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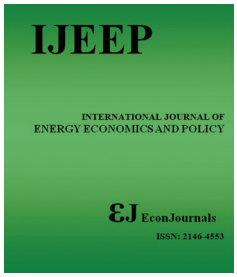

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Greenhouse Gas Emissions and Economic Growth in Africa: Does Financial Development Play any Moderating Role?

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ABSTRACT

The study had two major objectives. Firstly, to investigate the influence of greenhouse gas emissions (GGE) on economic growth. Secondly, to find out if the interaction between GGE and financial development enhanced economic growth in Southern and Western African nations. Four econometric estimation methods, namely dynamic generalized methods of moments (GMM), pooled ordinary least squares (OLS), fixed and random effects were used with annual data ranging from 2001 to 2012. The impact of GGEs on economic growth was found to be non-significant positive (pooled OLS), non-significant negative (fixed and random effects) and significant positive (dynamic GMM). The interaction between GGEs and financial development was found to have had a significant positive effect on economic growth under the dynamic GMM, fixed and random effects. The non-significant positive influence of GGEs on economic growth is a finding produced by the pooled OLS regression approach.

Keywords: Greenhouse Gas Emissions, Economic Growth, Africa
JEL Classificiations: F43, N27, Q5

1. INTRODUCTION

1.1. Background of the Study, Problem Statement and Research Gaps

Energy consumption alongside greenhouse gas emissions (GGEs) as determinants of economic growth have in the last two decades been of particular interest to researchers, academics and policymakers. The research work by these important stakeholders led to an international agreement known as the Kyoto Protocol signed in 1997. The latter was meant to reduce greenhouse gases and carbon gas emissions in order to enhance economic growth (Obradovic and Lojanica, 2017. p. 511). Of particular concern to the empirical researchers is whether the Kyoto Protocol signed in 1997 has so far produced the desired effect. This is the reason why there has recently been several empirical work done to explore the impact of greenhouse/carbon gas emissions on economic growth, findings of which are varied, mixed and divergent.

In the theoretical literature, the impact of greenhouse/carbon gas emissions on economic growth has been found to be either positive or negative. Positive in the sense that more greenhouse or carbon gas emissions is a result of increased manufacturing activities which are necessary to spearhead economic growth. Negative in the sense that increased greenhouse or carbon gas emissions pushes up the global average surface temperatures, which according to Nordhaus (1991 causes floods, drought and excessively high temperatures. Empirical researchers on the subject matter found out results which can be classified into four main categories. (1) Greenhouse or carbon gas emissions and economic growth affect each other, (2) positive influence of greenhouse/carbon gas emissions on economic growth, (3) negligible impact of greenhouse/carbon gas emissions on

economic growth and (4) negative effect of greenhouse/carbon gas emissions on economic growth. The mixed and varied findings is evidence that there is no consensus yet on the impact of GGEs on economic growth. Moreover, both theoretical and empirical literature on the influence of greenhouse/carbon gas emissions on economic growth assumes a linear relationship exists between the two variables, an assumption which is quite far from the truth. Majority of the empirical studies on the subject matter ignored not only the dynamic nature of economic growth data but possible endogeneity problem between greenhouse/carbon gas emissions and economic growth.

1.2. Contribution of the Study

The current study fills in the above-mentioned literature gaps in the following three ways: (1) By investigating the impact of the interaction between greenhouse/carbon gas emissions and financial development on economic growth, the current study acknowledges that the two variables are related in a non-linear manner. (2) İt uses dynamic generalized methods of moment (GMM) estimation approach which takes into account the dynamic nature of the economic growth data and the possible endogeneity issues on the relationship between greenhouse/carbon gas emissions and economic growth. (3) İt focused on African countries, a bloc of countries which have so far to a large extent been ignored by prior empirical studies on the similar subject matter.

1.3. Structure of the Paper

The remaining portion of the paper is organised as follows: Section 2 discusses the greenhouse/carbon gas emissions and other factors' influence on economic growth from the theoretical angle whilst section 3 is the empirical literature on the impact of greenhouse/carbon gas emissions on economic growth. Section 4 discusses the greenhouse/carbon gas emissions and economic growth trends in Southern and Western Africa during the period ranging from 2001 to 2012. Section 5 is the research methodology estimation techniques, data analysis and interpretation whilst section 6 concludes.

2. GREENHOUSE/CARBON GAS EMİSSİONS AND OTHER FACTORS' İMPACT ON GROWTH: THEORETİCAL VİEW

Table 1 summarises the theoretical view on emission and other factors effects on economic growth.

Table 1: Theory intuition and a priori expectation

Variable	Proxy used	Theory intuition	Expected sign
Economic growth (GROWTH)	**GDP per capita**	**-**	**Not applicable**
Carbon or GGE	Total GGE (kt of CO2 equivalent)	Increase in carbon/GGE pushes up the global average surface temperatures. This can lead to floods, drought or excessively high temperatures which are not good for the health of human beings and the economy (Nordhaus, 1991). On the other hand, the increase in carbon/GGE is a direct result of increased economic or industrial expansion activities.	±
Foreign direct investment (FDI)	Net FDI inflow (% of GDP)	Foreign direct investment flows alongside capital, technology, expertise, human capital development, all of which increases the productive capacity of the host countries' economies (Kumar and Pradhan, 2002; Romer, 1986; Lucas, 1988). The over-reliance on FDI creates an economy that is predominantly monopolistic in structure hence leading to the underutilisation of resources and negative economic growth (Bornschier and Chase-Dunn (1985)	±
Natural resources (NATURAL)	Total natural resources rents (% of GDP)	In line with the eclectic paradigm hypothesis advanced by Dunning (1973), natural resources forms part of the locational advantages in the host country thereby attracting FDI and enhancing economic growth. The abundance of natural resources especially in African countries has triggered civil conflict thus negatively influencing economic growth	±
Population growth (POP)	Population growth (annual %)	Higher population growth rates increase the size of the market and the demand of goods and services. This does not only attract FDI but also provides a fertile ground for the expansion of economic growth activities. On the other hand, increase in population size means that financial resources that could have been utilised for economic growth stimulation initiatives are now used towards non-productive but essential services for example health and education	±

(*contd..*)

Table 1: (*Continued*)

Variable	Proxy used	Theory intuition	Expected sign
Economic growth (GROWTH)	**GDP per capita**	**-**	**Not applicable**
Financial development (FIN)	Domestic credit to private sector by banks (% of GDP)	Increased financial development enhances economic growth through boosting savings mobilization and efficient allocation of resources Townsend (1983), Shaw (1973), Goldsmith (1969) and McKinnon (1973). On the other hand, high financial development discourages long term foreign investment (FDI) while promoting speculative foreign portfolio investment which destabilises the economy	±
Trade openness (OPEN)	Total trade (% of GDP)	High levels of trade openness subject the country to external shocks, a situation which might not be good for the local economy. On the other hand, trade openness is advantageous to the economy as it allows domestic companies to easily access more affordable and efficient raw materials, technology and other inputs in global markets	±
Exchange rates (EXCH)	Value of the local currency against the United States Dollar (US$)	A weak currency is good for the economy as it promotes the competitiveness of the country's exports thereby helping to generate more foreign currency whilst the opposite is true in the case of a country having a strong currency. On the other hand, the advantage of having a strong currency is that it minimises imported inflation	±
Unemployment rate (UNEMPL)	Total unemployment (% of total labour force)	Some foreign investors are attracted to set up their production facilities in countries which are characterised by high unemployment as this guarantees them of cheaper labour force. High levels of unemployment reduces the demand of goods and services hence stifling production in the economy	±
Infrastructure development (INFR)	Fixed telephone subscriptions (per 100 people)	High levels of infrastructural development not only enhances economic growth through attracting FDI but also acts as one of the inputs into the production process. Whilst infrastructural development boost long term economic growth, it might have a negative effect on economic growth in the short term as it takes away financial resources that could have been used for projects that have a direct and immediate link with economic growth	±
Interaction term	Total GGE (kt of CO2 equivalent) × domestic credit to private sector by banks (% of GDP)	Frankel and Rose (2012) noted that financial markets contribute towards reduction in carbon or GGE through efficiently allocating financial resources to the domestic firms to enable them to purchase environment friendly technology. On the other hand, financial development boosts the scale of manufacturing activities through provision of financial assistance to the domestic companies, thus increasing gas emissions, pollution and environmental degradation Aye and Edoja (2017. p. 10). It is against this backdrop that the current study expects the interaction term to have either a positive or negative effect on economic growth	+

Source: Author compilation

3. INFLUENCE OF CARBON OR GGE ON ECONOMİC GROWTH–EMPİRİCAL VİEW

This section discusses prior empirical research on the impact of carbon or GGE on economic growth. Lu (2017) investigated the relationship between energy consumption, GGE and economic growth in 16 Asian countries using the fully modified ordinary least squares with data ranging from 1990 to 2012. Low GGE were found to have enhanced economic growth whilst higher levels of GGE were found to have had a deleterious effect on economic growth in the Asian countries studied. Lapinskiene et al. (2014) studied the relationship between economic growth and GGE in European Union countries using panel data analysis with data from 1995 to 2010. Among other findings, increased emissions of greenhouse gases were found to have had a negative influence on economic growth in the European Union countries. On the contrary, Cifci and Oliver (2018) observed that the reduction in GGE was associated with a decline in economic growth, possibly because of the heavy financial burden involved. Nordhaus (1991) also consented that GGE cause global warming, whose negative consequences on economic growth could be dire. Table 2 summarises the empirical literature on the influence of GGE on economic growth.

The empirical research on the impact of carbon or GGE on economic growth produced mixed findings (Table 3). Firstly, carbon or GGE were found to have had a positive impact on economic growth. Secondly, economic growth was negatively affected by carbon or GGE. Thirdly, both carbon/GGE and economic growth affected each other. Fourthly, there is a negligible relationship between the two variables. Clearly, the

Table 2: The relationship between carbon or GGE and economic growth - empirical research

Author	Country/ Countries of study	Period	Methodology	Results
Hamit-Haggar (2012)	Canada	1990–2007	Panel data analysis	In line with the environmental Kuznets curve, a non-linear relationship was found to have characterised the relationship between GGE and economic growth. Economic growth was found to have been Granger caused by GGE in the short run only. In the long run, a weak causality running from economic growth and energy consumption towards GGE was detected.
Azam et al (2016)	United States of America, India, China and Japan	1971-2013	FMOLS	Carbon emissions and energy usage were observed to have had a deleterious impact on economic growth in the countries studied.
Narayan et al (2016)	181 countries	1960-2008	Panel data analysis	To a larger extent, economic growth led to a decline in the amount of carbon emissions. The finding is consistent with the environmental Kuznets curve.
Mapapu and Phiri (2017)	South Africa	1970-2014	Quantile regression approach	Economic growth went up in response to low levels of carbon gas emissions.
Albiman et al (2015)	Tanzania	1975-2013	Toda and Yamamoto non-causality test (1995)	Economic growth was found to have increased the quantity of carbon emissions in Tanzania.
Lin et al (2018)	China and India	1969-2015	Bootstrap Autoregressive Distributive Lag	Carbon gas emissions and economic growth were found to have affected each other.
Obradovic and Lojanica (2017)	Greece and Bulgaria	1980–2010	Vector Error Correction Model (VECM)	Economic growth was found to have been positively influenced by carbon emissions and energy consumption in the long run in Bulgaria and Greece.
Appiah et al (2017)	Ghana	1970–2016	OLS	Carbon emissions went up in direct response to increased levels of economic growth.
Palamalai et al. (2015)	India	1970–2012	VECM	Increased quantity of carbon gas emissions boosted the level of economic growth activities in India.
Jouini (2017)	Tunisia	1970–2010	VECM	Increased carbon emissions enhanced economic growth in Tunisia.
Issaoui et al (2016)	Middle East and North African countries	1990–2010	FMOLS	Economic growth had a positive effect on carbon emissions in the short run. The same study observed that lower carbon gas emissions enhanced economic growth in the long run.
Kumar (2011)	India	1971–2007	VECM	Carbon emissions had a negative influence on economic growth in India.
Ejuvbekpokpo (2014)	Nigeria	1980–2010	OLS	Economic growth was negatively affected by carbon emissions in Nigeria.
Nnaji et al (2013)	Nigeria	1971–2009	ARDL	Among other findings, economic growth was found to have been Granger caused by carbon emissions in Nigeria.
Alam (2013)	Developing and developed countries	1993–2010	Panel data analysis	Economic growth was found to have been positively influenced by carbon emissions in the short run.

Source: Author compilation, FMOLS: Fully modified ordinary least squares, OLS: Ordinary least squares

relationship between carbon/GGE and economic growth is far from being a settled matter in the field of green economics and finance.

4. GGE AND ECONOMİC GROWTH TRENDS İN SOUTHERN AND WESTERN AFRİCA

Table 3 shows the GGE and economic growth trends in Southern and Western African countries during the period ranging from 2001 to 2012.

South Africa, Mozambique, Tanzania, Zambia and Nigeria were the only countries which recorded the highest mean GGE above the overall mean of 127,333.59 kt of CO_2 equivalent. The same countries (Mozambique, South Africa, Tanzania, Zambia, Nigeria) are outliers because their mean total GGE are well above the overall mean of 127,333.59 kt of CO_2 equivalent. Botswana, Namibia, Burkina Faso, Ivory Coast, Guinea-Bissau, Liberia, Niger, Senegal, Sierra Leone and Togo are also outliers because their mean total GGE are well below the overall mean of 127,333.59 kt of CO_2 equivalent.

In terms of economic growth, only Botswana, Namibia and South Africa had their mean GDP per capita above the overall mean

GDP per capita of 1,351.92 whilst the remaining African countries studied had their mean GDP per capita below the total overall mean. Madagascar, Mozambique, Tanzania, Guinea-Bissau, Liberia, Niger, Sierra Leone and Togo are outliers because their mean GDP per capita is well below the overall mean GDP per capita of 1,351.92. South Africa, Botswana and Namibia are also outliers because their mean GDP per capita well exceeded the overall mean GDP per capita. In order to curtail the detrimental effects of outliers on the quality of the overall results, the study converted all the data into natural logarithms, following Hair et al.'s (2014) argument.

5. RESEARCH METHODOLOGY

5.1. Data, Data Description and its Sources

The study used annual panel data ranging from 2001 to 2012 for 17 Southern and Western African countries. They include Botswana, Namibia, South Africa, Madagascar, Mozambique, Tanzania, Zambia, Burkina Faso, Ivory Coast, Ghana, Guinea-Bissau, Liberia, Niger, Nigeria, Senegal, Sierra Leone and Togo. The study only included Southern and Western African countries whose data for the variables of interest could be found. Table 1 shows the proxies that were used to represent the dependent, independent and control variables. International Monetary Fund, African Development Bank, World Bank Indicators and International Financial Statistics Agency were the four sources of data from which the data used in the study was extracted.

5.2. Econometric Model

Equation 1 is the general econometric format, explaining the relationship between GGE and economic growth.

$$GROWTH_{i,t}=\beta_0+\beta_1 GGE_{i,t}+\beta_2 X_{it}+\mu+\varepsilon_{it} \quad (1)$$

Where GGE stands for GGE and X are the control variables (FDI, natural resources, population growth, financial development, exchange rates, trade openness, infrastructure development and unemployment). Unlike equation 1, equation 2 shows all the variables is an econometric format that describes the impact of GGE on economic growth.

$$GROWTH_{i,t}=\beta_0+\beta_1 GROWTH_{i,t-1}+\beta_2 GGE_{i,t}+\beta_3 FIN_{i,t}+\beta_4(GGE_{i,t} FIN_{i,t}+\beta_5 FDI_{i,t}+\beta_6 NATURAL_{i,t}+\beta_7 POPUL_{i,t}+\beta_8 OPEN_{i,t}+\beta_9 EXCH_{i,t}+\beta_{10} UNEMPLOY_{i,t}+\beta_{11} INFR_{i,t}+\mu+\varepsilon \quad (2)$$

$$GROWTH_{i,t}=\beta_0+\beta_1 GGE_{i,t}+\beta_2 FIN_{i,t}+\beta_3(GGE_{i,t}. FIN_{i,t})+\beta_4 FDI_{i,t}+\beta_5 NATURAL_{i,t}+\beta_6 POPUL_{i,t}+\beta_7 OPEN_{i,t}+\beta_8 EXCH_{i,t}+\beta_9 UNEMPLOY_{i,t}+\beta_9 INFR_{i,t}+\mu+\varepsilon \quad (3)$$

Arellano and Bond's (1991) dynamic GMM was used to estimate equation 2 whilst equation 3 was estimated using pooled ordinary least squares (OLS), fixed and random effects estimation techniques.

5.3. Data Analysis, Reporting of Results and Interpretation

All the data was found to be integrated of order 1 (Table 4). A long run relationship between and among all the variables used was detected (Table 5), thus paving way for main data analysis (Table 6).

Table 3: Mean GGE and economic growth trends in Southern and Western Africa (2001–2012)

Country	Total GGE (kt of CO2 equivalent)	GDP per capita
Southern Africa		
Botswana	48,547.63	5,292.74
Namibia	32,245.22	3,808.28
South Africa	482,467.27	5,378.39
Madagascar	119,543.00	353.80
Mozambique	331,618.01	399.62
Tanzania	219,820.65	523.97
Zambia	326,868.89	990.99
Western Africa		
Burkina faso	43,854.14	461.94
Ivory coast	28,617.29	1,021.68
Ghana	104,269.27	893.33
Guinea-Bissau	7,321.91	473.11
Liberia	2,487.05	237.47
Niger	10,460.03	283.62
Nigeria	310,395.07	1,252.44
Senegal	51,199.30	845.75
Sierra leone	21,096.31	348.87
Togo	21,859.98	416.59
Overall mean	127,333.59	1,351.92

Source: Author's compilation

Table 4: Panel root tests – individual intercept

Level				
Variable	LLC	IPS	ADF	PP
L (GROWTH)	−6.5959***	−0.3218	41.4123	58.4894***
L (GGE)	−3.1950***	−1.6917**	47.6081*	123.002***
L (FDI)	−3.7535***	−3.0708***	64.7289***	96.3956***
L (NATURAL)	−4.4268***	−1.6494**	55.1409**	61.6619***
L (POPUL)	−7.2378***	−2.7222***	70.2650***	41.0566
L (FIN)	−4.2733***	0.0177	35.5957	35.7181
L (OPEN)	−3.9710***	−0.3554	39.9668	29.7394
L (EXCH)	−6.5431***	−2.7970***	70.8353***	90.5300***
L (UNEMPL)	1.2874	2.0352	27.4278	12.5829
L (INFR)	−1.7981**	−0.7922	44.5595	35.8463
First difference				
L (GROWTH)	−9.0902***	−5.0363***	90.3578***	122.807***
L (GGE)	−11.4905***	−7.7695***	124.271***	271.656***
L (FDI)	−8.8333***	−5.8513***	102.998***	200.562***
L (NATURAL)	−9.9108***	−4.8616***	87.4703***	123.888***
L (POPUL)	−9.9050***	−4.3168***	86.5816***	85.8917***
L (FIN)	−4.5614***	−3.4899***	69.5578***	156.053***
L (OPEN)	−5.8959***	−3.6308***	75.4320***	116.437***
L (EXCH)	−7.9772***	−4.3582***	80.1325***	90.4147***
L (UNEMPL)	−1.6124*	−0.8926*	46.6980**	78.3466***
L (INFR)	−5.6019***	−3.3593***	70.7877***	148.782***

LLC, IPS, ADF and PP stands for Levin et al. (2002); Im et al. (2013); ADF fisher Chi-square and PP fisher Chi-square tests respectively. *, ** and *** denote 1%, 5% and 10% levels of significance, respectively. Source: Author's compilation from E-views

Under pooled OLS approach, GGE had a non-significant positive effect on economic growth in Southern and Western African countries, consistent with Cifci and Oliver (2018) whose study observed that an increase in GGE enhanced economic growth. Following authors such as Goldsmith (1969) Townsend (1983), McKinnon (1973) and Shaw (1973), the pooled OLS approach found out that financial development had a significant positive

influence on economic growth. The interaction between GGE and financial development produced a non-significant positive effect on economic growth, in line with theoretical expectation (Table 1).

Both GGE and financial development had a non-significant negative impact on economic growth under both the fixed and random effects framework, results which are theoretically backed (Table 1). Under both fixed and random effects, the interaction between GGE and financial development was found to have had a significant positive effect on economic growth, a finding which confirms theoretical predictions.

Following Nor et al. (2015), the dynamic GMM approach shows that the lag of economic growth had a significant positive influence on economic growth in the Southern and Western African countries studied. Consistent with not only the fixed and random effects results but theoretical literature in Table 1, the interaction between GGE and financial development had a significant positive impact on economic growth under the dynamic GMM framework.

Economic growth was positively and significantly influenced by FDI under the fixed effects whereas FDI was found to have had a non-significant positive influence on economic growth under both pooled OLS and random effects. The findings resonate with Romer (1986) and Lucas (1988) whose study noted that FDI flows into the host country alongside technology, expertise, capital, human capital, all of which are necessary ingredients for economic growth. The negative effect of FDI on economic growth, a finding under dynamic GMM was supported by Bornschier and Chase-Dunn (1985) whose study argued that FDI promotes a predominantly monopolistic economic structure which underutilises resources. Natural resources were found to have had a significant positive effect on economic growth under pooled OLS, fixed and random effects yet dynamic GMM approach observed that economic growth was positively but non-significantly affected by natural resources in the Southern and Western African nations studied. The findings to a larger extent resonate with Dunning's (1973) eclectic paradigm hypothesis which argued that natural resources enhance economic growth through its ability to attract FDI.

Under the pooled OLS, population growth was found to have had a significant negative effect on economic growth whereas economic growth was negatively but non-significantly influenced by population growth under both random effects and dynamic GMM approach. According to the fixed effects framework, population growth positively but non-significantly affected economic growth. Under all four estimation approaches used, trade openness had a significant negative effect on economic growth. Consistent with theoretical predictions, the depreciation of the local currency led to a significant negative impact on economic growth under pooled OLS, random effects and the dynamic GMM estimation approaches. On the other hand, the depreciation of the local currency non-significantly had a positive influence on economic growth. All these results are supported by theoretical literature (Table 1).

An increase in unemployment had a significant positive effect on economic growth under pooled OLS and a non-significant positive impact on economic growth under the random effects. The results resonate with a theoretical argument which says that high unemployment is synonymous with cheap labour thereby attracting foreign investment. The fixed effects show that unemployment had a non-significant positive influence on economic growth. Under pooled OLS and random effects approaches, infrastructural development had a significant positive causal effect on economic growth whereas under dynamic GMM framework, infrastructural development had a non-significant positive impact on economic growth. Last but not least, infrastructural development had a non-significant influence on economic growth in Southern and Western African nations studied, a finding which is inconsistent with most theoretical predictions.

Table 5: Kao residual co-integration test - individual intercept

Estimation technique	T-statistic	Probability
Augmented Dickey–Fuller (ADF)	−2.4156	0.0079

Source: Author's compilation from E-views

Table 6: Main data analysis - results

Variable	Pooled OLS	Fixed effects	Random effects	Dynamic GMM
$GROWTH_{i,t}$	-	-	-	0.9746***
GGE	0.0934	−0.0822	−0.1147	0.0512**
FIN	0.8499**	−0.4641	−0.1614	0.1733*
GGE.FIN	0.0465	0.0819**	0.0705**	0.0172**
FDI	0.0450	0.0519*	0.0319	−0.0140
NATURAL	0.1281*	0.3093***	0.1799***	0.0186
POPUL	−1.1492***	0.2752	−0.1367	−0.0576
OPEN	−0.4436***	−0.3027***	−0.2638**	−0.0193*
EXCH	−0.0399*	0.1950	−0.0763*	−0.0117**
UNEMPL	0.1474**	−0.1262	0.0186	−0.0099
INFR	0.2483***	−0.0026	0.1424***	0.0077
Number of countries	17	17	17	17
Number of observations	204	204	204	204
Adjusted R-squared	0.7675	0.9179	0.4482	0.9846
F-statistic	68.02	88.24	17.49	J-statistic 192.00
Prob (F-statistic)	0.00	0.00	0.00	Prob (J-statistic) 0.00

***, ** and * denote 1%, 5% and 10% levels of significance, respectively. Source: Author's compilation from E-views, OLS: Ordinary least squares, GMM: Generalized methods of momen

5.4. Robustness Tests

Equation 4 shows a lagged variable econometric model which was used to test for robustness.

$$GROWTH_{i,t}=\beta_0+\beta_1 GGE_{i,t-1}+\beta_2 FIN_{i,t-1}+\beta_3(GGE_{i,t-1}.FIN_{i,t-1})+\beta_4 FDI_{i,t-1}+\beta_5 NATURAL_{i,t-1}+\beta_6 POPUL_{i,t-1}+\beta_7 OPEN_{i,t-1}+\beta_8 EXCH_{i,t-1}+\beta_9 UNEMPLOY_{i,t-1}+\beta_{10} INFR_{i,t-1}+\mu+\varepsilon \quad (4)$$

The use of the alternative approach was found to be necessary consistent with Matthew and Johnson's (2014) argument that it takes a long time for macro-economic variables to have an effect on each other.

Whilst GGE had a non-significant positive influence on economic growth, the impact of financial development on economic growth was positive and significant under the pooled OLS approach. The combination of both GGE and financial development had a non-significant positive causal effect on economic growth under the pooled OLS framework. Both GGE and financial development had a non-significant negative influence on economic growth under fixed and random effects. Yet the interaction between GGE and financial development had a significant positive causal impact on economic growth under both fixed and random effects. This shows that whilst GGE and financial development might separately have a negative influence on economic growth, the growth of the economy is enhanced if both variables are interacted in the same economy (Table 7).

6. CONCLUSİON

The study had two major objectives. Firstly, to investigate the influence of GGE on economic growth. Secondly, to find out if the interaction between GGE and financial development enhanced economic growth in Southern and Western African nations. Four econometric estimation methods, namely dynamic GMM, pooled OLS, fixed and random effects were used with annual data ranging from 2001 to 2012. Theoretically, the positive and negative influence of GGE on economic growth is quite compelling. On the empirical front, four views have been emerged, (1) the positive influence of GGE on economic growth, (2) the negative effect of GGE on economic growth, (3) a bi-directional causality and (4) a negligible relationship between the two variables.

Currently, there exists some gaps in the literature. For example, no study that the author is aware of has so far explored the impact of the interaction between GGE and financial development on economic growth. Evidently, the existing theoretical and empirical literature shows a lack of consensus when it comes to the relationship between GGE and economic growth. The impact of GGE on economic growth was found to be positive but non-significant (pooled OLS), negative but non-significant (fixed and random effects) and positive and significant (dynamic GMM). The interaction between GGE and financial development was found to have had a significant positive effect on economic growth under the dynamic GMM, fixed and random effects.

The non-significant positive influence of the interaction between GGE and financial development on economic growth is a finding produced by the pooled OLS regression approach. Southern and Western African countries are therefore urged to implement policies aimed at deepening the levels of financial development in order to delete the negative effects of GGE on economic growth.

Table 7: The lagged independent variable approach (t-1)

Variable	Pooled OLS	Fixed effects	Random effects
GGE	0.0791	-0.0064	-0.0881
FIN	0.7919**	-0.1617	-0.0942
GGE.FIN	0.0398	0.0513*	0.0602*
FDI	0.0673*	0.0564*	0.0559*
NATURAL	0.1059	0.3057***	0.1566***
POPUL	-1.3218***	0.1529	-0.4301***
OPEN	-0.4344***	-0.2369**	-0.2461**
EXCH	-0.0401*	0.2789**	-0.0647*
UNEMPL	0.1270*	-0.1216	0.0606
INFR	0.1744***	0.0066	0.0739***
Number of countries	17	17	17
Number of observations	204	204	204
Adjusted R-squared	0.7696	0.9109	0.4357
F-statistic	68.80	80.78	16.67
Prob (F-statistic)	0.00	0.00	0.00

***, ** and * denote 1%, 5% and 10% levels of significance, respectively.
Source: Author's compilation from E-views, OLS: Ordinary least squares

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