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Energy Consumption and Manufacturing Performance in Sub-Saharan Africa: Does Income Group Matter?

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ABSTRACT

This paper investigates the link connecting energy consumption with Manufacturing performance by using panel data for sampled low-income Sub-Saharan Africa (SSA) and middle-income SSA during the period 1995–2013. The panel cointegration test provides evidence of cointegration among the variables for both the low-income and the middle-income group in SSA. The result of the Fully Modified Ordinary Least Square indicates that in the long run, increase in energy consumption leads to increase in manufacturing performance for both the sampled low-income and middle-income SSA countries. This implied that both the low-income and middle-income SSA countries are energy dependent countries. In this regard, this study shows that energy is a relevant factor in socio-economic development for both the low-income and the middle-income SSA countries. Thus, policies on energy that will ensure lower negative impact on manufacturing performance are recommended.

Keywords: Energy Consumption, Manufacturing Performance, Sub-Sahara Africa
JEL Classifications: Q430, Q470

1. INTRODUCTION

The ongoing debate on the relationship connecting energy consumption with economic growth has generated contradicting view in the literature (Oh & Lee, 2004). The first argument favors a unidirectional causal relationship running from energy consumption to economic growth. Meaning that economic growth depend on energy consumption and hence, any policy on energy consumption should make sure that it has less damaging influence on economic growth.

The second groups are of the opinion that it is economic growth that Granger causes energy consumption and by implication, energy consumption is determined by economic growth. From the view of the third group, it is considered that there is no causal association connecting economic growth with energy consumption. This is otherwise referred to as neutral group. In the last view, energy consumption and economic growth believe to Granger causes each other. In this case, feedback relationships exist for energy-growth nexus.

The aim of this study is to investigate the association connecting energy consumption with manufacturing performance for the four low-income SSA countries (Congo Republic, Kenya, Togo and Zimbabwe) and five middle-income SSA countries (Botswana, Nigeria, Senegal, South Africa and Sudan). The study will in this case be considered as relevant in the field of energy economics as it focuses on the performance of manufacturing sector which may affect economic growth in SSA countries. Also, by making comparison between the low-income and the middle-income group of SSA countries for a more meaningful result.

The remainder of this paper is planned as follows: Section I is the introductory section. Section II provides the literature review for the study while Section III displays the method of data analysis. Estimated results are contained in Section IV followed by policy implication in Section V. Finally, Section VI concludes the study.

2. LITERATURE REVIEW

From empirical and policy point of view, the causal relationship between energy consumption and gross domestic product (GDP) has an important implication (Odhiambo, 2014). Taking the instance of a unidirectional causality running from GDP to energy consumption, this entails that energy consumption is determined by GDP and for that reason; policies on energy conservation can be achieved with small or no negative consequence on GDP (Odhiambo, 2009). Equally, a unidirectional causality running from energy consumption to GDP means that GDP depends on energy consumption and for that, energy policy should be watchful as any decline in energy consumption might affect GDP negatively.

The relationship between energy consumption and economic growth started with the work of Kraft and Kraft (1978) for the United States (US), and afterward extended to cover industrialized economies of Germany, Greece, Japan, France, among others. Yet, contradicting empirical conclusions have emerged in the literature for energy-growth nexus (Ozturk & Acaravci, 2010). Generally, several factors have contributed to the absence of universal agreement on the relationship connecting energy consumption with economic growth, which includes the differences in the development stages for different economies studied, differences in the data used and the methodology utilized (Wang et al., 2011).

Taking the energy-led growth hypothesis, several empirical studies have argued in favor of unidirectional causality running from energy consumption to economic growth. For example, Lee (2005) examine the co-movement and the causal relationship between energy consumption and economic growth for a panel of 18 developing countries and maintained that energy consumption causes economic growth. Also, Mahadevan and Asafu-Adjaye (2007) utilized the panel error correction model (ECM) to asses energy consumption, prices and economic growth for 20 net energy exporting countries during the period 1971–2002. Their findings reveal that energy consumption causes economic growth in Argentina, Saudi Arabia, Nigeria, Malaysia, Venezuela, Kuwait and Indonesia.

Despite the empirical findings on energy-led growth hypothesis, the growth-led energy hypotheses are of the view that economic growth drives energy consumption. Starting with the study of Kraft and Kraft (1978) for the US, the study reveals causality running from economic growth to energy consumption. Following that, Zhang and Cheng (2009) used the Toda-Yamamoto test for China and established causality running from economic growth to energy consumption. Similarly, Stern and Enflo (2013) demostrated causality running from economic growth to energy consumption for Sweden. More recently, utilizing the autoregressive distributed lag (ARDL)-Bound testing procedure, Odhiambo (2014) found causality running from economic growth to energy consumption in Ghana and Cote D' Ivoire.

Although, unidirectional causality has been reported in the literature, Some studies provided a proof of feedback causal relationship between energy consumption and economic growth. Ghali and El-Sakka (2004) utilized the vector ECM for Canada and found bidirectional causality among energy consumption with economic growth. Also, Fuinhas and Marques (2012) employed the ARDL-Bound testing procedure and revealed a feedback relationship between energy consumption and economic growth for Portugal, Italy, Greece, Spain and Turkey.

In the last view, some studies argued that there is no causal relationship between energy consumption and economic growth. Taking the studies of Soytas and Sari (2003) they revealed that there is no causal relationship between energy consumption and economic growth for Indonesia, Canada, Poland, UK and US. Furthermore, Ozturk and Acaravci (2010) maintained the neutrality hypothesis for Turkey by using the ARDL-Bound Testing approach. In a related study, Ozturk and Acaravci (2011) demonstrates no causal relationship among energy consumption and economic growth in 11 Middle East and North American countries.

3. METHOD OF DATA ANALYSIS

3.1. Data

In this paper, annual data for panel of four lower-income SSA (Congo Republic, Kenya, Togo and Zimbabwe) and five middle-income SSA countries (Botswana, Nigeria, Senegal, Sudan and South Africa) is utilized by covering the period 1995–2012. The study utilized manufacturing performance as the dependent variable with energy consumption, capital and labour as the independent variables while corruption and economic freedom variables (control variables) are the institutional quality that can influence manufacturing performance. Table 1 describes the variables used in this study.

3.2. Empirical Model

In this paper, relationship connecting manufacturing performance with energy consumption is examined by incorporating capital, labour economic freedom and corruption variable in the following equation:

$$manf_{it}=f(eng_{it},cap_{it},lab_{it},cpi_{it},ef_{it}) \quad (1)$$

where $manf_{it}$ is the manufacturing performance, eng_{it} represents energy consumption, cap_{it} represents capital, lab_{it} represents labour

Table 1: Definition of variables and data sources

Variables	Description	Definition	Source
MANF	DV	Manufacturing value added (constant USD)	WDI
ENG	IV	Energy use (kg of oil equvalent)	WDI
CAP	IV	Growth capital formation (current USD)	WDI
LAB	IV	Population growth (annual percentage)	WDI
EF	CV	Economic freedom	TI
CPI	CV	Corruption perception index	HF

WDI: World development indicator, TI: Transferance international, HF: Heritage foundation inputs, cpi_{it} represents corruption variable, and ef_{it} represents economic freedom variable.

The variables *(eng, cap* and *lab)* are chosen based on the biophysical theoretical point of view where energy, labour and capital are regarded as the important inputs in determining output whereas, *cpi* and *ef* are the control variables that can affect manufacturing performance. This paper consequently, specifies the following model:

$$manf_{it}=\rho_0+\rho_1 eng_{it}+\rho_2 cap_{it}+\rho_3 lab_{it}+\rho_4 cpi_{it}+\rho_3 ef_{it}\mu_{it} \quad (2)$$

where ρ_0 is the intercept, ρ_1, ρ_2, ρ_3, ρ_4 and ρ_5 stands for the parameters estimated, t represents the time series, i represents the entity data for each country in the model and μ is the error term.

3.3. Estimation Procedure

Firstly, before examining the existence of panel cointegration, it is important to test the stationarity property of the series. For that reason, this paper employed the panel unit root test proposed by Im, Pesaran and Shin (IPS) (2003) which is based on the Dickey-Fuller procedure. The Im et al. (2003) proposed a panel unit root by putting together information from the cross-section dimension with that from the time series dimension. The test has superior power in analyzing long run relationship in panel data. Given the following autoregressive specification:

$$y_{it}=\gamma_i y_{it-1}+\phi_{it} X_{it}+\mu_{it} \quad (3)$$

where: i represents 1,……, N for each country in the panel, t represents 1,……, N which is the time period X_{it} represents exogenous variables in the model and γ are the autoregressive coefficients.

Specifically, Im et al. (2003) take the average of the ADF unit root test while allowing for different order of serial correlation.

$$\mu_{it}=\sum_{j=1}^{p_i}\varphi_{ij}\mu_{it-j}+\varepsilon_{it} \quad (4)$$

Substituting Equation (4) in Equation (3):

$$y_{it}=\gamma_i y_{it-1}+\sum_{j=1}^{p_i}\varphi_{ij}\mu_{it-j}+\phi_i X_{it}+\varepsilon_{it} \quad (5)$$

where γ_i is the number of lags in the ADF regression. The null hypothesis that each series in the panel contain a unit root (H_0:γ_i=1$\forall_i$) is tested against the alternative hypothesis which states that at least one of the individual series in the panel is stationary (H_1: $\gamma_i \leq 1$). The t-bar statistic as specify by IPS average the individual statistic as follows:

$$t-bar=\frac{1}{N}\sum_{i=1}^{N}t_{\rho i} \quad (6)$$

where t_{pi} represents the individual t-statistics for testing H_0:γ_i=1$\forall_i$ in Equation (5).

3.4. Panel Cointegration Tests

Establishing stationary in the panel unit root test qualifies the series to examine cointegration among the dependent variable and the independent variables. To examine the existence of cointegration among the variables, the Pedroni (1999, 2004) cointegration test is utilized. Pedroni proposed the following regression:

$$y_{i,t}=\alpha_i+\delta_i t+\beta_{1i}x_{1i,t}+\beta_{2i}x_{2i,t}+\ldots+\beta_{Ki}xK_{i,t}+e_{i,t} \quad (7)$$

where K signifies the number of regressors, t stands for time period, i is the entity unit in the panel, α_i denotes the intercepts and $\delta_i t$ is the specific time effect.

Seven tests for panel cointegration were proposed by Pedroni (1999; 2004) which include the heterogeneous panel tests and the heterogeneous group mean panel tests. While the heterogeneous panel tests pooled residuals within the dimension in the panel, the heterogeneous group mean panel tests pooled residuals between the dimension in the panel. The tests are presented in Equation (6) to Equation (12):

Panel v-statistics:

$$z_\upsilon=\left(\sum_{i=1}^{N}\sum_{i=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{it-1}{}^{2}\right)^{-1} \quad (8)$$

Panel ρ-statistics:

$$z_\rho=\left(\sum_{i=1}^{N}\sum_{i=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{it-1}{}^{2}\right)^{-1}\sum_{i=1}^{N}\sum_{i=1}^{N}\hat{L}_{11i}^{-2}\left(\hat{e}_{it-1}\Delta\hat{e}_{it}-\hat{\lambda}_i\right) \quad (9)$$

Panel PP-statistics:

$$z_t=\left(\hat{\sigma}^2\sum_{i=1}^{N}\sum_{i=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{it-1}^{2}\right)^{-1/2}\sum_{i=1}^{N}\sum_{i=1}^{N}\hat{L}_{11i}^{-2}\left(\hat{e}_{it-1}\Delta\hat{e}_{it}-\hat{\lambda}_i\right) \quad (10)$$

Panel ADF-statistics

$$z_t{*}=\left(\hat{S}{*}^2\sum_{i=1}^{N}\sum_{i=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{it-1}^{*2}\right)^{-1/2}\sum_{i=1}^{N}\sum_{i=1}^{N}\hat{L}_{11i}^{-2}\hat{e}_{it-1}^{*}\Delta\hat{e}_{it}^{*} \quad (11)$$

Group ρ-statistics:

$$\tilde{Z}_\rho=\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{e}_{it-1}^{2}\right)^{-1}\sum_{t=1}^{T}\left(\hat{e}_{it-1}\Delta\hat{e}_{it}-\hat{\lambda}_i\right) \quad (12)$$

Group PP-statistics:

$$\tilde{Z}_t=\sum_{i=1}^{N}\left(\hat{\sigma}^2\sum_{t=1}^{T}\hat{e}_{it-1}^{2}\right)^{-1/2}\sum_{t=1}^{T}\left(\hat{e}_{it-1}\Delta\hat{e}_{it}-\hat{\lambda}_i\right) \quad (13)$$

Group ADF-statistics:

$$\tilde{Z}_t * = \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{s}_i^{\,2} \hat{e}_{it-1}^{*2} \right)^{-1/2} \sum_{t=1}^{T} \left(\hat{e}_{it-1}^{*} \Delta \hat{e}_{it}^{*} \right) \quad (14)$$

Where $\hat{e}_{it}$ represents the estimated residual in $\hat{L}_{11i}^2$, $\hat{L}_{11i}^2$ is the estimated long-run covariance matrix of $\Delta\hat{e}_{it}$, $\hat{s}_i^2 (\hat{s}_i^{*2})$ are the long-run variances for individual *i* and $\hat{\sigma}_i^2$ are the contemporaneous variances for individual *i*.

3.5. Coefficients Estimation

Once cointegration is found among the variables, this study will further estimate the long run co-efficient through the process of fully modified ordinar least square (FMOLS). The FMOLS has the ability to take care of non-exogeinity and serial correlation in the model. It also offers consistent and efficient cointegration vectors estimation. The panel cointegration starts with OLS as:

$$y_{it}=\alpha_i+x_{it}\beta+e_{it} \quad (15)$$

$$x_{it}=x_{i,t1}+\varepsilon_{it}$$

where $\xi_{it} = [e_{it,}\varepsilon_{it}^{'}]$ represent the stationary with covariance matrix Ω_i, β will be consistent if error process satisfy y_{it} and x_{it}.

Following Phillips and Hansen (1990) technique for the OLS estimators correction within the panel data as well as allowing dynamics heterogeneity in the short run, (Pedroni, 1996; 2000) eliminate the order bias caused by endogenous regressors. Therefore, Equation (16) estimates the Pedroni's FMOLS as:

$$\hat{\beta}_{FM} = \left(\sum_{i=1}^{N} \hat{\Omega}_{221}^{2} \sum_{T=1}^{T} (x_{it}\hat{x}_t)^2 \right)^1 \sum_{i=1}^{N} \hat{\Omega}_{11i}^{1} \hat{\Omega}_{22i}^{1} \left(\sum_{t=1}^{T} (x_{it}\bar{x}_t) e_{it} T \hat{\gamma}_i \right) \quad (16)$$

$$\hat{e}_{it} = e_{it}\hat{\Omega}_{22i}^{1}\hat{\Omega}_{21i}, \quad \hat{\gamma}_1 = \hat{\Gamma}_{21i} + \hat{\Omega}_{21i}^{0}\hat{\Omega}_{22i}^{1}\hat{\Omega}_{21i}(\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^{0})$$

where $\Omega_i = \Omega_i^0 + \Gamma_i + \Gamma_i$ stands for the matrix of the decomposed covariance, Ω_i^0 denotes the contemporaneous covariance matrix, and, Γ_i symbolize a weighted sum of auto covariances.

4. ESTIMATION RESULTS

The estimated result is started by presenting the IPS unit root test result. Tables 2 and 3 represent the panel unit root test result for low-income and middle-income SSA countries, respectively. The result in Table 2 demonstrates that all the variables in the model are non-stationary at level in both constant and constant with time trend. For that reason, the null hypothesis of panel unit root in the level of the series cannot be rejected and conclude that the variables are non-stationary with and without time trend at level. On the other hand, the series become stationary at 5 percent significance level after taking the first difference for both constant with time trend and constant with no time trend.

As in Table 2, similar result is shown in Table 3 for middle-income SSA. The results in Table 3 also displays that the series are non-stationary at level using both constant with no time trend and constant with time trend. On the other hand, the series become stationary at 5% significance level after taking the first difference for both constant with time trend and constant with no time trend.

The null hypothesis of each series is non-stationary cannot be rejected at levels for both the low-income and middle-income groups in the sampled SSA countries. However, after differencing the series, the null hypothesis of each series is non-stationary is rejected at 5% level of significance for both the low-income and middle-income groups in the sampled SSA countries. Thus, it can be concluded that the series are *I(1)* and this qualifies the series to proceed to cointegration test.

4.1. Panel Cointegration Analysis

Following the stationarity test, which confirms the series to be stationary at first difference, next is to apply Pedroni (1999; 2004) cointegration test to investigate whether the variables are cointegrated or otherwise. The results of the Pedroni panel cointegration for the low-income and middle-income SSA countries are shown in Table 4.

Table 2: Panel unit root test result for the low-income SSA countries

Variables	Level		First difference	
	Constant	Constant+Trend	Constant	Constant+Trend
manf	1.918	0.056	−3.146*	−3.457*
	(0.997)	(0.522)	(0.000)	(0.000)
eng	0.186	−1.527	−4.656*	−3.542*
	(0.574)	(0.063)	(0.000)	(0.000)
cap	2.982	−1.268	−6.262*	−5.786*
	(0.998)	(0.102)	(0.000)	(0.000)
lab	2.385	2.935	−2.302**	−9.351*
	(0.908)	(0.970)	(0.010)	(0.000)
cpi	−0.239	−0.127	−3.701*	−2.914*
	(0.405)	(0.449)	(0.001)	(0.001)
ef	−1.339	−1.424	−11.156*	−7.130*
	(0.061)	(0.074)	(0.000)	(0.000)

*indicates 5% level of significance. Figures in parenthesis represent probability. SSA: Sub-Saharan Africa

Table 3: Panel unit root test result for the middle-income SSA countries

Variables	Level		First difference	
	Constant	Constan+Trend	Constant	Constant+Trend
manf	3.928	0.537	−5.527*	−5.252*
	(1.000)	(0.704)	(0.000)	(0.000)
eng	1.846	−0.038	−7.133*	−5.931*
	(0.967)	(0.484)	(0.000)	(0.000)
cap	3.171	0.427	−5.469*	−3.252*
	(0.999)	(0.665)	(0.000)	(0.000)
lab	0.764	−0.632	−1.154	−5.685*
	(0.777)	(0.263)	(0.124)	(0.000)
cpi	−1.076	−0.770	−7.044*	−5.813*
	(0.140)	(0.220)	(0.000)	(0.000)
ef	−0.477	−0.816	−7.773*	−7.502*
	(0.316)	(0.207)	(0.000)	(0.000)

*indicates 5% level of significance. Figures in parenthesis represent probability. SSA: Sub-Saharan Africa

In Table 4, the low-income SSA group reveals that the null hypothesis of no cointegration cannot be rejected for Panel υ-statistics, Panel ρ-statistics and Group ρ-statistics. However, the null hypothesis of no cointegration is rejected for Panel PP-statistics, Panel ADF-statistics, Group PP-statistics and Group ADF-statistics at 5% level of significance. Likewise in the middle-income SSA group, the null hypothesis of no cointegration cannot be rejected for Panel ρ-statistics and Group ρ-statistics. But, the null hypothesis of no cointegration is rejected for Panel υ-statistics, Panel PP-statistics, Panel ADF-statistics, Group PP-statistics and Group ADF-statistics at 5% level of significance. Accordingly, it can be concluded that the panel cointegration tests result for the aggregate energy consumption provide evidence that the independent variables possess cointegration in the long run for the low-income and middle-income groups in the sampled SSA countries with respect to manufacturing performance.

In summary, the Pedroni (1999; 2004) tests indicate that the independent variables possess cointegration in the long run for the low-income and middle-income groups in the sample of SSA countries with respect to manufacturing performance. Following the confirmation of the existence of long run relationship among manufacturing performance and the independent variables, next is to estimate the coefficients of the long run relationship.

4.2. Estimation of the Long Run Relationship

Establishing the existence of a long run relationship between manufacturing performance and the independent variables for the low-income and middle-income SSA countries qualifies this study to estimate the FMOLS regression. Table 5 represents for the FMOLS regression for low-income and middle-income SSA countries. From Table 5, the low-income SSA model disclosed the estimated co-efficient of *eng, cpi* and *cap,* to be statistically significant at 5% level of significance. On the other hand, *lab* and *ef* for are found to be statistically insignificant in explaining manufacturing performance in the low-income SSA model. The coefficient of 1.54 for energy consumption means that one kilogram (kg) increase in energy consumption causes USD1.54 increase in the value of manufacturing output in low-income SSA countries. Accordingly, greater level of energy consumption means that the manufacturing sector is performing, thereby making possible increase in the performance of manufacturing sector in the low-income SSA countries. This is in accordance with the studies of Lee and Chang (2008) for 16 Asian countries, Stern and Eflo (2013) for Swedish, Alper and Oguz (2016) for EU member countries and Danmaraya and Hassan (2016) for Nigeria. In the study of Alper and Oguz (2016), energy consumption and economic growth is investigated for EU countries and maintained that energy consumption has positive impact on economic growth.

Similarly, the coefficient of 0.11 provides that USD1 increase in capital lead to USD 0.11 increase in manufacturing performance in the low-income SSA countries. This is in accordance with the studies of Ouédraogo (2010) for Burkina Faso, Shahbaz and Dube (2012) for Pakistan and, Ozturk and Al-Mulali (2015) for GCC countries. Additionally, the coefficient of 0.33 reveals that increase in corruption perception index would increase manufacturing performance by USD 0.33. As a result, the higher the corruption index, the higher will be the performance of the manufacturing sector. While the result for energy consumption, capita and corruption index are in line with a-priori expectation result (positive effect on manufacturing performance), the result for labour is found to be insignificant in explaining manufacturing performance in low-income SSA countries.

Furthermore, the middle-income SSA model reveals the estimated co-efficient of *eng, lab* and *cap,* to be statistically significant at 5% level of significance for middle-income SSA countries, while *ef* and *cpi* are statistically insignificant in explaining manufacturing performance. The coefficient of 0.34 for energy consumption explains that one kg increase in energy consumption caused USD 0.34 increase in the value of manufacturing output in middle-income SSA countries. Hence, greater level of energy consumption implies that the manufacturing sector is performing, thereby making possible increase in the performance of manufacturing sector of SSA countries. This finding follows the studies of Shahbaz and Lean (2012) for Tunisia; Bartleet and Gounder (2010) for New Zealand and Odhiambo (2014) for different income group.

Likewise, the coefficient of 0.11 explained that USD1 increase in capital leads to USD 0.11 increase in manufacturing performance of energy consumption in low-income SSA. As well, the coefficient of 2.12 maintains that one percent increase in labour input would increase manufacturing performance b USD 2.12. The result for energy consumption, labour and capita are in line with a-priori expectation result (positive effect on manufacturing performance) in explaining manufacturing performance in SSA countries.

Table 4: The pedroni panel cointegration test for the low-income and middle-income SSA countries

Test	Low-income SSA		Middle-income SSA	
	Statistics	Prob.	Statistics	Prob.
Panel υ-statistics	−0.774	0.780	−1.684	0.046*
Panel ρ statistics	1.510	0.934	1.655	0.951
Panel PP-statistics	−1.739	0.048*	−2.490	0.006*
Panel ADF-statistics	−1.945	0.025*	−1.765	0.038*
Group ρ-statistics	2.528	0.994	2.340	0.990
Group PP-statistics	−2.145	0.016*	−2.841	0.002*
Group ADF-statistics	−2.417	0.007*	−1.635	0.048*

*indicates 5% level of significance. SSA: Sub-Saharan Africa

Table 5: FMOLS regression for low-income and middle-income SSA countries

Variables	Low-income		Middle-income	
	Coefficient	t-statistics	Coefficient	t-statistics
eng	1.548* (0.428)	3.611	0.341* (0.005)	2.842
cap	0.111* (0.023)	4.723	0.110* (0.000)	4.490
lab	−0.069 (0.109)	−0.629	2.126* (0.000)	7.514
cpi	0.331* (0.134)	2.467	0.064 (0.304)	1.035
ef	0.081 (0.061)	0.293	0.141 (0.458)	0.745

*indicates 5% level of significance. Figure in parenthesis represents standard error. SSA: Sub-Saharan Africa, FMOLS: Fully modified ordinar least square

5. CONCLUSION AND POLICY IMPLICATIONS

From the policy point of view, policy makers should provide policies that will encourage energy consumption in both low-income and middle-income SSA countries. This is owing to the fact that energy consumption contributes immensely to the performance of the manufacturing sector in both low-income and middle-income SSA countries. Equally important, policies on increasing investment in energy supply to meet the region growing energy need should be provided to encourage energy consumption in SSA countries. This is in consideration of manufacturing sector heavily relying on energy input and that energy preservation policy in SSA countries can have an adverse effect on manufacturing performance and economic growth in general. In this respect, SSA countries should provide a better way of managing the region's energy resources to support sustainable economic growth. In addition, the region should expand policies on deeper regional energy cooperation to increase the reliability and affordability of energy.

In conclusion, this study investigates the association connecting energy consumption with manufacturing performance for the low-income and middle-income SSA countries during the the period 1995-2012. The result of the cointegration test establishes the presence of a long run connection among the variables. Furthermore, the coefficients of the long run reveal that energy consumption, corruption index and capital positively affect manufacturing performance in the low-income SSA countries while the relationship between energy consumption and capital positively affect manufacturing performance in the middle-income SSA countries. The study further recommends a more comprehensive policy on energy consumption in consideration of its effect on manufacturing performance.

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