Electricity Consumption, Corruption and Economic Growth: Evidence on Selected African Countries.

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ABSTRACT

An important prerequisite for reducing poverty, sustainable development and achievement of the millennium development goal has to some extent been tied to access to electricity. However, the subject matter; 'electricity consumption causing economic growth' has seen conflicting results from the theoretical and empirical front, if indeed a relationship exist at all.

The study tests, within a panel context the long-run relationship between electricity consumption and economic growth for 13 African Countries from 2006 to 2017 by employing recently developed panel co-integration techniques. Implementing a three stage approach made up of panel unit root, panel co-integration and Granger causality test to examine the causal relationship between electricity consumption, electricity price, corruption, employment and growth.

The study provides empirical evidence that a bidirectional causal relationship between electricity consumption and economic growth exist in the short run, suggesting that lack of electricity could hamper economic growth as well as an investment in electricity infrastructure would in turn improve economic growth. Also reveals that corruption causes the level of electricity consumption and GDP in the short run. On the long-run front electricity consumption and electricity price granger causes GDP and GDP causes electricity consumption.

Keywords: Africa, electricity consumption, economic growth, corruption, panel co-integration, panel data

1. Introduction

The role Electricity plays in our present day lives cannot be over emphasised, especially its contribution in key vital sectors, including Education, Agriculture, communication and manufacturing sectors (Adebola, 2011; Kouakou, 2011). According to Adeola (2011), Electricity consumption is key for economic development and personal satisfaction not just on the grounds that its nurtures the productivity of the factors of production (e.g Capital and Labour e.t.c.), more also that increased electricity consumption connotes high economic status of a Country. Furthermore, according to Ouedraogo (2013) speaking of economic status, a quarter of the world's population has no access to electricity, suggesting that the lack of access to electricity is hence a hindrance to sustainable development and economic growth. As reported by UNIDO (2001), it has been widely acknowledged that in varying ways, electricity consumption affects the realisation of the millennium development goals[1]. However, Ouedraogo (2013) infers that from the theoretical and the qualitative standpoint, there seem to be consensus on the effect of electricity consumption on the growth and development of any given economy, but an empirical consensus is yet to be met.

A large number of studies have examined extensively the Granger-causal[2] relationship between electricity consumption and economic growth around the world over the past decades using different approaches, time periods and control variable(s). In any case, the result on the direction of the causality remains inconclusive. Some empiral studies (e.g. Adebola, 2011; Mozumder and Marathe, 2007; Ghosh 2002) found a one way causality from economic growth to electricity that economic growth Granger-cause electricity consumption, while some other studies disputed that electricity consumption Granger-cause economic growth (e.g. Nadia, 2012; Augueste, 2011; Tang, 2008,2009; Yuan et al., 2007; Stern, 1993).

Nonetheless the direction of causality between electricity consumption and economic growth could have critical policy implications. For instance where electriciy consumption Granger causes economic growth, policies to reduce electricty consumption may have an adverse effect on the growth of the economy. Along these lines, it is imperative to give empirical proof on the likely existence of a long run relationship between electricity consumption and economic growth for a given location. (Ouedraogo, 2013; Akinlo, 2008; Squalli, 2007; Wolde-Rufael, 2006; Jumbe, 2004)

A growing number of recent research conducted by some authors show a certain interest in African countries (see Emmanuel, 2013; Ouedraogo, 2013; Adebola, 2011; Kouakou, 2011; Odhiambo, 2009a, b; Wolde-Rufael, 2006; Squalli, 2007; Jumbe, 2004). Regardless of this expanding literature on the causality between electricity consumption and economic growth in Africa, none of these literatures has considered how the perception of corruption in Africa may affect electricity consumption. According the The Transparency International Global Corruption Index, the corruption in public utilities in both poor and rich countries alike have barely dropped. The corruption perception index (CPI) between 2004 & 2007 reveals a slight drop from 35% to 33% in the share of the population who have directly experienced corruption in the delivery utilities (e.g. electricity and water). For this reason, Lourdes & Antonio (2009) pointed out how corruption in utilities could be a major issue amongst policymakers.

Against this backdrop, this study aims to re-investigate the causual relationship between electricity consumption and economic growth in a multivarate framework. Thus, incorporating employment, corruption perception index[3], consumer price index is used as a proxy for electricity price as data for electricity price are not available for all 13 countries selected for this study. In doing so this study may

[1] The Millennium Development Goals (MDGs) are eight international development goals that were officially established following the Millennium Summit of the United Nations in 2000, following the adoption of the United Nations Millennium Declaration. which includes; eradication of poverty and hunger, achieving universal basic education, promoting gender equality and women empowerment, reduce child mortality, improve maternal health care, combat HIV/AIDs, malaria and other diseases and ensure environmental sustainability

[2] Granger causality

[3] The corruption perception index ranks countries on the scale of 1 to 10, 1 been very corrupt and 10 been very clean

increase the reliability of its findings, as the problem associated with omitted variables may be avoided. Also this would be the first study on electricity consumption-growth connection (nexus) using the corruption index as a control variable. Following this, this study would attempt to compare and capture the the effect of corruption index as against just price and employment, by examining the long run relationship with and without corruption and causality with and without corruption.

2. An Overview of the Electricity Situation in Africa

The World Bank reports (2012) that Africa's largest deficit in Infrastructure would be found in the power sector. Whether considered in terms of electricity consumed, generation capacity or security of supply, Africa lags behind when compared with other continents around the world. It is shocking to note that Africa's electricity infrastructure only delivers about a small part of what is obtainable elsewhere in the developing world. According to the World Bank report (2012), the 48 Sub-Saharan Africa countries put together with an estimated population of 800 million people, only generates just about same amount of electricity as Spain with an estimated population of 45 million people. With an average electricity consumption of about 124 kilowatt hours per capita per year and falling, just enough energy to power a 100 watt bulb per person for around three hours, this is shockingly just about the tenth of what is obtainable elsewhere in the developing world.

This wide disparity is not only observed when benchmarking electricity consumption in Africa against other developing countries, but also can be observed within Africa. Table 1 shows a ranking of Africa countries by the estimated amount of electricity consumed. For example: Nigeria with an estimated population of 160 million people consumes about 91 kilowatt per hour per capita and South Africa with an estimated population of 51 million people, electricity consumption stands at about 3552 kilowatt per hour per capita.

Table I: List of African Countries by Electricity Consumption

Country	**Africa Rank**	World Rank	Amount **(kWh)**
South Africa	**1**	18	181,200,000,000
Egypt	**2**	35	69,960,000,000
Algeria	**3**	64	22,900,000,000
Libya	**4**	69	18,770,000,000
Morocco	**5**	71	14,610,000,000
Nigeria	**6**	72	14,550,000,000
Zimbabwe	**7**	79	9,813,000,000
Tunisia	**8**	80	9,748,000,000
Ghana	**9**	81	8,835,000,000
Zambia	**10**	105	5,458,000,000
Kenya	**11**	107	3,981,000,000
Congo, DR	**12**	108	3,839,000,000

Cameroon	**13**	113	3,360,000,000
Cote D'Ivoire	**14**	116	2,983,000,000
Tanzania	**15**	118	2,752,000,000
Sudan	**16**	122	2,222,000,000
Uganda	**17**	128	1,620,000,000
Ethiopia	**18**	129	1,594,000,000
Botswana	**19**	130	1,564,000,000
Senegal	**20**	133	1,412,000,000
Mozambique	**21**	135	1,390,000,000
Angola	**22**	136	1,348,000,000
Mauritius	**23**	137	1,219,000,000
Reunion	**24**	140	1,005,000,000
Swaziland	**25**	142	962,900,000
Madagascar	**26**	146	772,100,000
Gabon	**27**	148	742,500,000
Guinea	**28**	149	735,200,000
Malawi	**29**	151	715,300,000
Congo, DR	**30**	152	633,000,000
Benin	**31**	153	631,100,000
Togo	**32**	154	614,500,000
Namibia	**33**	155	603,100,000
Mali	**34**	161	446,600,000
Liberia	**35**	162	435,900,000
Niger	**36**	167	325,100,000
Burkina Faso	**37**	168	259,600,000
Sierra Leone	**38**	169	232,600,000
Somalia	**39**	171	227,900,000
Eritrea	**40**	172	205,100,000

Source: World bank Data (2017)

4. Corruption in Public Utilities and Economic Growth

Scholars have noted the adverse impact of corruption on Economic growth and development (Hanna, et al., n.d.). Mauro (1995) study on corruption and growth presents the earliest empirical evidence that corruption impedes economic growth as corruption reduces investments, thereby lowering ecomonic growth, and other recent studies have confirmed this finding. For example, Lambsdorff (2003), finds that if the level of corruption in Tanzania can be reduced to that of the United Kingdom, productivity would increase by 10 percent. Dreherand Herzfeld (2005) estimate that a 1 percennt increase in corruption reduces GDP growth by 0.13 percentage points and GDP per capita by 425 US$. Other resent studies are Bertrand, et al. (2008) and Olken & Barron (2009). Furthermore, Transparency International points out that corruption may damage not only a country's economy, but also its political systems and institutions, civil society, and natural environment. As such, most development agencies have incorporated anti-corruption policies into their core strategies, with the World Bank alone supporting over 600 anticorruption programs since 1996.

Table 2: Summary of selected literature review on the causality between electricity consumption - growth for multi-countries

Authors	Period	Countries	Methodology Employed	Direction of Causality
Ehobon (1996)	1960-1984	Nigeria, Tanzania	Engle-Granger Causality	EC↔GDP
Murray and Nan (1996)	1970-1990	15 countries	Engle-Granger Causality Test	Mixed results
Wolde-Rufael (2005)	1971-2001	Algeria, Congo DR, Egypt, Ghana, Ivory Coast,	ARDL Bounds Testing,Toda and Yamamoto (1995) Causality Approach	EC↔GDP
Wolde-Rufael (2006)	1971-2001	Cameroon, Ghana, Nigeria, Senegal, Zambia, Zimbabwe, Algeria, Congo Republic, Kenya, South Africa, Sudan	ARDL Bounds Testing,Toda and Yamamoto (1995) Causality Approach	EC↔GDP
Yoo (2006)	1971-2002	Indonesia, Malaysia, Singapore and Thailand	Engle-Granger Causality test Hsiao's version of Granger Causality Method	GDP→EC (Indonesia, Thailand) EC↔GDP(Malaysia, Singapore)
Narayan and Prasad (2008)	1971-2002	30 OECD Countries	Bootstrapped Causality testing approach	EC→GDP (Australia, Italy, Slovak Republic, Czech Republic, Portugal) GDP→EC (Finland, Hungary, Netherlands) EC↔GDP(Iceland, Korea, UK) GDP- - -EC (rest 19 countries)
Squalli (2007)	1980-2003	11 OPEC countries	ARDL Bounds Testing, Toda and Yamamoto (1995) Causality approach	EC↔GDP (Iran, Qatar, Venezuella) GDP→EC (Algeria, Iraq, Libya) Mixed results with different model (Nigeria, Indonesia, Kuwait, Saudi Arabia, UAE)
Chen et al. (2007)	1971-2001	China, Indonesia, Hong Kong, India, Malaysia, Korea, Taiwan, Philippines, Singapore, Thailand	Pedroni panel Co-integration, ECM, Panel Causality test	EC↔GDP

Ciarreta and Zarraga (2008)	1971-2001	Austria, Belgium, Denmark, Finland, France, Sweden, Norway, Germany, Italy, Luxembourg, Netherlands, Switzerland	Panel Co-integration, GMM, panel Causality test	EC→GDP (in the long run) GDP ---ELC (in the short run)
Akinlo (2008)	1980-2003	Gambia, Ghana, Senegal, Cameroon, Kenya	ARDL Bounds testing/ VAR	EC↔GDP
Apergis and Payne (2009)	1991-2005	Commonwealth of Independent States	(Pedroni, 1999) and (pedroni, 2004) for Co-integration and ECM causality for short run	EC→GDP
Narayan and Smyth (2009)	1974-2002	Iran, Isreal, Kuwait, Oman, Syria, Saudi Arabia	Bootstrapped Causality Testing Approach	EC↔GDP
Wolde-Rufael (2009)	1971-2004	Algeria, Benin, South Africa	Toda and Yamamoto (1995) Causality Test	EC↔GDP

Note: **EC→GDP** means that the causality runs from electricity consumption to growth. **GDP→EC** means that the causality runs from economic growth to electricity consumption. **EC↔GDP** means that bi-directional causality exists between electricity consumption and growth. EC - - - GDP Neutrality

A summary of the findings in recent studies on the causal relationship beteween electricity consumption and economic growth for multi-countries are reported in Table 2 above. From the table it is observed that contracditory results are still being reported. Example of such is the studies by Yoo (2006) and Chen et al. (2007), Yoo (2006) found causality from electricity consumption to economic growth for Indonesia and Thailand using Hsiao's version of Granger Causality Method while Chen et al. (2007) found bidirectional causality for same country within a panel context. Ehobon (1996), using the Engle-Granger Causality and Wolde-Rufael (2006)using the Toda and Yamamoto (1995) Causality approach, found a bidirectional causality between electricity consumption and economic growth for Nigeria, while Squalli (2007) found a mixed result.

Overall, results from the studies reviewed shows that the literature on the electricity and growth causal relationship produced a conflicting result without consensus in the existence or direction of causality.

5. Methodology

In examining the relationship between electricity consumption, economic growth, prices, employment and corruption, firstly, panel unit root analysis is conducted to determine the order if integration of the variable, secondly, panel cointegration analysis is employed to check the existence of a long run relationship among the variables, panel causality analysis to check the direction of the causality, panel fully modified ordinary least square (FMOLS) and panel dynamic ordinary least square (DOL) estimates are employed in this study.

And finally the panel error correction model is employed to examine the long run vs. short run causality relationship and well as the direction of the causality.

5.1 Panel Unit Root Test

As part of a preliminary analysis, panel unit root tests would be used to test each variable to determine the order of integration (either integrated in level or in first deference), this is because co-integration necessitates that variables be integrated of same other. According to Ilhan, et al. (2010), when employing conventional unit root tests or cointegration tests routine (e.g., ADF or residual-based cointegration tests) it is likely to encounter the low power problem for non-stationary data. Therefore to take advantage of the additional information provided by pooled data section time series to increase test power, it is imperative to employ panel data unit root test as opposed to traditional unit root test.
Against this backdrop, the Im, Pesaran and Shin (IPS)(2003) would be used to check for unit root in this study. According to Eggoh, et al. (2011) the IPS unit root test is less restricitive and more power in comparism to the Levin and Lin (1993), Levin et al. (2002) and Breitung (2000), in the sense that IPS allows for heterogeneity within a dynamic panel data framework which solves the serial correlation problem that Levin and Lin (1993) encounters. The IPS Unit root test is based on the following equation:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{\rho} \emptyset_{ij} \Delta y_{i,t-j} + \varepsilon_{i,t} \quad i=1,2,\ldots, N; \quad t=1,2..T, \qquad (1)$$

Where y_{it} represents the series of country *i* in the panel over period *t*, α_i represents the independent fixed effect and ρ_i is chosen to make the residual uncorrelated over time. IPS unit root tests the null hypothesis of the unit root for each country in the panel. The null hypothesis is that $H_0: \rho_i = 0$ for all i against the alternative hypothesis $H_1: \rho_i < 0$ for some $i = 1, \ldots, N$ and $\rho_i = 0$ for $i = N_1 + 1, \ldots, N$ (Ciarreta & Zarraga, 2010) (Ilhan, et al., 2010)[4]

5.2 Panel Cointegration Test

Once the variables in the series are individually integrated of the same order, the second step of the empirical analysis would be to investigate the possibility of a long run relationship between electricity consumption, gdp, price, employment and corruption, using Padroni (1999) cointegration technique. Like the IPS that takes into account the heterogeneity of the variables in the panel, Padroni's cointegration test also allows for heterogeneity among variables of the panel which makes it an improvement over other tests (Ciarreta & Zarraga, 2010) (Ilhan, et al., 2010). The Padroni co-integration test is based on the following model:

$$LGDP_{it} = \alpha_{it}^{a} + \delta_{it}^{a} t + \beta_{i1}^{a} LEC_{it} + \beta_{i2}^{a} LP_{it} + \beta_{13}^{a} LEMP_{it} + \varepsilon_{it}^{a} \qquad (2a)$$

$$LGDP_{it} = \alpha_{it}^{b} + \delta_{it}^{b} t + \beta_{i1}^{b} LEC_{it} + \beta_{i2}^{b} LP_{it} + \beta_{13}^{b} LEMP_{it} + \beta_{14}^{b} LCI_{it} + \varepsilon_{it}^{b} \qquad (2b)$$

where $i = 1, \ldots, N$ for each country in the series and $t = 1, \ldots, T$ is the time period; $\alpha_i$represents the country specific intercept, $\delta_i$represents the time fixed effects, LGDP,LEC, P, LEMP and LCI are the natural logarithms of Electricity consumption per capita, real GDP per capita, Price , Employment and

[4] A battery of Unit root test was conducted and included in the appendix due to work constraint and giving the results obtained are conflicting.

Corruption respectively. Equation (2a) and (2b) are co-integration equations of the panel series without and with corruption index. Equations (2a) and (2b) are tested to capture the possible effect of corruption in the long run.

5.2.1 Estimating the Long Run Cointegration Relationship in a Panel Context

Once the variables in the series are cointegrated, estimation of the long-run relationship between electricity consumption and economic growth is the next step. There exist various estimators for obtaining the cointegrating relationship within the panel data context, which includes, the Ordinary least squares (OLS) estimators fully modified OLS (FMOLS) estimators, Pull mean group (PMG) and dynamic OLS (DOLS) estimators. Ouedraogo (2013) puts foward that, using an OLS estimator in the cointegration panel context to estimate the long run equation would lead to a biased estimation of the variables except the independent variables are exogenous, hence conclusive inferences can not be made from the OLS estimators. The Fully modified OLS estimators was put forward by Pedroni (2001) while the Dynamic ordinary least squares was recommended by Koa and Chiang (2000) and Mark and sul (2002) as an alternative to the FMOLS.

The DOLS estimator assumes a parametric approach by adjusting th error terms to include past and future values of the I(1) regressors (Eggoh, et al., 2011). On the other hand the FMOLS estimator adopts a non-parametric appraoch, also factoring in the possibility of a corrletion between the error term and the regressors at first differnce as well as the existence of a constant term to deal with serial correlation correction, so that both the Fully modified ordinary least squares and the Dynamic ordinary least squares estimates of the standard errors are consistent and hence conclusive inferences can be made (Ouedraogo, 2013).

The DOLS and FMOLS estimations are employed in estimating the long run co-integration relation and the estimations are based on the following model:

$$LGDP_{it} = \alpha_i + \beta_{i1}LEC_{it} + \beta_{i2}LP_{it} + \beta_{i3}LEMP_{it} + \sum_{k=k_i}^{k}\gamma_{ik}\ \Delta LEC_{it-k} + \vartheta_{it}^{a_1} \quad (3a)$$

$$LGDP_{it} = \alpha_i + \beta_{i1}LEC_{it} + \beta_{i2}LP_{it} + \beta_{i3}LEMP_{it} + \beta_{i4}LCI_{it} + \sum_{k=k_i}^{k}\gamma_{ik}\ \Delta LEC_{it-k} + \vartheta_{it}^{b_1} \quad (3b)$$

$$LEC_{it} = \alpha_i + \beta_{i1}LGDP_{it} + \beta_{i2}LP_{it} + \beta_{i3}LEMP_{it} + \sum_{k=k_i}^{k}\gamma_{ik}\ \Delta LEC_{it-k} + \vartheta_{it}^{a_2} \quad (3c)$$

$$LEC_{it} = \alpha_i + \beta_{i1}LGDP_{it} + \beta_{i2}LP_{it} + \beta_{i3}LEMP_{it} + \beta_{i4}LCI_{it} + \sum_{k=k_i}^{k}\gamma_{ik}\ \Delta LEC_{it-k} + \vartheta_{it}^{b_2} \quad (3d)$$

$$LP_{it} = \alpha_i + \beta_{i1}LEC_{it} + \beta_{i2}LGDP_{it} + \beta_{i3}LEMP_{it} + \sum_{k=k_i}^{k}\gamma_{ik}\ \Delta LEC_{it-k} + \vartheta_{it}^{a_3} \quad (3e)$$

$$LP_{it} = \alpha_i + \beta_{i1}LEC_{it} + \beta_{i2}LGDP_{it} + \beta_{i3}LEMP_{it} + \beta_{i4}LCI_{it} + \sum_{k=k_i}^{k}\gamma_{ik}\ \Delta LEC_{it-k} + \vartheta_{it}^{b_3} \quad (3f)$$

$$LEMP_{it} = \alpha_i + \beta_{i1}LEC_{it} + \beta_{i2}LP_{it} + \beta_{i3}LGDP_{it} + \sum_{k=k_i}^{k}\gamma_{ik}\ \Delta LEC_{it-k} + \vartheta_{it}^{a_4} \quad (3g)$$

$$LEMP_{it} = \alpha_i + \beta_{i1}LEC_{it} + \beta_{i2}LP_{it} + \beta_{i3}LGDP_{it} + \beta_{i4}LCI_{it} + \sum_{k=k_i}^{k}\gamma_{ik}\ \Delta LEC_{it-k} + \vartheta_{it}^{b_4} \quad (3h)$$

$$LCI_{it} = \alpha_i + \beta_{i1}LEC_{it} + \beta_{i2}LP_{it} + \beta_{i3}LGDP_{it} + \beta_{i4}LEMP_{it} + \sum_{k=k_i}^{k}\gamma_{ik}\ \Delta LEC_{it-k} + \vartheta_{it}^{b_5} \quad (3k)$$

$$i = 1, \dots, N \quad t = 1, \dots, T$$

where $i = 1, \dots, N$ for each country in the series and $t = 1, \dots, T$ is the time period, LEC_{it}, $LGDP_i$, $P_{it}, LEMP_{it}$, and $LCI_{it}\ are$ the logs of Electricity consumption per capita, GDP per capita, price, employment, and corruption respectively. LEC_{it}, $LGDP_i$, P_{it}, $LEMP_{it}$ are co-integrated with slopes $\beta_{i1\dots i3}$ for equations (3a), (3c), (3e) and (3g) while LEC_{it}, $LGDP_i$, P_{it}, $LEMP_{it}$ and LCI_{it} are co-integrated with slopes $\beta_{i1\dots i4}$ in equations (3b), (3d), (3f), (3h) and (3i) following form equations (3a) to

(3i),$\xi_{it} = \hat{\mu}_{it}\Delta LEC$ is a stationary vector made up of the estimated residual of the co-integrating regression and the differences in the regressor.

5.3 Panel Granger Causality Test

Once established that Electricity consumption, economic growth, electricity price, and corruption are co-integrated in the long run implies Granger causality in at least one direction, however the Pedroni (1999) co-integration procedure does not indicate the direction of the causality. Hence to determine the direction of the Granger causality in the long run, a two-stage process is employed.

The first step involves estimating the long run models equation (2a) without corruption and (2b) with corruption, to obtain the residual series. The second step involves including the estimated error correction term as a variable into the following equations that would be estimated using the dynamic error correction model as specified below;

Series A (Granger Causality without Corruption)

$$\Delta LEC_{it} = \alpha_{1i} + \sum_{k=1}^{q} \alpha_{11ik}\Delta LEC_{it-k} \sum_{k=1}^{q} \alpha_{12ik}\Delta LGDP_{it-k} + \sum_{k=1}^{q} \alpha_{13ik}\Delta LP_{it-k} + \sum_{k=1}^{\overset{a}{q}} \alpha_{14ik}\Delta LEMP_{it-k} + \lambda_1 \vartheta_{it}^{a_2} + \mu_{1it} \quad (4a_1)$$

$$\Delta LGDP_{it} = \alpha_{1i} + \sum_{k=1}^{q} \alpha_{21ik}\Delta LGDP_{it-k} \sum_{k=1}^{q} \alpha_{22ik}\Delta LEC_{it-k} + \sum_{k=1}^{q} \alpha_{23ik}\Delta LP_{it-k} + \sum_{k=1}^{q} \alpha_{24ik}\Delta LEMP_{it-k} + \lambda_2 \vartheta_{it}^{a_1} + \mu_{1it} \quad (4a_2)$$

$$\Delta LP_{it} = \alpha_{1i} + \sum_{k=1}^{q} \alpha_{31ik}\Delta LP_{it-k} \sum_{k=1}^{q} \alpha_{32ik}\Delta LGDP_{it-k} + \sum_{k=1}^{q} \alpha_{33ik}\Delta LEC_{it-k} + \sum_{k=1}^{q} \alpha_{34ik}\Delta LEMP_{it-k} + \lambda_3 \vartheta_{it}^{a_3} + \mu_{1it} \quad (4a_3)$$

$$\Delta EMP_{it} = \alpha_{1i} + \sum_{k=1}^{q} \alpha_{11ik}\Delta EMP_{it-k} \sum_{k=1}^{q} \alpha_{12ik}\Delta LGDP_{it-k} + \sum_{k=1}^{q} \alpha_{13ik}\Delta LP_{it-k} + \sum_{k=1}^{a} \alpha_{14ik}\Delta LEC_{it-k} + \lambda_4 \vartheta_{it}^{a_4} + \mu_{1it} \quad (4a_4)$$

Series B(Granger Causality with Corruption)

$$\Delta LEC_{it} = \alpha_{1i} + \sum_{k=1}^{q} \beta_{11ik}\Delta LEC_{it-k} \sum_{k=1}^{q} \beta_{12ik}\Delta LGDP_{it-k} + \sum_{k=1}^{q} \beta_{13ik}\Delta LP_{it-k} + \sum_{k=1}^{q} \beta_{14ik}\Delta LEMP_{it-k} + \sum_{k=1}^{q} \beta_{15ik}\Delta LCI_{it-k} + \gamma_1\vartheta_{it}^{b_2} + \mu_{1it} \quad (4b_1)$$

$$\Delta LGDP_{it} = \alpha_{1i} + \sum_{k=1}^{q} \beta_{21ik}\Delta LGDP_{it-k} \sum_{k=1}^{q} \beta_{22ik}\Delta LEC_{it-k} + \sum_{k=1}^{q} \beta_{23ik}\Delta LP_{it-k} + \sum_{k=1}^{q} \beta_{24ik}\Delta LEMP_{it-k} + \sum_{k=1}^{q} \beta_{25ik}\Delta LCI_{it-k} + \gamma_2\vartheta_{it}^{b_1} + \mu_{1it} \quad (4b_2)$$

$$\Delta LP_{it} = \alpha_{1i} + \sum_{k=1}^{q} \beta_{31ik}\Delta LP_{it-k} \sum_{k=1}^{q} \beta_{32ik}\Delta LGDP_{it-k} + \sum_{k=1}^{q} \beta_{33ik}\Delta LEC_{it-k} + \sum_{k=1}^{q} \beta_{34ik}\Delta LEMP_{it-k} + \sum_{k=1}^{q} \beta_{35ik}\Delta LCI_{it-k} + \gamma_3\vartheta_{it}^{b_3} + \mu_{1it} \quad (4b_3)$$

$$\Delta EMP_{it} = \alpha_{1i} + \sum_{k=1}^{q} \beta_{41ik}\Delta EMP_{it-k} \sum_{k=1}^{q} \beta_{42ik}\Delta LGDP_{it-k} + \sum_{k=1}^{q} \beta_{43ik}\Delta LP_{it-k} + \sum_{k=1}^{q} \beta_{44ik}\Delta LEC_{it-k} + \sum_{k=1}^{q} \beta_{45ik}\Delta LCI_{it-k} + \gamma_4\vartheta_{it}^{b_4} + \mu_{1it} \quad (4b_4)$$

$$\Delta LCI_{it} = \alpha_{1i} + \sum_{k=1}^{q} \beta_{51ik}\Delta ECI_{it-k} \sum_{k=1}^{q} \beta_{52ik}\Delta LGDP_{it-k} + \sum_{k=1}^{q} \beta_{53ik}\Delta LP_{it-k} + \sum_{k=1}^{q} \beta_{54ik}\Delta LEC_{it-k} + \sum_{k=1}^{q} \beta_{55ik}\Delta LCI_{it-k} + \gamma_5\vartheta_{it}^{b_5} + \mu_{1it} \quad (4b_5)$$

Where represents the lagged error correction term gotten from equations (2a) and (2b), Δ is the differenced operator, k is the number of lags[5]. The specification of equation (4) makes provision for both the short run and long run causality to be tested.

[5] The optimal lag length are established using the Schwarz Bayesian information criteria

6.0 Data and Empirical Results

This study uses annual electricity consumption per capita, EC hereafter, Electricity Price[6] (Consumer price index is used as a proxy for electricity price, as data for electricity prices are not available), Employment (EMP) and Corruption index (CI) data in this study. EC is kilowatt per hour per capita, GDP per capita data with constant 2000 US$, Price (2005 = 100), Employment (Employment to population ratio, 15+, total (%)), and Corruption Index[7]. The data are sourced from World Bank (2013). The 13 countries included in this study are; Algeria, Cameroon, Cote D´Ivoire, Gabon, Ghana, Kenya, Namibia, Nigeria, Senegal, South Africa, Tanzania, Zambia, and Zimbabwe and are selected based on the availability of data for the 1991–2010 period[8]. The variables employed are used at the natural logarithms form. Table 3 provides the descriptive statistics of these five series for all countries.

Table 3: Descriptive statistics of variables over 1991-2010

	CORRUPTION INDEX	PRICE	ELECTRICITY CONSUMPTION PER CAPITA (KWh)	EMPLOYMENT	GDP PER CAPITA
Mean	827.6289	60.25033	1074.544	2043.51	2.97755
Median	247.1777	64.1	510.2134	98.5906	2.8
Maximum	5108.41	83.1	4213.882	293318	6
Minimum	55.2078	33.1	251.7653	0.116701	1
Std. Dev.	1316.012	12.85098	1155.205	23861.8	0.992351

6.1 Panel Unit Root Results

Table 4: IPS (2003) panel unit root test result

Null Hypothesis: No unit root (Non Stationary)					
Methods	Im, Pesaran and Shin (IPS) W-stat				
Variables	Constant	Constant & trend	Variables	Constant	Constant & trend
	Level			*1st Difference*	
LGDP	5.09 (0.999)	0.48 (0.684)	ΔLGDP	-4.73* (0.000)	-4.01* (0.000)
LCI	-1.23 (0.110)	0.84 (0.799)	ΔLCI	-4.85* (0.000)	-2.69* (0.000)

[6] Price is included in the multivariate framework because recent studies show that price has a crucial role in affecting income and energy consumption. The rational for using consumer price index as a proxy for electricity price is due to the fact that data for electricity price isn't available and studies like Mahadevan and Asufu-Adjaye (2007), Eggoh, et al. (2011) used consumer price index as proxy for energy price.

[7] The corruption perception index ranks countries on the scale of 1 to 10, 1 been very corrupt and 10 been not corrupt

[8] Only these 13 countries have complete data for the selected controlled variables (Employment, price and corruption index) and data for employment and price were not available for the selected countries before 1990, this informed the analysis period of 21 years. All 13 of these countries are below 5 on the corruption perception index scale making them perceived as corrupt countries according the corruption perception index.

LP	-2.52 (0.592)	-1.04 (0.150)	ΔLP	-3.09* (0.001)	-3.62* (0.001)
LEMP	1.26 (0.895)	4.19 (0.999)	ΔLEMP	-4.93* (0.000)	-3.64* (0.000)
LEC	2.82 (0.998)	0.08 (0.530)	ΔLEMP	-6.99* (0.000)	-5.02* (0.000)

Notes: * Rejection of null hypothesis of the null hypothesis of no unit root at 1% significance level, Δ stands for first difference operation, probability values are reported in parenthesis.

The results derived from the IPS unit root test at level and first difference, with and without trend are shown on Table 6. Ng and Perron (2001) propose the use of the Modified Schwarz Information Criterion (MSIC) to determine the number of lagged first differences to be included. Therefore it can be concluded from the IPS unit root test results in Table 6 that the null hypothesis of no unit root $(H_0: \rho_i = 0)$ can not be rejected at level (either with or without trend) at 1 or 10% level of significance for all the variable (electricity consumption per capita, GDP per capita, price, employment and corruption). However, when the variables are checked at first differenced, the null hypothesis of no unit root $(H_0: \rho_i = 0)$ is strongly rejected at 1% significance level, implying the variables in this series are integrated of other one (I(1)). Since it is required for all variables to be integrated at same level (either at level of at first difference) for co-integration test to be carried out, and the series are integrated at order one, the next test would be to test for co-integration among variables at I(1) level.

6.2 Panel Co-integration Results

Having established the variables in the series are integrated of I(1) level, as explained in section 3.2. Table 7 reports the panel co-integration results as groups as 'within' and 'between' dimensions for equations (2a) and (2b).

Table 5: Pedroni Panel Co-integration Test

Methods		Within dimension (panel statistics)			Between dimension (panel statistics)		
		Test	Statistics	Prob	Test	Statistics	Prob
LGDP LEC LP LEMP							
Pedroni (1999)		Panel v-Statistic	-2.86	0.998	Group rho-Statistic	2.41	0.992
		Panel rho-Statistic	1.15	0.876	Group PP-Statistic	-6.91	0.000*
		Panel PP-Statistic	-6.54	0.000*	Group ADF-Statistic	-5.51	0.000*
		Panel ADF-Statistic	-5.86	0.000*			
Pedroni (2004) (Weighted statistics)		Panel v-Statistic	-3.32	0.999			

	Panel rho-Statistic	0.77	0.780			
	Panel PP-Statistic	-7.16	0.000*			
	Panel ADF-Statistic	-6.59	0.000*			
LGDP LEC LP LEMP LCI						
Pedroni (1999)	Panel v-Statistic	-3.86	0.999	Group rho-Statistic	4.67	0.999
	Panel rho-Statistic	3.94	0.999	Group PP-Statistic	-7.74	0.000*
	Panel PP-Statistic	-1.54	0.062	Group ADF-Statistic	-1.69	0.045
	Panel ADF-Statistic	-0.57	0.284			
Pedroni (2004) (Weighted statistics)	Panel v-Statistic	-3.56	0.999			
	Panel rho-Statistic	3.04	0.999			
	Panel PP-Statistic	-4.50	0.000*			
	Panel ADF-Statistic	-3.04	0.001*			

Notes: *indicates 1% significance level.

From table 5 above, the results of equation (2a) suggests that at 1% significance level it is not conclusive that the null hypothesis of no co-integration cannot be rejected. As out of the 11 tests 6 are statistically significant at 1% and 5 are not significant. Also for equation (2b) the test results were also inconclusive, as only 3 of the 11 test are statistically significant.

Table 6: Kao's residual co-integration test

Model	ADF	P-value
LGDP LEC LP LEMP(2a)	-2.105581	0.011*
LGDP LEC LP LEMP LCI (2b)	-3.619637	0.000*

Notes: *indicates 1% significance level. The ADF is a residual-based ADF statistic (Kao 1999)

As discussed in section 3.2, the Kao residual co-integration test result is reported in table 8, which rejects the null hypothesis of no co-integration at 1% significace level for both equations (2a) and (2b) meaning there is a panel co-integration relatioship betwen the variables for both model. Therefore, the variables in equations (2a) and (2b) move together in the long run thus the next step is estimating the relationship.

4.1 The FMOLS and DOLS estimations Results

The estimation of equations 3a and 3b[9] (without and with corruption index) using both FMOLS and DOLS as is presented in tables 7 and 8.

[9] Equations 3c to 3i are estimated but not reported as only their error terms are required for the Granger causality test but are contained in the Appendix

Table 7: FMOLS and DOLS results for Equation 3a

FMOLS (3a)				
	Independent			
Dependent variable	variables			
LGDP	LEC	LP	LEMP	C
	0.344	0.085	-1.642	10.906
	(0.074)	(0.045)	(0.362)	(1.820)
R-squared	0.667			
DOLS (3a)				
	Independent			
Dependent variable	variables			
LGDP	LEC	LP	LEMP	C
	0.342	0.053	-1.560	10.960
	(0.080)	(0.052)	(0.405)	(2.059)
R-squared	0.738			

Notes: t-stats of null hypothesis H_0: β_i=1is reported in parenthesis,

Table A presents the estimated coefficients, LEC, LP and LEMP from Equation 3a (FMOLS) and 3b (DOLS),the coefficients from Equation 3ai was checked for statistical significance testing the null hypothesis $(\mathbf{H_0}: \boldsymbol{\beta}_\mathbf{i} = \mathbf{1})$, using their respective t-statistics LEC 8.889, LP 20.206 and LEMP 7.304 against their corresponding critical value 1.972[10] at 5% significance level. The test result suggests that all coefficients except employment have the correct signs and the null hypothesis $(\mathbf{H_0}: \boldsymbol{\beta}_\mathbf{i} = \mathbf{1})$ is rejected, hence, inferring that all the variables are statistically significant. Hence, given that the variables are expresses in natural logarithm, the coefficients can be interpreted as elasticities. The result from Equation 3a suggests that a 1% increase in electricity consumption per capita, price and employment increases real GDP per capita respectively by 0.344%, 0.085% and -1.642%.

Equation 3a (DOLS) produced a relatively similar result to the results of FMOLS, the coefficients obtained where equally check for statistical significance testing null hypothesis $(H_0: \beta_i = 1)$. The t-statistic obtained for LEC was checked against their corresponding critical value at 5% significance level 1.972 suggests that all coefficients are statistically significant with the correct signs with the exception of employment, therefore 1% increase in electricity consumption per capita, price and employment cause real GDP per capita to change by 0.342% 0.054% and -1.580% respectively.

Thus, the outcome of equation 3a shows a long-run relationship between real GDP per capita, electricity consumption per capita and the other control variables (employment and energy price).

[10] Critical values are obtained from t-statistical table using a degree of freedom of 205 for FMOLS and 194 for DOLS, at 5 percent significant level.

Table 8: FMOLS and DOLS results for Equation 3b

FMOLS (3b)					
Dependent variable	Independent variables				
LGDP	LEC	LP	LEMP	LCI	C
			-		
	0.191**	0.073**	2.167**	0.234**	
	(-7.796)	(-16.047)	(-8.454)	(-2.551)	13.649
R-squared	0.696				
DOLS (3b)					
Dependent variable	Independent variables				
LGDP	LEC	LP	LEMP	LCI	C
			-		
	0.189**	0.032**	2.007**	0.326***	
	(-5.772)	(-10.001)	(-5.135)	(-1.745)	13.123
R-squared	0.766				

Notes: t-stats of null hypothesis $H_{0:}$ β_i=1is reported in parenthesis, ** and ***indicates 5% and 10% significance levels respectively

Table 8 above, represents result obtained from equation 3b (with Corruption included as one of the control variables). For equation 3b (FMOLS) the coefficients were equally examined to ascertain statistical significant. The t-statistics obtained from the null hypothesis $(H_0: \beta_i = 1)$ are 7.796, 16.047, 8.454 and 2.515 for LEC, LP LEMP and LCI respectively, when compared with their critical values 1.972[11] at 5% significance level. All the variables were statistically significant and with the right signs with the exception of employment. Implying, 1% change in electricity consumption per capita, price and employment would real GDP per capita to change by 0.191%, 0.073 and -2.167% respectively. As for the corruption index, the estimate suggests that in a long run if corruption reduces by 1% real GDP per capita increases by 0.234%. Same hypothesis test $(H_0: \beta_i = 1)$ was examined on $3bii$ (DOLS), and the t-stat obtained from the coefficients are; 5.772, 10.001, 5.135and 1.745 for LEC, LP and LEMP and LCI respectively, check against their respective critical value 1.984 at 5% significance level shows that the coefficients are statistically significant, with the exception of the corruption index (LCI).

However, after re-examining LCI at 10% significant level (critical value 1.660), it became significant. Hence, the estimation result suggests; a 1% increase in electricity consumption per capita, price and employment would increase real GDP per capita by 0.189, 0.032 and -2.007 respectively. In the case of corruption, 1% decrease in corruption would increase real GDP per capita by 0.326%

Thus, for what is worth mentioning, the study suggests that the inclusion of corruption as a control variable is statistically significant and equally suggests a long-run relationship.

[11] Critical values are obtained from t-statistical table using a degree of freedom of 201 for FMOLS and 95 for DOLS, at 5 percent significant level.

6.3 Granger Causality Results

Table 10: Granger Causality Result without Corruption

Dependent Variables	Short-Run				Long-Run	Short Run Direction of Causality
	DGDP	DELC	DEMP	DP	ECT	ELC→GDP P→GDP
DGDP 4a(*i*)	-	0.2133** (4.66)	-0.0647 (0.05)	-0.0426** (4.06)	-0.0215* (-2.46)	
DELC 4a(*ii*)	0.3117** (3.74)	-	0.2813 (0.45)	-0.0087 (0.09)	-0.0163** (-2.09)	GDP → ELC
DEMP 4a(*iii*)	0.0618 (1.93)	-0.0403 (1.09)	-	0.0123 (2.25)	-0.0089 (-0.81)	No causality
DP 4a(*iv*)	0.1595 (0.16)	0.5205*** (3.31)	-0.2849 (0.36)	-	0.0289 (2.76)	ELC→P

Note: Figures denotes the sums of the lagged coefficients for the respective short run change. Values for f-statistics are giving in parenthesis for short run and t-statistics for long run. *,** and *** denotes statistical significance at 1%, 5% and 10% level respectively. "X → Y" means variable X Granger causes variable Y.

Table 11: Granger Causality Results with Corruption

Dependent Variables	Short-Run					Long-Run	Short Run Direction of Causality
	DGDP	DELC	DEMP	DP	CI	ECT	ELC→GDP CI→GDP
DGDP 4b(*i*)	-	0.114** (3.86)	-0.076 (0.04)	-0.031 (0.91)	0.176*** (3.55)	-0.019 (-1.37)	
DELC 4b(*ii*)	1.597** (3.14)	-	0.171 (0.09)	-0.007 (0.02)	0.053** (3.12)	-0.028*** (-1.70)	GDP→ELC CI→ELC
DEMP 4b(*iii*)	0.038 (0.25)	-0.050 (0.83)	-	0.012 (0.68)	-0.006 (.02)	-0.015 (-0.67)	No causality
DP 4b(*iv*)	0.474 (0.76)	0.531*** (3.14)	-2.031 (1.85)	-	0.493 (2.73)	0.052** (2.39)	ELC→P
DCI 4b(*v*)	0.887* (5.61)	0.554** (4.13)	-0.520 (0.40)	0.109 (2.20)	-	-0.129** (-2.06)	GDP→CI ELC→Ci

Note: Figures denotes the sums of the lagged coefficients for the respective short run change. Values for f-statistics are giving in parenthesis for short run and t-statistics for long run. *,** and *** denotes statistical significance at 1%, 5% and 10% level respectively. "X → Y" means variable X Granger causes variable Y.

Having established that there is evidence of co-integration long run relationship in equations 2(a) and 2(b), the next step is to examine the causality between these variables in both equations. Panel A and B reports the results for the short run and long run Granger Causality for equations 4a(1-4) for causality without corruption and equations 4b(1-5) for causality with corruption. The optimum lag structure of 2 was chosen using the Akaike and the Schwarz information criterions.

With respect to Equation 4a(1), electricity consumption per capita has a statically significant and positive impact on real GDP per capita in the short run, as well as price, whereas employment is not statically significant in the short run. However, comparing the results of equation 4a(1) to result in equation 4b(2), it is observed that the inclusion of corruption shows that electricity consumption per capita as well as corruption has a statistical significance impact on real GDP per capita, while employment and price are not statistically significant in the short run. This highlights in 4a(1) the fact that electricity consumption granger causes economic growth and can be said to be an important driving force for economic growth in the selected Africa countries, also the consumer price paid for electricity[12] in the short run granger causes (contributes to) real GDP per capita. While in 4b(1) real GDP per capita is also determined by electricity consumption per capita as well as provides empirical evidence that corruption (measured by the corruption perception index) affects growth in the selected countries. Moreover the error correction terms for 4a(1) is statistically significant at 1% and this represents the speed of adjustment to long run equilibrium while that of 4b(1) is not statistically significant implying there is no long run causal relationship. In electricity consumption 4a(2), it appears that GDP per capita has a positive impact on electricity consumption in the short run while employment and price are insignificant, and when corruption is included (4b(2)), the impact of real GDP per capita is relatively higher in the short run, it also puts forward that corruption affects the level of electricity consumption per capita. It implies that GDP is important to see an increase in the level of electricity consumption amongst selected countries, also that for an improvement in electricity consumption to be seen, the level of corruption has to drop. These empirical findings may infer bi-direction causality between economic growth and electricity consumption in the short run. The statistical significance of the error terms suggests that electricity consumption responds to deviations from long run equilibrium.

As regards price index, it is expected that electricity consumption has an impact on price, and after testing empirically it can be suggested that for 4a(4) and 4b(4) there is a positive and statically significant impact of electricity consumption on price without and with corruption respectively in the short run, implying that the price paid for electricity is granger caused by the amount of electricity consumed. In 4a(4) the error correction term is not significant implying that price do not respond to deviation in the long run, while for 4b(4) the error term is significant and infers price responds to deviations to long run equilibrium.

Finally for corruption 4b(*v*), real GDP per capita and electricity consumption per capita are statistically significant and has an impact on corruption in the short run. Thus suggesting, an increase in GDP and an improvement in the electricity consumption can in turn curb corruption in the selected countries.

Overall, the results from Panel A and Panel B (Granger causality without corruption and with corruption) shows a bi-directional casual relationship between economic growth and electricity consumption. Hence, an increase in GDP enhances electricity consumption and an increase in electricity consumption may in turn increase production in real sector. The results also show a unidirectional causality from price to GDP and electricity consumption to price in Panel A, and electricity consumption to price in Panel B. In Panel B, there is a bi-directional causal relationship between economic growth and corruption and between

[12] Note that Consumer price index was used as a proxy for electricity price.

electricity consumption and corruption. This suggest, that an increase in economic activities may reduce the level of corruption as well as a reduction in corruption would in turn increase productivity and hence economic growth. As for the corruption-electricity consumption relationship, it infers a reduction in corruption would increase the level of electricity consumption and hence increase productivity, which would in turn reduce corruption activities. Generally the inclusion of corruption in the electricity consumption- growth relationship, do not provide any tangible change to the result. Except that, the addition of corruption shows that it granger causes electricity consumption and GDP. This answers the research question and provides empirical evidence; that the corruption level in the selected countries not only affects the level of electricity consumption both in the short and long run, but also affects the level of GDP in the short run.

7.0 Conclusion and Policy Recommendation

This study examines the empirical evidence for the relationship between electricity consumption, electricity price, employment, corruption and economic growth (GDP). Aimed to check if the inclusion of corruption in the empirical evidence would provide empirical proof that the present level of electricity consumption in these selected Africa countries are currently affected by corruption.

For this purpose, recent development in unit root test for panel, panel co-integration, long and short run elasticities and causality techniques was employed to the investigation of the electricity consumption and economic growth relationship with price, employment and corruption as additional variables for 13 Africa countries for the period 2005-2017.

On the short run dynamic front, the results obtained from without and with corruption reveals that economic growth has a positive and statistically significant effect on electricity consumption and electricity consumption equally has a positive and statistically significant effect on GDP, implying there is a bi-directional causality between GDP and economic growth. This bi-directional relationship suggests an increase in real GDP would most likely affect electricity consumption in several ways. Also, an increase in electricity consumption would cause productivity to increase. As the saying goes, "energy is the ability to do work" therefore no energy, no work, and no work, no productivity.

At a micro level, when per capita income increases, people would in turn want to spend more on electricity consumption as a means to increase comfort or improve standard of living, and at a macro level an increase in GDP can induce increase in electricity consumption. On the other hand, like a virtuous circle increases in electricity consumption in the production process would in turn increase GDP (output).

Thus conversely, in the long run electricity consumption causes economic growth and economic growth causes increase in electricity consumption as well.

The implication of these findings is that, changes in electricity consumption have a significant impact in the level of income in these selected countries in the long run. Therefore since electricity is such an important factor for growth, electricity conservation policies have to be applied with caution so as to prevent it from impeding economic growth/ socio economic development in these countries both in the short run (transitory) and in the long run (permanent). Thus environmental friendly policies like electricity conservation, or efficiency improvement measures as well as demand side management policies would adversely affect economic activities both in the short run as well as in the long run. In order to balance economic growth and environmental friendly policies, Shahbaz, et al. (2011) suggests fossil fuels should be reduced by gradually substuting it with clearner energies e.g hydro, solar, renewables and wind power e.t.c. In addition, further investment should be made in the research and development of new/clearner electricity saving alternatives in the long run, with this electricity consumption can be reduced without adversely affecting economic growth in these economies.

As mentioned above, corruption index as measured by the Transperancy International was included in this electricity consumption and growth relationship study, so as to ascertain the relationship between the level of corruption in the selected African countries and their electricity consumption. The empiral result reveals a bi-directional causality between electricity consumption and corruption as well as between corruption and GDP. In the short run, corruption Granger causes electricity consumption and GDP, in turn the level of electricity consumption and GDP accordingly Granger causes the level of corruption in these countries. This means that when corruption reduces, electricity consumption would increase, also when electricity consumption in these countries increases it would in turn increase productivity (GDP) which would consequently cause corruption to reduce.

In that, the low level of electricity consumption in these countries are somewhat caused by the high level of corruption, this means that the infrastructures required to improve the level of electricity consumption is being impeded by high level of corruptionwhich in turn stagnates productivity. Thus, the high level of corruption can be as a result of the low productivity resulting from the low level of electricity consumption. This finding is in line with recent academic study that have shown precisely how corruption can impede Governments from providing basic public goods. For example; Bertrand, et al. (2008) discloses how corruption at the New Delhi DMV (Department of Motor Vehicles) results in less qualified drivers obtaining their licences faster than the qualified drivers all for a small fee, though both set of drivers follow exactly same application process, and Olken &Barron (2009) finds how Indonesia roads which are extensively financed from taxpayers are damaged by corrupt practices between law enforcement authority and truck drivers at truck weigh stations.

From the policy pespective, definite actions have to be taken to checkmate corrupt practices that affect public utilities in these countries, as suggested by Hanna, et al. (2011); an approach to tackle the hydra headed monster 'corruption' in public utilities at a national scale would call for the privitization of these corrupt utilities like healthcare, water supply or electricity. The rationale is that privatized companies are more inclined to profiteering, in that they would be in the look out for inefficencies in the production process. Hanna, et al. (2011) also noted that critics argue how this privitization processes can equally be corrupt and end up just been a change in nomenclature, but not necessarily an improvement in service quality.

Hanna, et al. (2001), equally advocates community monitoring to be a promising approach to curbing curruption in Public utilities, this approach can be successful if the community at large are not neck deep in the corrupt practices, involving the community can reduce the bottleneck of information asymmetry as well as keep both the Government regulatory body and the service providers on check.

In conclusion, where the research questions answered?

I. As for if the electricity consumption in the selected country affect economic growth in the selected countries; the empirical evidence shows that electricity consumption does affect economic growth.
II. Also if the economic well-being of these countries does affect their level of electricity consumption, the empirical evidence agrees that economic growth causes electricity consumption.
III. As of the inclusion of corruption and any notable difference, when comparing the results obtain with and without corruption there seem to be no notable difference in the result. But corruption in the selected countries sure granger causes economic growth as well as affects the level of their electricity consumption.

8.0 References

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