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Structural Determinants of Energy Consumption in an Importing Country: The Case of Togo

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

In the current changing world, the question of access to energy sources has become a concern for many countries. This article aims to identify the structural determinants of the level of energy consumption in a country heavily depending on imported energy by taking the example of Togo. Econometric estimations show that the energy consumption depends not only on internal factors but also on external ones. Considering the three main energy suppliers of Togo that are Ivory Coast, Ghana and Nigeria, the study shows a negative and significant effect of Ghana's growth on the level of energy consumption of the country. In terms of implications, the results of this study show that Togo should encourage investment in the search for alternative energy sources and work towards the realization of community projects in the energy sector in order to reduce its imports in terms of energy.

Keywords: Energy; energy dependence; energy consumption.

JEL Classification: E20, Q41, Q43.

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1. INTRODUCTION

The possibility of access to reliable and cheap energy sources, especially electricity is a prerequisite for a functioning economy. Indeed, electricity provides essential services needed for production, communication and exchange of goods and services. It promotes individual development through improving education and health conditions. Moreover, it contributes to improving the economic environment for more effective public intervention. This essential role of energy explains efforts many countries make towards ensuring energy security defined as the resilience of the energy system to exceptional and unforeseen events that threaten the physical integrity of the delivery of energy and can cause irregular increases in energy prices, regardless of economic fundamentals [1]. If some developed countries are able to reduce their energy dependence and ensure the diversification of energy sources through development of alternative sources, the situation in most of the developing countries remains precarious. Indeed, a significant part of the energy supplied to households and businesses in many of these countries is imported from outside. This strong energy dependence makes most of them vulnerable to the instability linked to the supply due to the growing needs of the supply countries. However, very few economic studies have examined the effect of energy dependency on energy consumption. Ignorance of these effects may partly explain the lack of motivation to improve investment in the energy sector.

In general, if the producing and exporting countries experience an improvement in their economic performance, it is not excluded that this could have effects on importing countries. Many recent studies tend to confirm the conservative thesis that the level of economic growth is accompanied by an increase in energy consumption [2,3]. Rising energy demand in the producing countries could affect the importing country. Thus, the objective of this study is to examine the effects of energy dependence on the level of energy consumption in Togo.

The remaining of the paper is organized as follows: the first section presents the literature review; the second section deals with the state of the energy sector in Togo; the third section provides the method used for the analysis while the fourth section discusses the results. Finally, the conclusion summarizes the different results and provides some avenues for future research.

2. ENERGY AND ECONOMIC GROWTH: STATE OF THEORETICAL AND EMPIRICAL DEBATES

2.1 Theoretical Debates

Since the founder article of [4], which establishes a unidirectional causality from GDP growth to the energy consumption in the United States for the period of 1947 to 1974, the cause and effect relationship between energy consumption and economic growth has become a large field of study in the economic literature. Several methods or techniques and different samples were used to try to establish a relationship between these two variables. However, the empirical results of these studies were very disparate and sometimes contradictory. Currently, four perspectives emerge regarding the direction of causality between energy consumption and economic growth. The first point of view known under the name of "growth hypothesis" suggests that the energy consumption plays an important role in economic growth. It implies that economic growth depends on the level of energy consumption. Accordingly, a reduction of this consumption can slowdown economic growth. From this perspective, we can consider energy as a factor of production on the same basis as capital and labour. The second view point can be described as "conservative assumption" and supports a unidirectional causality from economic growth to energy consumption. It suggests that energy conservation policies may have little or no impact on economic growth. The conservative hypothesis is supported in the case the increased energy consumption comes from the increase in real GDP. The third view, which can be described as "neutrality hypothesis" argues that there is no causal link between energy consumption and economic growth. In other words, the energy consumption and economic growth are independent. The fourth point of view or the "feedback hypothesis" suggests a two-way causal relationship between energy consumption and economic growth reflecting the interdependence and the potential for complementarities associated with the policies of the energy and economic growth. These conflicting views have generated empirical research that try to find the relationship between these economic variables.

2.2 Empirical Studies

Empirical studies on the relationship between energy consumption and economic growth in

developed and especially developing countries provide various results. [5] demonstrate the existence of conservative hypothesis for Congo using the Error Correction Model over the period going from 1960 to 1999. [6] empirically tests the causal relationship between energy consumption and economic growth and reveals that the growth hypothesis is confirmed in Nigeria using Johansen and Engle-Granger approaches on data covering the period of 1980-2006. [7] led to the assumption of neutrality in a case study on South Africa over the period 1980 to 2005. [8] found a relationship going from economic growth to energy consumption in Ghana using Granger causality test. Unlike the work of [6] study of [3] shows the existence in Nigeria of Conservative hypothesis using the Augmented Dickey-Fuller (ADF) unit root tests, the VAR analysis, error correction mechanism, and the Granger causality test for the period of 1970 to 2005. [9] reveals a unidirectional relationship from energy consumption to economic growth in Cameroon using several techniques including Dickey-Fuller unit root test, the Granger causality test and ECM for the period 1971-2009.

Except these works carried out in African countries, several studies were also interested in this causality in other countries or group of countries. For example, using the causality approach in the sense of Granger over the period 1954 to 1993, [10] demonstrate the conservation hypothesis for Taiwan. [11] show that the growth hypothesis exists where the amount of energy used is low and the neutrality appears if the level of energy consumption is high. [12] found that energy consumption has a positive impact on economic growth in the United States. [13] show the presence of conservation hypothesis in Iran during 1967-2007. By contrast, [14], and [15] reveal that the causality runs from economic growth to energy consumption in the case of Russia and Brazil.

An earlier study by [16] focused on sub-Saharan African countries and found a bidirectional causality between energy consumption and growth in Tanzania and Nigeria using Granger causality tests. In addition, [17] in his work support the conservation assumption for Algeria, the Democratic Republic of Congo, Egypt, Ghana, Ivory Coast, Morocco and Nigeria, the growth hypothesis for Cameroon, and the neutrality hypothesis for the Republic of Congo, Kenya, Senegal, South Africa, Sudan, Togo, Tunisia and Zimbabwe. [6] shows that there is a causal relationship in both directions between energy consumption and economic growth for the Gambia, Ghana, Sudan, Senegal and Zimbabwe; a relationship going from growth to energy consumption in Cameroon; the growth hypothesis in Congo and causal relationship Ivory Coast, Kenya, Nigeria and Togo. [18] found a causality going in the direction of energy consumption to economic growth in the case of Kenya and South Africa for the period of 1972-2006. [19] examines the long-term relationship and the causal relationship between energy consumption and economic growth for seven groups of African countries. He concluded that there exist a feedback hypothesis in Ivory Coast, the conservation hypothesis in Congo and also showed that there is a long-term relationship between the two variables in Cameroon, Congo, Cote d'Ivoire and South Africa.

[20] examine the causal relationship between energy consumption and economic growth in low-income countries and high-income areas for the period of 1971-2005. He found the presence of the conservation hypothesis and feedback hypothesis for low-income countries and high-income countries, respectively. [21] find a bidirectional causality between energy consumption and economic growth for 21 African countries over the years 1970-2006. [22] also support the feedback hypothesis for 30 Countries of Sub-Saharan Africa by applying the method of panel cointegration and error correction method between 1980 and 2008. Finally, a recent study by [23], using the method of Granger causality between oil exporting and importing sub-Saharan African countries for the periods from 1985 to 2011, shows a relationship going in the direction of energy consumption to the economic growth for the former and the feedback hypothesis for the latter.

3. ENERGY SECTOR IN TOGO

In Togo, the general management service of energy, placed under the Ministry of Mines and Energy (MME) is the technical branch which develops the energy sector policy and implements the actions of the State in terms of energy. The legal framework consists of the International Agreement on Electricity Code between Togo and Benin in July 1968 revised in 2003; of Law No. 2000-012 of 18 July 2000 on the electricity sector; of Decree No. 2000-089/ PR 08 November 2000 defining the modalities of activities regulated under the Law No. 2000-012 relating to the electricity sector; and Decree No. 2000-090 / PR of 8 November 2000 on the organization and functioning of the Regulatory

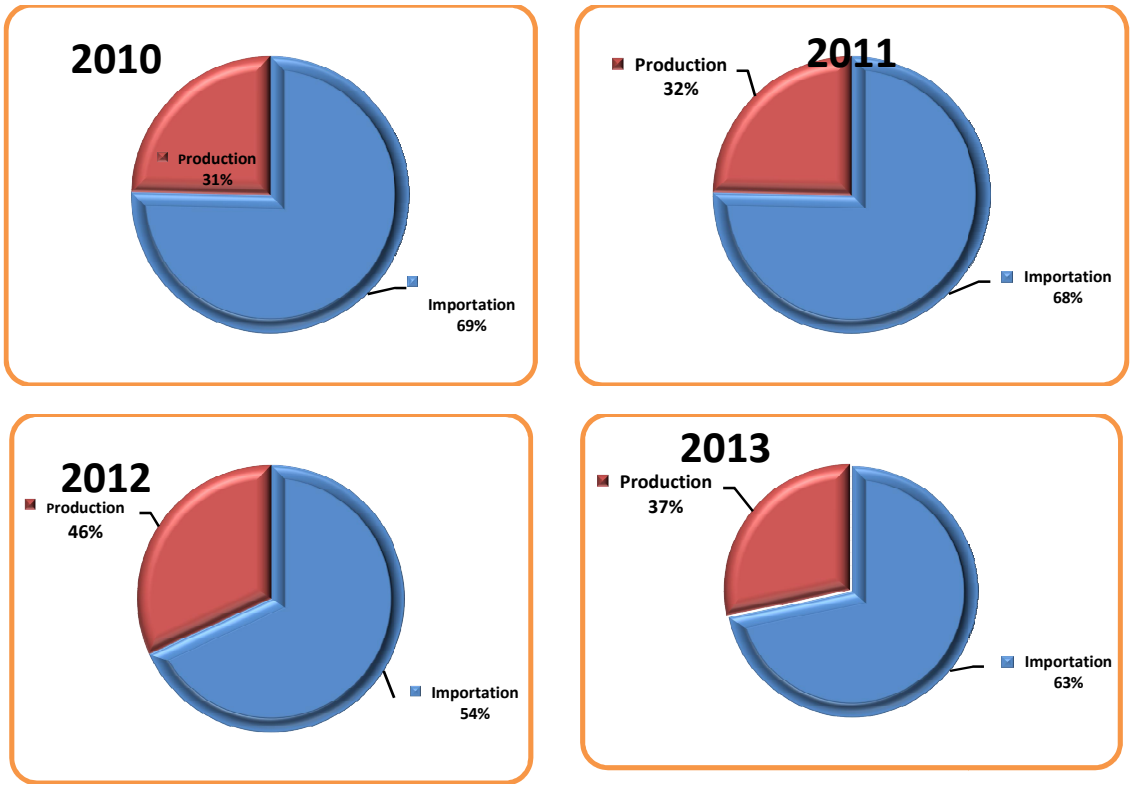

Fig. 1. Energy supply structure between 2010 and 2014 in Togo
Source: Author from data of the Ministry of Mines and Energy

Authority of Electricity Sector (ARSE)[1]. Electric Community of Benin (CEB), established by the International Agreement of 27 July 1968 is an international organization with a public nature which in its inception, received a monopoly on generation and transmission of electric energy and the monopoly on installations associated. The Code revised in 2003 attributed to the CEB on the territories of the two countries, the exclusive carrier to exercise the activities of importer and buyer for the needs of Togo and Benin. The ECB is thus the single transporter of electric energy to electricity distribution companies of Togo and Benin and important industries. However, the revised code opened the segment of production to independent producers, which resulted in the installation in Togo, of a company called Contour Global Togo (CGT) in 2010 through a Public Private Partnership and featuring a 100 MW thermal power plant. In addition, the Electric Energy Company of Togo (CEET) is a Crown corporation created by Decree No. 63 -12 of March 20, 1963 and placed under the Ministry of Mines and Energy is responsible for distribution and sale of electricity on the entire territory and has isolated means of production. September 05, 2000, following a reform of the sector, the Group Hydro Quebec Hélio sign a Convention disengaging CEET from electricity supply at the national level. Five years later, February 22, 2006 the end of the Group Hydro Quebec Hélio's contract resulted in the resumption of activities by the CEET as a state company. Thus in 2013, the number of subscribers to the CEET is estimated at 232,460 customers for Low Voltage (LVD) and 576 clients for Medium Voltage (MV).

The population explosion combined with the evolution of the current activities have contributed to increasing energy demand. According to statistics of the Ministry of Mines and Energy, energy demand is experiencing a growth of around 8% per year. But the poor quality of the installations leads to energy losses which increase production costs and the selling

[1] *It proposes draft standards and strategies aiming to control the regulated activities, to certify the conformity of the electric installations to the safety requirements and the applicable technical standards as well as the respect of dispositions of law by the dealers and owners, and to arbitrate any conflict between operators and the customers.*¶

price and as well as the total energy supply. Thus, except a few independent suppliers like Contour Global Togo, most power plants work with diesel engines only. Despite the various government interventions to improve the energy supply via the increase of the budget allocated to energy sector and the signing of the power sharing agreements at the sub-region level, there is a substantial gap between demand and supply leading the country to be a net importer of electricity. The below figure shows the energy supply structure between 2010 and 2014 in Togo (Fig. 1). According to this figure, shifting from energy dependence state to energy independent one is critical for the country. From 2010 to 2013, the share of imported energy has only decreased by 6%.

Togo's energy potential consists essentially of the electric power supplied from hydroelectric plants, generators and imports from neighbouring countries (Ivory Coast, Ghana and Nigeria). The renewable energies such as solar, wind, biogas and nuclear power do not yet record a sufficient growth to have a significant impact on production and domestic consumption. In terms of primary energy (biomass), it is used by the population living in rural areas and some urban households. To alleviate the situation of energy deficit and improve national coverage which is currently only 28%, Togo, registered in certain sub regional agreements and work for the development of new sites. The results of these actions are not yet noticeable.

4. STUDY METHODOLOGY

In this section we develop the model that will be used to identify the determinants of the level of energy consumption and the estimation technique as well as data sources.

4.1 Empirical Model

For an energy importing country, the level of energy consumption depends not only on parameters specific to the economy but also on the prevailing conditions in the countries from which energy is imported. Generally, strong economic growth in supplier countries as well as demographic changes may be accompanied by an increase in energy consumption in these countries. Ceteris paribus, these structural changes may prevent them from meeting the demand of the importing country. Moreover, when the currency of the importing country depreciates relative to the country of production, the import bill increases causing a decrease in imports and therefore the consumption level. The importing country thus undergoes two influences on energy consumption: influence related to the internal characteristics of the country itself and another one which depends on the conditions of the supply country. So to estimate the demand for energy consumption, in addition to structural factors specific to the Togolese economy, we consider the conditions of partner countries that provide energy to Togo. Consumer demand function can be written as follows:

$$DCE_t = f\left(X_{it}^N ; X_{jt}^E\right) \quad (1)$$

In this relationship DCE_t refers to the demand of energy consumption, X_{it}^N designate the internal variables that affect energy consumption in the country and X_{jt}^E represents foreign variables that influence supply and thus the level of energy consumption in the importing country.

Referring to the literature on energy demand, we consider four main internal factors that are the level of equipment or capital stock (K), population growth (L), the energy price approximated by the level of inflation in the country (Inf) and the level of economic activity measured by gross domestic product (GDP). Tus:

$$X_{it}^N = g\left(K_t ; L_t ; PIB_t^N ; Inf_t\right) \quad (2)$$

For external variables, we consider GDP growth resulting from improvements of the different types of capital (physical, human) and the exchange rate of the supplier countries. In the case of Togo, which imports energy from Ghana, Nigeria and Côte Ivory only the exchange rate between the CFA and the Naira will be taken into account due to the high variability[2] of Cedis due to the different policies of Ghana.

$$X_{jt}^E = h\left(PIB_{it}^E ; TC_t^{Naira}\right) \quad (3)$$

PIB_{it}^E denotes the growth rate of country i partner. However, in the estimates we consider the average growth rate of the three countries and the individual growth rate.

[2] *Cedis experienced various complex exchange regimes. ¶It is therefore difficult to evaluate its real effects on the imports of energy from Ghana.¶*

Combining equation (1), (2) and (3) one can write:

$$DCE_t = f\left(K_t; L_t; PIB_t^N; Inf_t; PIB_{it}^{Ext}; TC_t^{Naira}\right) \quad (4)$$

Under the extensive form and assuming a log linear function, equation (4) can be rewritten as follows:

$$LogDCE_t = \alpha_0 + \alpha_1 LogK_t + \alpha_2 LogL_t + \alpha_3 LogPIB_t^N + \alpha_4 LogInf_t + \alpha_5 LogPIB_{i_t}^{Ext} + \alpha_6 LogTC_t^{Naira} + \varepsilon_t \quad (5)$$

The expected signs of the coefficients in this specification are as follows:

$$\alpha_1 > 0; \alpha_2 > 0; \alpha_3 > 0; \alpha_4 < 0; \alpha_5 < 0; \alpha_6 < ou > 0$$

Equation (5) is estimated using four (4) models as we consider the average GDP of the partner countries or individual GDP of the three energy-supplying countries to Togo that are Ivory Coast, Ghana and Nigeria.

4.2 Data and Method of Estimation

To identify the key determinants of energy consumption, this study uses World Bank data (World Development Indicators (WDI, 2014)). These data cover different energy sources for most countries. However, the variables for which data are available for Togo is the consumption of electric energy which is largely imported from neighbouring countries. Renewable energies such as solar, wind, biogas and nuclear development is insufficient to impact production and domestic consumption. In terms of primary energy (biomass), it is mostly used by the population living in rural areas. But due to the unavailability of data on this source of energy, this study does not include this form of energy in the analysis. In other words, the study focuses on the consumption of electric energy. The study covers the period going from 1971 to 2014. The estimation method is ordinary least squares. However, we use econometric tests which allow us to define the best technique for estimation.

5. RESULTS AND DISCUSSION

This section is mainly devoted to the presentation of the analysis of the results of the estimations. These results were estimated after conducting various tests[3] including collinearity and stationarity tests that helped retain the appropriate estimation techniques with regard to the available data. These tests performed on the series showed that the series considered are stationary.

Consequently, the following equations were estimated using the ordinary least squares (OLS) technique and the results reflect the relationship between energy consumption and the different variables included. The model (1) considers the average annual growth rate of the three energy-supplying countries of Togo. By contrast, models 2, 3 and 4 consider the Ivory Coast growth rate, Ghana growth rate and Nigeria growth rate respectively (see Table 1).

The results of the different estimates show all the models are globally significant. This is reflected by the Fisher statistic whose value remains above 88 with zero probability for all equations. Moreover, R^2 of the different models reveals that almost 95% of changes in energy consumption are explained by the model variables. T-statistics show that most of the coefficients are significant at 1% and 5%. Variables are not only significant but also have the expected signs. Especially the accumulation of capital (K), population growth (L), the country's economic growth (PIBN) have a positive and significant effect on energy consumption in Togo. For contrast, the energy price approximated by the rate of inflation (Inf), the exchange rate of Naira (TCNAIRA) have a negative effect on energy consumption in Togo. These results are in line with the study of Tchagnao (Tchagnao, 2015) which analysed the relationship between energy consumption and economic growth in Togo and support the existence of the conservation hypothesis which stipulates that energy consumption is dependent on economic growth in Togo. The results of that study revealed also that the energy consumption is elastic with respect to capital in the short-term and inelastic in the long-term.

The *Model 1* expresses the relationship between energy consumption and the average annual growth of the three energy-supplying countries to Togo. The results (the detail results are depicted in the Table 1 of the appendix) of this model reveal that the average annual growth of the three energy-supplying countries (PIB^{EXT}) does not have a significant effect on energy consumption in Togo (Table 1). However, the estimation results of models 2, 3 and 4 who consider the growth of individual countries indicate that only the growth rate of Ghana (Model 3) has a negative and significant effect on

[3] *The results of the tests appear in the appendix of this paper.*¶

energy consumption in Togo (Table 2, Table 3 and Table 4 of the appendix).

The above mentioned results are explained by the degree of energy dependency between Togo and its supplier countries. According to the statistics of the Ministry of Mines and Energy, Nigeria is the first energy supplier, followed by Ghana and finally the Ivory Coast. Thus, because of its energy potential and extent, economic growth in Nigeria can only have a marginal effect on the energy consumption in Togo. In other words, the share of imported energy in total production of Nigeria is significantly lower so that even if the Nigerian growth is accompanied by an increase in energy consumption in Nigeria, the effect will be negligible on energy import demand of Togo. This explains the non-significance of the coefficient in the Model 4 (Table 4 of the appendix).

Regarding Ivory Coast, energy imports from this country are sufficiently low so that growth in Ivory Coast which is accompanied by an increase in energy consumption in the country has no effect on energy consumption in Togo.

Finally, Ghana is a country which is experiencing a relatively stable economic growth in recent years as shown in the Fig. 2. Unlike Nigeria which is a large country with important deposits, Ghana has fewer assets enabling it to cover its energy needs. Thus, strong growth which induces growth in energy consumption has significant impact on the supply of electricity to Togo. The results show that GDP growth per capita in Ghana by 10% induces a decrease in energy consumption in Togo by 0.12%. The high variability of GDP growth per capita in the supplier countries (Fig. 2) highlights the increased uncertainty regarding energy supply.

Table 1. Results of the OLS estimation, (Dependent variable is DCE (Energy consumption in KWh)

Variables indépendantes	Modèle 1	Modèle 2	Modèle 3	Modèle 4
K	0.189039**	0.161650**	0.181031***	0.174486**
	(2.550106)	(2.067503)	(2.972514)	(2.533839)
L	0.219737***	0.221056***	0.260294***	0.232409***
	(2.704554)	(2.754256)	(3.412514)	(2.747978)
INF	-0.008484***	-0.008133***	-0.009422***	-0.007968***
	(-3.255281)	(-3.339077)	(-4.100491)	(-3.133928)
PIB^N	0.006548**	0.006527**	0.007436**	0.006274**
	(2.114244)	(2.131249)	(2.617439)	(2.028018)
PIB^{EXT}	-0.001956	-	-	-
	(-0.281340)			
TC^{NAIRA}	-0.235644***	-0.230297***	-0.245167***	-0.231174***
	(-17.44010)	(-20.92373)	(-24.01856)	(-21.13157)
PIBH_CI	-	0.002135	-	-
		(0.430981)		
PIBH_NIG	-	-	-	0.000815
				(0.298935)
PIBH_GH	-	-	-0.011678**	-
			(-2.146708)	
C	19.76875***	19.82695***	19.79614***	19.77671***
	(93.70535)	(84.75332)	(102.1984)	(94.85017)
R^2	**0.952337**	**0.952492**	**0.958215**	**0.952352**
F_Stat.	**88.48575**	**88.78918**	**101.5570**	**88.51503**
Prob(F_stat.)	**0.000000**	**0.000000**	**0.000000**	**0.000000**
DW	**1.478816**	**1.394349**	**1.761984**	**1.454373**

Source: Author's estimates from World Development Indicators database, 2014

*. *** Significant at 1% threshold, ** significant at 5%. The values in parentheses are t-statistics*

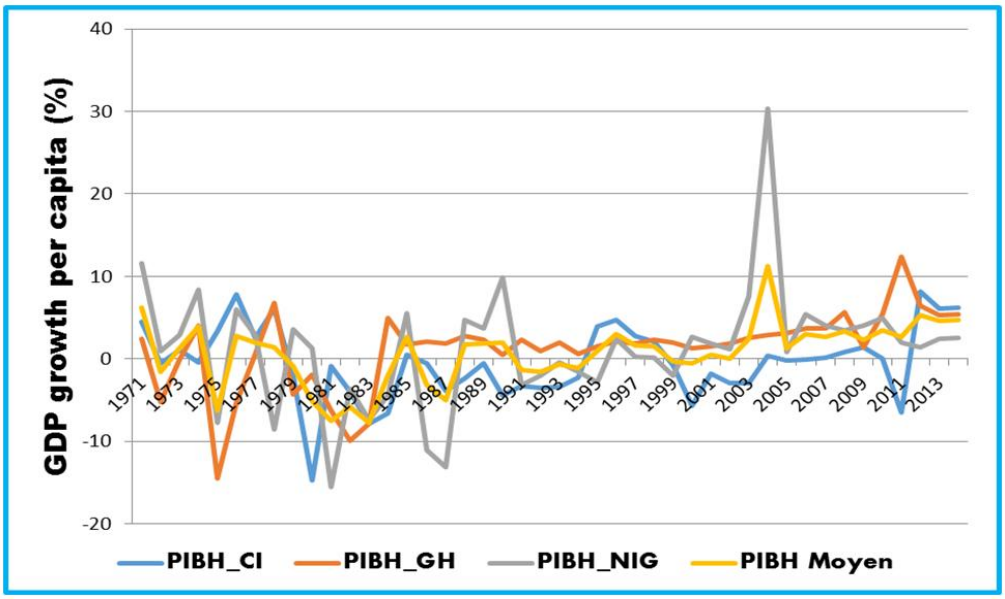

Fig. 2. Evolution of GDP growth rate per capita in Togo's energy supply countries
Source: *Author from World Development Indicators database, 2014*

6. CONCLUSION

The import of energy from foreign countries is a way for countries without sufficient means to meet their energy deficit. This situation of energy dependence is not free of consequences for the importing countries. Indeed, when the supplier countries experience economic growth, their needs in terms of energy consumption increases affecting those of importing countries. This study highlights the effect of Togo energetic dependence on energy consumption. The results reveal that among the three countries that supply energy to Togo, that are Ivory Coast, Ghana and Nigeria, only Ghana's economic growth affects Togo's energy consumption. More specifically, 10% growth in Ghana is accompanied by a drop in energy consumption in Togo by 0.12%. Beside this situation, Togo is experiencing high economic growth these last years compare to other developing countries. This means that the country needs to increase its energy consumption according to the conservative hypothesis. If the supplier countries fail to ensure the energy needed to boost growth, the country may be in a recession. To avoid such a situation, policy makers should encourage investment in the sector and promote alternative sources to reduce its energy dependence.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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APPENDIX

Table 1. Regression of the demand on the average growth rate of the partner countries

Dependent Variable: DCE
Method: Least Squares
Sample (adjusted): 1976 2014
Included observations: 39 after adjustments
Convergence achieved after 8 iterations

Variable	Coefficient	Std. error	t-statistic	Prob.
K	0.189039	0.074130	2.550106	0.0159
L	0.219737	0.081247	2.704554	0.0110
INF	-0.008484	0.002606	-3.255281	0.0027
PIBN	0.006548	0.003097	2.114244	0.0426
PIBEXT	-0.001956	0.006954	-0.281340	0.7803
TCNAIRA1	-0.235644	0.013512	-17.44010	0.0000
C	19.76875	0.210967	93.70535	0.0000
AR(5)	-0.514483	0.132929	-3.870368	0.0005
R-squared	0.952337	Mean dependent var		19.76867
Adjusted R-squared	0.941574	S.D. dependent var		0.465251
S.E. of regression	0.112458	Akaike info criterion		-1.351798
Sum squared resid	0.392048	Schwarz criterion		-1.010555
Log likelihood	34.36007	F-statistic		88.48575
Durbin-Watson stat	1.478816	Prob(F-statistic)		0.000000
Inverted AR Roots	.71+.51i	.71-.51i	-.27-.83i	-.27+.83i
	-.88			

Table 2. Effect of Ivory Coast's economic growth on Togo's energy consumption

Dependent Variable: DCE
Method: Least Squares
Sample (adjusted): 1976 2014
Included observations: 39 after adjustments
Convergence achieved after 7 iterations

Variable	Coefficient	Std. error	t-statistic	Prob.
K	0.161650	0.078186	2.067503	0.0471
L	0.221056	0.080260	2.754256	0.0098
PIBN	0.006527	0.003062	2.131249	0.0411
INF	-0.008133	0.002436	-3.339077	0.0022
PIBH_CI	0.002135	0.004953	0.430981	0.6695
TCNAIRA	-0.230297	0.011007	-20.92373	0.0000
C	19.82695	0.233937	84.75332	0.0000
AR(5)	-0.476835	0.134773	-3.538049	0.0013
R-squared	0.952492	Mean dependent var		19.76867
Adjusted R-squared	0.941765	S.D. dependent var		0.465251
S.E. of regression	0.112274	Akaike info criterion		-1.355059
Sum squared resid	0.390772	Schwarz criterion		-1.013815
Log likelihood	34.42365	F-statistic		88.78918
Durbin-Watson stat	1.394349	Prob(F-statistic)		0.000000
Inverted AR Roots	.70-.51i	.70+.51i	-.27+.82i	-.27-.82i
	-.86			

Table 3. Effect of Ghana's economic growth on energy consumption in Togo

Dependent Variable: DCE
Method: Least Squares
Date: 07/12/15 Time: 12:48
Sample (adjusted): 1976 2014
Included observations: 39 after adjustments
Convergence achieved after 7 iterations

Variable	Coefficient	Std. error	t-statistic	Prob.
K	0.181031	0.060902	2.972514	0.0057
L	0.260294	0.076276	3.412514	0.0018
PIBN	0.007436	0.002841	2.617439	0.0136
INF	-0.009422	0.002298	-4.100491	0.0003
PIBH_GH	-0.011678	0.005440	-2.146708	0.0398
TCNAIRA	-0.245167	0.010207	-24.01856	0.0000
C	19.79614	0.193703	102.1984	0.0000
AR(5)	-0.557724	0.127185	-4.385125	0.0001
R-squared	0.958215	Mean dependent var		19.76867
Adjusted R-squared	0.948780	S.D. dependent var		0.465251
S.E. of regression	0.105295	Akaike info criterion		-1.483424
Sum squared resid	0.343697	Schwarz criterion		-1.142181
Log likelihood	36.92677	F-statistic		101.5570
Durbin-Watson stat	1.761984	Prob(F-statistic)		0.000000
Inverted AR Roots	.72+.52i -.89	.72-.52i	-.27-.85i	-.27+.85i

Table 4. Effect of Nigeria's economic growth on Togo's energy consumption

Dependent Variable: DCE
Method: Least Squares
Sample (adjusted): 1976 2014
Included observations: 39 after adjustments
Convergence achieved after 7 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
K	0.174486	0.068862	2.533839	0.0166
L	0.232409	0.084575	2.747978	0.0099
PIBN	0.006274	0.003094	2.028018	0.0512
INF	-0.007968	0.002543	-3.133928	0.0038
PIBH_NIG	0.000815	0.002725	0.298935	0.7670
TCNAIRA	-0.231174	0.010940	-21.13157	0.0000
C	19.77671	0.208505	94.85017	0.0000
AR(5)	-0.496335	0.124085	-3.999960	0.0004
R-squared	0.952352	Mean dependent var		19.76867
Adjusted R-squared	0.941593	S.D. dependent var		0.465251
S.E. of regression	0.112440	Akaike info criterion		-1.352114
Sum squared resid	0.391925	Schwarz criterion		-1.010870
Log likelihood	34.36622	F-statistic		88.51503
Durbin-Watson stat	1.454373	Prob(F-statistic)		0.000000
Inverted AR Roots	.70-.51i -.87	.70+.51i	-.27+.83i	-.27-.83i

Peer-review history:
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