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Article

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International Journal of Energy Economics and Policy

Provided in Cooperation with:
International Journal of Energy Economics and Policy (IJEEP)

Reference: Atchike, Desire Wade/Zhao, Zhen-Yu et. al. (2020). The relationship between electricity consumption, foreign direct investment and economic growth : case of Benin. In: International Journal of Energy Economics and Policy 10 (4), S. 507 - 515.
https://www.econjournals.com/index.php/ijeep/article/download/9415/5160.
doi:10.32479/ijeep.9415.

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2020, 10(4), 507-515.

The Relationship between Electricity Consumption, Foreign Direct Investment and Economic Growth: Case of Benin

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Received: 14 February 2020 **Accepted:** 05 May 2020 **DOI:** https://doi.org/10.32479/ijeep.9415

ABSTRACT

Using the autoregressive distributed lag (ARDL) bounds test with dummy variables and the Toda-Yamamoto approach; this paper investigated the relationship between electricity consumption, foreign direct investment and economic growth in Benin for the period of 1980-2014. Confirming the growth theory for Benin, the results show evidence of unidirectional causalities from electricity consumption to both economic development and foreign direct investment and a long run relationship with a speed of adjustment of 60.72%. These findings suggest that the government of Benin should target the implementation of new strategies to improve access to electricity in order to attract more foreign investment and achieve a rapid and sustainable economic growth.

Keywords: Electricity Consumption, Foreign Direct Investment, Economic Growth, Benin
JEL Classifications: F21, F43, Q43

1. INTRODUCTION

The Government of Benin counts on its agricultural potential as well as its strategic geographical position for regional trade to foster its development. Developing affordable energy is the key to achieving these targets. Since the electric power consumption of Benin is highly dependent on external supplies, the country is exposed to power cuts and recurrent energy crises. The country aims to reduce its dependence on external electricity sources by improving its energy independence and by the diversification of its supply sources through the implementation of various interconnection projects with neighboring countries and the management of the national renewable energy potential.

Due to particularly challenging conditions, currency limitations and internal vulnerabilities, lending to West Africa countries for their development remains difficult for most banks. Hence, the private sector finance and foreign investment for development projects appears to be an alternative solution for countries such as Benin. However, the challenge is to be able to provide affordable and attractive financing frameworks that sustainably exploit commercial lending and investment opportunities for worldwide investors.

According to UNCTAD and World Investment Report (2019), corruption, poor quality of infrastructure, insecurity and problems related to the electricity supply limit Benin's potential attractiveness.

As the current government of Benin is adopting innovative reforms for development, this paper aims to identify the factors to target in order to achieve a rapid economic growth.

The rest of this paper is divided into 5 sections. A literature review of the background of this study is presented in section 2. Section 3 describes the models used for the analysis while section 4 introduced the data used. The research findings are presented in section 5 while section 6 concluded this article by providing some recommendations for the Beninese government.

2. RESEARCH BACKGROUND

2.1. Overview of Benin's Electricity Potential

According to BOAD (2019), the electricity sector in Benin faces challenges such as regulatory arrangements, financial sustainability and technical capacity. Benin has an installed capacity of 349 MW and an estimated electricity needs of 600 MW due to the rapid growing demand for electric power. The country has a relatively low access to electricity with an access rate of 43% (Rural: 17%, Urban: 73%) (IEA, IRENA, UNSD, WB, WHO, 2019).

According to ECREEE (2018), 288 MW of the total 297 MW of electricity generated by Benin comes from thermal sources compared to 9 MW from renewables, indicating that the country's renewable potential still remains untapped. Benin depends heavily on energy imports from neighboring countries such as Ghana, Nigeria and Ivory Coast (46.6% in 2014).

The country has a significant hydropower potential both for the development of large, medium, small and micro-hydro plants. According to Coyne and Bellier (1993), if subjected to hydropower development, the site of Bétérou Amont and the site of Olougbé Ter along the Oueme River, could generate between 23.2 MW to 70 GWh and between 29.5 MW to 72 GWh respectively. Previous studies revealed that some hydroelectric dams with a capacity ≤1000 kW could be developed in some sites such as: Cascade de Sosso (494 KW), Gbassé (450 KW), Koutakrouk Rou (60 KW), Chute Kota (45 KW), Ouabou (130 KW), Kouporgou (60 KW). (Directorate General for Energy, 2014).

Benin also has some solar energy potential. The average sunshine in Benin usually varies between 3.9 KWh/m²/day in the south and 6.1 kWh/m²/day in the North. The country is globally covered regarding solar energy, where the northern and the coastal area present the greatest potentials (Aza-Gnandji et al., 2018). With an installed solar capacity of 8 MW in 2017, the country plans to extend its solar capacity to 227 MW by 2030.

The coastal area of Benin Republic is the most favorable for wind energy production (Akpo et al., 2015). Wind speed measured at an altitude of 10 m varies from 3 to 5 m/s. However, there are more favorable areas in the northern region, in the center of the country and in the southern region, that are likely to host wind turbines. In the coastal region, the wind energy can be used for domestic light mainly in rural zone lacking electric energy (Awanou et al., 1991).

The CEB (Communauté Électrique du Bénin) is the sole actor responsible for buying and supplying the electricity produced while domestic production of electrical energy in Benin includes the energy produced by the national electrical company SBEE at the Yéripao hydroelectric plant (0.5 MW) located near Natitingou, and the energy produced by the thermal power plants.

Through a $375 million compact partnership with the Millennium Challenge Corporation with a $28 million contribution from the government, Benin aims to strengthen the national utility, attract private sector investment, and fund infrastructure investments in electricity generation and distribution as well as off-grid electrification for poor and unnerved households.

2.2. Overview of FDI in Benin

Benin is member of diverse institutions such as the West African Economic and Monetary Union (WAEMU), Economic Community of West African States (ECOWAS), the African Union (AU) and the World Trade Organization (WTO).

After the country's independence in 1960, Benin started to increase its private sector activities and investment. Between 1989 and 2005, following the economy liberalization period governed by the investment law No. 82-005, more than 150 state-owned companies such as the national oil distribution company, (Sonacop in 1999) had been privatized or liquidated by the Government of Benin (UNCTAD, 2006). The current government of Benin initiated a wide series of innovative reforms aiming at improving and attracting investors and helped Benin to be ranked 28th in Africa and 151st worldwide according to 2018 doing business. These reforms include the modernization of the public procurements' provision, the establishment of a unified regulatory framework for public-private partnerships, the reduction of state owned lands transfer fees, a single business registration desk as well as multiple tax incentives in order to support private investments. Some of Benin's traditional investors are France, Nigeria, Brazil, Ivory Coast and Senegal. The other main foreign investing countries are other European countries and Canada.

According to the UNCTAD and World Investment Report (2019), between 2017 and 2018, an increase in FDI inflows from USD 200 million to USD 208 million has been observed in Benin. In addition to being one of the most democratic countries in Africa, Benin has the advantage of its strategic location near the sea and to share a border with Nigeria, Africa's leading economy.

The country made significant progress in strengthening transparency and ending corruption as shown by the progress in scoring of corruption transparency index from 36 in 2016 to 41 in 2019 (CPI, 2019).

2.3. Brief Review of Previous Studies on Causal Relationships between Electricity Consumption and Economic Development in Benin

Throughout the years, several studies had analyzed the causal relationship between energy and economic growth in Africa. According to Apergis and Payne (2009) and Ozturk and Acaravci (2010), when analyzing the relationship between energy consumption and economic growth, the result may fall between the 4 following hypothesis: (1) conservation hypothesis when economic growth causes energy consumption, (2) growth hypothesis when energy consumption causes economic growth, (3) feedback hypothesis when they cause each other and (4) neutrality hypothesis when there is no causal relationship between economic growth and energy consumption.

Among the articles related to Benin, Wolde-Rufael (2005) found no causal relationship between economic growth and energy consumption for countries including Benin. This finding was confirmed by Rault et al. (2014) who reached the same conclusion about Benin after investigating 16 African countries. In line with these 2 previous studies, Dogan (2014), Menegaki and Tugcu (2016) and Fatai (2014) also obtained the same result of no causality between energy consumption and economic growth for Benin.

Contrarily, a bunch of studies had obtained opposite results by finding evidence of correlation between energy consumption and economic growth for Benin. Shifting from energy consumption to electricity consumption, Wolde-Rufael (2006) first concluded a causal relationship from electricity consumption to economic growth and later found evidence of causality from economic growth to energy consumption. Al-mulali and Binti (2012), adding the CO_2 emission to the first 2 variables found that energy consumption causes economic growth. Ouédraogo (2013) found a bidirectional causality between energy consumption and GDP for Benin while Zerbo (2017) evidenced a long-run relationship between energy consumption and economic growth.

As can be observed in Table 1, most of these studies have used panel data on a bunch of countries including Benin and were focused on energy consumption. As noticed by Dakpogan and Eon (2018a), few studies have specifically investigated the electricity consumption economic growth nexus in Benin. Differentiating themselves from the previous studies which used panel data series, Asumadu and Owusu (2016) focused their analysis on the specific case of Benin finding a causality between industrialization, electricity consumption, economic growth and CO_2 emission. Dakpogan and Eon (2018a, 2018b) successively found that electricity losses and a negative shock in electricity consumption both negatively affect economic growth in Benin.

To the best of our knowledge, none of previous studies has investigated the implication of the Foreign Direct Investment in the electricity-economic development nexus in Benin. Hence the present study aims to fill this gap of knowledge by analyzing a country specific relationship between electricity consumption, foreign direct investment and economic growth specifically for Benin.

3. METHODOLOGY

Prior to employing techniques such as the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) and Zivot Andrew (ZA) tests to check the presence of unit roots, this study first identified the presence of structural breaks by the Chow breakpoint test and introduced dummy variables to correct the observed breaks. The ARDL test is applied for cointegration and finally the Toda and Yamamoto (1995) granger non causality approach is applied to define the direction of causality between the variables.

3.1. Chow Test and Dummy Variables

The chow test is usually used to check for the presence of structural break in variables. The Chow test estimates the F statistics which are then compared to the quintile of the Snedecor-Fisher distribution with number of degrees of freedom (Chow, 1960). In EViews, the case involving a single breakpoint is computed as follows:

Table 1: Previous studies on causality between energy consumption and economic growth related to Benin

Authors	Variable	Country	Findings for Benin
Wolde-rufael (2005)	GDP per capita, energy consumption per capita	19 African countries	No causal relationship between economic growth and energy consumption
Wolde-rufael, (2006)	Electricity consumption per capita and GDP per capita	17 African countries	Causality from electricity consumption to economic growth
Wolde-rufael (2009)	Capital stock, employment and total energy consumption	17 African countries	Causality from Economic growth to energy consumption
Al-mulali and Binti (2012)	Energy consumption, CO_2 emission and GDP	30 African countries	Energy consumption causes economic growth
Ouédraogo (2013)	GDP, electricity consumption, energy consumption	15 ECOWAS countries	Causal relationship running from energy consumption to GDP in the long run, and a causal relationship running from GDP to energy consumption in the short run
Rault et al. (2014)	Energy use and economic growth	16 African countries	No causality was found between economic growth and energy consumption
Dogan (2014)	Economic growth and energy consumption	4 sub-Sahara African countries	No causal relationship between economic growth and energy consumption
Menegaki and Tugcu (2016)	Energy consumption, GDP, CO_2 emissions, rents, trade and inflation	42 African countries	No causal relationship between energy consumption and GDP
Fatai (2014)	Energy consumption and real GDP	18 sub-Sahara African countries	No causal relationship between Energy consumption and economic growth
Asumadu and Owusu (2016)	Carbon dioxide emission, electricity consumption, industrialization, and economic growth	Benin	Industrialization and electricity consumption granger causes GDP
Zerbo (2017)	GDP, Energy use, Arable land, physical capital, total trade, Financial deepening	13 Sub-Saharan African countries	No causal relationship between energy consumption and economic growth
Dakpogan and Eon (2018a)	GDP, gross capital formation, labour force, electricity supply, gross capital formation	Benin	Long run causal relationship between electricity losses and GDP
Dakpogan, and Eon (2018b)	GDP, electricity consumption	Benin	Negative shocks on electricity consumption have caused negative shocks on real GDP

$$CHOW = \frac{(RSS_P - (RSS_1 + RSS_2)/k}{(RSS_1 + RSS_2)/(N_1 + N_2 - 2k)} \quad (1)$$

Where:
RSSp=Pooled (combined) regression line.
RSS1=Regression line before break.
RSS2=Regression line after break.

3.2. Unit Root Test

The first step of running any econometric analysis is to run the unit root test of stationarity because the use of non-stationary data could affect the results by leading to spurious regressions such as white noise.

Since some breaks were observed in the beginning of the series, according to Leybourne and Newbold (2000), traditional unit root tests such as Augmented Dickey Fuller (ADF) and Phillip Perron (PP) can lead to biased results. Hence, this study applied Kwiatkowski–Phillips–Schmidt–Shin (KPSS) and Zivot Andrew (ZA) tests.

Zivot–Andrews (Z–A) unit root test identifies and determines the structural break date. This test allows for one endogenously determined structural break, developed by Zivot and Andrews (1992).

The Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test is based on linear regression. It is used to identify the stationarity of time series. A time series is said stationary when statistical properties such as the mean and variance are constant over time (Kwiatkowski et al., 1992). The series is broken into three parts: A deterministic trend (βt), a random walk (rt), and a stationary error (εt), with the regression equation:

$$x_t = r_t + \beta_t + \varepsilon_t \quad (2)$$

3.3. ARDL Model

After identifying the order of integration of the different variables and making sure that any of them is I(2), the next step is to test the presence of long run relationship between the variables by applying the ARDL test for cointegration developed by Pesaran and Smith (1998) and Pesaran et al. (2001).

ARDL is chosen because it can avoid endogeneity problems and does not require variables to be integrated of the same order. It can be applied when variables are I(0), I(1) or mixed (Pesaran et al., 2001). According to (Ahmed and Long, 2013), ARDL can estimate simultaneously both short-run and long-run parameters and an error correction model can be integrated without fear of losing long-run information (Harris and Sollis, 2003; Belloumi, 2014; Kripfganz and Schneider, 2016). Moreover, ARDL is more reliable in the case of short data span like the data of this study. Therefore, there are important advantages examining the relationship between GDP, FDI and electricity consumption in Benin within the framework of an ARDL model. After building models with each of the variables as dependent variable and following the work of Long et al. (2018), the model adopted for this study is specified as follows:

The ARDL model is specified as:

$$\Delta(Elec)_t = \beta_o + \delta_1(Elec)_{t-1} + \delta_2(Gdp)_{t-1} + \delta_3(Fdi)_{t-1} + \sum_{i=1}^{p}\gamma_i\Delta(Elec)_{t-i} + \sum_{i=1}^{p}\sigma_i\Delta(Gdp)_{t-i} + \sum_{i=1}^{p}\sigma_i\Delta(Fdi)_{t-i} + \alpha + \beta t + \varepsilon_t \quad (3)$$

Where $\Delta(Elec)_t$ is the first difference of the dependent variable, Gdp and Fdi, are the explanatory variables, Ut is the white noise error term and δ_1, δ_2, and δ_3 are the long run parameters.

3.4. Toda Yamamoto

According to Clark and Mirza (2006), unit root tests and cointegration might suffer from size distortions leading to the choice of an inaccurate model for the non-causality test. In addition, Sims et al. (1990) pointed out that even when the variables are cointegrated, it is not advisable to use the asymptotic distribution theory to test for causality. To obviate those shortcomings, the Toda and Yamamoto test is based on augmented VAR modelling and has the advantage of not depending on the order of integration or cointegration properties of the variables. Therefore, the TY can be applied whether the variables are cointegrated or not or whether there are I(0), I(1) or I(2) since it applies a Wald test statistic that asymptotically has a Chi-square (χ^2) distribution (Wolde-Rufael, 2009).

Prior to running the TY test, it is important to determine the true la length (k) and the maximal order of integration (d_{max}). The TY test is run by artificially increasing the correct order of integration (k) by the maximal order of integration (d_{max}) and then a VAR model of (k + d_{max}) order is estimated (Toda and Yamamoto, 1995). The models used for this study are expressed as follows:

$$Elec_t = \alpha_0 + \sum_{i=1}^{k}\alpha_{1i}Elec_{t-i} + \sum_{j=k+1}^{d_{max}}\alpha_{2j}Elec_{t-j} + \sum_{i=1}^{k}\beta_{2j}GDP_{t-j} + \sum_{i=1}^{k}\beta_{2j}GDP_{t-j} + \sum_{i=1}^{k}\gamma_{2j}FDI_{t-j} + \sum_{i=1}^{k}\gamma_{2j}FDI_{t-j} \quad (4)$$

$$FDI_t = \alpha_0 + \sum_{i=1}^{k}\gamma_{2j}FDI_{t-j} + \sum_{i=1}^{k}\gamma_{2j}FDI_{t-j} + \sum_{i=1}^{k}\alpha_{1i}Elec_{t-i} + \sum_{j=k+1}^{d_{max}}\alpha_{2j}Elec_{t-j} + \sum_{i=1}^{k}\beta_{2j}GDP_{t-j} + \sum_{i=1}^{k}\beta_{2j}GDP_{t-j} \quad (5)$$

$$GDP_t = \alpha_0 + \sum_{i=1}^{k}\beta_{2j}GDP_{t-j} + \sum_{i=1}^{k}\beta_{2j}GDP_{t-j} + \sum_{i=1}^{k}\alpha_{1i}Elec_{t-i} + \sum_{j=k+1}^{d_{max}}\alpha_{2j}Elec_{t-j} + \sum_{i=1}^{k}\gamma_{2j}FDI_{t-j} + \sum_{i=1}^{k}\gamma_{2j}FDI_{t-j} \quad (6)$$

4. DATA

4.1. Data Collection

Data used in this study are annual time series data for Benin. Data collected from the World Bank World Development Indicators

(WDI, 2019), UNCTAD (2019), the global economy.com were crosschecked. To assure the quality of this research, the period studied is dependent on the reliability of data, and thus the time period used is 1980-2014. The 34 years' time length of observations is reasonable to employ model estimation techniques. The real GDP is expressed in US dollars at constant 2010 prices while the electric power consumption is expressed in units of Kilowatt hours (kwh/capita) and the FDI is in current US$.

4.2. Data Analysis

The variables were all transformed into natural logarithms to reduce heteroscedasticity. The reason of this transformation lies in the fact that logarithm variables have their economic meaning because they are an approximation of the growth of the respective differenced variables. The variables were plotted in graphs and as seen in Figures 1-3, several breakpoints can be observed for the different variables.

4.2.1. Chow breakpoint test

The chow breakpoint test was employed to ultimately confirm the structural break observed in Figure 1 using the electricity consumption single series of data set.

The Chow breakpoint test was applied for the year 1983 for electricity consumption. The result of the Chow test as shown by Table 2 confirms a break at year 1983. This break could be explained by the electrical crisis recorded in Benin in the 1980s, 1990s, and 2000s (République du Bénin, 2008).

4.2.2. Dummy variable

To correct the structural break, a dummy variable was generated to respecify the model (Dm=0 before year 1983 and Dm=1 after year 1983). Since the sample has a relatively small size (34 observations), this study considers only one structural break. New series were introduced with the dummy variable interaction terms with the regressors (DMFDI and DMGDP). As can be seen in the CusumSQ graph in Figure 4, the model is now stable after introducing the dummy variables.

Table 3 summarized the variables used for the estimation purpose for this article and Table 4 gave their descriptive statistics.

Figure 1: Trend of ELEC

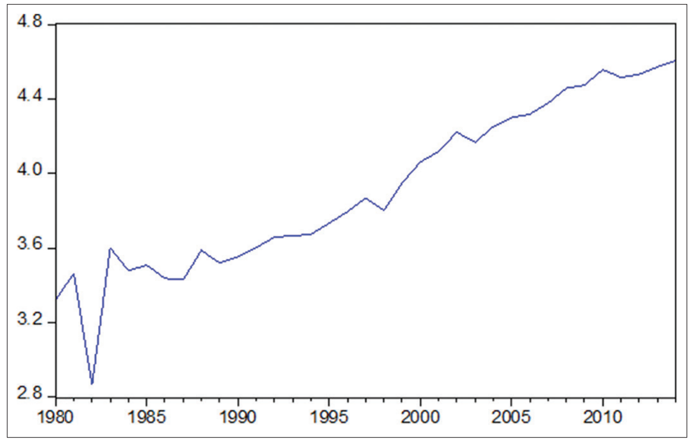

Figure 2: Trend of FDI

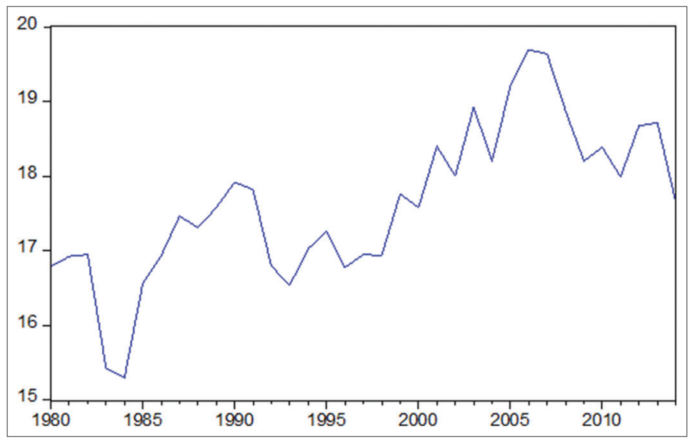

Figure 3: Trend of GDP

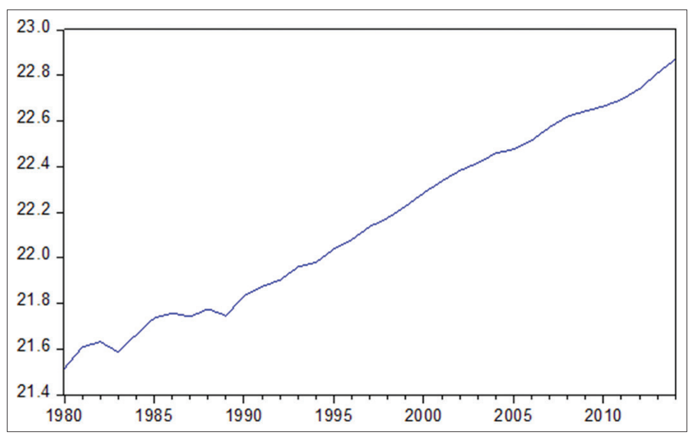

Table 2: Chow breakpoint test for electricity at year 1983

F-statistic	16.41402	Prob. F(3,29)	0.0000
Log likelihood ratio	34.73790	Prob. Chi-square (3)	0.0000
Wald Statistic	49.24205	Prob. Chi-square (3)	0.0000

5. ESTIMATION PROCEDURE

5.1. Unit Root Test

To avoid biased results from traditional unit root tests, this study applied Kwiatkowski–Phillips–Schmidt–Shin (KPSS) and Zivot Andrew (ZA) tests. The results of the tests reported in Table 5 show that the series are mixed I(0) and I(1) and most importantly, none of the series is I(2).

5.2. Lag Selection

The optimal lag is selected based on the Akaike Information Criterion (AIC) and confirmed by Schwarz Criterion (SC). Enders (2004) recommended that the optimal lag for annual series should range between 1 and 3. The optimal lag can vary from one variable to another; the test was conducted for each of the variables resulting in optimal lag 2 for Elec and lag 1 for all the other variables (Table 6).

5.3. ARDL Bound Test

Based on these results of the unit root tests, the ARDL model developed by Pesaran et al. (2001) can be applied for the cointegration.

Figure 4: CusumSQ of corrected model with dummies

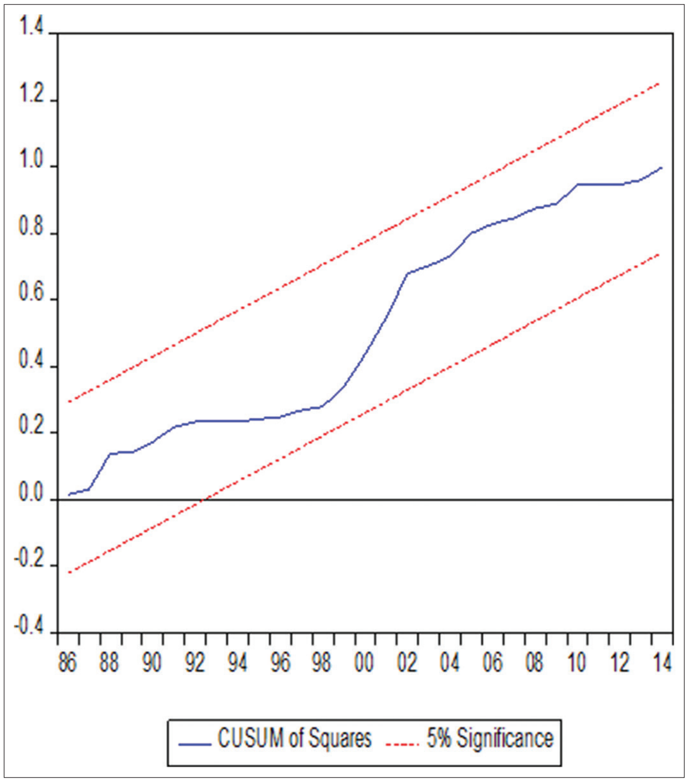

Table 3: Variables symbols description

Variables	Variables symbols
Electricpower consumption (in natural log form)	ELEC
Foreign direct investment (In Natural log form)	FDI
Real GDP growth (in natural log form)	GDP
Dummy variable interaction terms with FDI	DMFDI
Dummy variable interaction terms with GDP	DMGDP

Table 4: Descriptive statistics of variables

Statistics	ELEC	FDI	GDP	DMFDI	DMGDP
Mean	3.9163	17.634	22.1563	16.1870	20.3061
Median	3.8026	17.579	22.1370	17.5794	22.1370
Max.	4.6074	19.6983	22.8721	19.6983	22.8721
Mini.	2.8660	15.2971	21.5147	0.0000	0.0000
Std. Dev.	0.4490	1.0343	0.4081	5.1286	6.3189
Skewness	−0.0399	−0.0338	0.1193	−2.7568	−2.9417
Kurtosis	2.0907	2.8715	1.6895	9.0448	9.6965
Jarque-Bera	3.9163	17.6346	22.1563	97.6227	115.8764
Prob.	1.2148	0.0307	2.5873	0.0000	0.0000

Under the ARDL model, the first level of critical value is calculated on the assumption that all variables included in the model are I(0), while the second one is calculated on the assumption that the variables are I(1). The equation is estimated by ordinary least squares (OLS). The null hypothesis of no cointegration can be rejected when the F-statistic is higher than the critical value of both the I(0) and I(1) regressors, and accepted if otherwise (Belloumi 2014, Ngozi et al. 2017).

Based on AIC standard, regarding the data of the observation, the optimal model automatically selected is ARDL (1,0,0,0,1) for an unrestricted intercept and no trend. Based on the result of bound test shown in Table 7 the result of t-statistic test is 46.28871 which is greater than the critical value of the upper bound (upper bound=4.01) at the significance level of 5%, thus rejecting the null hypothesis. It can then be concluded the model exhibits the presence of long run cointegration relationship between the variables when Elec is the dependent variable.

Next step is to estimate the error correction model which identifies the short run dynamics of the system as well as the long run linkage.

5.4. Error Correction Model

Having established cointegration, we proceed to analyze the long-run relationships and shortrun dynamics using a log-level autoregressive distributed lag (ARDL) error correction representation approach.

The error correction term as shown in Table 8 is ECM=−0.6072 with a significant probability of Prob.=0.0000. The negative sign of the error correction term and the significant probability value decides how quickly equilibrium is restored. However, a negative short run relationship was also observed between GDP and ELEC when considering the break occurred in 1983.

5.5. Diagnostic Tests

A series of diagnostic and stability tests were performed to assure the reliability of the results.

The diagnostic tests examine serial correlation using the Lagrange multiplier test of residual serial correlation and heteroscedasticity based on the regression of squared residuals on squared fitted values. According to Table 9, both tests results P > 5%. Therefore, no evidence of autocorrelation was found and the residuals are homoscedastic. The Cusum and CusumSQ graphs were also stable. The results can then be considered robust and reliable.

Table 5: ZA and KPSS unit root tests results

Test	Variable				
ZA	ELEC	FDI	GDP	DMFDI	DMGDP
Level	ts: −8.518117 P:0.001529 (2000)	ts: −3.627856 P:0.008467 (2005)	ts: −4.325759 P:0.002305 (1987)	ts: −3.115086 P:0.082521 (2008)	ts: −3.289753 P:0.675088 (1994)
First diff.			ts: -6.950492 P: 0.000529 1990	ts:-13.01485 P:0.06591 1993	ts:-8.131868 P:0.002772 1990
KPSS	ELEC	FDI	GDP	DMFDI	DMGDP
Level	0.1562**	0.5835**	0.6968	0.1497**	0.1506**
First diff.	0.3906	0.2555	0.2847***	0.1049	0.1141

( ) indicates year of break; ** 5% significance; *** 1% significance

Table 6: Lag selection

Variable	Lag	LogL	LR	FPE	AIC	SC	HQ
ELEC	2	19.08359	14.64231*	0.022101*	−0.974763*	−0.838717*	−0.928988*
FDI	1	−30.0600	33.39637*	0.408731*	1.943030*	2.033727*	1.973547*
GDP	1	72.38504	164.9031*	0.000822*	−4.265760*	−4.175063*	−4.235243*
DMFDI	1	−69.3395	29.86727*	4.418862*	4.323611*	4.414308*	4.354127*
DMGDP	1	−79.1457	22.45938*	8.006052*	4.917926*	5.008624*	4.948443*

Table 7: Result of Bound test for ELEC

Test statistic	Value	Significance level (%)	I(0)	I(1)
F-statistic	46.28871	10	2.45	3.52
k	4	5	2.86	4.01
		2.5	3.25	4.49
		1	3.74	5.06

Table 8: Result of error correction model for ELEC

Variables	Coefficient	Std. error	t-s	Prob.
C	−12.04173	0.739676	−16.2797	0.0000
D(DMGDP)	−57.35128	3.520258	−16.2917	0.0000
ECM*	−0.607285	0.037254	−16.30127	0.0000

Table 9: Results of diagnostic tests

Test	F-stat.	R^2	Conclusion
Breusch-godfrey serial correlation LM test	0.03079	0.2439	No serial CORRELATION
Heteroskedasticity test: Breusch-Pagan-Godfrey	0.2677	0.9278	Residuals are homoscedastic
Cusum and CusumSQ tests			Normal

Table 10: Toda Yamamoto granger non causality test results

Dependent variable	Independent variable	P. val.	Conclusion
ELEC (Eq.4)	FDI	0.5119	No causality
	GDP	0.4255	No causality
FDI (Eq.5)	ELEC	0.0078	Causality
	GDP	0.2547	No causality
GDP (Eq.6)	ELEC	0.0209	Causality
	FDI	0.9293	No causality

5.6. Toda Yamamoto Granger Non Causality Test

When evaluating the TY test, one could add an interaction between the two dummy variables. But we found these effects to be insignificant and therefore the dummies where dropped in order to not confuse interpretation of the results. The TY test is run based on (k=1) and (dmax=1). The results of the TY test are shown in Table 10.

A unidirectional causal relationship is observed in equation (4) for ELEC when FDI is the dependent variable ($P = 0.0078 < 0.05$). Another unidirectional causal effect is observed from ELEC to GDP ($P = 0.0209 < 0.05$) in equation (5).

6. CONCLUSION AND POLICY RECOMMENDATION

This article investigates the relationship between electricity consumption, foreign direct investment and economic development in Benin.

The importance of electricity consumption in promoting economic growth is shown by the unidirectional causality running from ELEC to GDP confirming the growth hypothesis for Benin. This suggests that Benin should increase access to electricity to foster its development in agreement with Wolde-Rufael (2006) which recommended that a country such as Benin must increase the energy use in order to achieve sustainable economic growth.

The unidirectional causal relationship observed from ELEC to FDI suggests that an increase in the access of electricity will foster the attractiveness of the country to foreign investment. In fact, this observation was made by Payne (2010) and Ozturk (2010) stipulating that firms tend to avoid countries where electricity is not available and at low cost. Taking into account the possible negative effects of this variable in setting priorities, an option could be to attract private investment in developing renewable energy production in the country in order to reduce the dependence on importing electricity from neighboring countries such as Ghana, Nigeria and Ivory Coast.

The empirical results also indicate the presence of long run relationship between the variables for electricity consumption. The error correction term observed in the long run is ECM=−0.6072 and significant at 1%. This implies that 60% of the disequilibrium of the previous year's shocks are corrected back to the long run equilibrium in the current year. In other words, this adjustment will take 1 years and 7 months (i.e., 1/0.6072=1.6469 year). As a consequence, electricity demand will not decrease any time soon since the country will keep growing and attracting more foreign investment. Therefore, Benin's government could develop a well-established PPP framework for electricity projects to avoid the financing models that are bureaucratic, complex and prolonged in order to attract private capital in generating renewable energies (Ibrahiem, 2015). Recently, Benin has taken several initiatives to attract foreign investment (particularly in the electricity production sector), such as creating a presidential investment council (an online platform for providing information to investors has also been put in place). This finding is in line with the Government's Action Plan (PAG 2016-2021) which affects 56.8% of energy development capital needs to the private sector (PAG, 2016).

These results suggest that the Beninese government should give priority to improving its access to electric power consumption in order to increase foreign investment and achieve economic growth.

Future research works should be carried on, adding the period from 2015 to 2021 to evaluate the effect of the reforms implemented by the PAG program to see how the causality evolved over time with the new political reforms.

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