International Journal of Innovation Scientific Research and Review
Vol. 03, Issue, 03, pp.996-1003, March, 2021
Available online at http://www.journalijisr.com

Research Article

ISSN: 2582-6131

THE CONSUMPTION OF ELECTRICITY NON-RENEWABLE ORIGIN AND ECONOMIC GROWTH IN TUNISIA

***Aloui Amel**

Faculty of Legal, Economic and Management Sciences of Jendouba. Jendouba University Laboratory for the Promotion of Natural and Cultural Heritage.

Received 16th January 2021; Accepted 19th February 2021; Published online 15th March 2021

ABSTRACT

This article addresses the issue of electricity and economic growth in Tunisia consumption. Our first objective is to investigate and analyze the causal relationship between electricity consumption and economic growth in Tunisia over the period from 2000 to 2019.To examine this relationship we used a multivariate approach to co integration, an error correction model based on recent advances in time series econometrics is estimated. The empirical results showed that there are short-term relationships and a long-term relationship between GDP and electricity consumption in Tunisia. The results also indicate the existence of a causal relationship uniform directional between GDP and electricity consumption. Our empirical results support the idea that in Tunisia the current energy deficit is a huge burden on the state budget.

Keywords: energy; growth; causality; MCE; Co integration.

INTRODUCTION

The proliferation of industrial products development at four corner of the world in the automotive, aviation and transport any kind ever faster mobilized an increasing amount of fossil fuels in 1950 dice coal, gas and oil gradually emerged as the engine of the global economy. In 1900 the global fossil fuel consumption was about 500 Mtoe, for a population of 1.6 billion people, in 2011 consumption was multiplied by 24 to reach 12,274 million tonnes while the population has increased 4.46. Energy has become an essential commodity for the operation of our civilization, and access to these sources has become a major issue for the functioning of the economy, the development of the aerospace automotive industry, naval construction, rail and electrical equipment, in international relations, and therefore an important factor in national politics. The energy sector covers more area, environmental and economic challenges facing the sector are properly colossal on the battlefields clash states: producers, exporters or importers of energy, public and private companies involved in direct or indirect manner in the sector.

The energy, the engine of the global economy

World consumption of energy at the end of the twentieth century is of the order of 12 billion (toe) per year to be 7 billion people, per capita consumption of about 1 .7 toe per year, this result hides wide disparities and very large inequalities. For example, the United States consumes it only 25% of world energy while less than 5% of the population, their annual consumption per capita is around 7.5 toe as she does that is 3.5 tonnes on average for a European who nevertheless has an annual income of about 75% of the American income. Per capita consumption of energy for poor countries is a few hundred pounds a year, nearly 2 billion people lack access to modern energy sources, these individuals use firewood whose collection worse in some areas affected by rapid desertification and worrying. These inequalities in energy consumption generally correspond to the unequal distribution of wealth. There is a strong but complex link between economic development and energy consumption. The three major fossil fuels dominate the global demand for energy, our consumption of primary energy dependent for 40% oil, 25% coal and 25% natural gas. The remaining 10% is the participation of hydro, nuclear and renewable energy such as wind power, solar power and biomass. Over 90% of our consumption, we dependent on non-renewable energy, which by definition is finite., Even though the actual volume of stocks is probably more important than is generally believed, in fact when producing a ton of coal, crude oil, or natural gas, it reduces the volume of one tonne of geological stock. The share of renewable energy has increased very little they remain expensive compared to traditional energy sources, they do not cover political, economic and financial comparable to oil or natural gas issues. This illustrates the high degree of structural rigidity of the global energy system, it is marked by the weight of history, particularly with the rapid development of transport based on cheap oil, today the sector road, air maritime and consumes more than half the world's oil. A multitude of various actors to ensure the proper functioning of the physical and financial flows, coal, oil, and natural gas; transportation pipelines, by ships and trucks, distribution, storage, financial transactions, etc. The world's primary energy supply is inherently large regional inequality related to local availability of natural resources and policy conducted, some countries produce almost all of the energy they consume more imports almost all of energy they need. Each country is a given energy situation depends on national energy resources of energy policy followed with constraints and flexibilities pleased the less.

Dependence on fossil fuels

In less than a century, we have built a strong dependence vis-à-vis oil, if oil flows are interrupted, cars and trucks stop, aircraft fleet is grounded, ships are in port millions of people will find themselves without electricity or heating, we do not have, a very short-term, alternative energy, except some industrial plant that can use either fuel oil, natural gas and coal. Certainly a total interruption is unthinkable but partial interruptions, local, accidental are possible. Since 1945 the oil flow from the Gulf have been threatened several times but the sudden disappearance of a particular source has been

***Corresponding Author: Aloui Amel,**
Faculty of Legal, Economic and Management Sciences of Jendouba. Jendouba University Laboratory for the Promotion of Natural and Cultural Heritage.

offset by the regulatory function of neighboring countries and the political and military vigilance of the Western powers. Since 1970 we can say that the biggest majority of oil-exporting countries have increased their dependence vis-à-vis their oil exports. For all of these countries, exports contribute significantly to the financing of state budgets and are a very important source of foreign exchange. Major industrialized oil-importing countries, which have made in 1973 at what point they entaient dependent, have instead sought to reduce their dependence. The share of oil in the production of added value to decrease greatly since the first oil shock. This is due to a structural transformation of the value added by efficiency and diversification of energy. Thus the external energy bill, which was between 2 and 5% of GDP after the first oil shock, fell less than 1% in major industrialized countries. And to oil shocks, the economy of these countries has become less vulnerable. However, the increase in weight of the whole transport sector in GDP shows that it is still very dependent on oil imports, but this dependence varies from one country to another if one takes into account the tax deductions and modal structure of the transport sector. To mitigate their growing dependence on oil importing countries can use as part of their energy policy a set of instruments to reduce dependence and master their consumption. Stockpiling of security to rependre quickly to a relatively short crisis is too effective strategy. In this regard, a system of coordination of strategic stocks has been established under the auspices of the IEA. Other tools include: improving energy efficiency, diversification of supply sources and energy mix. For diversification and following the first oil shock the French state to proceed with the construction of a major nuclear park to grow by 25 to 50% share of energy aims. The situation is more and more difficult for countries developing or importing fossil fuel their economic growth rate is lower than their rate of energy consumption, energy costs weigh heavily on their balance of trade and finance as their energy system is not effective. They also have less freedom to use the tools available in industrialized countries. At every point of view it is to reduce energy dependence, to protect the use of deficit reduction and climate change, the way of reproductive energy is in the process of undergoing a profound change, if the drilling far and so deep the odds are proof, oil will not come out of our life in the near future, but if we are to meet the challenge of energy we have to find alternatives to fossil fuel.

Tunisia and the current energy situation

Since 2002 the structure of energy production recorded a single change in the area of wind power production increased by 2% in 2010 against 0.4% in 2002, if production capacity has not changed. Natural gas remains in Tunisia on fuel used by against other forms of energy involved in this low energy mix. Tunisia is ranked among the countries with low energy diversification, but this configuration makes it too dependent on fossil fuel exporting country and therefore extremely sensitive to any possible oil crisis, has to face the end of this handicap measures to diversify production electricity must be taken, with recourse to other forms of renewable and nuclear energy.

One of the solutions required to escape this dependence is the liberalization of the electricity generation industry that can lead to an improvement of supply, energy diversification, and reducing some of the negative effects of the trade balance. The structure of primary energy resources is composed of 53% crude oil and 45% natural gas. The share of renewable energy is negligible. The primary energy demand has declined during 2011, reaching 13,230 GWh against 13551Gwh 2010, a decrease of 2.36%. This results in an energy saving of about 321 GWh. The share of natural gas in electricity generation has largely increased, it increased from 95.39% in 2009 to approximately 98.92% in 2018, while that of petroleum products declined from 0.0619% to in 2018 against 3.45% in 2009 the renewable progress as to a rate of 0.67% in 2018 against a rate of 0.63% in 2009. This origin is explained by the incentive of Government to replace energy production from oil by the renewable energy and natural gas, following the rise in oil prices which has several negative consequences on the balance of payments and energy bills to pay. Energy consumption is estimated in 2018, 19.524 Gwh in which the industry is in first place with 36.25%, the stability of the energy consumption in the industrial sector is due to the emergence of new industry more energy efficient and / or development sectors and consumes less energy activities as the service sector. Residential energy consumption developed with an increasing rate from 2010 to 2019, this is due to the increase in living standards of households.

Evolution of the energy balance

The energy sector in Tunisia despite weak fossil energy resources, played a decisive role in social and economic development of the country. Unfortunately in recent years the Tunisian energy balance recorded a net deterioration. Marked by an ever-increasing demand for energy of all economic sectors and a decline in participation of energy in the GDP. Generally, the energy balance of Tunisia gone through three phases, one phase between (1990-1994) which was in surplus which, between the second (1994-2000) called equilibrium and then the last phase since (2001) which is a deficit.

Review of empirical literature

GDP energy relationship has been studied by many researchers in the last decade. In Hong Kong, India, Portugal, Taiwan and Malaysia, it was found that energy consumption and economic growth are co integrated, even more, a causal relationship between economic growth and energy was found . Similarly, the relationship of cause and effect between electricity consumption and economic growth has been found in Bangladesh and Côte d'Ivoire. However, a bi-directional causality relationship was found in Malawi and Poland and between economic growth and energy consumption. Co integration relationship was found in the former Soviet republics and by BildiriciKayakci, Nigeria by Akinlo, Lebanon by Abosedra et al, China by Shiu and Lam, Bangladesh by Ahamad and Islam, Malaysia by Chandran et al. Fiji Islands Narayan Singh, China by Shengfng et al, and the Middle East by Narayan and Smyth. The same results were also found in Turkey and AltinayKaragol and Pakistan by Jamil and Ahmad. However, Malaysia Tan Tang and found a relationship bidirectional causality rather than cointegration between energy consumption and economic growth. These results were reached by Ouedraogo in Burkina Faso, in South Africa by Odhiambo, Algeria and Abderrahmani by Belaid, and Pakistan by Shahbaz and Lean. Moreover, Narayan et al. Showed that energy consumption increased economic growth for all seven major developed countries except the United States country. The relationship between energy consumption and economic growth ranged between African countries on the basis of WoldeRufael, he found that energy consumption and economic growth are co integrated in several African countries. Also it was found that some African countries have a unidirectional causality from economic growth to energy consumption, also a two-way causal relationship between the variables was found in the rest of African countries. Squalli also found mixed results for Petroleum Exporting Countries (OPEC), while for some countries economic growth depends on energy, other countries are less dependent or independent. Yoo and Kwak found that the causal relationship between energy consumption and economic growth varied for the South American country where causality was unidirectional energy consumption to economic growth in Argentina Brazil, Chile, Colombia and Ecuador. They also found that the causal relationship between energy consumption and economic growth was bidirectional Venezuela. However, no causal link has been found between the two variables in Peru. Similarly, Narayan Prasad and found a cause and effect mixed between energy consumption and economic growth in the Organization for Economic Cooperation and Development (OECD) where the causal unidirectional consumption energy for economic growth has been found in a number of OECD countries, while the rest of the countries have no causal relationship between them. Different causal relationships have been defined in the ASEAN countries by Yoo, who has been linked bidirectional causality between energy consumption and economic growth in Malaysia and Singapore while a unidirectional causal relationship of energy consumption to economic growth was found in Indonesia and Thailand. In addition, Apergis and Payne concluded that the relationship between energy consumption and varied between countries according to their level of economic development growth. The results of the study indicated that a bi-directional causality between energy consumption and economic growth has been found in a large country with upper and lower middle income Causation-way has not been found in low-income countries. However, Ozturk Acaravci and concluded that there is no long term relationship or short-term relationship between energy consumption and economic growth in a number of Middle East and North Africa (MENA) and in countries in transition.

Table 1: Study on the causal relationship between electricity consumption and GDP

Author(s)	Country and period	Method	Conclusions
Apergis and Payne	Emerging countries (1990–2007)	Co integration test of pedroni FMOLS	-The renewable and non-renewable energy and GDP growth are co integrated - Renewable electricity and non-renewable have a long term effect on GDP growth
Ho et Siu	Hong Kong (1966–2002)	Johansen Co integration Test error correction model	- Energy and GDP growth are co integrated. - Energy consumption→ GDP growth
Payne	U.S.A. (1949–2007)	Causality test of Toda-Yamamoto	- Unidirectional causality EC to EG
Apergisand Payne	Eurasia 1992–2007	Pedronicointegration test FMOLS ECM Granger causality	- The renewable and non-renewable electricity and GDP are co integrated. - Renewable electricity and has a long term effect on GDP growth.
Shahbaz and al	Portugal 1971–2009	ARDL test Johansen Co integration Test ECM Granger causality	- Energy and GDP growth are co integrated and have a long term relationship - Electricity consumption → GDP growth of India
Apergis and al	19 countries in developed and developing channel 1984–2007	ECM Granger causality	- Negative relationship between NEC and CO2, - Positive relationship between CO2 and REC
Salim and Rafiq	Brazil, China, India, Indonesia, Philippines and Turkey 1980–2006	Granger causality test	- In the long term, REC is significantly determined by E in Brazil, China, India, Indonesia, the Philippines and Turkey. - There is a bi-directional causality between short-term REC and EG
Tugcu and al	G-7 1980–2009	Johansen Co integration Test	- Neutral hypothesis for France, Italy, Canada and the USA.
Shiu andLam	China 1971–2000	Johansen Co integration Test ECM Granger causality	- Energy and GDP growth are co integrated - Energy consumption → GDP growth

Table 1: Study on the causal relationship between electricity consumption and GDP (continued)

Yoo	**South africa 1970–2002**	**Johansen Co integration Test ECM Granger causality**	**- Electricity and GDP are co integrated - GDP growth → energy consumption**
BélaïdandAbderrahmanI	Algéria 1971–2010	Hansen co integration test VECM Granger causality	- GDP growth → energy consumption
Bowden and Payne	USA 1949–2006	Causality test of Toda-Yamamoto	- Unidirectional causality residential REC to EG.
Gurgul and Lach	Pologne 1982–2007	Johansen Co integration Test Causality test of Toda-Yamamoto	- Energy and GDP growth are co integrated - GDP growth of the → energy-consumption
Apergis and Payne	88 countries 1990–2006	panel co integration test ECM Granger causality	- Energy and GDP growth are co integrated - GDP growth → energy consumption in middle-income countries. - Energy → GDP growth in low-income countries.
Yoo andKwak	7 countries in Latin America1975–2006	Johansen Co integration Test Granger causality test ECM Granger causality	- GDP growth → electricity consumption in Argentina, Brazil, Chile, Colombia, Ecuador. - Electricity consumption → GDP growth in Venezuela. - Electricity consumption → GDP growth in Peru
Narayan andSmyth	Middle East 1974–2002	ECM Granger causality Westerlund panel co integration	- Energy and GDP growth are co integrated and electricity has a positive long-term impact on GDP growth - Energy → GDP growth

Empirical Analysis of the relationship between electricity consumption and economic growth

Data source

Statistics are collected from the database of the World Bank (WBI 2020) available free on its website. These include the following series: GDP, gross fixed capital formation. Data on the total workforce were collected from the database of UNCTAD and finally electricity consumption is collected from the site of US Energy Information Administration.

Data Definition

- LP: This is the logarithm of real Gross Domestic Product, GDP is defined as the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. (WDI 2020)
- LE: logarithm of the consumption of electricity generated from fossil fuels (oil, gas or coal) measures the production of power plants and combined heat and power plants less transmission and distribution, transmission losses and energy use power plants and CHP. (US EIA 2020)
- LF: logarithm of gross capital formation consists of outlays on additions to the fixed assets of the economy plus net changes in inventories. Fixed assets include land improvements, factories, machinery and equipment purchases, road construction, etc. including schools, offices, private residential dwellings, and commercial and industrial buildings. (WDI 2020)
- LE: logarithm of the total active population comprises all persons who supply labor for the production of goods and services during a given period. This definition includes both workers and job seekers, people looking for their first job, the staff of the armed forces and seasonal or part-time workers. (WDI 2020)

Analysis of stationary series

Before reviewing the results of estimates it is imperative to study the stationary time series which bear on our regressions. The principle is a statistical series will not be stationary if it is auto correlated persistently, i.e. its value at each period depends heavily on its past achievements. Variables whose autocorrelations are close to unity, and only decreasing slowly, but still significantly different from zero up to a certain order, are non-stationary variables.
The Dickey-Fuller test (DF) is based on an autoregressive model of order 1 (AR (1)) of the form

$$Xt = \mu + \theta Xt\text{-}1 + \varepsilon t \quad (1)$$

Where μ and are parameters and t is assumed to be white noise. But, if the series is correlated with high levels of delays, then the white noise assumption is violated. Assuming that a series follows an AR (p) process. One way to ensure the stationary time series is to apply the unit root test Dickey-Fuller Increases (ADF). The ADF test performs a parametric EQ high correlations to one order.

Table 2 shows the results of the serial analysis. These series were regressed using the following specification:

$$\Delta Xt = \mu + \beta t + \rho Xt\text{-}1 + \theta \Delta Xt\text{-}1 + \xi t \quad (2)$$

Table 2: Results of ADF test of Dickey-Fuller

Variables	μ	β	ρ	θ	$ADF\ test$ Stat	Seuil	$\overline{R}^2$	$D.W.$
ΔP	0.022	0.00024	-1.432	0.132	-4.39	1%	0.61	2.01
ΔE	0.042	-0.0007	-1.175	0.107	-3.82	5%	0.47	1.78
ΔT	0.024	-0.0003	-1.64	0.878	-5.91	1%	0.56	1.84
ΔF	-0.00031	0.00005	-0.747	0.160	-3.46	1%	0.27	2.01

Source: Our calculations based on output EVIEWS 6.0

The Augmented Dickey Fuller test indicates that the four series LP, LE, LT, LF are non-stationary in levels and stationary in first differences; the four series are I (1) there is a risk of Co integration. Co integration test is made from the residue of the model estimation

$$LP = LE + LP + LT \quad (3)$$

Analysis of the Augmented Dickey Fuller test on the residue suggests a stationary state of the residue, the four variables are co integrated.

Table 3: residue

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.041787	0.0413
Test critical values:	1% level	-2.647120	
	5% level	-1.952910	
	10% level	-1.610011	

Determining the number of delay

Table 4: Number of lags

Lag	LogL	LR	FPE	AIC	SC	HQ
0	211.0588	NA	4.44e-12	-14.78992	-14.59960	-14.73174
1	390.3457	294.5426	3.88e-17	-26.45326	-25.50169	-26.16236
2	425.6802	47.95404*	1.05e-17*	-27.83430	-26.12147*	-27.31067*
3	441.7253	17.19119	1.30e-17	-27.83752*	-25.36343	-27.08117

Johansen Test

Table 5: Test of the Trace

Unrestricted Co integration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.727810	69.99259	47.85613	0.0001
At most 1 *	0.556274	33.55748	29.79707	0.0176
At most 2	0.319961	10.80616	15.49471	0.2237
At most 3	0.000329	0.009213	3.841466	0.9232

- There Co integration because the null hypothesis of no co integration was rejected (69.99257> 47.85613) and (0.0001 <0.05) at 5%.
- The null hypothesis that there is at most one co integration relationship was rejected because it was (33.55748> 29.79707) and (0.0176 <0.05) at 5%.

Table 6: Test Maximum Eigen value

Unrestricted Co integration Rank Test (Maximum Eigen value)				
Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.727810	36.43511	27.58434	0.0028
At most 1 *	0.556274	22.75132	21.13162	0.0293
At most 2	0.319961	10.79695	14.26460	0.1647
At most 3	0.000329	0.009213	3.841466	0.9232

- There Co integration because the null hypothesis of no co integration was rejected (36.43511> 27.58434) and (0.0028 <0.05) at 5%.
- The null hypothesis that there is at most one co integration relationship was rejected because it was (22.75132> 21.13162) and (0.0293 <0.05) at 5%.

Identification of related Co integration

Table 7: Estimated Co integration relationship

1 Co integrating Equation(s):		**Log likelihood**	**424.9466**
Normalized co integrating coefficients (standard error in parentheses)			
LP	LE	LF	LT
1.000000	2.368901	-0.819312	-5.901677
	(0.74211)	(0.10384)	(1.68548)

According to the test results of Johansen Co integration, we note that the analysis of the trace and the maximum value in the plausibility shows in the confidence interval of 5% a relationship of long-term co integration.

$$P = -2.368901\,E + 0.819312\,F + 5.901677\,T \quad (4)$$

The equation of the standard long-term relationship show a 1% increase in the consumption of electricity in Tunisia generally reduce 2.36% of GDP in the long run, this is due to the Tunisian state grant for petroleum product that depends 97% electricity generation, this grant represents 4% of GDP and 10.6% of the state budget.

Estimated Error Correction Model

The choice of model error correction theorem comes from Engle and Granger have shown that for non-stationary series which have a unit root and are co integrated should be represented as a model error correction.

We note the following two models MCE:

$\Delta LP_t = 0.026892 + 0.038270\ \mu_{t-1} - 0.346244\ \Delta LP_{t-1} - 0.496127\ \Delta LP_{t-2} - 0.180480\ \Delta LE_{t-1} +$
(1.6) (0.82) (-1.61) (-2.12) (-1.43) (5)
$0.313228\ \Delta LE_{t-2} + 0.035373\ \Delta LF_{t-1} + 0.103595\ \Delta LF_{t-2} - 0.651008\ \Delta LT_{t-1} + 0.846982\ \Delta LT_{t-2}$
(2.73) (0.61) (1.55) (-0.41) (0.4)

$\Delta LE_t = 0.068953 - 0.135505\ \mu_{t-1} - 0.692788\ \Delta LP_{t-1} - 0.229420\ \Delta LP_{t-2} - 0.002668\ \Delta LE_{t-1} -$
(3.2) (-2.27) (-1.61) (-0.76) (-0.01) (6)
$0.122206\ \Delta LE_{t-2} + 0.058620\ \Delta LF_{t-1} - 0.026461\ \Delta LF_{t-2} - 6.340949\ \Delta LT_{t-1} + 3.972760\ \Delta LT_{t-2}$
(-0.82) (0.78) (-0.3) (-3.15) (1.48)

The analysis of the model error correcting shows that there is no long-run relationship between electricity consumption and GDP, it has a positive coefficient (0.038270) and is not significant (t = 0.825183). By cons there is a long-term relationship of GDP to consumption electrics. With a coefficient (-0.135505) is significant (t = 2273)). The Wald test shows a bidirectional short term relationship between electricity consumption and GDP. In the short term if you have a balance, GDP has an equilibrium level in the long term statistically significant adjusts at a rate of (3.8%) slower than the électricités.qui consumption at a speed of convergence of (13.55%), the gross fixed capital fits with 63.43% and employment with 0.7%. In the short term there is a depressive effect exerted by consumer electrics. On the growth rate (-0.18%) for a one-period lag. The electrics short-term consumption is negative and significant. So that in the short term, this variable negatively affects the evolution of GDP growth. In the long run, this coefficient is not significant and has a negative sign. Thus, an increase in electricity consumption by 1%, would reduce GDP by 0.18% in the short term and a decrease of 2.36% in the long term.

Short run relationship

Table 8: Direction of short term relationship between GDP and electricity consumption

Short term relationship of energy to GDP				Short term relationship of GDP to energy			
Wald Test: Equation: Untitled				Wald Test: Equation: Untitled			
Test Statistic	Value	df	Probability	Test Statistic	Value	df	Probability
Chi-square	8.176187	2	0.0168	Chi-square	6.380725	2	0.0412

According to the Wald test and based on the statistics of Chi-square there is a relationship of short-term electricity consumption to GDP because we have (0.0168 <0.05) and a short-term relationship of GDP to electricity consumption because we have (0.0412 <0.05).

Testing causal

The existence of co integration between the variables suggests the existence of a causal relationship between these variables, bidirectional or unidirectional causality. Determine the direction of causality is an important element in the development of economic policy or to make predictions.

The study of direction of causality between economic variables namely, GDP, consumer electrics. Gross capital formation and the work will allow us to better know the Tunisian economic and energy reality.

Table 9: direction of causality between GDP and electricity consumption, employment and gross fixed capital

Null Hypothesis:	Obs	F-Statistic	Prob.
LE does not Granger Cause LP	28	3.33522	0.0535
LP does not Granger Cause LE		4.78807	0.0183
LF does not Granger Cause LP	28	0.96729	0.3950
LP does not Granger Cause LF		0.60111	0.5566
LT does not Granger Cause LP	28	0.25492	0.7771
LP does not Granger Cause LT		1.06934	0.3597
LF does not Granger Cause LE	28	0.22219	0.8025
LE does not Granger Cause LF		0.18385	0.8333
LT does not Granger Cause LE	28	5.14989	0.0142
LE does not Granger Cause LT		0.13477	0.8746
LT does not Granger Cause LF	28	0.16702	0.8472
LF does not Granger Cause LT		0.48084	0.6243

.

From this table, twelve hypotheses were tested simultaneously, ie the causality between the four variables taken in pairs. We therefore tested the hypothesis of knowing whether the development of consumer electrics does not cause economic growth and vice versa. The same assumptions were taken between gross fixed capital formation and GDP and between the level of employment and GDP.

We note that the 5% threshold, the Granger test suggests a unidirectional causality between GDP and consumer electrics. Ie in the case of Tunisia, it is GDP that causes increased consumption electrics and not vice versa, supporting the thesis that wants the Tunisian government subsidies for energy 4% of GDP are very large and worsens the budget deficit of the state. Tunisia to ensure its economic expansion and cope with its energy deficit in 2013 reached 2 million tons oil equivalent (TOE) should use a different mode of energy generation, such as nuclear or renewable energy that will allow them to ensure its energy independence vis a vis the products of fossil fuel exporting country and its energy. the widening of the deficit of the energy balance was thus accentuated to reach at the end of December 2019 a new record of 7.75 billion dinars after 6.2 billion a year earlier and 4 billion in 2017. This sharp increase in the energy deficit bears the mark of the 19.6 increase in imports of energy products under the effect of the increase in our purchases of natural gas which reached 3.7 billion dinars against 2.2 billion in 2018. Furthermore, still at 5%, the level of employment measured by the active labor force affects the energy consumption and not vice versa. This follows from the increasing energy demand in Tunisia from industry, service and commercial chain.

Conclusion

Tunisia's energy mix is marked by a decline in output of around 5% and an increase in demand of 6%. During the last twenty years the hydrocarbon production was 7 Mtoe but face a growing annual demand for 3.1% energy deficit reached 1.9 Mtoe in 2015, and will reach in 2020 the 3.5Mtep and in 2030 the danger of 7Mtep. With this current rate of growth, the energy deficit will become more important as we will not find another deposit of oil or gas that is why we should implement measures and instruments to secure and ensure our energy supply, improve power production and diversify our energy mix. Today Tunisia needs to develop plans for energy transformation to ensure a better future and escape to a growing dependence on fossil fuels explorer countries. The energy will be the engine of economic activities wholes and an indicator of social dynamics on which Tunisia will bet.

REFERENCES

1. Abosedra S, DahA, Ghosh S. (2009) Electricity consumption and economic growth, the case of Lebanon. Appl. Energy; 86: pp. 429–32.
2. Abbas F, Choudhury N. (2012) Electricity consumption – economic growth Nexus: an aggregated and disaggregated causality analysis in India and Pakistan. JPolicy Model; 35: pp. 538-3.
3. Bildirici ME, Kayıkçı F. (2012) Economic growth and electricity consumption in former Soviet Republics. EnergyEcon2012; 34: pp. 747–53.
4. Dickey, D.A., Fuller, W.A. (1979). Distribution of the estimators for autoregressive time Series with a unit root.Journal of the American statistical Association 74, pp. 427–431.
5. Economic Report of the President, (2006). United States Government Printing Office, Washington, DC.
6. Engle, R.F., Granger, C.W.J., (1987). Cointegration and error correction: representation, Estimation and testing. Econometrica 55, pp. 251–276.
7. Gurgul H, Lach L. (2012). the electricity consumption versus economic growth of the Polish economy. Energy Econ; 34: pp. 500–10.
8. Harris, J.M., (2006). Environmental and Natural Resource Economics: A Contemporary Approach. Houghton Mifflin Company, Boston, U.S.A.
9. Harris, R., Sollis, R., (2003). Applied Time Series Modelling and Forecasting.John Wiley & Sons, Chichester, England.
10. Henriques, I., Sadorsky, P., (2008). Oil prices and the stock prices of alternative energy Companies. Energy Economics 30, pp. 998–1010.
11. Hlouskova, J., Wagner, M., (2006). The performance of panel unit root and stationarity Tests: results from a large scale simulation study. Econometric Reviews 25, pp. 85–116.
12. Im, K.S., Pesaran, M.H., Shin, Y., (2003). Testing for unit roots in heterogeneous panels. Journal of Econometrics 115, pp. 53–74.
13. International Energy Agency, (2006).World Energy Outlook. IEA, Paris.
14. Jumbe CBL. (2004), Cointegration and causality between electricity consumption and GDP: empirical evidence from Malawi. Energy Econ; 26: pp. 61–8.
15. Jarque, C.M., Bera, A.K., (1980). Efficient tests for normality, homoskedasticity and serial Independence of regression residuals. Economics Letters 6, pp. 255–259.
16. Kouakou AK. (2011), Economic growth and electricity consumption in Coted'Ivoire: evidence from time series analysis. Energy Policy; 39: pp. 3638–44.
17. Kwiatkowski, D., Phillips, P.C.B., Schmidt, P., Shin, Y., (1992). Testing the null hypothesis of stationarity against the alternative of a unit root. Journal of Econometrics 54, pp. 159–178.
18. Levin, A., Lin, C.F., Chu, C., (2002). Unit root tests in panel data: asymptotic and finite Sample properties. Journal of Econometrics 108, pp. 1–24.
19. Lee, C.C., (2005). Energy consumption and GDP in developing countries: a cointegrated Panel analysis. Energy Economics 27, pp. 415–427.
20. Lean HH, Smyth R. (2010), Multivariate Granger causality between electricity generation, exports, prices and GDP in Malaysia. Energy; 35: pp. 3640–8.
21. Maddala, G.S., Wu, S., (1999). A comparative study of unit root tests with panel data and a new simple test. Oxford Bulletin of Economics and Statistics 61, pp.631–652.
22. Narayan, P.K., Narayan, S., (2005). Estimating income and price elasticities of imports for Fiji in a cointegration framework. Economic Modelling 22, pp. 423–438.
23. Pao HT. (2009) Forecast of electricity consumption and economic growth in Taiwan by state space modeling. Energy; 34: pp. 1779–91.
24. Pantula, S.G., Gonzalez-Farias, G., Fuller, W.A., (1994). A comparison of unit-root test criteria. Journal of Business and Economic Statistics 12, pp. 449–459.
25. Phillips, P.C.B. Perron, P. (1988). Testing for a unit root in time series regression.Biometrika 75, pp. 335–346.
26. Shahbaz M, Tang CF, Shabbir MS. (2011). Electricity consumption and economic growth nexus in Portugal using cointegration and causality approaches. Energy Policy 2011; 39: pp. 3529–36.
27. Shiu, A. Lam, P L. (2004). Electricity consumption and economic growth in China. Energy Policy 32, pp. 47-54.
28. Squalli, J., (2007). Electricity consumption and economic growth: bounds and causality analyses of OPEC members. Energy Economics 29, pp. 1192–1205.
29. Stock, J.H., Watson, M.W., (1989). Interpreting the evidence in money-income causality. Journal of Econometrics 40, pp. 161–182.

30. Thoma, M., 2004. Electrical energy usage over the business cycle. Energy Economics 26, pp. 463–485.
31. US Energy Information Administration. http://www.eia.gov/

****