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EFFECTS OF ENERGY USE ON SOCIOECONOMIC PREDICTORS IN AFRICA: SYNTHESIZING EVIDENCE

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Abstract: The paper examined the effects of energy use on socioeconomic predictors in Africa. The Gary Becker hypothesis and the Michael Grossman demand for healthcare model were used to interact with energy related predictors on socioeconomic essentials. Our experimented model foretold the urgent need for government intervention programmes to resolve the energy misery in the African region.

Keywords: socioeconomic predictors, energy, health investment, human capital, life expectancy.

JEL Codes: P48, Q28, R58, I38.

1. Introduction

Africa has continued to battle health challenges with the health care sector bedeviled with poor funding resulting in lack of requisite infrastructure and equipment to meet the health care needs of the burgeoning population. In most cases, policies and programmes targeted at rejuvenating the sector are bugged with poor implementation, irregularities and corruption. In recent times, the region has been hit with health crises, which continue to see an increase in premature death and abysmal decrease in life expectancy in the region. In this paper, we investigate the abilities of Grossman model to describe the effects of energy use on the socioeconomic predictors in Africa. We interact the cumulative effects of energy related factors on human welfare indicators. Our experimental model unveiled the energy misery, which allowed us to formulate policy intervention strategies that can help improve the quality of life in Africa.

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Economic literature explaining the link between socioeconomic decisions on consumption and health investment is credited to the seminar work of Gary Becker in 1960. Becker developed a framework for assessing the time, cost and benefits, and future value of health as human capital (Becker, 1960, 2007). Thus, Becker hypothesis revealed that the individual's heath investment might have implication on its lifetime productivity.

The above theoretical framework provoked a considerable body of research starting from the novelty work of Grossman (Grossman, 1972a, 2017; Margolis, Hockenberry, Grossman, & Chou, 2014). Grossman developed a model for conceptualizing the above conjectures presented by Becker on the basis of demand for healthcare, which is dominated and widely used to explore a wide range of issues related to health, socioeconomics, inequalities in medical cares, health preventions, and health insurance scheme (Sepehri, 2015). One uniqueness in this model is the ability to predict that an individual would invest in health until the marginal benefit of health is equal to its marginal cost (Zweifel, 2012), this equilibrium demand for health entails that the length of an individual's life expectancy would be determined endogenously (Hren, 2012). Over the years, controversy continued to trail the empirical support for this underlying model (Zhan et al., 2016). These studies provide mixed evidence on the possibility that higher income is associated with longer life expectancy. We are of the opinion that despite the individual's level of income, access to modern health facilities is a crucial factor in health preservation and improved life expectancy.

The novelty of this present study is based on the understanding that life is a priceless commodity. More often than not, decisions affecting the quality of life are not individual, but necessarily more of political decision on regular basis. This implies that public sector can be found not only in health care but also in many other sectors, such as the energy sector relating to access to electricity, transport and environmental sectors, etc. The argument thus remains that because of the human elements of psychological factors there is allegedly no measurement of such important factors as mathematics may find no application, and econometric estimate may not be possible for political intervention on health-related matters. However, this thought could all be dismissed as utterly mistaken.

In the light of the above remarks, we may describe our position as follows: The study aims to investigate the predictors of socio-economic and political decision as they influence the cost of survival (health well-being) of an individual in the African region. Specifically, the study questioned whether reduction in quality of life a consequence of political decision is was or whether socioeconomic status accounts for preservation and elongation of life. To the best of our knowledge, we claim that energy related shortage as it affects the quality of life and well-being is still missing in the existing literature. As such, this present study probes how energy consumption could be used to preserve and extend quality of life by one year. Can we have assumed that higher political decision and socioeconomic predictors as well as improvement in energy access can have possible correlation with better health?

This study also advanced the frontier of knowledge in many ways: First, the study is built on the standard theoretical framework developed by Gary Becker for assessing the Human Capital investment has earlier stated. We replicate and modify the Grossman demand for healthcare model and set our baseline empirical strategy on the work of Breyer et al., (2009), and Zweifel, (2012). Our model is estimated using the panel Generalized Method of Moment (GMM) econometric techniques. This method is suitable in a dynamic adjustment macroeconomic framework. The method has been found to improve estimation over Ordinary Least Square, (OLS) in the presence of unknown heteroscedasticity and autocorrelation form (Marshall et al., 2017; Carson & Grogger, 2016; Hadjiantoni, 2015; Gragg, 1983).

Overtime, the GMM technique has proven that moment could be exploited under weak assumption, as the technique proves more efficient in a case where parameters are over identified. We showed that improvement in health is found on the degree of political commitment, socioeconomic status and ability to pay for health condition of an individual. Our analysis highlighted some socioeconomic and political intervention issues surrounding the cost of survival in the region, which cannot be compromised for health intervention policy in the region. Of most importance is the issue of government's reluctant attitude to provide essential needs, which are crucial to preserve and extend the lives of the citizens. This has continually affected their capacity to function productively. We claimed that the aforesaid issues are building blocks behind the slow growth experienced in the region. Also, the capacity of the region to reproduce sustained labour force also reflects in the rate of premature deaths, which is established in our findings. Our policy thus hints on the need to quickly address the existing interventions in health policies and re-established new vision channels towards providing fiscal space for health care system in the region. Also, the persistent power failure and infrastructural decay experienced in the energy industry / sector need intervention programme(s) set towards providing affordable electricity that will meet the health care needs of the region.

The study is organized as follows: Section 2 provides theoretical explanation on health-energy related issues; section 3 describes the variables used, measures and sources of data; section 4 makes up empirical strategy and model, analysis of data and discussions of findings, section 5 concludes.

2. Literature review

Some of the studies provide evidence that individual's demand for health status is constrained by the level of the individual's socio-economic status. (Becker et al. 1994, Pinto, Nord, Ubel, Menzel, & Richardson, 2002, Murphy & Topel, 2005 Breyer et al., 2009, Zweifel 2012, Chetty et al., 2016). They used the Grossman model to explain how the individual's quest to preserve and extend life can be constrained by access to education, degree of urbanization, health access, as well as water and sanitation facilities (Zweifel, 2012). Other studies argue that individual's capacity to function or the state of health is based on the individual's social behaviour (Becker et al., 1994). Few studies also found that the educational status of an individual has significant implication on his health status (Pinto et al., 2002). Similarly, some studies in the same dimension on socio-economic factors observed a causal flow from health to education (Wagstaff, 1986). In another vein, other related studies argue for population growth as a potential channel through which qua life of an individual could reduce (Becker et al., 1994). While the evidence presented are mixed, the implication of the diverse results points to the fact that socioeconomic factors such as access to health, population, social behaviour, population and other risk factors can possibly constraint the preservation and extension of one's life.

Contemporary studies' attempt to link the possibilities of political regime with the health status of an individual at macro level documented mix evidence. Some of the studies argue that individual serves as a key productive and consuming factor in the economy (Abrahams, McHiza, & Steyn, 2011) while relative few attributed a democratic state to the possibility of public opinion to meet the health need of the people and, in turn preserves and extend their potential life expectancy (Miranda, Farmer, & Farmer, 2011; Lake et al. 2012; Gerring, Thacker, Enikolopov, Arévalo, & Maguire, 2013; Weaver, 2015; Palas, Ashraf, & Ray, 2017). Few related studies in the same dimension linked possible electoral incentives, labour market policy and welfare issues to individual health status in a state (Vågerö, 2007;Wilkinson, Lam, & Fitzpatrick, 2010; Marshall et al., 2017). While the argument promoted by these studies raise lots of curiosity with possible dimensions, we do not totally agree with the claims made based on the fact measuring democratic regime with life preservation and extension might be mere descriptive than a major policy intervention exploit.

On further examination, our agreement with these studies would be based, however, on two major points. First, the possibility of renewed labour policies to upswing the minimum wages during electoral process can justify the quest for such studies. For instance, promoting minimum wage can act as stimuli for salary increment and in turn marginal effects on the household's ability to pay for the state of health. However, possible inflation, which may arise as a result of increase in wages, can have adverse effect on the economy. Also, the possibility for exogenous shock to expose the country's output cannot be ignored. Second, health policies can act as electoral incentives to improve welfare. For instance, enhancing health education and improving maternal health condition couple with intervention in healthcare training as well as access to healthcare at affordable price can serve as good channel through which health policies can be used as electoral incentive for welfare purposes.

Variations in political decisions and health outcome have continued to generate compelling debate in the academia. Some studies attempt to assess the political commitment on health and health care as it reflects health outcome documenting mixed results (Darden, 2017; Greaves & McCafferty, 2017; World Health Organisation, 2014; Mackenbach & McKee, 2015; MacKerron & Mourato, 2013). We observed that lack of comparable data has limited the submission of some group of studies. These groups of studies have pricked our indulgence to the implication of political decision on quality of life. In most cases, the strength the studies are based on conceptualization rather than adventure to test and formulate possible policy interventions.

In general, the review of all these literature shows that social inequalities, income, level of education, political dimension, political decision and commitment, and social behaviour are critical concerns to health-related issues. The ambiguity in the results recorded in previous literature thus remain the major reason for renew interest on the subject with intense debate. Furthermore, the intellectual appeal of Grossman model is equally questioned and serves as subject of dispute among contemporary studies. According to critics, the model has over inflated the degree to which individual could preserve and extend his life and the ability to pay for health condition on many grounds. Also, a clarion call to reconcile the extent to which individual income and political decision via government action could possibly constrain the possibilities/capability of an individual to preserve and extend life has been made. This has also been labeled as a major gap and puzzle among contemporary issues that need to be tackled and reconciled with empirical evidence.

3. Methodology

The theoretical foundation of this study is based on Gary Becker theory of investment in human capital. The theory is considered because it emphasized on decision making based on the value of time relevant to investments in health because of the benefits and costs of these investments which are positively related to consumer's lifetime income, (Becker, 1960, 2007). Thus, benefits rise because these investments reduce morbidity and mortality, and increase the time available to engage in productivities.

Based on the theoretical intuition of the aforesaid Gary Becker investment in Human capital, and the empirical strategy of Grossman demand for healthcare model used by Zweifel (2012), the baseline model for this present study is specified as:

$$W^B = f(E^c) \tag{1a}$$

where, W^B = Quality of life (representing human welfare development),

E^c = energy and related factor.

Following the approach by Zweifel (2012), we investigate the link between energy use and socioeconomic predictors. We regress human development indices (that is a vector of human development index and inequality adjusted human development index) on energy consumption while taking into consideration other key associated variables like pollutants and natural resource rents.

3.1. Model

Our empirical model for analyzing the effects of energy consumption on human welfare development is estimated functionally as:

$$hd_{i,t} = \theta_0 + \theta_1 ec_{i,t} + \theta_2 tnat_{i,t} + \theta_3 ep_{i,t} + \mathrm{B}CV_{i,t} + \mu_{i,t} \tag{1}$$

Where: *hd* is a vector of human welfare development indices (that is human development index (*hdi*) and inequality adjusted human development index (*ihdi*)); *ec* is energy consumption; and *tnat* is total natural resources rents[†]. The control variables[‡] (*CV*) are gross domestic product per capita (*gdppc*), gross fixed capital formation (*gfcf*), government spending on education (*gedu*), health expenditure (*hexp*), inflation rate (*inf*), domestic credit to private sector (*dcps*), trade openness (*trade*), infrastructural development (*infr*), and urbanization rate (*urban*), and aggregate institutional index (*insq*). The institution quality variable consists of six indices, namely control of corruption, voice and accountability, rule of law, government effectiveness, regulatory quality and political stability. Their values range from –2.5 (being the weakest) to 2.5 (being the strongest). More so, θ_0, θ_{1-3} are parameters, B is a vector of parameter coefficients of our control variables, i is country, t denotes time and μ is the error or disturbance term with expected mean zero and constant variance. The combined subscript of time (*t*) and cross-individual differences (*i*) data in Equation (1) are properties of the pooled ordinary least square (OLS). Due to some of its inherent flaws in the pooled OLS technique, a system of generalized method of moments was used to (a) account for cross-

[†] We considered the total natural resources rent and not the oil resources rent because the study was not limited to oil producing African nations.

[‡] They are sets of variables capable of influencing HDI and inequality adjusted HDI, carefully selected in human development literature

sectional dependence and unobserved heterogeneity by controlling for time invariant omitted indicators and (b) control for reverse causality or simultaneity bias by the process of instrumentation (Ajide, Alimi, & Asongu, 2019).

3.2. Data, choice of variables and theoretical expectations

The study used annual data series for the period 1999-2014. The choice of our data set was due to data availability because these are the data available across a sizeable sample of 23 African countries[§]. This selection was influenced by the data available for energy use per capita. Like previous studies, our key variable is energy use which is available on the World Bank database – World Development Indicators (2018). It is expected energy consumption that will lead to an increase in income which also improves human living conditions in terms of literacy level and quality of life. Similarly, total natural resources rent have direct relationship with human development index. It implies that countries with enormous natural resources receive more income through rents which invariably make more resources available for human development. However, environmental pollution measured by carbon emission has an adverse effect on human lives. This indicates that there will be more environmental degradation resulting from increasing usage of fossil fuel as a source of generating energy.

As for the control variables, we expect that more income will improve the level of human development. Thus, a positive relationship between GDP per capita and human welfare is presumed. Likewise, a direct impact is expected from investment, government spending on education, and health care expenditure to human welfare development. It implies that a country witnesses more private funds capable of ensuring economic growth if its investment climate is favourable for businesses. This will generate more income for human welfare growth. More so, spending on human capital development will improve human lives. In the case of macroeconomic instability measured by unstable price, it will worsen human welfare development as cost of living increases. It thus suggests a negative relationship between inflation and human welfare indicators. Financial support in terms of making credit facilities easily accessible and available to everybody in a society enhances economic growth, which also supports human welfare. The nexus between globalization measured by trade openness and human welfare development is mixed. First, it drives human welfare development by ensuing that people have access to commodities and services that are locally produced in their country. On the second hand, it can also worsen human welfare by making the

[§] They are Angola, Benin, Botswana, Cameroon, Congo Dem. Rep., Congo Rep., Cote D'Ivoire, Eritrea, Ethiopia, Gabon, Ghana, Kenya, Mauritius, Mozambique, Namibia, Niger, Nigeria, Senegal, South Africa, Tanzania, Togo, Zambia, Zimbabwe.

country to be at disadvantage in its encounter with other countries if their resources are tamped without being compensated appropriately or turned into a dumping site or experiences unfavourable balance of payment. Infrastructural development is expected to enhance human welfare since this ensures creation of social amenities that sustained human activity improvement. A negative relationship is assumed between urbanization and human welfare; high urbanization rate puts pressure on available amenities and infrastructure in urban centres, which become a challenge toward improving human welfare. A good institutional setting will ensure human welfare development by making sure that people achieve their individual goals without infringing on others' right.

3.3. Motivation for choice of data and estimation procedure

The human development indicators are measured with the inequality adjusted human index , in accordance with recent inclusive development literature in Africa (Ajide, Alimi, & Asongu, 2019; Asongu, Efobi, & Beecroft, 2015). Evidently, the indicators account for the overall wellbeing of the people. However, recent studies have argued that due to low budget on health and education, the need to account for its place in the model to enable researcher explain to some extent how the indicators account for the total composition of the human capital development becomes imperative (Neagu, Dumiter, Braica, Jimon, & David, 2019; Silva & Ferreira-Lopes, 2014; Tan, Ma, Bunn, & Zhang, 2015).
In Africa, crises on energy use arise from four angles. First, the balance between demand and supply and sustainability of market forces remained indeterminate. Second, the dual role played by consumer as the producer and consumer of energy use which is part of the setting of energy model poses crisis on energy balancing and grid setting. Third, endangering human life to variation of climatic condition requires tradeoff between energy efficiency and associated carbon trapping facilities, which are determined by a number of factors. In most countries of Africa, power (electricity) demand by far outstrips the supply and this same undersupply is equally erratic. The continent is thus faced with chronic power problem, which has deterred her economic development programmes, notwithstanding the availability of enormous natural resources in the region (Ebhota & Inambao, 2016). These issues justify the inclusion of the variables used.
Considering the place of education in the mix, it has been established that as a factor, it helped the individual to develop the ability to creatively think and develop self-control for one's life. Education is used to capture government policy as it is likely to have severe impact on the quality of life indicators (Oke, Bokana, & Shobande, 2017). Similarly, we checked the likelihood of political decision on the overall HDI, since recent studies have claimed that low fiscal spending on health care might have a negative implication on overall HDI (Dardanoni & Wagstaff,

1990; Hren, 2012; Simcock, Thomson, Petrova, & Bouzarovski, 2017). The inclusion of GDP per capita is to re-examine the extent to which an individual could pay for energy used. In Africa, majority of household could not pay for their energy bill, which was due to inflationary pressure, low income earning as well as the erosion in the purchasing power. Thus, average household is subjected to biofuel which impacted negatively on their quality of life (Bhattacharyya, 2012; Mazur, 2011a; Mirowsky & Ross, 2004; Miyamoto, 1999; Nadimi & Tokimatsu, 2018; Schill et al., 2012).

In terms of natural rent, the cursory evidence provided by these examples suggests that natural resources are not a necessary or sufficient condition for economic development (Larke & An, 2011; Tan et al., 2015). In this study, we account for two different strands of literature: (1) idea of resource curse -that an abundance of natural resource might have severe implication on the overall wellbeing of the people (Bleaney, 2014), and (2) the idea that quality of institution also matter to use fiscal management mechanism to regulate the economic activities in order to conserve resource, mitigate carbon emission and improve HDI (Bhattacharyya, 2012; Mazur, 2011b; Nadimi & Tokimatsu, 2018; Niu, Yao, Shao, Li, & Wang, 2018; Shao & Yang, 2014; Wang & Luo, 2018).

In this study, the *system* generalized method of moment (GMM) is used. The choice of the *system* GMM estimation techniques, especially, reflects cross-country disparities which describe for likely endogeneity in all regressions via instrumentation and controls for the unnoticed heterogeneity and removes possible small sample biases from difference estimator. In this study, we work with Roodman (2009b, 2009a), extension of (Arellano & Bover, 1995), which has been established to restrict over identification and restrict the explosion of instruments (Baltagi, 2008; Baltagi, Egger, & Kesina, 2018; Love & Zicchino, 2006). Also, the system-GMM estimator adopted in this study generally found to produce efficient and precise estimates as compared with that of the difference-GMM (Baltagi, 2008; Baltagi et al., 2018).

4. Empirical results

4.1. Preliminary Statistics results

Prior to the discussion of empirical findings, the descriptive statistics and correlation matrix of the variables were discussed in Tables 1 and 2 respectively. The average values of HDI and inequality-adjusted HDI were 0.490 and 0.438, while the mean value of energy use (kg of oil equivalent) per capita is 661.98. The average share of government expenditure on education and healthcare spending in GDP stood at 4.42% and 2.29% correspondingly. On average, a country within our dataset compilation has GDP per capita, CO_2 emission per capita and fixed telephone subscription (per 100 people) of US$2312.6, 1.076 and 3.092 respectively. More so, the mean share of investment, total natural resources rents, domestic credit to private sector and total trade in GDP are 20.63%, 14.34%, 21.61%, and 77.8% respectively. Additionally, the average value of institutional quality is -0.552, implying weak institutional settings of the countries. Finally, unstable price grew at annual rate of 101.86% while urban population growth on annual basis is 3.68%.

Table 1 Descriptive Statistics

Variables	Measurements	Mean	Std Dev.	Maximum	Minimum	Obs.
HDI	Human Development Index (HDI)	0.490	0.109	0.782	0.235	354
IHDI	Inequality Adjusted HDI	0.438	0.131	0.769	0.129	300
EC	Energy use (kg of oil equivalent per capita)	661.98	608.52	3098.4	113.42	361
	Energy use (kg of oil equivalent per capita) (log)	6.234	0.671	8.039	4.731	361
GEDU	Government expenditure on education, total (% of GDP)	4.418	1.628	10.679	1.100	207
HEXP	Health expenditure, public (% of GDP)	2.293	1.031	5.357	0.045	366
GDPPC	GDP per capita (constant 2010 US$)	2312.6	2630.5	11925.8	186.66	365
	GDP per capita (constant 2010 US$) (log)	7.170	1.067	9.386	5.229	365
CO2	CO2 emissions (metric tons per capita)	1.076	1.921	10.024	0.017	365
GFCF	Gross fixed capital formation (% of GDP)	20.631	7.523	43.051	2.000	342
TNAT	Total natural resources rents (% of GDP)	14.344	14.172	62.693	0.001	365
DCPS	Domestic credit to private sector by banks (% of GDP)	21.611	19.780	106.26	0.449	348
INSQ	Institutional Quality	-0.552	0.662	0.880	-2.100	368
INFR	Fixed telephone subscriptions (per 100 people)	3.092	5.872	31.503	0	368
INF	Inflation, consumer prices (annual %)	101.86	1335.50	24411	-8.484	344
TRADE	Trade (% of GDP)	77.804	27.732	156.86	27.014	353
URBAN	Urban population growth (annual %)	3.676	1.240	5.744	-0.351	365

Note: Std. Dev. is standard deviation; Obs. Is observation; HDI denotes human development index; and GDP means gross domestic product.

Source: Investigator, 2019

Table 2 Correlation Matrix

	IHDI	EC	GEDU	HEXP	GDPPC	CO2	GFCF	TNAT	DCPS	INSQ	INFR	INF	TRADE	URBAN
HDI	0.766	0.643	0.222	0.269	0.897	0.609	0.330	-0.034	0.617	0.589	0.660	-0.032	0.421	-0.481
IHDI	1	0.423	0.118	0.173	0.757	0.446	0.276	-0.092	0.508	0.616	0.624	-0.128	0.449	-0.395
EC		1	0.113	0.245	0.680	0.884	0.073	0.029	0.480	0.371	0.373	-0.002	0.038	-0.373
GEDU			1	0.493	0.151	0.169	0.114	-0.238	0.260	0.283	0.025	-0.078	0.010	-0.053
HEXP				1	0.240	0.312	0.347	-0.294	0.388	0.566	0.199	-0.102	0.107	-0.146
GDPPC					1	0.659	0.196	0.065	0.509	0.539	0.567	-0.032	0.449	-0.410
CO2						1	0.053	-0.094	0.649	0.482	0.499	-0.015	0.049	-0.435
GFCF							1	-0.062	0.075	0.428	0.108	-0.110	0.196	0.024
TNAT								1	-0.422	-0.504	-0.331	0.032	0.428	0.347
DCPS									1	0.601	0.811	-0.055	0.171	-0.642
INSQ										1	0.630	-0.111	0.116	-0.450
INFR											1	-0.011	0.317	-0.736
INF												1	0.037	-0.110
TRADE													1	-0.244

Note: HDI denotes human development index; IHDI is inequality Adjusted HDI; EC is energy consumption; GEDU is government expenditure on education; total (% of GDP); HEXP denotes health expenditure, public (% of GDP); CO2 is carbon emission; GDPPC is GDP per capita (constant 2010 US$); GFCF is gross fixed capital formation (% of GDP); TNAT is total natural resources rents (% of GDP); INSQ is institutional Quality; INF means inflation, consumer prices (annual %); DCPS is domestic credit to private sector by banks (% of GDP); TRADE denotes trade (% of GDP); INFR is fixed telephone subscriptions (per 100 people); and URBAN is urban population growth (annual %).

Source: Investigator, 2019

Table 2 showing the correlation matrix of our variables indicate that energy consumption has a positive level of association with HDI and inequality-adjusted HDI, but the coefficient of the former is higher than the latter. It implies that the impact of energy use on human welfare is not inclusive most especially after taking into consideration unequal differences among people in the countries. Likewise, other welfare enhancing indicators like expenditure on human capital development were found to have positive coefficients although weak. However, total rent from natural resources having negative correlation values support the resource curse hypothesis evidenced in some of the resource rich nations. The findings of the correlation coefficients were related to the directions of the links between the variables in Figures 1(a-c) and 2(a-c). The charts reveal the scatter graphs of energy use, human capital investment variables (education and health), HDI and inequality-adjusted HDI. These are just preliminary analysis subject to further confirmation in the empirical estimation after controlling for other economic variables. Meanwhile, the coefficients of correlation of other explanatory variables were also reported in the table. The values of the coefficients were low, and they indicate the absence of multicollinearity problem while the ones with high coefficients were not considered together in a model. It indicates that they are suitable for empirical analysis.

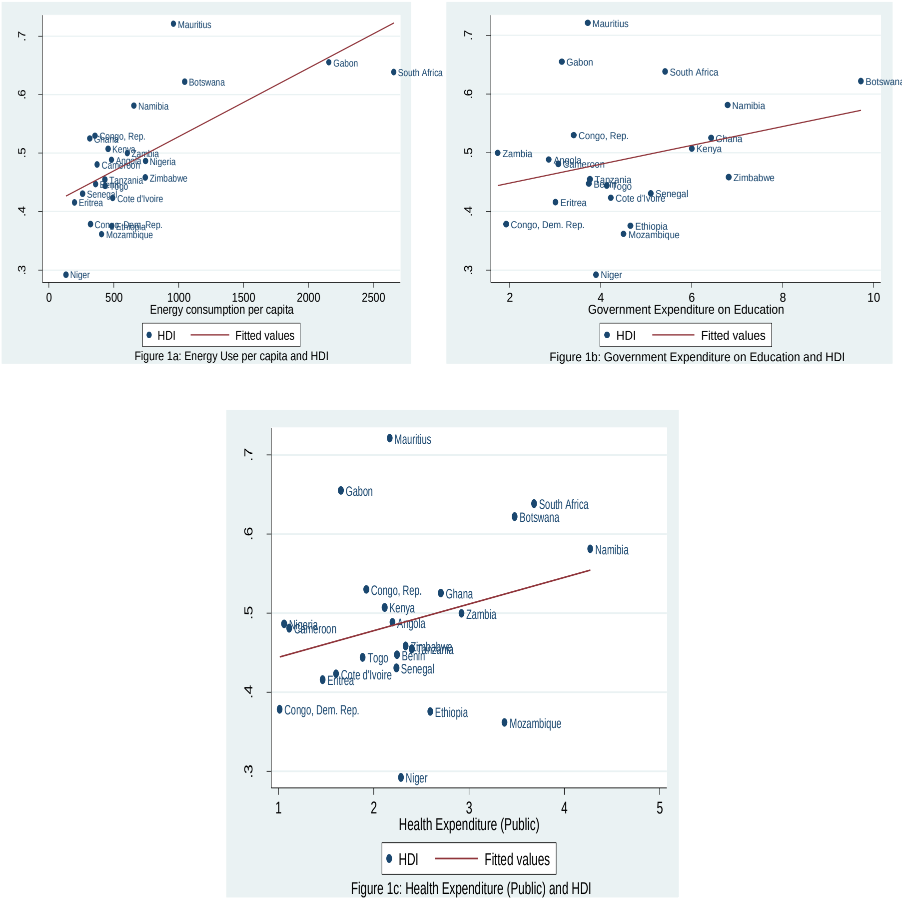

Figure 1a: Energy Use per capita and HDI

Figure 1b: Government Expenditure on Education and HDI

Figure 1c: Health Expenditure (Public) and HDI

Figure 1 Energy Use, Human Capital Investment Indices (Education and Health) and HDI

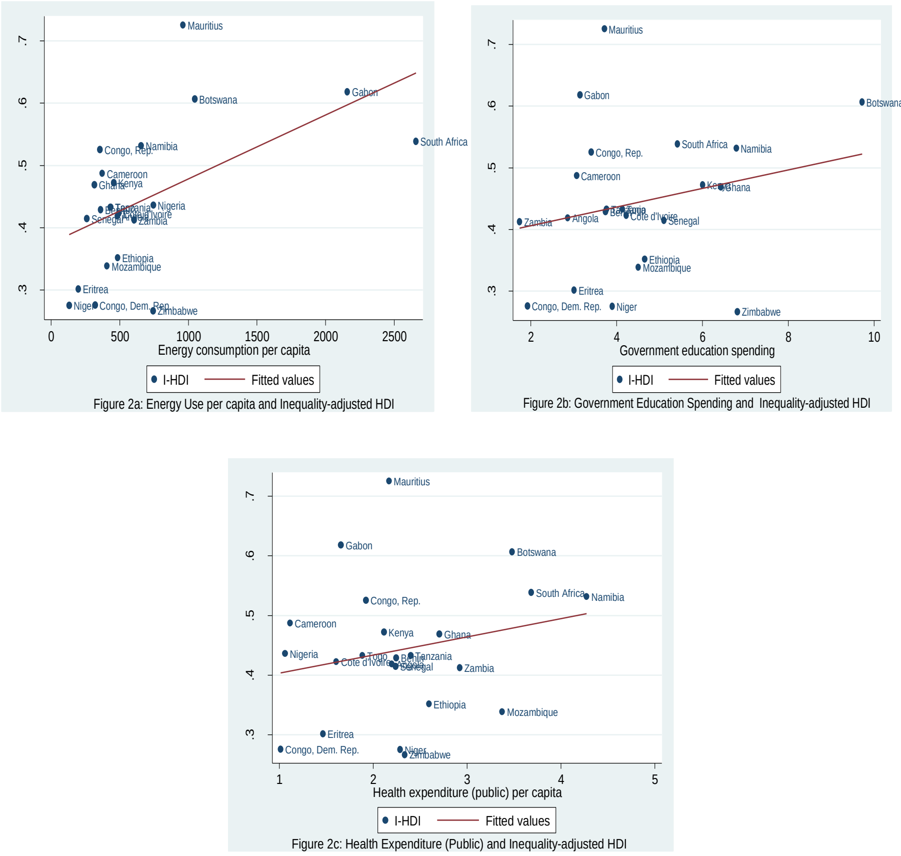

Figure 2a: Energy Use per capita and Inequality-adjusted HDI

Figure 2b: Government Education Spending and Inequality-adjusted HDI

Figure 2c: Health Expenditure (Public) and Inequality-adjusted HDI

Figure 2 Energy Use, Human Capital Investment Indices (Education and Health) and Inequality-adjusted HDI

4.2. Econometric results

Table 3 presents the baseline GMM model on the effect of energy uses on the human welfare development. The findings were presented in eight columns while each indicator (HDI and inequality-adjusted HDI) has four columns below.

Table 3 System GMM Regression Results (Energy Use and Human Welfare Development)

Variables	**Human Development Index (HDI)**				**Inequality Adjusted HDI**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
HDI(-1)/I-HDI(-1)	**0.906*** **	**0.872*** **	**0.932*** **	**0.894*** **	**0.680*** **	**0.931*** **	**0.895*** **	**1.105*** **
	(0.051)	**(0.106)**	**(0.049)**	**(0.114)**	**(0.174)**	**(0.222)**	**(0.220)**	**(0.248)**
Energy consumption	**0.027** **	**0.015** **	**0.011* **	**0.019** **	**0.054** **	**0.041*** **	-0.046	**0.061** **
	(0.011)	**(0.007)**	**(0.006)**	**(0.08)**	**(0.026)**	**(0.015)**	(0.034)	**(0.029)**
Total natural rent		**0.0005* **		**0.0019*** **		0.005		-0.002
		(0.00023)		**(0.0004)**		(0.0031)		(0.002)
Carbon emission			**-0.018** **	**-0.015** **			**-0.024** **	**-0.019* **
			(0.008)	**(0.006)**			**(0.012)**	**(0.011)**
GDP per capita	**0.052*** **	**0.049*** **	**0.031*** **	**0.0049*** **	**0.042*** **	**0.031** **	**0.042* **	**0.055*** **
	(0.017)	**(0.011)**	**(0.009)**	**(0.013)**	**(0.015)**	**(0.019)**	**(0.022)**	**(0.016)**
Gross fixed capital formation	**0.003** **	**0.0003** **	**0.00024** **	**0.0003** **	-0.008	-0.010	-0.000	-0.017
	(0.0012)	**(0.00011)**	**(0.0001)**	**(0.001)**	(0.006)	(0.010)	(0.003)	(0.015)
Govt. expenditure on education	**0.002* **	0.001	**0.003** **	**0.002* **	0.007	0.020	0.004	0.020
	(0.001)	(0.003)	**(0.0015)**	**(0.0011)**	(0.016)	(0.019)	(0.009)	(0.028)
Health expenditure	**0.005* **	0.004	**0.006** **	0.007	0.017	0.034	-0.018	-0.117
	(0.002)	(0.003)	**(0.003)**	(0.005)	(0.046)	(0.058)	(0.028)	(0.085)
Institutional quality	-0.015	-0.014	-0.012	-0.016	0.103	0.259	0.046	0.259
	(0.010)	(0.017)	(0.009)	(0.017)	(0.135)	(0.203)	(0.146)	(0.235)
Inflation	**-0.0004** **	**-0.0004** **	**-0.0003** **	**-0.0004** **	**-0.004** **	**-0.005* **	**-0.002** **	**-0.004** **
	(0.0002)	**(0.0002)**	**(0.00014)**	**(0.0002)**	**(0.002)**	**(0.003)**	**(0.001)**	**(0.002)**
Domestic credit to priv. sector	0.0003	**0.0002**	**0.0003* **	0.0003	-0.001	-0.003	**-0.002** **	0.001
	(0.0005)	**(0.0001)**	**(0.00015)**	(0.0002)	(0.001)	(0.003)	**(0.001)**	(0.003)
Trade	-0.0005	-0.0004	-0.0003	-0.0002	0.002	0.002	-0.000	0.003
	(0.0007)	(0.0003)	(0.0003)	(0.00014)	(0.002)	(0.002)	(0.001)	(0.003)
Infrastructure	**0.003** **	**0.004** **	0.002	**0.003** **	**0.005* **	**0.003** **	0.005	**0.002* **
	(0.001)	**(0.002)**	(0.001)	**(0.0014)**	**(0.003)**	**(0.001)**	(0.004)	**(0.0011)**
Urban population	-0.004	-0.002	0.004	0.002	0.011	0.081	-0.003	0.115
	(0.004)	(0.005)	(0.007)	(0.008)	(0.080)	(0.151)	(0.133)	(0.205)
Constant	**-0.089** **	**-0.050* **	**-0.048** **	**-0.069** **	**-0.131** **	**-0.359** **	**0.387** **	**-0.204** **
	(0.039)	**(0.027)**	**(0.023)**	**(0.025)**	**(0.052)**	**(0.163)**	**(0.156)**	**(0.105)**
AR(1)	(0.011)	(0.013)	(0.019)	(0.017)	(0.019)	(0.018)	(0.023)	**(0.052)**
AR(2)	**(0.921)**	**(0.375)**	**(0.374)**	**(0.280)**	**(0.413)**	**(0.560)**	**(0.666)**	**(0.254)**
Sargan OIR	(0.007)	**(0.341)**	**(0.381)**	**(0.367)**	**(0.514)**	**(0.377)**	**(0.592)**	**(0.657)**
Hansen OIR	**(0.644)**	**(0.924)**	**(0.984)**	**(0.973)**	**(0.989)**	**(0.930)**	**(1.000)**	**(1.000)**
Fishers	**7946.7*** **	**3684.7*** **	**8873.8*** **	**1972.4*** **	**1286.3*** **	**1767.2*** **	**1224.4*** **	**1627.0*** **
Instruments	17	19	19	21	17	19	19	21
Countries	23	23	23	23	23	23	23	23
Observations	342	342	342	342	258	258	258	258

Note: Standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.10$; HDI denotes human development index; and I-HDI is inequality Adjusted HDI. The bolded values signify significance of (a) estimated parameters and F-statistics and (b) failure to reject the null hypotheses of: (i) no autocorrelation in the AR(1) & AR(2) tests and; (ii) the validity of the instruments in the Sargan OIR test.

Source: Investigator, 2019.

The empirical findings revealed that the coefficient of energy consumption is positive and significant, indicating that an increase in energy use has great impact on human welfare development measured by both HDI and inequality-adjusted HDI. Also, income derived from natural resources rent was found to drive human welfare positively at 5% critical level. The table further showed that carbon emission had an adverse effect on human welfare improvement. Likewise, the

result suggests that income growth had direct link with human welfare growth in the selected SSA countries. More so, other covariates that significantly influence human welfare growth are inflation and infrastructural development.
Furthermore, the lag one of human welfare indicators (HDI and inequality-adjusted HDI) that were positive, less than one and statistically significant at 5% indicate convergence condition in the selected countries. The Fishers tests were found to be significant at 0.05 critical value, implying that all the coefficients are jointly significant at the conventional level. For the post estimation test, we did not reject the null hypothesis of the first order of serial correlation [AR(1)] while the null hypothesis of the second order of serial correlation was not accepted. This is consistent with the findings of Arellano and Bond (1991) and Arellano and Bover (1995), as it implies that there is no autocorrelation in the model. Similarly, the Sargan and Hasen test are expected to be rejected for the instruments to be valid. It suggests that the instruments are valid and do not correlate with disturbance term.

5. Final Remarks

We have examined the nexus between Energy use and socioeconomic predictors in Africa. As observed, access to quality and qualitative energy remains restricted or unavailable in most developing African countries. The quest to secure energy by all means has led to the embrace of carbon emitting alternative energy sources, which are detrimental to the health of individuals and the society. Worst still is the poor state of medical and health infrastructure in the region rising from the low budgetary allocation and expenditure on health, and related issues by the government. While the individual strives to achieve a better standard of living through access to energy, good health care and other amenities that boost/support good living, such services and facilities are never accessible to all and, where available are too expensive. In the midst of all, the African population keeps surging at an alarming rate while hundreds of children die in millions.
To a considerable extent, appropriate level of investment in health and health care is expected to contribute to continuous reduction in morbidity and mortality. Therefore, this study is a renew thinking that provides evidence justifying the rationale for political decision(s) to channel resources to improve the health status of citizens in Africa, in order to improve the quality of life and by extension life expectancy in the region.

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