]}$
Grenada	$-3.1653_{-[4.2733]}$	$-3.1653_{-[3.5577]}$	$-3.1653_{-[3.2124]}$
Botswana	$-1.8671_{-[4.2733]}$	$-1.8671_{-[3.5577]}$	$-1.8671_{-[3.2124]}$
Burkina Faso	$0.5168_{-[4.2733]}$	$0.5168_{-[3.5577]}$	$0.5168_{-[3.2124]}$
Bahamas	$-1.9510_{-[4.2733]}$	$-1.9510_{-[3.5577]}$	$-1.9510_{-[3.2124]}$
Cuba	$-1.9349_{-[4.2733]}$	$-1.9349_{-[3.5577]}$	$-1.9349_{-[3.2124]}$
Ecuador	$0.6307_{-[4.2733]}$	$0.6307_{-[3.5577]}$	$0.6307_{-[3.2124]}$
Burundi	$-0.1264_{-[4.2733]}$	$-0.1264_{-[3.5577]}$	$-0.1264_{-[3.2124]}$
Benin	$-0.4552_{-[4.2733]}$	$-0.4552_{-[3.5577]}$	$-0.4552_{-[3.2124]}$
Algeria	$1.2968_{-[4.2733]}$	$1.2968_{-[3.5577]}$	$1.2968_{-[3.2124]}$
Venezuela	$-0.6951_{-[4.2733]}$	$-0.6951_{-[3.5577]}$	$-0.6951_{-[3.2124]}$
Uruguay	$-2.3130_{-[4.2733]}$	$-2.3130_{-[3.5577]}$	$-2.3130_{-[3.2124]}$
USA	$-0.1267_{-[4.2733]}$	$-0.1267_{-[3.5577]}$	$-0.1267_{-[3.2124]}$
Luxembourg	$-2.0855_{-[4.2733]}$	$-2.0855_{-[3.5577]}$	$-2.0855_{-[3.2124]}$
Italy	$-0.6997_{-[4.2733]}$	$-0.6997_{-[3.5577]}$	$-0.6997_{-[3.2124]}$
Norway	$-2.1609_{-[4.2733]}$	$-2.1609_{-[3.5577]}$	$-2.1609_{-[3.2124]}$
Netherlands	$0.2160_{-[4.2733]}$	$0.2160_{-[3.5577]}$	$0.2160_{-[3.2124]}$
Niger	$1.3495_{-[4.2733]}$	$1.3495_{-[3.5577]}$	$1.3495_{-[3.2124]}$
Congo	$-1.6143_{-[4.2733]}$	$-1.6143_{-[3.5577]}$	$-1.6143_{-[3.2124]}$
Senegal	$-0.0972_{-[4.2733]}$	$-0.0972_{-[3.5577]}$	$-0.0972_{-[3.2124]}$
SA	$-2.3933_{-[4.2733]}$	$-2.3933_{-[3.5577]}$	$-2.3933_{-[3.2124]}$
Seychelles	$-1.5331_{-[4.2733]}$	$-1.5331_{-[3.5577]}$	$-1.5331_{-[3.2124]}$
Sierra-Leone	$-2.8050_{-[4.2733]}$	$-2.8050_{-[3.5577]}$	$-2.8050_{-[3.2124]}$
Zambia	$-2.1389_{-[4.2733]}$	$-2.1389_{-[3.5577]}$	$-2.1389_{-[3.2124]}$
Uganda	$1.7300_{-[4.2733]}$	$1.7300_{-[3.5577]}$	$1.7300_{-[3.2124]}$
Tunisia	$-2.3799_{-[4.2733]}$	$-2.3799_{-[3.5577]}$	$-2.3799_{-[3.2124]}$
Swaziland	$-1.9715_{-[4.2733]}$	$-1.9715_{-[3.5577]}$	$-1.9715_{-[3.2124]}$
Sudan	$2.6206_{-[4.2733]}$	$2.6206_{-[3.5577]}$	$2.6206_{-[3.2124]}$
India	$4.8156_{-[4.2733]}$	$4.8156_{-[3.5577]}$	$4.8156_{-[3.2124]}$
Hong Kong	$-1.3271_{-[4.2733]}$	$-1.3271_{-[3.5577]}$	$-1.3271_{-[3.2124]}$
Bhutan	$-0.8942_{-[4.2733]}$	$-0.8942_{-[3.5577]}$	$-0.8942_{-[3.2124]}$
Bangladesh	$0.8514_{-[4.2733]}$	$0.8514_{-[3.5577]}$	$0.8514_{-[3.2124]}$
Japan	$0.5636_{-[4.2733]}$	$0.5636_{-[3.5577]}$	$0.5636_{-[3.2124]}$

The ADF test statistics are reported above. The critical values are as follows: -[4.2733] is the critical value at 1% level; -[3.5577] is the critical value at 5% level and -[3.2124] is the critical value at 10% level. The numbers in brackets are critical values. Superscripts 1, 2, 3 indicate statistical significance at 1%, 5%, and 10% critical levels. Eviews 7 was used to compute the ADF unit root test. The null hypothesis for the test is "series x, has a unit root".

2.1. The Johansen Cointegration Test

This paper examines the long term relationship between exports revenue and electricity consumption. Allow exports to be denoted as EXP_t and electricity consumption as $ELEC_t$. Following Johansen (1988) the idea of using cointegration vector in the study of non-stationary time series comes from the breakthroughs of Granger (1981); Granger and Weiss (1983) and Engle and Granger (1987). The connection with error correction models has been further investigated by a number of authors for instance Stock (1987) and Johansen (1988) among others. For the Johansen cointegration test consider an m vector of X_t of variables. By implication if EXP_t and $ELEC_t$ are cointegrated then following Mallory and Lence (2012) there should exist $r(0 \leq r \leq m)$ linear combinations of such variables. If we allow for vector X_t with cointegrating rank $r(0 \leq r \leq m)$ the long run

$VECM$ can be represented as:

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + e_t \qquad (1)$$

The definition of terms will be as follows. Π will be an $m \times m$ matrix depicting long run impacts, Γ an $m \times m$ lag parameter matrix and e_t an m-vector of residuals following Mallory and Lence (2012). By implication, if there is cointegration between EXP_t and $ELEC_t$ then matrix Π can be expressed as $\Pi = \alpha\beta^T$. The Johansen cointegration test comprises of two tests: the trace test and the maximum-eigen value test. Following Mallory and Lence (2012) the trace test statistic for the null hypothesis that there are at most r cointegrating vectors will be computed as $-T\sum_{i=r+1}^{m} ln(1-\lambda'_i)$. The maximum-eigen value test statistic was used to reveal the null hypothesis that there are r cointegrating vectors against the alternative of $r+1$. The model is $-Tln(1-\lambda'_{r+1})$.

2.2. Saikkonen and Lütkepohl Cointegration Approach

In extension to the Johansen cointegration test, the recent cointegration methodology by Saikkonen and Lütkepohl is carried out. Saikkonen and Lütkepohl (2000) considered the data generation process (DGP) of an $n-$dimensional multiple time series as $y_t = (y_{1t}, \dots, y_{nt})'$. By implication the VAR representation of order $p(VAR)$ will be:

$$y_t = v + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t \qquad t = p+1, p+2, \dots, \qquad (2)$$

Saikkonen and Lütkepohl allowed A_j to be the coefficient matrix $n \times n$. Then if y_{t-1} is subtracted from both sides of the above equation and rearranging terms the resulting error correction model will be:

$$\Delta\tilde{y}_t = v + \Pi\tilde{y}_{t-1} + \sum_{j=1}^{p-1} \Gamma_j \Delta\tilde{y}_{t-j} + \varepsilon_t \qquad t = p+1, p+2, \dots, \qquad (3)$$

The definition of the terms is as follows. Matrix $\Pi = -(I_n - A_1 - \cdots - A_p)$ while $\Gamma_j = -(A_{j+1} + \cdots + A_p)$ $(j = 1, \dots, p-1)$ are $n \times n$ matrices. The assumption made is that the error term is a martingale difference such that $E(\varepsilon_t | \varepsilon_{s,} s < t) = 0$; and $E(\varepsilon_t \grave{\varepsilon}_t | \varepsilon_{s,} s < t), = \Omega$ is a non-random positive definite matrix. Saikkonen and Lütkepohl (2000) proposed that the process y_t is assumed to be at most $1(I)$ and cointegrated with rank $r \leq 0 < r \leq n$. Therefore, matrix Π can be expressed as $\Pi = \alpha\beta^T$. Even though the Johansen and the Saikkonen and Lütkepohl test appear to be similar, the major difference between the two is that under the Saikkonen and Lütkepohl test, the estimation of the deterministic term D_t is carried out first and subtracted from the time series observations.

2.3 Testing for Granger Causality

Cointegration tests are important in the investigation of long run comovement but do not provide the direction of causality between the variables. In this paper we follow the assumption made by Granger (1969). The postulation is if A_t is a stationary stochastic process, then $\bar{A}_t$will then represent the set of past values while $\bar{\bar{A}}_t$ will be the set of past and present values. if we allow EXP_t to be exports at time t and $ELEC_t$ as electricity consumption at time t, feedback will be occurring if EXP_t is causing $ELEC_t$ and $ELEC_t$ is also causing EXP_t. The assumption made in this paper is that if stochastic variables EXP_t, $ELEC_t$ are strictly stationary, EXP_t will Granger cause $ELEC_t$ if past and current values of EXP_t contain additional information on the future values of $ELEC_t$. If EXP_t and $ELEC_t$ are cointegrated an error correction term is required for testing causality following Granger et al (2000). Denote EXP_t as y_{1t} and $ELEC_t$ as y_{2t}. The causal models will then be:

$$\Delta y_{1t} = \alpha_0 + \delta_1(y_{1t-1} - \gamma y_{2t-1}) + \sum_{i=1}^{k} \alpha_{1t}\Delta y_{1t-i} + \sum_{i=1}^{k} \alpha_{2i}\Delta y_{2t-i} + \varepsilon_{1t} \qquad (4)$$

$$\Delta y_{2t} = \beta_0 + \delta_2(y_{1t-1} - \gamma y_{2t-1}) + \sum_{i=1}^{k} \beta_{1t}\Delta y_{1t-i} + \sum_{i=1}^{k} \beta_{2i}\Delta y_{2t-i} + \varepsilon_{2t}$$

3. Results

The long run affiliations between electricity consumption and exports were examined using the Johansen and the Saikkonen and Lütkepohl cointegration test. The Johansen cointegration test was carried out at 5% critical level. Countries which demonstrated long run relationships between exports and electricity consumption were Bolivia, Canada, El Salvador, Grenada, Benin, Venezuela, Netherlands, Senegal, South Africa, Zambia, Colombia, Ecuador, Algeria, Niger and Congo. Tables 2 and 3 show results of the Johansen cointegration test. Note that El Salv., Burk. F., Sierra-L., and Luxem stand for El Salvador, Burkina Faso, Sierra-Leone and Luxembourg.

Table 2: Results of the Johansen Cointegration Test

Country	Eigenv.	Tr. St	5%	ρ-value	Eigenv.	MES	5%	ρ-value
		TRACE TEST				MAXIMUM EIGENVALUE TEST		
Argentina	0.20620	7.63320	15.49470	0.50540	0.20620	7.15950	14.26460	0.47040
	0.01510	0.47360	3.84140	0.49130	0.01510	0.47360	3.84140	0.49130
Barbados	0.23620	8.84863	15.49470	0.41490	0.23630	8.35510	14.26460	0.34370
	0.00420	0.13050	3.84140	0.71780	0.00420	0.13050	3.84140	0.71780
Bolivia	0.49200	22.16850	15.49470	0.00430[1]	0.49250	20.99930	14.26460	0.00370[1]
	0.03700	1.16920	3.84140	0.27960	0.03700	1.16920	3.84140	0.27960
Canada	0.38960	16.19340	15.49470	0.03920[1]	0.38960	15.30700	14.26460	0.03410[1]
	0.02818	0.88630	3.84140	0.34650	0.02818	0.88620	3.84140	0.34650
Chile	0.30700	11.8410	15.49470	0.16750	0.30700	11.48920	14.26460	0.13130
	0.01130	0.35180	3.84140	0.55310	0.01130	0.35180	3.84140	0.55310
Colombia	0.33600	17.48380	15.49470	0.02480[1]	0.33600	12.69520	14.26460	0.08720
	0.14310	4.78850	3.84140	0.02860[1]	0.14310	4.78850	3.84140	0.02860[1]
Dominica	0.23700	8.62930	15.49470	0.40080	0.23700	8.38580	14.26460	0.34080
	0.00780	0.24340	3.84140	0.62170	0.00780	0.24350	3.84140	0.62170
El Salv.	0.43780	19.14710	15.49470	0.01340[1]	0.43780	17.85260	14.26460	0.01300[1]
	0.04090	1.29460	3.84140	0.25520	0.04090	1.29460	3.84140	0.25520
Grenada	0.41040	16.46320	15.49470	0.03560[1]	0.41010	16.36430	14.26460	0.02290[1]
	0.00320	0.09890	3.84140	0.75320	0.00320	0.09880	3.84140	0.75320
Botswana	0.48430	25.24110	15.49470	0.00130[1]	0.48240	20.52810	14.26460	0.00450[1]
	0.14100	4.71290	3.84140	0.02990[1]	0.14100	4.71290	3.84140	0.02990[1]
Burk. F.	0.32840	12.39110	15.49470	0.13910	0.32844	12.34490	14.26460	0.09840
	0.00150	0.04830	3.84140	0.82610	0.00150	0.04830	3.84140	0.82610
Bahamas	0.08120	3.15180	15.49470	0.95960	0.08120	2.37090	14.26460	0.97960
	0.02750	0.78090	3.84140	0.37690	0.02750	0.78090	3.84140	0.37690
Cuba	0.20560	7.13660	15.49470	0.56180	0.20560	7.13480	14.26460	0.47330
	0.00000	0.00180	3.84140	0.96320	0.00000	0.00180	3.84140	0.96320
Ecuador	0.31840	15.72300	15.49470	0.04620[1]	0.31840	11.88080	14.26460	0.11520
	0.11660	3.84220	3.84140	0.05000[1]	0.11660	3.84220	3.84140	0.00500[1]
Burundi	0.29180	13.25950	15.49470	0.10560	0.29180	10.69680	14.26460	0.17010
	0.07930	2.56260	3.84140	0.10940	0.07930	2.56260	3.84140	0.10940
Benin	0.033620	16.14350	15.49470	0.03990[1]	0.33620	12.70590	14.26460	0.08690
	0.10500	3.43760	3.84140	0.06370	0.10500	3.43760	3.84140	0.06370
Algeria	0.37709	20.02720	15.49470	0.00970[1]	0.37701	14.67000	14.26460	0.04310
	0.15870	5.35740	3.84140	0.02060[1]	0.15870	5.35740	3.84140	0.02060[1]
Venezuela	0.23450	14.36220	15.49470	0.07350	0.23460	8.28600	14.26460	0.35040
	0.17800	6.07620	3.84140	0.01370[1]	0.17800	6.07620	3.84140	0.01370[1]
Uruguay	0.22380	8.79820	15.49470	0.38440	0.22380	7.85340	14.26460	0.39380
	0.03000	0.94480	3.84140	0.33100	0.03000	0.94480	3.84140	0.33100
USA	0.34940	14.01210	15.49470	0.08260	0.34940	13.32750	14.26460	0.06990
	0.02180	0.68460	3.84140	0.40800	0.02180	0.68460	3.84140	0.40800

Note: [1] shows statistical significance at 5% critical level.

Table 3: Results of the Johansen Cointegration Test

Country	Eigenv.	Tr. St	5%	ρ-value	Eigenv.	MES	5%	ρ-value
		TRACE TEST				MAXIMUM EIGENVALUE TEST		
Luxemb.	0.16750	7.71800	15.49470	0.49600	0.16750	5.68220	14.26460	0.65340
	0.06360	2.03560	3.84140	0.15360	0.06360	2.03580	3.84140	0.15360
Italy	0.30170	1434280	15.49470	0.07400	0.30170	11.13410	14.26460	0.14760
	0.09830	3.20870	3.84140	0.07320	0.09830	3.20860	3.84140	0.07320
Norway	0.22500	8.15990	15.49470	0.44850	0.22500	7.89970	14.26460	0.38900
	0.00830	0.26020	3.84140	0.61000	0.00840	0.26020	3.84140	0.61000
Netherlands	0.25740	13.44850	15.49470	0.09940	0.25740	9.22450	14.26460	0.26790
	0.12738	4.22390	3.84140	0.03980[1]	0.12740	4.22400	3.84140	0.03980[1]
Niger	0.40500	20.02500	15.49470	0.00970[1]	0.40500	16.0961	14.26460	0.02540[1]
	0.11900	3.92830	3.84140	0.04750[1]	0.11900	3.92830	3.84140	0.04750[1]
Congo	0.27890	15.59350	15.49470	0.04830[1]	0.27890	10.13810	14.26460	0.20300
	0.16140	5.45530	3.84140	0.01950[1]	0.16140	5.45530	3.84140	0.01950[1]
Senegal	0.50440	24.52710	15.49470	0.00170[1]	0.50440	21.76200	14.26460	0.00270[1]
	0.08530	2.76540	3.84140	0.09630	0.08530	2.76540	3.84140	0.00963[1]
SA	0.39050	16.78020	15.49470	0.03190[1]	0.39050	15.35080	14.26460	0.03350[1]
	0.04500	1.42940	3.84140	0.23190	0.04500	1.42940	3.84140	0.23190
Seychelles	0.23250	10.53500	15.49470	0.24180	0.23560	8.20858	14.26460	0.35180
	0.07230	2.32910	3.84140	0.12760	0.07230	2.32910	3.84140	0.12700
Sierra-L.	0.27280	12.44790	15.49470	0.13670	0.27280	9.87780	14.26460	0.22010
	0.07956	2.57000	3.84140	0.10890	0.079560	2.57000	3.84140	0.10890
Zambia	0.46400	19.96540	15.49470	0.00990[1]	0.46400	19.33280	14.26460	0.00720[1]
	0.02020	0.63300	3.84140	0.42620	0.20210	0.63300	3.84140	0.42620
Uganda	0.26030	10.45680	15.49470	0.24720	0.26040	9.93495	14.26460	0.25820
	0.03510	1.107300	3.84140	0.29270	0.03510	1.10730	3.84140	0.29270
Tunisia	0.37930	15.69210	15.49470	0.04067[1]	0.37930	14.78260	14.26460	0.04130[1]
	0.02879	0.90580	3.84140	0.34120	0.02879	0.90580	3.84140	0.34120
Swaziland	0.20110	8.01160	15.49470	0.16420	0.20110	6.96090	14.26460	0.49380
	0.03330	1.05070	3.84140	0.30530	0.03330	1.05070	3.84140	0.30530
Sudan	0.55630	25.19900	15.49470	0.01300[1]	0.55630	25.18940	14.26460	0.00070[1]
	0.00003	0.00950	3.84140	0.92170	0.00030	0.00960	3.84140	0.92170
India	0.37070	17.25560	15.49470	0.02690[1]	0.37070	14.35590	14.26460	0.04840[1]
	0.08930	2.89960	3.84140	0.08860	0.08920	2.89970	3.84140	0.08860
Hong Kong	0.18660	6.53570	15.49470	0.63220	0.18660	6.40240	14.26460	0.56210
	0.00430	0.13320	3.84140	0.71510	0.00430	0.13320	3.84140	0.71510
Bhutan	0.60210	29.31540	15.49470	0.00020[1]	0.60210	28.56960	14.26460	0.00020[1]
	0.02380	0.74580	3.84140	0.38780	0.02377	0.74570	3.84140	0.38780
Bangladesh	0.43680	17.85130	15.49470	0.02170[1]	0.43680	17.80001	14.26460	0.01320[1]
	0.00170	0.05120	3.84140	0.82090	0.00170	0.05120	3.84140	0.82090
Japan	0.31040	11.52300	15.49470	0.18130	0.31040	11.52030	14.26460	0.13000
	0.00000	0.00270	3.84140	0.95640	0.00000	0.00270	3.84140	0.95640

Note: [1] shows statistical significance at 5% critical level.

The Saikkonen and Lütkepohl cointegration test was conducted at 90%; 95% and 99% critical level. The procedure is to firstly estimate the deterministic term and then subtracting it from the series observations for all the countries under examination. The ρ-values registered were typically less than the upper bounder of 99% thus majority of countries reveal long run statistical affiliations between exports and electricity consumption.

Table 4: Results of the Saikkonen and Lütkepohl Cointegration Test

Country	90%	95%	99%	ρ-value	90%	95%	99%	ρ-value
Argentina	13.880	15.760	19.710	0.60280[1,2,3]	5.470	6.790	9.730	0.70700[1,2,3]
Barbados	13.880	15.760	19.710	0.28710[1,2,3]	5.470	6.790	9.730	0.52080[1,2,3]
Bolivia	13.880	15.760	19.710	0.92710[2,3]	5.470	6.790	9.730	0.71290[1,2,3]
Canada	13.880	15.760	19.710	0.08500[1,2,3]	5.470	6.790	9.730	0.97300[3]
Chile	13.880	15.760	19.710	0.57440[1,2,3]	5.470	6.790	9.730	0.98240[3]
Colombia	13.880	15.760	19.710	0.95020[3]	5.470	6.790	9.730	0.87250[1,2,3]
Dominica	13.880	15.760	19.710	0.86980[1,2,3]	5.470	6.790	9.730	0.54770[1,2,3]
El Salvador	13.880	15.760	19.710	0.09210[1,2,3]	5.470	6.790	9.730	0.89540[1,2,3]
Grenada	13.880	15.760	19.710	0.06370[1,2,3]	5.470	6.790	9.730	0.69240[1,2,3]
Botswana	13.880	15.760	19.710	0.04610[1,2,3]	5.470	6.790	9.730	0.94970[2,3]
Burkina F.	13.880	15.760	19.710	0.52100[1,2,3]	5.470	6.790	9.730	0.25240[1,2,3]
Bahamas	13.880	15.760	19.710	0.30480[1,2,3]	5.470	6.790	9.730	0.25480[1,2,3]
Cuba	13.880	15.760	19.710	0.76090[1,2,3]	5.470	6.790	9.730	0.83670[1,2,3]
Ecuador	13.880	15.760	19.710	0.15730[1,2,3]	5.470	6.790	9.730	0.93650[2,3]
Burundi	13.880	15.760	19.710	0.05440[1,2,3]	5.470	6.790	9.730	0.97450[3]
Benin	13.880	15.760	19.710	0.11480[1,2,3]	5.470	6.790	9.730	0.95180[3]
Algeria	13.880	15.760	19.710	0.45840[1,2,3]	5.470	6.790	9.730	0.40260[1,2,3]
Venezuela	13.880	15.760	19.710	0.21850[1,2,3]	5.470	6.790	9.730	0.88290[1,2,3]
Uruguay	13.880	15.760	19.710	0.56450[1,2,3]	5.470	6.790	9.730	0.76850[1,2,3]
USA	13.880	15.760	19.710	0.80140[1,2,3]	5.470	6.790	9.730	0.92920[2,3]
Luxemb.	13.880	15.760	19.710	0.59350[1,2,3]	5.470	6.790	9.730	0.91750[2,3]
Italy	13.880	15.760	19.710	0.09350[1,2,3]	5.470	6.790	9.730	0.90260[2,3]
Norway	13.880	15.760	19.710	0.05780[1,2,3]	5.470	6.790	9.730	0.85660[1,2,3]
Netherlands	13.880	15.760	19.710	0.39940[1,2,3]	5.470	6.790	9.730	0.96930[3]
Niger	13.880	15.760	19.710	0.91400[2,3]	5.470	6.790	9.730	0.18780[1,2,3]
Congo	13.880	15.760	19.710	0.50420[1,2,3]	5.470	6.790	9.730	0.25650[1,2,3]
Senegal	13.880	15.760	19.710	0.01850[1,2,3]	5.470	6.790	9.730	0.72200[1,2,3]
SA	13.880	15.760	19.710	0.58240[1,2,3]	5.470	6.790	9.730	0.91530[2,3]
Seychelles	13.880	15.760	19.710	0.79780[1,2,3]	5.470	6.790	9.730	0.83790[1,2,3]
Sierra-L.	13.880	15.760	19.710	0.53070[1,2,3]	5.470	6.790	9.730	0.91810[2,3]
Zambia	13.880	15.760	19.710	0.71800[1,2,3]	5.470	6.790	9.730	0.22880[1,2,3]
Uganda	13.880	15.760	19.710	0.89190[1,2,3]	5.470	6.790	9.730	0.97870[3]
Tunisia	13.880	15.760	19.710	0.32970[1,2,3]	5.470	6.790	9.730	0.99950
Swaziland	13.880	15.760	19.710	0.83680[1,2,3]	5.470	6.790	9.730	0.68940[1,2,3]
Sudan	13.880	15.760	19.710	0.00430[1,2,3]	5.470	6.790	9.730	0.18210[1,2,3]
India	13.880	15.760	19.710	0.65770[1,2,3]	5.470	6.790	9.730	0.46480[1,2,3]
Hong Kong	13.880	15.760	19.710	0.22410[1,2,3]	5.470	6.790	9.730	0.91490[2,3]
Bhutan	13.880	15.760	19.710	0.00160[1,2,3]	5.470	6.790	9.730	0.79040[1,2,3]
Bangladesh	13.880	15.760	19.710	0.47050[1,2,3]	5.470	6.790	9.730	0.58750[1,2,3]
Japan	13.880	15.760	19.710	0.70960[1,2,3]	5.470	6.790	9.730	0.22690[1,2,3]

Note: [1] shows statistical significance at 90% critical level; [2] shows statistical significance at 95% critical level; [3]shows statistical significance at 99% critical level; Note that ρ-values less than critical levels of 90%, 95% and 99% represent cointegration. The test was carried out using JMulti 4 statistical package. The deterministic term of the VECM was defined as. Superscripts 1, 2, 3 show statistical significance at 90%, 95%, and 99% critical levels. LR = Likelihood Ratio. Superscripts 1, 2, 3 show statistical significance at 90%, 95%, and 99% critical levels.

The Granger causality test was carried out to investigate the direction of causation between the variables under examination. Electricity consumption led exports income in the following economies: Barbados; Bolivia; Chile; El Salvador; Grenada; Burkina Faso; Niger; Tunisia and Bangladesh. Countries which revealed bidirectional causality were Botswana; Burundi; Algeria; Senegal; Bhutan and Japan. Accrued exports income induced electricity consumption in the following economies; Colombia; Dominica Republic; USA; Luxembourg; Italy; Netherlands; Republic of Congo; Sudan; and India. Table 5 shows results of the Granger causality test.

Table 5: Granger Causality Test Results

Country	Causality	ρ-values[1]	Causality	ρ-values[1]
Argentina	$\text{EXP(ARG)}_t \rightarrow \text{ELEC(ARG)}_{t(0.28)}$	$0.75970_{[31]}$	$\text{ELEC(ARG)}_t \rightarrow \text{EXP(ARG)}_{t(1.89)}$	$0.17170_{[31]}$
Barbados	$\text{EXP(BAR)}_t \rightarrow \text{ELEC(BAR)}_{t(0.54)}$	$0.58740_{[31]}$	$\text{ELEC(BAR)}_t \rightarrow \text{EXP(BAR)}_{t(3.61)}$	$0.04130_{[31]}$**
Bolivia	$\text{EXP(BOL)}_t \rightarrow \text{ELEC(BOL)}_{t(0.81)}$	$0.45390_{[31]}$	$\text{ELEC(BOL)}_t \rightarrow \text{EXP(BOL)}_{t(11.75)}$	$0.00020_{[31]}$**
Canada	$\text{EXP(CAN)}_t \rightarrow \text{ELEC(CAN)}_{t(1.15)}$	$0.33370_{[31]}$	$\text{ELEC(CAN)}_t \rightarrow \text{EXP(CAN)}_{t(0.55)}$	$0.58470_{[31]}$
Chile	$\text{EXP(CHI)}_t \rightarrow \text{ELEC(CHI)}_{t(0.91)}$	$0.41670_{[31]}$	$\text{ELEC(CHI)}_t \rightarrow \text{EXP(CHI)}_{t(6.40)}$	$0.00550_{[31]}$**
Colombia	$\text{EXP(COL)}_t \rightarrow \text{ELEC(COL)}_{t(3.50)}$	$0.04630_{[31]}$**	$\text{ELEC(COL)}_t \rightarrow \text{EXP(COL)}_{t(0.20)}$	$0.82050_{[31]}$
Dominica	$\text{EXP(DOM)}_t \rightarrow \text{ELEC(DOM)}_{t(4.02)}$	$0.02990_{[31]}$**	$\text{ELEC(DOM)}_t \rightarrow \text{EXP(DOM)}_{t(0.82)}$	$0.45320_{[31]}$
El Salvador	$\text{EXP(ELS)}_t \rightarrow \text{ELEC(ELS)}_{t(1.80)}$	$0.19260_{[31]}$	$\text{ELEC(ELS)}_t \rightarrow \text{EXP(ELS)}_{t(6.25)}$	$0.00610_{[31]}$**
Grenada	$\text{EXP(GRE)}_t \rightarrow \text{ELEC(GRE)}_{t(3.03)}$	$0.06710_{[31]}$	$\text{ELEC(GRE)}_t \rightarrow \text{EXP(GRE)}_{t(5.61)}$	$0.00940_{[31}$**
Botswana	$\text{EXP(BOT)}_t \rightarrow \text{ELEC(BOT)}_{t(3.40)}$	$0.04900_{[31]}$**	$\text{ELEC(BOT)}_t \rightarrow \text{EXP(BOT)}_{t(12.62)}$	$0.00010_{[31]}$**
Burkina F.	$\text{EXP(BUR)}_t \rightarrow \text{ELEC(BUR)}_{t(2.32)}$	$0.11780_{[31]}$	$\text{ELEC(BUR)}_t \rightarrow \text{EXP(BUR)}_{t(3.65)}$	$0.04010_{[31]}$**
Bahamas	$\text{EXP(BAH)}_t \rightarrow \text{ELEC(BAH)}_{t(0.01)}$	$0.98630_{[31]}$	$\text{ELEC(BAH)}_t \rightarrow \text{EXP(BAH)}_{t(2.49)}$	$0.10480_{[31]}$
Cuba	$\text{EXP(CUB)}_t \rightarrow \text{ELEC(CUB)}_{t(1.95)}$	$0.16230_{[31]}$	$\text{ELEC(CUB)}_t \rightarrow \text{EXP(CUB)}_{t(0.66)}$	$0.52720_{[31]}$
Ecuador	$\text{EXP(ECU)}_t \rightarrow \text{ELEC(ECU)}_{t(1.28)}$	$0.29560_{[31]}$	$\text{ELEC(ECU)}_t \rightarrow \text{EXP(ECU)}_{t(2.44)}$	$0.10690_{[31]}$
Burundi	$\text{EXP(BUR)}_t \rightarrow \text{ELEC(BUR)}_{t(4.59)}$	$0.01960_{[31]}$**	$\text{ELEC(BUR)}_t \rightarrow \text{EXP(BUR)}_{t(10..31)}$	$0.00050_{[31]}$**
Benin	$\text{EXP(BEN)}_t \rightarrow \text{ELEC(BEN)}_{t(2.76)}$	$0.08190_{[31]}$	$\text{ELEC(BEN)}_t \rightarrow \text{EXP(BEN)}_{t(1.84)}$	$0.17920_{[31]}$
Algeria	$\text{EXP(ALG)}_t \rightarrow \text{ELEC(ALG)}_{t(8.73)}$	$0.00130_{[31]}$**	$\text{ELEC(ALG)}_t \rightarrow \text{EXP(ALG)}_{t(4.18)}$	$0.02660_{[31]}$**
Venezuela	$\text{EXP(VEN)}_t \rightarrow \text{ELEC(VEN)}_{t(1.62)}$	$0.21680_{[31]}$	$\text{ELEC(VEN)}_t \rightarrow \text{EXP(VEN)}_{t(2.09)}$	$0.14340_{[31]}$
Uruguay	$\text{EXP(URU)}_t \rightarrow \text{ELEC(URU)}_{t(0.92)}$	$0.41110_{[31]}$	$\text{ELEC(URU)}_t \rightarrow \text{EXP(URU)}_{t(0.04)}$	$0.96060_{[31]}$
USA	$\text{EXP(USA)}_t \rightarrow \text{ELEC(USA)}_{t(4.85)}$	$0.01620_{[31]}$**	$\text{ELEC(USA)}_t \rightarrow \text{EXP(USA)}_{t(1.02)}$	$0.37220_{[31]}$
Luxembourg	$\text{EXP(LUX)}_t \rightarrow \text{ELEC(LUX)}_{t(3.42)}$	$0.04820_{[31]}$**	$\text{ELEC(LUX)}_t \rightarrow \text{EXP(LUX)}_{t(1.55)}$	$0.23130_{[31]}$
Italy	$\text{EXP(ITA)}_t \rightarrow \text{ELEC(ITA)}_{t(6.19)}$	$0.00630_{[31]}$**	$\text{ELEC(ITA)}_t \rightarrow \text{EXP(ITA)}_{t(2.63)}$	$0.08960_{[31]}$
Norway	$\text{EXP(NOR)}_t \rightarrow \text{ELEC(NOR)}_{t(1.43)}$	$0.25720_{[31]}$	$\text{ELEC(NOR)}_t \rightarrow \text{EXP(NOR)}_{t(0.67)}$	$0.52300_{[31]}$
Netherlands	$\text{EXP(NET)}_t \rightarrow \text{ELEC(NET)}_{t(8.77)}$	$0.00120_{[31]}$**	$\text{ELEC(NET)}_t \rightarrow \text{EXP(NET)}_{t(1.76)}$	$0.19100_{[31]}$
Niger	$\text{EXP(NIG)}_t \rightarrow \text{ELEC(NIG)}_{t(0.43)}$	$0.65750_{[31]}$	$\text{ELEC(NIG)}_t \rightarrow \text{EXP(NIG)}_{t(7.76)}$	$0.00230_{[31]}$**
Congo	$\text{EXP(CON)}_t \rightarrow \text{ELEC(CON)}_{t(5.64)}$	$0.00920_{[31]}$**	$\text{ELEC(CON)}_t \rightarrow \text{EXP(CON)}_{t(0.52)}$	$0.59960_{[31]}$
Senegal	$\text{EXP(SEN)}_t \rightarrow \text{ELEC(SEN)}_{t(7.12)}$	$0.00340_{[31]}$**	$\text{ELEC(SEN)}_t \rightarrow \text{EXP(SEN)}_{t(5.48)}$	$0.01030_{[31]}$**
SA	$\text{EXP(SA)}_t \rightarrow \text{ELEC(SA)}_{t(1.78)}$	$0.18890_{[31]}$	$\text{ELEC(SA)}_t \rightarrow \text{EXP(SA)}_{t(3.02)}$	$0.06570_{[31]}$
Seychelles	$\text{EXP(SEY)}_t \rightarrow \text{ELEC(SEY)}_{t(0.63)}$	$0.33850_{[31]}$	$\text{ELEC(SEY)}_t \rightarrow \text{EXP(SEY)}_{t(3.00)}$	$0.06690_{[31]}$
Sierra-Leone	$\text{EXP(SIE)}_t \rightarrow \text{ELEC(SIE)}_{t(2.57)}$	$0.09590_{[31]}$	$\text{ELEC(SIE)}_t \rightarrow \text{EXP(SIE)}_{t(0.44)}$	$0.64570_{[31]}$
Zambia	$\text{EXP(ZAM)}_t \rightarrow \text{ELEC(ZAM)}_{t(0.23)}$	$0.79200_{[31]}$	$\text{ELEC(ZAM)}_t \rightarrow \text{EXP(ZAM)}_{t(2.39)}$	$0.11170_{[31]}$
Uganda	$\text{EXP(UGA)}_t \rightarrow \text{ELEC(UGA)}_{t(0.68)}$	$0.51370_{[31]}$	$\text{ELEC(UGA)}_t \rightarrow \text{EXP(UGA)}_{t(1.20)}$	$0.31670_{[31]}$
Tunisia	$\text{EXP(TUN)}_t \rightarrow \text{ELEC(TUN)}_{t(0.29)}$	$0.75040_{[31]}$	$\text{ELEC(TUN)}_t \rightarrow \text{EXP(TUN)}_{t(9.03)}$	$0.0010_{[31]}$**
Swaziland	$\text{EXP(SWA)}_t \rightarrow \text{ELEC(SWA)}_{t(1.36)}$	$0.27360_{[31]}$	$\text{ELEC(SWA)}_t \rightarrow \text{EXP(SWA)}_{t(3.00)}$	$0.06690_{[31]}$
Sudan	$\text{EXP(SUD)}_t \rightarrow \text{ELEC(SUD)}_{t(5.77)}$	$0.00850_{[31]}$**	$\text{ELEC(SUD)}_t \rightarrow \text{EXP(SUD)}_{t(0.41)}$	$0.66540_{[31]}$
India	$\text{EXP(IND)}_t \rightarrow \text{ELEC(IND)}_{t3.62)}$	$0.04100_{[31]}$**	$\text{ELEC(IND)}_t \rightarrow \text{EXP(IND)}_{t(2.20)}$	$0.13070_{[31]}$
Hong Kong	$\text{EXP(HK)}_t \rightarrow \text{ELEC(HK)}_{t(0.01)}$	$0.98710_{[31]}$	$\text{ELEC(HK)}_t \rightarrow \text{EXP(HK)}_{t(0.23)}$	$0.79190_{[31]}$
Bhutan	$\text{EXP(BHU)}_t \rightarrow \text{ELEC(BHU)}_{t(8.52)}$	$0.00140_{[31]}$**	$\text{ELEC(BHU)}_t \rightarrow \text{EXP(BHU)}_{t(3.60)}$	$0.04160_{[31]}$**
Bangladesh	$\text{EXP(BAN)}_t \rightarrow \text{ELEC(BAN)}_{t(0.03)}$	$0.97370_{[31]}$	$\text{ELEC(BAN)}_t \rightarrow \text{EXP(BAN)}_{t(3.45)}$	$0.04670_{[31]}$**
Japan	$\text{EXP(JAP)}_t \rightarrow \text{ELEC(JAP)}_{t(0.02)}$	$0.02240_{[31]}$**	$\text{ELEC(JAP)}_t \rightarrow \text{EXP(JAP)}_{t(0.00)}$	$0.00290_{[31]}$**

Note: $\text{EXP}(m)_t \leftrightarrow \text{ELEC}(m)_{t(x)}$ In this causal relationship, m represents the country code and subscript x is the F-statistic. Subscript [31] represents the number of observations. [1] represents the ρ–value at 5% critical level. Asterisks (**) represent a causal relation.

4. Discussion

This paper investigated the relations between exports revenue and electricity for forty different economies between 1980 and 2012. The empirical study used the Johansen Cointegration test as well as the recent cointegration methodology proposed by Saikkonen and Lütkepohl. Even though many studies have been published on the relations between exports and energy consumption, many studies focused intently on oil and factors that affect its consumption and utility such as prices and exchange rates. It is worth noting that even though most studies provide detailed analyses on the energy-exports relationship, the direct relationship between exports and electricity consumption has not been studied to length. Other forms of energy have not been fully attended to such as tidal energy, wind energy, geothermal energy and their dynamic relationship with exports. The Saikkonen and Lütkepohl as well as the Johansen cointegration tests have been used to determine long run relations between the variables. The results of this study vary from country to country. Twenty one economies revealed that there are long term affiliations between exports and electricity consumption, following the results of the Johansen cointegration test. All countries exhibited long run relationships between exports and electricity consumption according to the Saikkonen and Lütkepohl test. Furthermore, the Granger causality test showed ten economies with a single-way causal relation from electricity consumption to exports revenue. Nonetheless, six economies particularly Botswana, Burundi, Algeria, Senegal, Bhutan, and Japan showed bidirectional causal relations between exports income and electricity consumption. Accrued exports income led electricity consumption in six different economies (Colombia; Dominica Republic; USA; Luxembourg; Italy; Netherlands; Congo; Sudan; and India). The results of this study have implications of course. The ramifications of this paper are proportionate to previous arguments by Narayan and Smyth (2008), and Akinlo (2009). The scholars posited that economic growth depends on energy consumption. In this study, almost half of the sample showed statistically significant relations between electricity consumption and exports income resembling economic growth as evidenced by Johansen cointegration test. The results are further supported by the empirical study by Kahrl and Richard-Holst (2008). The study found that exports are the major source of energy demand in the Chinese economy thus implying a significant relationship. This study also supports the feedback hypothesis based on the Granger causality test results. This has been evidenced been by six countries revealing a bidirectional causal relationship between exports revenue and electricity consumption. The conclusion reached by this paper is that electricity consumption plays a significant role in exports revenue. In effect, there is a long run statistically significant relationship between exports and electricity consumption. It is now time to also focus on other forms of energy and relations with exports such as tidal energy; wind energy; hydroelectric power and solar energy.

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