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CLIMATE CHANGE AND HOUSEHOLD CONSUMPTION EXPENDITURE GROWTH IN SOME SELECTED AFRICAN COUNTRIES: A GENERALIZED METHOD OF MOMENT (GMM) APPROACH

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ABSTRACT

Household consumption expenditure in African nation is constrained with falling income, economic crisis and poverty. Africa is located around the tropic which makes the continent vulnerable to climate change. The rising pattern of poverty precipitated by falling household consumption is caused by climate change due to the nature economic activities of African nation. One of the economic agenda of African nation is to attain sustainable development goal which is constrained by poor household expenditure, malnourishment and poverty. The bulk of African population is engaged in occupation influenced by climatic factors. It is in view of this that this study investigates the effect of climate change on household consumption expenditure. This study uses a panel data set from fifty-four (54) African countries span 2013 to 2022. The technique of estimation employed is the Generalized Method of Moment (GMM). The results of the result of study indicates that there is a short run relationship. The lag value of household consumption expenditure at first and second lag is statistically significant and is best instruments to be included in the model. The coefficient C_{o2} emission has a positive and statistical significant effect on household consumption. Temperature, economic globalization and social globalization have a negative but non-significant effect on household consumption expenditure. Political globalization has a positive but non-significant effect on household consumption expenditure in African countries. The increase adequate finance and preparedness to address issues of climate change to reduce the surge effect on household consumption would make adaptation strategy possible.

Keywords: Green Growth, Renewable Energy, C_{o2} Emission

1.0 INTRODUCTION

Final Household consumption expenditure in Africa is instable amid economic rigidities, policy reversals, economic crisis, disease outbreak and economic crisis. The affects GDP, African growth is driven by Household consumption expenditure and forms about 40 percent of GDP component and a cause of dwindling GDP in period of instabilities (Hattingh, Leke & Russo, 2017).

In the event of economic shock, much policy tailored towards strong economic performance is commendable but futile amid poor resilience and inefficient structural transformation and even worse slow and uneven recovery path among African nations. Aside rising poverty and inequality rate in Africa, failing economic policies and mitigating strategies to avert this crisis also endanger household consumption expenditure and put it at risk.

Since the continent is resource abundant and fails to produce for export, this characterized Africa growth economic history as consumer sector with not only high aggregate demand for finished products but a large market for investors to invest heavily in the consumer sector. However, there are occasions of unprecedented global economic threats causing slowdown in economy and in some instances, the coping and adaptive capacity to absorb global economic and climatic shock is unhealthy for Africa.

Climate change in the world is caused by unprecedented economic and social challenges arising from unsustainable household consumption expenditure as nations strive towards acquiring economic prosperity. The world at large is faced with economic recessions, pandemics and these sets economic and social challenges for individual nations reducing output and household final consumption expenditure (European Environment Agency, 2023). The aftermath of this pandemic is the spread and uneven recovery which has substantially inflicted the household making livelihood difficult.

Report from European Environment Agency (2023) shows that household consumption in Europe in 2000 to 2019 causes environmental and climate pressures and this was driven by resource extraction, production and processing, transportation, consumption and waste management. However, several studies in African are limited to the effect of climate change on growth (Dasgupta, Emmerling & Shayegh, 2020; Abidoye & Odusola, 2015; Barbier & Hochard, 2017). Dursun and Ogunleye (2014) on GDP growth employment and poverty in seven west African countries, Moyo, Mishi and Ncwadi (2022) human capital and poverty. These studies did not consider the effect of climate change on household consumption expenditure

About 90 percent of deaths in low and middle income countries are caused by disaster (United Nation, 2019). Food security, nutrition and enhance sustainable agriculture will be stalled even though larger populations are engaged in especially women and children in the rural area. Zhou, Chen, Li, Wang, and Zhang (2015) on China, India and Senegal climate change causes poverty. Severe climatic condition has variability effect on African region especially on poverty, food insecurity and inequality as well.

Adaptation capacity is one of the key drivers to reducing impact of climate change in African region but constraint by numerous factors such as poor financial resources of the vulnerable groups which continues to reflect the outburst surge effect of climate change amidst control and policy strategy (Mideksa, 2009) this causes uncontrolled devastating effect on income levels and distribution of agriculturalist. The disruption of agricultural productivity escalates food prices making household income and consumption less in the face of market value making households to unhealthy food options. However, climate affect household disproportionately through increased cost of living.

The event of economic recession and epidemic already had precipitate poor welfare and the most vulnerable are usually poor, even the speed of mechanism at which the poor ought to recover is slim

whereas the capacity to absorb shock is uneven with inequality widening in income distribution as well as quality of life.

The issue of climate change and quality of life has been reiterated in several conventions since decade ago, the early adoption strategy to mitigate the surge effect demonstrate prepare redness and commitments to surrendering resources to control it. Unfortunately, it was undeniably spelt out by United Nations Framework Convention (UNFCCC, 2007) it was stated that African countries are at risk of impact of climate change effect on household welfare and livelihood. Conceptually, adaptation and variability constitute the extent to which measures are taking to reduce the impact of climate change on household consumption.

While context of poverty in advanced economies cannot be related or validated for developing countries, the unique causes and channels through which climate change affects poverty cannot be misunderstood. Therefore, African nations have experiences in severity of climate change coupled with vulnerability and adaptation strategy. African nations have faced with low productivity with rising population, which is also characterized with large, malnourished persons with low per capital income. In addition, the deliberate fight against poverty has failed to meet up international standard of Dollar consumption per persons per day. This study is significant in that it will unveil critical issues of lingering poverty spikes and ineffectiveness of policies in recent time to addressing poverty in African countries. However, with recent studies on poverty and climate change, they are majorly restricted to developed economies.

Similarly, most studies are skewed towards economic causes of poverty while developing economies are late starters in climate change as causes of poverty in Africa.

There is a mixed of evidence in the area of measure of poverty, the use of popular dollar units and household expenditure. In recent time, researchers comfortably measure poverty by the channels it is driven. Rosen, (2002) measures poverty as consumption plus net additions to wealth. This supports the theories of welfare and consumption (permanent and current hypothesis of consumption and welfare). The major reasons for employing household consumption expenditure rather that dollar rate per head is that the former covers the vulnerable while the latter captures the poor. The objective of this study is to investigate the impact of climate change on household consumption; the specific objective is to examine the nature of relationship either (short or long run). It is also to investigate other determinants of household consumption expenditure and causality relationship

1.1 Research Problem

Although several studies have emerged on climate change and household consumption expenditure, the empirical evidence shown cannot be relied upon given the weak tools of analysis these studies employed

The wide spread of analysis on the issue also has not unveil the channels and mechanism through which climate change affects household consumption expenditure. Similarly, the application of robust estimation technique such generalized method of moment GMM is significant to analyzing adequately the cause and effect relationship for policy reference.

African nations had received substantial in funding and intervention from donor nation and organization, the impact on household seem minimal with high rate of vulnerability among large populace especially in rural area. Despite this funding, the problem continues to persist. In addition, theories on household consumption are limited to income as driven factor to consumption. Such theories cannot support recent changes due to the context. Therefore, it cannot answer some of the research questions on climatic change as factors determining consumption.

The objectives of this study are:

i. to estimate the effect of climate change on household consumption expenditure in selected African countries
ii. to estimate the causality relationship between climate change and household consumption expenditure in African countries

2.0 LITERATURE REVIEW

There are vast literatures on climate change and poverty. Animashaun, Emediegwu, Osadolor and Okoror (2022) effect of changes in temperature on households' consumption expenditure using data span 2010 to 2016 on Nigeria. The authors reported that rural households spend more during dry season.

In another study, Tokoya, Aiyeku, Shonibare, Ipinjolu and Dairo (2022) confirms Keynesian framework of income determining household consumption expenditure using Nigerian data. However, in African context food prices, income, consumption expenditure, poverty and other welfare indicators are driven by climatic factors. This is because the larger population is in the rural area with poor agricultural technology, this population produces at subsistence level and sell small volume of output to the market, in some cases, the climatic condition affects yield thus, reducing the quality and quantity to the market triggering excess demand over supply triggering prices of goods and materials for industrial use and consequently raising cost of doing business and high risk investment climate. This makes investors drag feet in investment activities and reduced demand for labour which eventually reduces income levels and income as well as subjecting citizenry to poverty. In another way, not only do climatic factors also affect productivity, it also hampers on quality services as it spread to banking, industries transport and so on due to dynamic temperature, precipitation and release of C_{o2} Emission

In a similar study, using data on African countries, (Hope, 2009) wrote on the link between climate change and poverty using simple linear regression analysis, the result of the study indicates that climate change impact negative threat o Poverty in Africa.

In 2015, Abidoye, and Odusola explore the nexus between climate change and economic growth spanning 1961 to 2009 using panel data set data for 34 countries using Bayesian approach The result of their study shows that a 1°C increase change or increase in temperature reduces GDP growth by 0.67 percentage point all things being equal. Sample countries for the study are Sudan, Chad, Uganda, Botswana and Tunisia. The impact on countries is heterogeneous with greater impact on Democratic Republic of Congo, Zimbabwe, Central African Republic and Madagascar. However, less impact is evident on Nigeria, Botswana and Swaziland.

On another study on Africa, Barbier and Hochard (2017) in their study used secondary data span the period 2000 to 2012 to analyze climate change and poverty. The objective of this study was informed as a result the increased poverty in African countries. The authors employed 83 developing countries. Results of the study showed that there is a significant relationship between poverty and climate change

In a related study, Thornton, Jones, Owiyo, Kruska, Herrero, Orindi, Bhadwal, Kristjanson, Notenbaert, Bekele and Omolo (2008) in a study employed data on sub–Saharan African countries to estimate the effect of climate change on poverty. The authors used the Correlation test technique. The result of their study shows that there is a negative association between climate change ad poverty.

In a study, Zhou, Chen, Wang, and Zhang (2017) used secondary data spanning 1990 to 2015 employed panel data set on China, India and Senegal, to investigate empirically the relationship between climate

change on poverty reduction, the authors applied C_{o2} emissions and forest area percentage as measures proxy for climate change, the study apply correlation analysis. The data or indicators employed by these authors includes population, forest area, C_{o2} emissions, food production index, livestock production index, prevalence of undernourishment, prevalence of mortality rate, improved sanitation access, electricity access, improved water source access and secondary school enrolment. The result of the study revealed that climate change, poverty indicators, agriculture production and human well-being are significantly correlated. Several studies are limited to the effect of income on consumption testing the Keynesian framework. However, this study investigates the effect of climate change parameters on household consumption expenditure.

2.1 Theoretical framework

Keynes theory on Absolute Income Hypothesis (AIH) argued that consumption is a function of income. Keynes premise is built on the axiom of current disposable income a major parameter explaining household consumption expenditure. Another theory on consumption is the Friedman on Permanent Income which consumption is determined by current and expected income. The theory goes to point that individual's work to have a smooth consumption expenditure pattern and not to work today earns a living but also earn a living tomorrow making consumption expenditure sustained.

Porto, Porto and Garbero (2016) used GMM estimator the effects of economic openness and globalization on the structure

Provincial government expenditure using panel data set on Argentina spans the period 1993-2010 using 23 provinces. The result of the study shows that economic openness or globalization negatively impacts the share of social expenditures. The coefficients for economic openness and the KOFA index are negative and significant

2.2 Gaps in the literature

Household consumption expenditure Npishs tends to have taken the center stage for measuring of poverty in recent time, it is the best quantitative measure. Several studies have not used it.

In addition to adequately analyze the effect of climate on poverty, the application of heterogeneous panel and country specificity of data set is relatively scanty as several studies concentrates on single country analysis. This study will employ 54 African countries.

3.0 METHODOLOGY

3.1 Type of Data

This study employs panel data set spanning the period 2013 to 2022. The availability of data set is used to select data from African countries inform of non probability sampling procedure. The study also sampled fifty four (54) selected African countries and it covers the periods of several economic rigidities and lots of policy reversals in African region. The rationale for taking larger number of countries under this study is the gains associated with panel data set with larger sample countries with small time period which is suitable for GMM estimator. The period covered also covers so many periods of economic episodes and trajectory that has yielded gains or losses on human welfare. It also exposes some of the outcomes of homogenous policies used by African countries impacting multiples of failures of policies and their effect on human development indexes with the view to positioning the economic, social and political parameters and possibly tracking global competitiveness and sustainable development goals.

Model specification

$$HC_{it} = \beta_0 + \beta_1 HC_{t-1} + \beta_1 TEMP_{t-1} + \beta_2 Co2_{it} + \beta_3 ecoglo_{it} + \beta_4 polglo_{it} + \beta_5 xocglo_{it} + +\varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3,1)$$

Where:

HC is Households and NPISHs Final consumption expenditure, PPP (constant 2021 international $)

3.2 Technique of Data Analysis

The two popular estimators under generalized method of moments (GMM) include Differenced GMM and augmented system GMM. The classification of regressors are done on basis of predetermined meaning residuals correlated with past errors not with current and future errors, endogenous where residuals are correlated with past and current errors as well. The other is exogenous residual not correlated with errors in the temporal periods. The estimation is accomplished with different options and sub options such as nolever, nodiffsagan, robust, small and so on. The is a general rule of thumb is that if the dependent variable in the equation is driving towards random walk of equal to one (1), the differenced GMM is a biased and inefficient estimate and the lag value of the dependent variable cannot be included as an instruments in the GMM model (Blundell & Bond, 1999). Thus to achieve a robust estimate, the system GMM is most efficient

To specify the dynamic model, it takes the form of autoregressive process

$$InY_{it} = \phi InY_{it-1} + YZ'_{it} + \beta X'_{it} + d_t + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

where Z' Implies control variables, X' implies explanatory variables InY_{it-1} is lagged value of dependent variable to be included as additional instrument in the GMM model. The log of the dependent variable is a function of its own lag, a function of a vector of controlled variables, a vector of explanatory variables, year dummies and error term.

The Differenced GMM is expressed as:

$$Y_{it} = \sum_{j=1}^{p} \alpha_j \, y_{i,t-1} + x_{it}\beta_1 + W_{it}\beta_2 + V_{it} + \mu_{it} \qquad i=1,\ldots N \qquad t=1,..T$$

The α_j are P parameters to be estimated

x_{it} is a $1\times K_j$ vector of strictly exogenous covariates

β_1 is a $K_j \times 1$ vector of parameters to be estimated

W_{it} is a $1 \times K_2$ vector of predetermined and endogenous covariates

V_{it} are the panel level effect which maybe correlated with covariates. μ_{it} Imply the i.i.d over the whole sample with variance σ_{ϵ}^2

The V_{it} and the μ_{it} are assumed to be independent for each I over all t.

The idea is that GMM estimator is purely short run estimate but the significant coefficients are import tools in generating long run equilibrium. Bond (2002) argued that the original estimator is the differenced GMM

and the augmented estimator is refer to as system GMM. One step differenced GMM is the initial regression performed (Roodman, 2009). Although several studies have use the differenced GMM estimator because simulation studies suggest modest efficiency gain from using two-step even when the model is affected by heteroscedasticity.

4.0 RESULT

This section of study analyses data and interprets results. It considers the selection of model between differenced and system GMM. The results are presented in different tables. The analysis shows the selection of most appropriate technique of estimator between differenced and system

Table 1:

Choice selection between Differenced and System GMM

Differenced GMM	1.037228
SYSTEM GMM	1.039489
POOLED OLS	1.03675
FIXED EFFECT	.9963868

Bond (2001) posit that if after taking the coefficient of differenced GMM it is lower than that of fixed effect and closer to that of pooled OLS the system GMM is taken. It is important to note that the differenced GMM will be of efficient benefit to this study.

4.1 Differenced GMM

The differenced GMM classified outcomes in term of options and sub options. The option with no collapse option will not reveal robust outcome unlike the equation with robust option. The different GMM becomes inefficient and biased when the value of the lag of dependent variable is close to one (1). Such instance, the lag value of the dependent variable cannot be used as an instrument in the model.

Table 2:

Differenced GMM with different sub options

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5
L.nnpishs	1.187***	1.037***	1.187***	1.037***	1.037***
	(0.078)	(0.156)	(0.078)	(0.156)	(0.15)
co2	1.20***	1.35***	1.20***	1.35***	1.35***
	(5.73)	(4.74)	(5.73)	(4.74)	(4.64)
Temper	1.846***	0.497*	1.846***	0.497*	0.497*
	(1.068)	(1.95)	(1.06)	(1.95)	(1.90)
Ecoglo	-1.46**	-1.46***	-1.46**	-1.46***	-1.46***
	(1.21)	(7.82)	(1.21)	(7.82)	(7.64)
Socglo	2.60*	-2.33*	2.60*	-2.33*	-2.33*
	(6.43)	(7.10)	(6.43)	(7.10)	(6.94)
Polglo	2.38**	2.32***	2.38**	2.32***	2.32***
	(2.05)	(1.32)	(2.05)	(1.32)	(1.29)
Number of instruments	27	12	27	12	12

Prob > F	0.000	0.000	0.000	0.000	0.000
F(7, 46)	506.15	176.16	506.15	176.16	1289.27
Number of obs	270	270	270	270	270
Number of groups	46	46	46	46	46
AR(1)	0.235	0.051	0.235	0.051	0.051
AR(2)	0.362	0.246	0.362	0.246	0.246
Hansen sta	0.736	0.302	0.736	0.302	0.302

*Notes *** ** * are statistically significant at 1% 5% and 10% level of significance respectively . t statistics in (parenthesis) are based on white heteroscedasticity consistent standard errors p-values reported for AR(2) and Hansen statistics*

Some of the conditions for interpretation are the AR(1) may or may not be statistically significant, this does not threaten the model, AR(2) must not be statistically significant otherwise it means the lag value of the dependent variable is not efficient to be used as an instrument in the model. The number of instrument must not also be more than the number of groups to avoid instruments proliferation. The result of the differenced GMM indicates that in model 1, the instrument is high although not as much as the number of groups. The AR(1)is not significant and AR(2) as well indicating that the model does not suffer second order serial correlation. However, the Hansen statistics Is high. In model 2, including the robust option, the lag value of the dependent variable nnpishs, political globalization and co2 have positive and statistically significant. A percentage change in Co2 emission is associated to 1.3% increase in household consumption expenditure at 1% level of significance. while economic globalization has a negative and statistical significant effect on household consumption expenditure. AR(1) is good and significant 0.051. AR(2) is not significant indicating that the model does not suffer second order serial correlation. The number of instrument is far much less than number of groups. In addition, the Hansen statistics is not significant and not too high.

The model 3 is without the robust option and nodiffsagan option, the number of significant coefficient dropped with rise in Hansen statistics and instruments which pose concern.

The result of model 4 has with collapse option without nodiffsagan option; this result is not different with result in model 2. The result in model 5 is without the small option shows the same as model 2. This shows that the differenced GMM is good with collapse option. The robust check includes lags of differenced GMM to check for robustness of coefficients, standard errors

Table 3:

Robustness checks using second and third lags

Variables	Coefficients/standard errors
l. nnpishs	0.830*** (0.33)
l.2 nnpishs	-.880*** (0.51)
l.3	1.007*** (0.45)
Co2	1.86*** (9.63)
Temper	-0.146*

	(0.97)
Ecoglo	-1.50**
	(1.61)
Socglo	-2.44*
	(1.01)
Polglo	1.82**
	(2.47)
Number of instruments	12
Prob > F	0.000
Number of obs	180
No of groups	46
AR(1)	0.266
AR(2)	0.435
Hansen sta	0.094

*Notes *** ** * are statistically significant at 1% 5% and 10% level of significance respectively . t statistics in (parenthesis) are based on white heteroscedasticity consistent standard errors p-values reported for AR(2) and Hansen statistics*

The robust check using the second and third lag is employed to evaluate the outcome variable is suitable to be used as instrument in the model. The results shows that coefficient nnpishs at different lags up to lag 3, the coefficients are statistically significant. The coefficient Co2 emission has a positive and statistically significant effect on household consumption expenditure. A one percent change in co2 emission is associated with 1.86 percent change in household consumption expenditure. AR(2) is not statistically significant which exempt the model to suffer second order serial correlation coupled with the number of instruments lower than the number of groups.

5.0 CONCLUSION

Considering wide range of literature on the subject, this study investigate the effect of climate change on household consumption expenditure using panel data set of 54 African countries The period of study under study covers 2013 to 2022. Several unprecedented economic crisis faced in the economy during the period under study. The Generalized Method of Moment is used due to its numerous advantages it has over other estimates. The short run estimates shows that a percentage change in household consumption expenditure is associated to 1.03% increase in lag value of household consumption expenditure at 1% level of significance. the positive and statistical significance of coefficient Co2 emission shows that there is prevalent increase in emission also shows the degree at which Africa as a nation has tackle menace coupled with poor coping strategies on the part of vulnerable. Since the result only shows short run and no long run relationship between climate change and household consumption expenditure, it can also be infer that there exist a short run causality between these parameters. The rise in Co2 emission is due to increasing activities to increase growth which increases household consumption but will eventually decline due to coping strategies and increasing income levels given an inverted U shape curve. This explains the environmental Kuznet curve hypothesis.

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8.0 APPENDIX

System GMM

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model8
l.nnpishs	1.166*** .071	1.039*** .140	1.05*** .023	0.997*** .030	1.02*** .008	1.05*** .023	0.997*** .03	0.983 .06
co2	7.30*** 3.87	9.57*** 4.37	-1.24* 4.82	1.28* 2.15	5.85* 7.72	-1.24* 4.82	1.28* 2.15	6.90 2.46
tempre	2.239*** 1.06	1.26** 1.20	-.495** .53	.315** . 23	.143*** .077	-.495** .53	0.315** .237	0.802 .36
ecoglo	-1.31** 1.11	-1.01** 6.56	-1.67* 1.32	-9.88** 7.07	-3.87** 2.58	-1.67* 1.32	-9.88** 7.07	-2.75 4.01
socglo	8.66** 7.32	2.59* 6.97	-1.22* 1.29	6.75** 5.80	2.71** 1.68	-1.22* 1.29	6.75** 5.80	-1.21 8.02
polglo	1.66** 1.91	1.24** 1.12	-1.16** 8.25	3.61** 3.03	1.29** 9.02	-1.16** 8.25	3.61 3.03	
Number of instruments	27	12	34	14	22	34	14	12
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F(7, 46)	353.97	145.41	13678.48	1.51e+06	26051.39	13678.04	1.51e+06	0.182
Number of obs	270	270	316	316	316	316	316	316
No of groups	46	46	46	46	46	46	46	46
AR(1)	0.137	0.047	0.122	0.038	0.088	0.122	0.038	0.113
AR(2)	0.309	0.283	0.299	0.285	0.309	0.299	0.285	0.312
Hansen sta	0.736	0.302	0.000	0.172	0.000	0.000	0.172	

Authors computation using STATA