

## **ELECTRICITY CONSUMPTION NEXUS ECONOMIC GROWTH: A bounds test Approach**

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This article aims to study the relationship between electricity consumption and economic growth in Benin and Côte d'Ivoire. The choice of these two countries is justified by that one electricity producer and one importer of electricity. To do this, we used the co integration test of Pesaran, Shin and Smith (2001) and causality test of Toda Yamamoto (1995). The data from our studies comes from World Bank and related to the electricity consumption, economic growth here materialized by GDP and Gross Fixed Capital Formation. Estimates of the co integration test of Pesaran et al (2001) suggest that both the Benin and Côte d'Ivoire that electricity consumption has a positive long run economic growth, but in the short run its influence on growth economy is not significant. In addition, the Toda-Yamamoto test reveals bidirectional causality between electricity consumption and economic growth in Benin and an absence of causality between electricity consumption in Côte d'Ivoire; allowing that policy energy can be put into execution without compromising economic growth.

**Keys Words: Electricity consumption, Growth, Causality, Co integration**

### **1. Introduction**

#### *Context*

Economic development requires investment in the productive system. This implies the prior existence of a source of energy able to power the industry which create higher added value. Electricity occupies an important place in the development process of any nation. For a long time, the role energy in economic growth is not to dismantle the extent it has been very useful in the process of developing and industrialized countries.

With the increase of economic growth in African countries and in order to develop policies aimed at maintaining this high growth. It therefore appears appropriate to worry about the energy challenges that could be an obstacle to the overall growth of the continent, including the achievement of the Millennium Development Goals (MDGs).

Nevertheless, although the availability of electrical energy is not the only panacea to the problems and challenges social and economic in Africa. The fact remains that the regular supply of electricity is a necessary condition for the emergence of the continent (KANE, 2009).

In addition, in this millennium marked by a dramatic advanced the New Technologies of Information and Communication Technology (TIC), it seems impossible to imagine a development without adequate services of energy. It is to go in the sense that Philippe Busquin says "electricity is the same title as TIC, a vital good for society"<sup>1</sup>

In order to make the electricity sector, a dynamic sector that can boost economic growth, many African countries are making in favour of structural adjustment programs, an extensive program of restructuring their economies.

However, for Benin and Côte d'Ivoire, these reforms did not prevent these countries to face for many years, an energy crisis, mainly due to insufficient supply electrical energy to face a strong demand growth.

#### *Problem*

If the presence of electricity is a key factor in economic growth. It is time to truly consider the role played by modern energy services to boost human development (UNDP, 2005), because economic growth cannot be achieved without really knowing the nature and importance of the contribution of the electricity in development. Therefore, knowledge of the direction of causality between electricity

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<sup>1</sup> Communication on energy and economic growth, Brussels 14 March 2004

policies should be designed.

### **Study Objective**

The aim of this study is to identify the nature of relationships that may exist between electricity consumption and economic growth in order to provide adequate energy policies.

### **Hypotheses**

The hypotheses of this study are as follow :

- ✓ H1: There is a positive long run relationship between economic growth and electricity consumption in both countries.
- ✓ H2: There is a positive short long run relationship between economic growth and electricity consumption in both countries
- ✓ H3: Growth economics granger cause electricity consumption

### **Literature review**

The analysis of causality between the electricity consumption and economic growth has been the subject of numerous publications in the literature. However, the findings of these studies lead to conflicting results. These results differ depending on the time of conducting the study, the methodology used by the authors.

Indeed, it is Kraft and Kraft (1978) that we owe the first studies on the causal relationships between energy demand and gross domestic product. In order to highlight the existence of a link between GDP and energy demand in the U.S., Kraft and Kraft start from an analysis of the energy and GNP of U.S. consumption over the period 1947-1974 to reach the conclusion that there is a unidirectional relationship from the gross national product to energy demand.

However, the results of Kraft and Kraft have been the subject of criticism from Akarca and Long.

For Akarca and Long (1980), the results of Kraft and Kraft are biased to the extent that the period chosen for the study is considered to be unstable because it included the first oil shock. Thus, they shorten the study period 1950-1968, they show a lack of causal relationship between GDP and energy consumption.

Yang (2000) found bidirectional causality between electricity consumption and economic growth for Taiwan and Morimoto and Hope (2004) for Sri Lanka, Glauser and Lia (1997) for South Korea and Singapore. Causality from economic growth to electricity consumption has been found in India (Ghosh, 2002) for Australia by Narayan and Smyth (2005) and Fatai et al (2004) and the United States (Thoma, 2004). However, Shiu and Lam (2004) found that for China, it is the electricity consumption causes economic growth, as Wolde-Rufael (2004) to Shanghai.

For Fiji's island, Narayan and Singh (2006) from co integration techniques of Pesaran et al (2001) find a long-term relationship from electricity consumption to GDP.

On Africa, few studies are devoted to the relationship between economic growth and electricity consumption (Jumbe 2004). However, there are some authors who have tried to highlight this relationship. These studies are mostly based on the techniques of co integration, causality and error correction model (ECM).

The first is from Ebohon O. (1996) on Tanzania and Nigeria. Using the conventional Granger test, this author found bidirectional causality between economic growth and energy consumption for these two countries. The second more recent study for Malawi and was conducted by C. Jumbe (2004). Based on the methodology of Engle and Granger co integration and Granger causality, the analysis led to the conclusion that, on the one hand, there is bidirectional causality between electricity consumption and GDP and secondly, there is a unidirectional causality from non-agricultural GDP to electricity consumption

Akinlo (2009) used the Hodrick Prescott filter to decompose the series on electricity consumption and economic growth. It concludes that the granger causality is probably related to the economic cycle. The author suggests more investment in the electricity sector in order to reduce inefficiencies in the supply and use of electricity to stimulate economic growth in Nigeria.

In Burkina Faso a west African country, Ouédraogo(2010) use the techniques of Pesaran and al(2001) to identity the relationship between electricity consumption, investment and GDP. He find that there is a bidirectional relation between energy and investment.

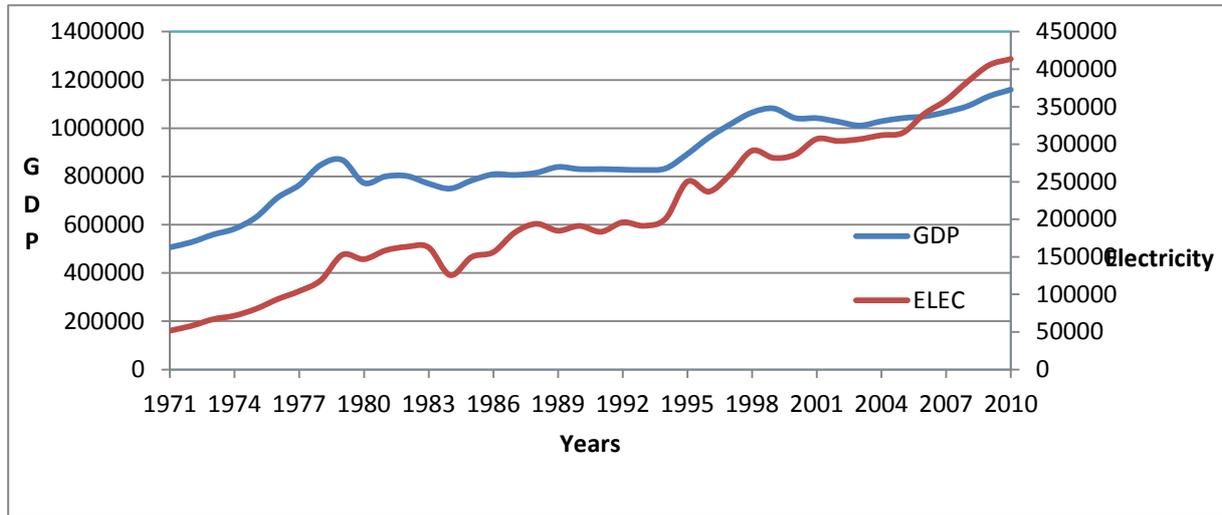
### **Data and Materials and Methods**

To achieve the objectives of this study and verify the above assumptions, we used information retrieval, descriptive statistics and econometric approach.

**Analysis of the evolution of the study variables**

The curve of electricity consumption and economic growth has the same trend until 2008 when electricity consumption exceeds economic growth. They are subject to the same upheavals. The observation of these graphs shows that economic growth and GDP have a same evolution during the period 1960-2008. After 2008, electricity consumption increase than economic growth.

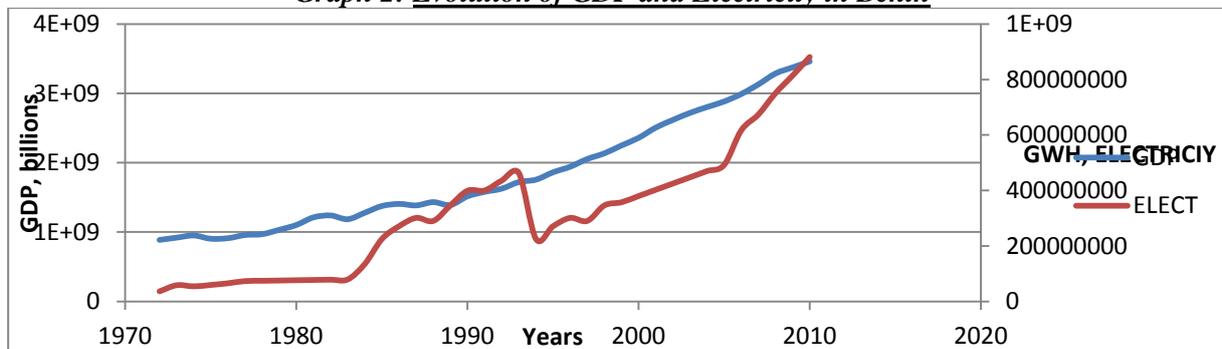
**Graph 1: Evolution of GDP and Electricity in Côte d'Ivoire**



Source: Our Calculations, Data from World BANK 2010

Graph 2 shows the simultaneous evolution of economic growth and electricity consumption in Benin. Benin is an electricity importer but Côte d'Ivoire is a producer of electricity. The electricity consumption in Bénin is uprising. The observation of Figure 7 below betrays that electricity consumption has steadily upward trend. Over the period 1971-2011, the national electricity consumption increased from 32 GWh in 1971 to 905.666. The electricity consumption provides form the importation from Nigeria, Ghana and Côte d'Ivoire.

**Graph 2: Evolution of GDP and Electricity in Benin**



Source: Our Calculations, Data from World BANK 2010

**Econometric analysis**

**The study data**

This study uses annual data covering the period 1971-2008. These data come from the World Development Indicators 2010 of the World Bank. The choice of this period of study is required in order to avoid series with missing data. In addition, the series offered by this institution give us the opportunity to make estimates over a long period allowing to achieve sufficiently robust results. These data relate to the real Gross Domestic Product (GDP), consumption of electricity, Gross Fixed Capital Formation (GFCF). GDP in real terms was made using the deflator (2000 = 100).

**Cointegration and Causality**

We use the ADF and PP to verify the existence or not of unit root in first differences. After this we add the order of integration in our causality test. The test of co integration used in this paper is the bounds test approach proposed by Pesaran shin and Smith (2009). It give better and robust result than the classic test of Engle Granger and Johansen. It can also be used when series are mixture I (0) or I

lack of data. The Pesaran and al model is:

$$\Delta \ln (PIB)_t = \alpha_0 + \phi t + \sum_{i=1}^p \varphi_{i1} \Delta \ln PIB_{t-i} + \sum_{i=0}^p \beta_{i1} \Delta \ln ELECT_{t-i} + \sum_{i=0}^p \gamma_{i1} \Delta \ln FBCF_{t-i} + \alpha_1 \ln PIB_{t-1} + \alpha_2 \ln ELECT_{t-1} + \alpha_3 \ln FBCF_{t-1} + \varepsilon_{1t}$$

After the model specification, we have:

**Table1: Estimation results for Bénin.**

- For Benin

<b>DLPIB</b>			
	Coefficient	t-stat	p-value
<i>lpib<sub>t-1</sub></i>	-0,53	-3,87	0,0009*
<i>lElect<sub>t-1</sub></i>	0,12	3,98	0,0007**
<i>lFbcf<sub>t-1</sub></i>	0,03	3,34	0,0370**
<b>Intercept</b>	8,14	4,31	0,0003*
<b>tendance</b>	0,009	1,99	0,0622***
$\Delta lpib_{t-1}$	0,42	2,87	0,0090*
$\Delta lpib_{t-3}$	0,28	3.16	0.0047*
$\Delta lelect_{t-1}$	0,013	1,89	0,0720***
$\Delta lelect_{t-3}$	-0,20	-2,57	0,0176***
$\Delta Fbcf_{t-1}$	0,009	-1.604	0,1235

R2 = 0,70  
 F-Stat = 4,49  
 Prob (F-stat) = 0,001672

Source: Our calculations on Eviews, \* 1%, \*\* 5%, \*\*\*10% significance threshold

**Causality**

The causality is resumed by this figure

**Table2: Causality test of Toda-Yamamoto for Benin.**

Type of causality	Stat Chi-square	p-value
LPIB does not cause LELECT	12.76	0.0052
LELECT does not cause LPIB	16.79	0.0008

Source: Our calculations on Eviews

- For Côte d’Ivoire

**Table3: Estimation results for Côte d’Ivoire**

<b>DLPIB</b>			
	Coefficient	t-stat	p-value
<i>lpib<sub>t-1</sub></i>	-0.72	-4.10	0.0005*
<i>lElect<sub>t-1</sub></i>	0.18	2.34	0.0287**
<i>lFbcf<sub>t-1</sub></i>	0.03	3.34	0.0029**
<b>Intercept</b>	8.14	4.31	0,003*
<b>tendance</b>	0.004	1.96	0.0055***
$\Delta lpib_{t-1}$	0.45	2,87	0,0090*
$\Delta lpib_{t-3}$	0.104	3.16	0.0047*
$\Delta lelect_{t-1}$	0.013	1.89	0.0720***
$\Delta lelect_{t-3}$	-0.20	-2.57	0,0176***
$\Delta Fbcf_{t-1}$	0.001	-1.604	0.1235

R2 = 0,80  
 F-Stat = 7.86  
 Prob (F-stat) = 0.0000024

The result of the Toda Yamamoto for Côte d'Ivoire is as follow:

**Table 4: causality test of Toda-Yamamoto for Côte d'Ivoire**

Type of causality	Stat Chi-square	p-value
LPIB does not cause LELECT	7.10	0.028
LELECT does not cause LPIB	1.90	0.385

Source: Our calculations on Eviews

The test of Pesaran and al 's (2001) co integrations made in the case of our study indicates the presence of a long-term relationship from economic growth to electricity consumption in Côte d'Ivoire and Benin. An increase in electricity consumption will result in a 1% increase in economic growth of 0.12% to 0.18% in Benin and Côte d'Ivoire. In these two models, Investment has a positive long run effect on GDP as indicates by the literature. But in a short run, we observe that electricity influence marginally the GDP. This situation means that the level of consumption in these countries is not enough to influence economic in short run. The causality test implanted in this study reveals that in Côte d'Ivoire, the causality go to economic growth from electricity consumption and in Benin, this relation is bidirectional. The result of Côte d'Ivoire could be explained by the political instability that has engulfed the country 10 years ago. This situation could cause the lack of investment in the electricity sector. The absence of causality could also be justified by the fact that the Ivorian economy, during the war, its economy based on the service sector, which consumes less electricity.

### 3. Conclusions

The subject we have discussed in the context of this paper addresses the major issues and key challenges related to energy and the MDGs. We therefore analyzed the relationship between electricity consumption and economic growth in both countries: one producer and one importer. Referent in us to new estimates in time series techniques, we find that electricity plays a role promising long term for these two countries. Moreover, short-term, this influence is virtually nil due to an industrial fabric strongly influenced by informal and very little in electricity consummation. Implementation of causality test of Toda and Yamamoto us achieve conclusion of the existence of a unidirectional relationship from GDP growth to electricity consumption for Côte d'Ivoire and bidirectional causality for Benin. This study suggest that a big effort can be make in the sector of electricity of each country because it have a real effect on the growth economic. Government must make more investisement in this sector. Encourage the private sector

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