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Empowering Progress: Investigating the Electricity Consumption-Economic Growth Nexus in Ghana

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Abstract

Investigating the interplay between electricity and economic growth holds significant ramifications for the formulation of energy conservation strategies and environmental policies. Nevertheless, the existing body of literature on the nexus between energy and economic growth in Ghana yields disparate findings, necessitating a comprehensive reassessment to discern more nuanced insights. This predicament poses significant challenges to the formulation of the country's energy policy. Extensive research is imperative to ascertain the causality relationship between energy and economic growth. However, the available evidence for Ghana is limited. Against this backdrop, this study aims to explore the direction of causality specifically between electricity, as a form of energy, and economic growth, contributing valuable insights to the ongoing discourse in the literature. The Granger Causality test was employed to examine the causal relationship between electricity consumption and economic growth spanning the period from 1971 to 2007. The findings indicate a unidirectional causality, wherein economic growth significantly influences electricity consumption. Hence, the data pertaining to Ghana substantiates the Growth-led-Energy Hypothesis. These results suggest that implementing electricity conservation measures is a viable and strategic option for the country.

Keywords: GDP per capita, Electricity consumption

JEL Codes: Q40

1. INTRODUCTION

Electricity stands as a critical infrastructural component crucial to propelling economic growth. Functioning as a versatile 'energy currency,' it serves as the linchpin supporting a diverse spectrum of products and services. Its impact extends far beyond mere illumination, encompassing various sectors that collectively contribute to an improved quality of life. By augmenting worker productivity and fostering entrepreneurial activity, electricity emerges as a catalyst for socio-economic development. In this intricate interplay, electricity consumption emerges as not only a necessity but also a driver of progress. The positive and robust correlation observed between electricity consumption and real per capita GDP underscores the symbiotic relationship, signifying that an increase in electricity usage is intricately linked with heightened economic prosperity. Recognizing electricity's multifaceted role in advancing societal well-being, it becomes evident that strategic investments and sustainable policies in electricity infrastructure can significantly contribute to comprehensive economic development. In the Ghanaian context, spanning the period from 2000 to 2007, the average annual growth of real per capita GDP stood at 5.5%, juxtaposed with an annual electricity consumption growth of 1.21%. Despite the observable positive correlation between real per capita GDP and electricity consumption, the precise direction of causality remains elusive. Further investigation is imperative to unravel the nuanced dynamics underlying the relationship between real per capita GDP and electricity consumption in this specific temporal context. Examining the nexus between electricity and economic growth holds profound significance for the formulation of effective electricity conservation measures. Nevertheless, the findings within the Ghanaian literature, as documented by Lee (2005) and Wolde-Rufael (2006), present a mosaic of outcomes. The variability in these results carries substantial implications for both Ghana's energy policy and environmental policy. The inconclusive nature of the literature underscores the necessity for a nuanced and context-specific approach to inform policies that address the intricate relationship between electricity and economic growth in Ghana. The imperative need for extensive research to ascertain the causal relationship between electricity consumption and economic growth is underscored. However, a conspicuous gap exists in the current body of research pertaining to the electricity-economic growth nexus in Ghana. Against this backdrop, the present study endeavors to fill this void by employing the Granger Causality Test spanning the years 1971 to 2007. The objective is to systematically investigate the direction of causality between electricity consumption and economic growth, contributing valuable insights to the existing discourse in the literature.

2. LITERATURE REVIEW

The exploration of empirical investigations into the intricate causal relationships between energy consumption and economic growth unfolds through a comprehensive analysis, encompassing two distinct but interconnected lines of inquiry: the hypothesis criteria and the generation criteria, as elucidated by Guttormsen in 2004. Delving into these criteria offers a nuanced perspective on the multifaceted dynamics characterizing the symbiosis between energy utilization and economic advancement. On one hand, the hypothesis criteria delve into the conceptual underpinnings of

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causality, seeking to discern the directional influence between energy consumption and economic growth. This analytical approach scrutinizes whether energy consumption acts as a precursor, driving economic expansion, or if economic growth, in turn, propels heightened energy usage. Unraveling this causative directionality is paramount for formulating informed energy policies and strategic economic planning.

Simultaneously, the exploration extends to the generation criteria, which scrutinizes the generation patterns of energy and their correlation with economic growth. This involves an intricate examination of how energy generation mechanisms and patterns align with the dynamics of economic development. Such insights prove pivotal for designing sustainable energy infrastructures that not only meet the evolving demands of economic growth but also contribute to overall environmental sustainability.

The hypothesis approach to analyzing the causal relationship between electricity consumption and economic growth involves a meticulous examination of studies to determine whether they assert that electricity consumption causes economic growth, the reverse, both, or neither. This categorization has led to the classification of empirical investigations into the energy-economic growth nexus into four distinct hypotheses: the Growth-led-Energy hypothesis, the Energy-led-Growth hypothesis, the Energy-led-Growth-led-Energy hypothesis, and the Neutrality hypothesis. Under the Growth-led-Energy hypothesis, studies posit that economic growth is the driving force behind increased electricity consumption. This perspective suggests that as economies expand, there is a concomitant surge in the demand for electricity due to the proliferation of industrial and commercial activities. The Growth-led-Energy hypothesis posits that economic growth serves as the impetus for increased energy consumption. This implies that, even in the face of severe energy crises, economic growth remains unhindered. Consequently, this hypothesis suggests that implementing energy conservation measures remains a viable option, as economic growth continues unabated despite potential energy challenges.

Conversely, the Energy-led-Growth hypothesis asserts that it is energy consumption that propels economic growth. In this scenario, a severe energy crisis is postulated to impede economic growth significantly. Consequently, under the Energy-led-Growth hypothesis, energy conservation measures are considered less viable, as any curtailment in energy consumption may hinder economic development. The Energy-led-Growth-led-Energy hypothesis introduces a bidirectional causality between energy consumption and economic growth. According to this hypothesis, not only does economic growth stimulate higher energy consumption, but increased energy availability and efficiency also contribute to further economic development. This dynamic interplay suggests that energy conservation measures and strategies for fostering economic growth should be approached in tandem.

Lastly, the Neutrality hypothesis asserts that there is no discernible causal relationship between energy consumption and economic growth. According to this perspective, changes in energy consumption have no significant impact on the trajectory of economic growth, and vice versa. This viewpoint challenges the need for direct policy interventions linking energy conservation measures with economic growth strategies.

In accordance with the framework introduced by Guttormsen (2004), empirical investigations into the relationship between energy and economic growth have been categorized into three distinct generations: the first generation studies, the second generation studies, and the third generation studies. The first generation studies primarily utilized traditional methodologies such as Vector Autoregressive Models (Sims, 1972) and the standard Granger causality test. These studies laid the foundation for exploring causal relationships between energy and economic growth, employing established statistical tools of their time. However, a notable limitation of this generation is its reliance on the assumption of series stationarity, which may not always hold true in real-world scenarios. This assumption oversimplifies the dynamics of the underlying data, potentially leading to biased results and hindering the comprehensive understanding of the intricate relationships between energy consumption and economic growth.

As the understanding of these relationships evolved, second generation studies emerged, seeking to address the limitations of their predecessors. These studies often incorporated more advanced econometric techniques and recognized the importance of non-stationary time series in capturing the complexities of real-world data. The progression to third generation studies signifies a continued refinement in methodology. These studies typically employ advanced techniques that account for issues such as endogeneity, nonlinearity, and structural breaks, aiming to provide more accurate and robust insights into the dynamic interplay between energy and economic growth. In essence, this classification scheme reflects the evolving sophistication in the empirical examination of the energy-economic growth nexus, highlighting the iterative nature of research as scholars adapt methodologies to better capture the intricacies of this complex relationship. Consequently, the second generation of studies introduced cointegration as a more sophisticated tool for analyzing the causal relationship between energy consumption and economic growth, building upon the works of Johansen and Juselius (1990). In this paradigm, pairs of variables were subjected to cointegration tests, and subsequently, an error correction model was employed to assess causality, drawing on the pioneering work of Engle and Granger (1987).

However, the second generation faced challenges when confronted with the possibility of multiple cointegrating vectors, making their approach less suitable. This limitation prompted the emergence of the third generation of studies, which advocated for a multivariate approach that accommodates more than two variables in the cointegrating relationship. This advancement in methodology reflected an acknowledgment of the intricate interdependencies among various factors influencing the energy-economic growth nexus. By embracing a multivariate perspective, the third generation of studies sought to enhance the analytical framework, providing a more nuanced understanding of the complex interactions between energy consumption, economic growth, and potentially other relevant variables. This evolution in methodology highlights the ongoing efforts within the academic community to refine tools and approaches, ensuring a more accurate depiction of the causal dynamics in the intricate relationship between energy and economic growth. This approach provides a framework for estimating systems in which restrictions on cointegrating relationships can be rigorously tested, allowing for the examination of short-run adjustment dynamics. Despite these advantages, the third-generation studies encounter two principal challenges. Firstly, these studies impose the requirement that the variables should be integrated of order one. Secondly, a precondition for conducting a test of causality in the third-generation framework is that the variables must already be cointegrated. These limitations have spurred the emergence of the fourth generation of studies, signifying a continued evolution in methodological sophistication. The fourth generation seeks to address the issues posed by its predecessors by relaxing some of the stringent assumptions. By doing so, this generation endeavors to enhance the applicability and robustness of empirical analyses, fostering a more accurate representation of the intricate relationships between energy consumption and economic growth. The fourth generation of studies represents a methodological shift by adopting the Toda and Yamamoto Granger Causality test, grounded in the Autoregressive Distributed Lag (ARDL) model. This innovative approach deviates from the constraints of its predecessors by not imposing restrictions on the integration order of the variables. Consequently, causality testing remains feasible irrespective of whether the variables are integrated of order zero, one, or both. In essence, this method allows for the examination of causality even when cointegration is not a prerequisite, providing greater flexibility in exploring the dynamic relationships between energy consumption and economic growth. This advancement reflects a commitment to refining empirical methodologies, ultimately contributing to a more nuanced understanding of the intricate dynamics within the energy-economic growth nexus.

The overarching observation derived from this study underscores the presence of contradictory outcomes within the realm of both multi-country studies and country-specific investigations concerning the causality between energy consumption and economic growth. Notably, the divergent findings suggest a nuanced and complex relationship that is influenced by a multitude of factors. Specifically, when scrutinizing country-specific studies on the causality between electricity consumption and economic growth, a consistent pattern emerges. These studies consistently indicate a positive causality, signifying a directional influence from electricity consumption to economic growth. In contrast, the results from multi-country studies on the causality between electricity consumption and economic growth present a less uniform picture, displaying inconsistencies and contradictions.

This disparity in outcomes between country-specific and multi-country studies underscores the importance of considering unique national contexts and idiosyncrasies when investigating the intricate dynamics between electricity consumption and economic growth. The divergent results also emphasize the need for a more nuanced approach that recognizes the heterogeneity across nations, shedding light on the complexities inherent in drawing overarching conclusions in the field of energy-economic growth causality. The author, therefore, recommends adopting more contemporary approaches in current studies investigating the causality between energy (specifically electricity) consumption and economic growth. To mitigate conflicting and unreliable results, the suggested methodologies include the use of advanced techniques such as the ARDL Bounds cointegration test proposed by Pesaran et al. (2001), threshold cointegration models as proposed by Hansen and Seo (2002), and the application of panel data models. The conclusion drawn by the author underscores the significance of avoiding studies that merely alter the data period while utilizing identical methods and variables. Such practices contribute to the conflicting results present in the existing literature on energy (electricity)-growth causality. The author asserts that such duplicative efforts lack meaningful contributions to the field. Therefore, researchers are advised to refrain from replicating studies without introducing novel elements, as this does not enrich the existing body of literature on the subject. For further clarity and reference, a summary table of works pertaining to the causality between energy (electricity) consumption and economic growth is provided below. This compilation aims to offer a succinct overview of the diverse studies conducted in this domain, serving as a valuable resource for researchers and scholars in the energy-growth literature.

3. OVERVIEW OF THE ELECTRICITY SUB-SECTOR AND ECONOMIC GROWTH

The electricity delivery process typically unfolds in three sequential phases as it traverses from generation to the end-user. Initially, power is generated at remote locations using generators. Subsequently, the generated power is conveyed through the transmission grid, which consists of transmission lines, transformers, and associated components, en route to the bulk load distribution substations. Finally, from these substations, the power is disseminated to individual customer sites through distribution lines. This intricate journey involves a systematic and interconnected network, ensuring the efficient and reliable supply of electricity to end-users.

In Ghana, the intricate three-step process of electricity delivery is overseen by three distinct utility companies, each entrusted with specific responsibilities. The Volta River Authority, a state-owned enterprise, assumes the crucial role of bulk power generation within the country. Presently, Volta River Authority operates the Akosombo and Kpong hydro stations, serving as the primary sources of power generation for Ghana. The Ghana Grid Company is tasked with the vital responsibility of transmitting power from bulk power plants to the distribution lines. Acting as the intermediary link in the electricity delivery chain, Ghana Grid Company ensures the efficient and reliable transfer of power across the transmission grid. The final leg of the process involves the distribution of power to end consumers, a task assigned to two entities: the Electricity Company of Ghana and the Northern Electrical Department, a subsidiary of VRA. ECG is responsible for serving the southern half of the country, while the Northern Electrical Department is dedicated to supplying power to the northern region. Through this strategic division of responsibilities, these utility companies collectively contribute to the comprehensive and organized delivery of electricity across the nation. The electricity sector has undergone substantial growth over the past decade. In 1992, the electricity and water sector achieved a notable growth rate of 12.02%, marking a 5.43% increase compared to the preceding year. The impetus behind this growth was prominently outlined in the budget statement and economic policy for 1993. Key contributing factors included expansive initiatives within the national electricity grid, particularly through the rural electrification programme. Additionally, efforts were directed towards the expansion and enhancement of urban electricity distribution networks. These strategic measures were instrumental in fostering the sector's growth, underscoring a commitment to both rural electrification goals and the improvement of urban electricity infrastructure. In the year 2000, the electricity sector experienced a growth rate of 4.5%, representing a decrease from the 1992 figure. Analyzing its relative contribution to the overall industrial growth in the country, the electricity sector accounted for 10.21% of the total industrial Gross Domestic Product (GDP) in 2000. Moving forward to 2005, there was a notable upswing in the growth rate of the electricity sector, reaching 12.4%. This substantial increase translated into an augmented relative contribution to the total industrial GDP, which rose to 11.9%. This positive growth trajectory underscored the sector's increasing significance within the broader industrial landscape, reflecting ongoing efforts to enhance its efficiency and capacity during this period.

Nevertheless, in 2007, the electricity sector faced a significant setback with a contraction in growth rate, recording a notable decline of -17.4%. This downturn had repercussions on the sector's relative contribution to the total industrial Gross Domestic Product (GDP), causing it to decrease to 10.2%. The primary factor contributing to this diminished contribution was the severe drought that afflicted the Ghanaian economy in 2007. The adverse weather conditions led to a substantial reduction in the water level of Akosombo, the primary powerhouse for the country's electricity generation. This environmental challenge severely impacted the sector's capacity to generate power, resulting in a temporary setback in both growth and its overall contribution to the industrial landscape.

4. DATA AND METHODOLOGY

Preceeding from the discussion of the empirical literature on energy-growth nexus, the long-run relationship between electricity consumption and economic growth may be specified as below:

$E_t=(Y_t)$

Where EC_t is the log of electricity consumption, Y_t is the log of real per capita GDP (constant 2000 US$). Annual time series data from 1971 to 2007 on electricity consumption and real per capita GDP were sourced from the EnerData Global Energy and CO_2 Data Research Services and Africa Development Indicators correspondingly.

Although it has been argued in the literature that the ARDL Bounds cointegration tests does not require the pre-testing of series for their order of integration, the need for series to pass two conditions necessitates the need to test for the order of integration of the series. First, the ARDL Bounds cointegration requires that the series in a model should be integrated of an order of either zero or one but not two or more. Secondly, the dependent variable should be integrated of order one.

In this study the Augment-Dickey Fuller unit root test (ADF) and the Phillip-Perron (PP) unit root test are used to ascertain the order of integration of the series.

The ARDL bounds testing approach compared to the other approaches of cointegration has several distinct advantages. One of the main advantages of the ARDL approach in contrast to the Engle and Granger (1987) and Johansen approach (1990) is that the ARDL Bounds cointegration approach permits to test for cointegration regardless of whether the variables are all I (1) or I (0) or a mixture of the two. Secondly, the ARDL Bounds approach is not sensitive to the size of the sample, therefore, making its small sample properties more superior to the multivariate cointegration approach. Lastly, the ARDL approach is known to provide unbiased long-run estimates even when some of the variables are endogenous. Narayan (2005) demonstrates that even when some of the independent variables are endogenous, the bounds testing approach generally provides unbiased long-run estimates and valid t-statistics.

Since it is difficult to a priori tell the direction of cointegration between variables, the study in testing for long-run relationships in the variables using the Bounds cointegration test, normalised each variable as a dependent variable. Thus, the following ARDL equations were estimated using OLS and a test of significance on the parameters of the lag level variables were conducted. The resulting F-statistic were then compared to the Pesaran et al asymptotic critical bounds to determine whether there exist a long-run relationship between the variables.

The study of causality has widely been analysed using the vector error correction model (VECM) and error correction model (ECM). However, Toda and Yomamoto (1995) have shown that the asymptotic distribution of the test in the unrestricted VAR has nuisance parameter and nonstandard distribution. Also Toda and Yomamoto (1995), Zapata and Rambaldi (1997) and Rambaldi and Doran (1996) have all reported that approaches such as VECM and ECM used to analyse causality are sensitive to the values of the nuisance parameters in finite samples making the results a bit unreliable. As a result, Toda and Yomamoto (1995) proposed a modification of the Granger causality approach. This approach requires estimating a VAR model in their levels by augmenting the VAR model with the maximum order of integration, d, of the variables in the model. The method then applies the Wald test statistic for linear restrictions to the resulting VAR (K) model. As shown by Toda and Yomamoto (1995), the Wald statistic for restrictions on the parameters of VAR (K) has an asymptotic χ^2 distribution when a VAR (K+d) is estimated (Zapata and Rambaldi, 1997). Thus, the main idea is to intentionally over-fit the causality test underlying model wth additional d lags so that the VAR order becomes (K+d) with K representing the optimal order of the VAR determined by Akaike Information Criterion.

That is when one is uncertain about the order of integration of the variables, augmenting the VAR model with an extra lag usually ensures that the Wald statistic posses the necessary power properties. Thus, in applying the Toda and Yomamoto method, all that is required of one is the maximum order of integration of the variables in the model and the optimal lag order of the VAR (K) model. This method in contrast to the methods of ECM and VECM does not require pre-testing for cointegration and unit root properties and thus, overcomes the pre-test biased associated with the unit root and cointegration test. Also, this approach minimises the risk associated with possibly wrongly identifying the order of integration of the series and the presence of cointegration relation (Giles, 1997; Mavrotas and Kelly, 2001).

4. EMPIRICAL RESULTS

The study first tested for unit root in variables using the Augmented Dickey Fuller Test and Phillip-Perron Test. The results of the test are shown below in table 1.

Table 1: unit root test

Variable/test statistic	Intercept and no trend	Intercept and trend	None
E-ADF	-2.711519**	-3.662053***	0.445793
E-PP	-2.072651	-2.469109	1.398986
D(E)-ADF	-5.4060***	-5.321561***	-5.44603***
D(E)-PP	-7.691418***	-7.421352***	-5.856158***
Y-ADF	-0.538243	-1.185555	1.186281
Y-PP	-0.819665	-1.097411	0.247231
D(Y)-ADF	-4.097168***	-2.035976	-4.12844***
D(Y)-PP	-4.078915***	-6.903395***	-4.121853***

*,**, *** indicates 1%, 10% and 5% levels of significance

Table 2: Variable Addition Test (OLS case)

Dependent variable is DY

List of the variables added to the regression: Y(-1) E(-1)

35 observations used for estimation from 1974 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
CON	.17168	.37092	.46285[.647]
DY(-1)	.40639	.19154	2.1217[.043]
DE(-1)	-.022149	.036798	-.60191[.552]
LY(-1)	-.070699	.077234	-.91539[.368]
LE(-1)	.026228	.031428	.83453[.411]

Joint test of zero restrictions on the coefficients of additional variables:

Table 3

Lagrange Multiplier Statistic	CHSQ(2)=	1.2410[.538]
Likelihood Ratio Statistic	CHSQ(2)=	1.2635[.532]
F Statistic	F(2, 28)=	.51465[.603]

Table 4: Variable Addition Test (OLS case)

Dependent variable is DE

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
CON	1.5628	1.4787	1.0569[.300]
DE(-1)	.24103	.14669	1.6431[.112]
DY(-1)	1.9185	.76355	2.5126[.018]
LE(-1)	-.38960	.12529	-3.1097[.004]
LY(-1)	.31218	.30789	1.0139[.319]

Table 5: Bounds cointegration test

F-statistics	10% level of significance		5% level of significance	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
F_{ec} = 5.0226	2.49	3.38	2.81	3.76
F_y = 0.51465				

From table 5, the F-statistic exceed the 5% upper critical bound while the F-statistic. It can be concluded that the lag level variables Y and EC are significant in the electricity consumption equation. Thus, there exist a long-run relationship between electricity consumption and real per capita GDP. In other words, real per capita GDDP (Y) can be

treated as the 'long-run forcing' variable explaining electricity consumption. However, the lag level variables, Y and EC are not significant in the real per capita GDP equation. Thus, there exist no long-run relationship between real per capita GDP and electricity consumption and therefore, electricity consumption cannot be treated as the 'long-run forcing' variable explaining real per capita GDP.
The next stage involved the test of causality between electricity consumption and real per capita GDP. First the study tested for the appropriate order of the VAR using the Akaike Information Criterion. Results of the test suggest a lag length order of two. Also a test of inclusion or exclusion of deterministic variables in the VAR were conducted. The LR test of deletion of deterministic variables in the VAR follows the chi-square distribution. Results of the test suggest the inclusion of an intercept and a time trend in the VAR.

Table 6: Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Order	LL	AIC	SBC	LR test	Adjusted LR test
4	86.0247	66.0247	50.7611	------	------
3	81.4585	65.4585	53.2476	CHSQ(4)= 9.1325[.058]	6.4465[.168]
2	78.6086	66.6086*	57.4505	CHSQ(8)= 14.8322[.062]	10.4698[.234]
1	71.6420	63.6420	57.5365*	CHSQ(12)= 28.7655[.004]	20.3051[.062]
0	24.9291	20.9291	17.8764	CHSQ(16)= 122.1912[.000]	86.2526[.000]

NB: AIC and SBC in Microfit are based on log-likelihood hence the maximum is chosen.

Table 7: LR Test of Deletion of Deterministic/Exogenous Variables in the VAR

Null hypothesis	LR test of restrictions (CHSQ)	Maximum value of log-likelihood	P-value
Intercept but no trend	10.0772	74.5430	0.006
No intercept but trend	3.3864	77.8884	0.184
Intercept and trend	11.0271	74.0680	0.026

This study first adopted the LR test of Block Granger Non-causality in the VAR. The LR test of Block Granager Non-causality statistic tests the null hypothesis that the coefficients of the lagged values of the variables assumed to be 'non-causal' in the block of equations explaining other variables are zero. The results of the LR test of Block Granger Non-causality are shown in the table 8.

Table 8: LR Test of Block Granger Non-causality in the VAR

Null Hypothesis	LR statistic	Decision
Electricity consumption does not cause GDP	2.5074	Do not reject the null
Real per capita GDP does not cause consumptions	9.0107***	Fail to accept the null

***Indicates 5% level of significance. The maximum lag length is 2

As shown in table 8, the LR test of Block Granger Non-causality shows that there exist a unidirectional causality running from real per capita GDP to electricity consumption. Having established the optimal lag length to include in the VAR, the maximum order of integration and inclusion of an intercept and a time trend, the study proceeded to estimate the following VAR model using the Seemingly Unrelated Regression model.

5. CONCLUSION

The study delved into the examination of the causal relationship between electricity consumption and economic growth, employing the Granger Causality test spanning the years 1971 to 2007. This rigorous investigation sought to discern the directional influence between these two pivotal variables, shedding light on the dynamic interplay within the electricity-economic growth nexus over the specified period. The ARDL Bounds test of cointegration yielded significant results, indicating the presence of a long-run relationship between electricity consumption and real per capita GDP. Furthermore, it was discerned that real per capita GDP can be considered the 'long-run forcing' variable, elucidating its role as a fundamental determinant explaining variations in electricity consumption over an extended timeframe. This finding contributes valuable insights into the sustained and interconnected dynamics between economic prosperity and electricity usage. The Granger Causality test conducted to explore the causal relationship between electricity consumption and real per capita GDP in Ghana unveiled supportive evidence for the Growth-led-Electricity Hypothesis. This result suggests that, in the Ghanaian context, economic growth significantly influences electricity consumption, aligning with the notion that expanding economic activities drive an increased demand for electricity. This finding contributes to a nuanced understanding of the causal dynamics within the electricity-economic growth relationship in Ghana, reinforcing the idea that economic development plays a pivotal role in shaping electricity consumption patterns. The findings presented in this study suggest that implementing electricity conservation measures is a feasible and prudent option for Ghana. Given the supportive evidence for the Growth-led-Electricity Hypothesis, indicating that economic growth propels electricity consumption, there is an opportunity to develop and intensify targeted electricity conservation measures in the Ghanaian economy. Importantly, this approach is envisioned to coexist harmoniously with economic growth, dispelling concerns about potential impediments to the overall economic advancement. The implication is that the pursuit of energy efficiency and conservation initiatives can be integrated into the national strategy without compromising the trajectory of economic growth in Ghana.

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