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Institutional quality and green economic growth in West African economic and monetary union



Dado Fabrice Degbedji^a, Armand Fréjus Akpa^{a,*}, Augustin Foster Chabossou^a,
Romanus Osabohien^b

^a Laboratoire d'Economie Publique (LEP), Faculté des Sciences Economiques et de Gestion, Université d'Abomey-Calavi (UAC), Abomey-Calavi, Benin

^b Department of Economics and Development Studies, Covenant University, Ota, Nigeria

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ABSTRACT

Purpose: This study examined the how institutions influence green economic growth in the West African Economic and Monetary Union (WAEMU) countries with view to contributing to Sustainable development goal of good health and well-being (SDG 3), clean water and sanitation (SDG 6), decent work and economic growth (SDG 8), sustainable cities and communities (SDG11), responsible consumption and production (SDG12).

Methodology: The study made use of data sourced from the Development Indicators (WDI) and Governance Indicators (WGI) from 2002 to 2017 covering the eight (08) WAEMU countries. The study applied the Fully Modified Ordinary Least Squares (FMOLS), which is robust to the heterogeneity and endogeneity presence, to estimate the long-run parameters of the institutional quality effect on green economic growth.

Findings: Findings obtained from the study show that the institution's quality influence differs across the countries of study. The findings implication is that institutional quality enhances green economic growth. In specific terms, institutions level enhances green economic growth in counties such as Cote d'Ivoire, Mali, Niger, Senegal, and Togo. On the contrary, it however, deteriorates green economic growth in other countries such as Benin and Burkina Faso.

Conclusion: Against this finding, the study recommends that there is the need for WAEMU countries to consider the improvement of institutional framework, making sure that a robust institutional mechanism such as elimination of corruption, improve government effectiveness, strong credibility of government commitments and policies, an efficient judiciary, sound policies and regulations to reach the green economic growth desired level.

Implication: The findings implication is that good institutional framework such as good governance, control of corruption, political stability and absence of violence among others, are essential factors in promoting green economic growth. The findings highlight the importance of investment in renewable energy and sustainable agriculture as key drivers of green economic growth in the region. These findings have important implications for policymakers in the WAEMU region, as they provide evidence-based insights into the role of institutional quality in promoting sustainable and inclusive economic growth.

Originality: The study extends the frontiers of knowledge on green economic growth by using green economic growth a new established indicator that makes use of economic and environmental indices to ensure accurate and assessable economic prosperity.

1. Introduction

The preservation of the ecosystems is among the core aims of the Sustainable Development Goals (SDGs) achievement, particularly SDG 3 (good health and welfare), SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 18 (decent work and economic

growth), SDG 11 (sustainable cities), SDG 12 (responsible consumption and production), SDG 13 (climate change), SDG 14 (life below water) and SDG 15 (life on land). These goals are connected to attaining green economic growth which is an economic growth extension posits that economic prosperity is linked with environment preservation (Ahmed et al., 2022; Osabohien et al., 2022; Yin et al., 2022). Nevertheless, as

* Corresponding author.

E-mail addresses: fabricedegbedji95@gmail.com (D.F. Degbedji), frejusakpa@gmail.com (A.F. Akpa), achabossou@yahoo.fr (A.F. Chabossou), romik247@gmail.com (R. Osabohien).

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countries seek for development, it has resulted in environment pollution such as carbon emissions among others. Furthermore, these issues as a result of the quest for growth and development among others include climate change, land dilapidation, biodiversity loss, and deforestation (Ahmed et al., 2022; Hasnat et al., 2019).

However, to achieve green economic growth, suitably operational institution is needed (Ahmed et al., 2022; Haldar & Sethi, 2021; Karim et al., 2022). Seminal works by Williamson (1989) and North (1990) have stated that institutional quality remains one of the most major factors of economic growth. Indeed, according to Acemoglu and Robinson (2010), institutions frame and control rules and regulations in public by enforcing contextual limits. For Bhattacharya et al. (2017), institutions allow the government to decree needed environmental rules. Institutional indicators notably corruption, political stability, government regulation, the rule of law, and government efficacy, between others, are supposed to have a considerable influence on environmental policies and plans to lessen carbon emissions (Abid, 2017; Amin et al., 2021; Karim et al., 2022) and in turn to improve green economic growth. Mostly, institutional quality is linked to the policies executed by domestic institutions to fix official and cultural context, in which socio-economic activities occur (Salman et al., 2019). Therefore, showing the government ability to articulate and enact strategies and rules that boost private sector, expand contract execution quality, property rights defence, robust rule of law and the institutions neutrality from political impact (Canh et al., 2019; Salman et al., 2019). Alternatively, feeble institutions inadequately support private sector, which conducts to corruption, ineffective bureaucratic system and low environmental policies (Asoni, 2008; Salman et al., 2019). Also, Ahmed et al. (2022) stated that environmental governance proves that sustainability is realised via environmental guard, for which a powerful regime is required.

Though prior literature is of the view that institutional quality impacts economic growth (Adegboye et al., 2020; Botchouin, 2021; Campos et al., 2020) and carbon emissions (Bhattacharya et al., 2017; Karim et al., 2022; Salman et al., 2019), the institutional quality influence on green economic growth gained less attention (Ahmed et al., 2022). Thus, this current paper extends the frontiers of knowledge by examining the institutional quality impact on green economic growth in WAEMU countries. Indeed, WAEMU¹ states are chosen to analyse the effect institutional quality on green economic growth for two reasons. First, WAEMU nations is still experiencing increasing carbon emissions (Osadume & University, 2021; Youmanli, 2017). Also, industries establishment by foreign entrepreneurs joined with indigenous ones has made West African nations "pollution haven" due to feeble environmental regulations (Adu & Denkyirah, 2017; Osadume & University, 2021). The second reason is the poor institution quality because, according to the 2020 World Bank governance indicators (WGI), WAEMU nations drop behind main competitors in Africa and Asia in policy zones such as government effectiveness, control of corruption, regulatory quality, and rule of law (IMF, 2022).

This paper contributes to the extant literature by filling the gap between institutions and green economic growth and by showing that good governance is necessary to achieve economic growth which protects environment. Similarly, to control for country-specific effects, we stipulate a model by each country in the WAEMU region. This enables the study to draw a comparison among institutional quality the impact across countries. Furthermore, the study extends the frontiers of knowledge on green economic growth by using a green economic growth anew established indicator that makes use of economic and environmental indices to ensure accurate and assessable economic prosperity. In the same way, it helps policymakers to proffer accurate mechanisms for reaching a green economic growth agenda.

In the rest of this paper, the first part presents the theoretical and empirical literature association amongst institutional quality and green economic growth, the methodology used to analyse the data is presented

in the second part, then the results and the discussion section is presented in the third part, and the last part is devoted to the conclusions and policy implications.

2. Literature review

2.1. Theoretical literature review

Based on theory, capital and environmental governance nexus explains the association amongst quality and environmental sustainability (Ahmed et al., 2022; Osabohien et al., 2022). It implies that the actualisation of green growth agenda is via the preservation of the environment and the entire ecosystems. This requires that the government, based on environmental governance theory, should embark principles to mitigating carbon emissions. The advocates of this model are of the opinion that the proactiveness of the government and the environment quality nexus is direct. This is because the country's governance combines with environmental preservation actions, that significantly influence the standard of the environment resulting in sustainability.

On the other hand, capital theory which enhancement passes through capital accumulation, is one of the significant factors of sustainability (Ahmed et al., 2022). Both theories offer a concrete theoretical foundation for affirming that green economic growth is reached through the framework of the institutions at operation. This theoretical background affirms that prior studies by showing that green economic growth is compatible with sustainable development in three aspects (Fernando et al., 2019; Islam & Managi, 2019; Khoshnava et al., 2019), notably economic development, environmental conservation, and social sustainability.

The fundamental principle of environmental economics is that nature is capital, and, without its presence, economic activity cannot continue. Landmark work on sustainable income has led to the establishment of theoretical links between sustainable income and the depletion of natural resources. Hartwick (1977) shows that the rent from resource depletion should be exactly the level of capital investment required to achieve constant consumption over time. Daly (1990) argues that substitutability between natural resources and capital is limited, and that sustainability requires that total capital (man-made and natural) be kept intact.

The theoretical evolution of sustainability has led to the recognition that conventional national accounts such as gross domestic product and gross national product have not incorporated environmental degradation and resource depletion and cannot accurately measure sustainable income. In recent years, several studies have considered the aggregation of an economy's natural endowments as global stocks, similar to the accumulation of manufactured capital in national accounts (Thampapillai & Uhlin, 1997). The efforts of several international organizations such as the OECD, the World Bank and the United Nations have led to promising developments in environmental accounting and the estimation of green GDP in both developing and developed countries. Environmental accounting has also gained momentum in China, as its rapidly deteriorating environment has become a source of great concern to decision-makers.

2.2. Empirical literature review

Institutional quality influence on a country's ecological preservations and socioeconomic improvement has been examined by earlier literature (Ahmed et al., 2022; Salman et al., 2019; Sarkodie & Adams, 2018). Ahmed et al. (2022) concluded in South Asian that institutional quality and financial development improve long-term green economic growth. Similarly, Osabohien et al. (2022) shows that green environment significantly impacts welfare and overall, the economy growth. The results obtained by Salman et al. (2019) in three Asian economies (Indonesian, Korean, and Thai) can be summarized in three ways; #1: effective local institutions are important for the economic growth enhancement and concurrently mitigating carbon footprints; #2: institutional quality, energy consumption, and trade openness are economic growth important factors; and #3: in the short and long-term, uni-directional relationship is

¹ Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

experienced amongst the framework of institutions and economic growth, carbon footprints and energy consumption.

Lau et al. (2014a,b) found in Malaysia that good institutions were necessary to decrease carbon emissions in the quest for economic development. Also, Abid (2017) found in 41 European Union (EU) and 58 Middle East and Africa (MEA) countries that good institutions are crucial not only for the enhancement of economic growth but also for the mitigation of carbon emissions. Similarly, Bhattacharya et al. (2017) found that institutions play an essential role in economic growth and for the lessening of carbon emissions and this in 85 advanced and developing economies. The Sarkodie and Adams (2018) study's submitted that in South Africa that disaggregated and aggregated energy, economic development, urbanization, and political institutions occupy a key position in environmental quality.

Charfeddine and Khediri (2016) found in the United Arab Emirates that environment quality of is enhanced by electricity consumption, urbanization, and trade openness. Raju et al. (2020) offered evidence to prove that, in the South Asian economy, governance and economic growth are determined by political principles, administrative solidity, and continuity in the rule of law. Nawaz (2015) found in Asia a diverse correlation amongst institutions and economic growth among countries. In addendum, the long-run impact of institutions on economic growth is more active in developed than in developing countries.

Similarly, Shapkova and Makrevska (2017) found in the emerging economies of Central and Eastern Europe and the Balkans that institutional quality particularly rule of law, corruption control, regulatory quality, and voice and accountability advance economic growth. In contrast, Gani (2011) found in developing countries that corruption control reduces economic growth. Siddiqui and Ahmed (2019) found in Pakistan a long-run association amongst institutional quality and economic growth and unidirectional causality amongst institutional quality and economic growth, running from institutional quality to economic growth. Montassar and Gaaliche (2013) found in Tunisia using a vector error correction model (VECM) that there is a causal association amongst governance and economic growth.

In summary, the study concludes from the literature review that: Most of them highlight the association amongst governance, economic growth, environmental performance, and social progress. But the institution's quality and green economic growth nexus has been relatively excluded or has received little discussion. In this regard, we examine through this study the institutional quality effect on green economic growth in WAEMU countries. We apply the green economic growth measures proposed by Ahmed et al. (2022) and Sohag et al. (2015).

3. Methodology

3.1. Specification of the model

Founded on the above theoretical assumptions, this work develops an econometric model to analyse the institutional quality effect on green

economic growth in WAEMU countries, referring to Ahmed et al. (2022), Bhattacharya et al. (2017) and Salman et al. (2019). Equation (1) presents the empirical model as follows:

$$GEGC_{it} = \beta_0 + \beta_1 QI_{it} + \beta_2 FD_{it} + \beta_3 TRADE_{it} + \beta_4 ELEC_{it} + \beta_5 IVA_{it} + \varepsilon_{it} \tag{1}$$

where $GEGC_{it}$ represents the green economic growth per capita computed using the formula of equation (2), QI_{it} indicates the institutional quality obtained by PCA on the six governance indicators (appendix 1), FD_{it} financial development captured by the share of credit extended to the private sector in % of GDP, $TRADE_{it}$ is the trade openness measured as the sum of import and export divided by GDP, $ELEC_{it}$ denotes the access to electricity and IVA_{it} captures the industry value added. Similarly, ε_{it} refers to the error term, $i(i=1, 2, \dots, 8)$ is the countries studied and $t(t=2002, \dots, 2017)$ is the study period. In the model, β_0 refers to the constant term, while β_1, \dots, β_5 are the parameters to be estimated.

In this study, green economic growth refers to the dependent variable, which is calculated according to the green economic growth measure proposed by Ahmed et al. (2022) and Sohag et al. (2019), which is represented in equation (2):

$$GGDPC_{it} = GDPC_{it} + Educ_{it} - Min_{it} - For_{it} - CO_{2it} \tag{2}$$

where $Educ_{it}$ is the education expenses, Min_{it} denotes the minerals such as coal, crude oil and natural gas depletion in monetary value, For_{it} represents the forest depletion in monetary value and CO_{2it} is the carbon dioxide emissions in monetary value.

3.2. Data and sources

Empirically, this study examines the institutional quality contribution to green growth in WAEMU countries. For this purpose, data were obtained from the World Bank's World Development Indicators (WDI) and World Governance Indicators (WGI) over the period 2002–2017 (Table 1). Green economic growth is the dependent variable and is calculated as GDP per capita plus education expenditure minus minerals such as coal, oil and natural gas depletion in monetary value, the deforestation in monetary value and the carbon dioxide emissions in monetary value of each country. This variable provides from the WDI, and this choice is based on Ahmed et al. (2022) and Sohag et al. (2015). Our results reveal that average per capita green economic growth over the period is -14.497 , ranging from -122.019 to 59.349 . Thus, on average, the green economic growth of the WAEMU countries has been destroyed (Table 2).

The interest variable is institutional quality, which is obtained by using PCA on the six governance indicators variables, which are obtained from the WGI. The variable use is supported by Adegboye et al. (2020), Ahmed et al. (2022) and Sarkodie and Adams (2018). The expected sign

Table 1
Estimation variable description.

Variables	Measures	Sources	Signs
GEG	Green economic growth, measured as GDP per capita plus education expenditure minus minerals such as coal, oil and natural gas depletion in monetary value, the deforestation in monetary value and the carbon dioxide emissions in monetary value of each country	Ahmed et al. (2022)	
QI	Quality of institution, first principal component of corruption control, political stability, governance effectiveness, rule of law, regulatory quality and voice and accountability	WGI/PCA	+
FD	Financial development, measured by the domestic credit provide by banks to the private sector (% of GDP)	WDI	+
ELEC	Population access to electricity (in %)	WDI	+/-
TRADE	Trade openness, measured as the sum of export and import of goods and services divided by growth domestic product.	WDI	+/-
IVA	Industry, value added (% GDP)	WDI	+/-

Note: WDI means World Development Indicators, WGI means World Development Indicators, PCA means Principal Component Analysis.
Source: Authors.

Table 2
Variables descriptive statistics.

Variables	Mean	Std deviation	Min	Max
Green economic growth per capita	-14.497	40.168	-122.019	59,349
Institutional quality	-5.160e-08	1.968	-4.281	3.689
Control of corruption	-0.692	0.368	-1.562	0.176
Government effectiveness	-0.626	0.476	-1.766	0.451
Quality of regulation	-0.586	0.307	-1.261	-0.047
Political stability/absence of violence	-0.505	0.676	-2.264	0.820
Voice and accountability	-0.373	0.504	-1.383	0.409
Rule of law	-0.694	0.405	-1.585	0.065
Financial development	17.239	8.124	0.738	41.799
Trade openness	30.957	8.773	15.366	59.051
Electricity	30.340	17.966	0	65.635
Industry	19.471	3.841	12.253	28.372

Source: Authors' computation.

is positive, implying that institutional quality rises green economic growth. With a minimum of -4.281 and a maximum of 3.689, the institutional quality average value is also -5.16e-08 (Table 2). Also, Table 3 shows that globally, the mean of each governance indicators is negative, indicating the weakness of institutional quality in WAEMU.

Financial development is captured by domestic credit from banks to the private sector as a percentage of GDP and provided from Li et al. (2020) and Zakaria and Bibi (2019). The expected sign is positive, implying that financial development through credit provision to the private sector increases private sector investment in pollution-free technology, which increases green economic growth. Financial development has an average of 17.239, with a minimum and maximum of 0.738 and 41.799, respectively. Electricity access is measured by the population percentage with electricity access. It is provided by Charfeddine and Khediri (2016), Sarkodie and Adams (2018) and Akpa et al.

Table 3
Panel unit root tests results.

Variables	Statistics without time trend	Statistics with time trend	Orders of cointegration
Levin-Lin-chu test			
Green economic growth per capita	-20.493***	-16.737***	I (1)
Institutional quality	-11.873***	-23.354***	I (1)
Financial development	-6.943***	-4.527***	I (0)
Trade openness	-17.183***	-10.492***	I (1)
Electricity	16.152***	-15.191***	I (0)
Industry	-15.197***	-24.932***	I (0)
Im-Pesaran-Shin test			
Green economic growth per capita	-12.260***	-5.290***	I (1)
Institutional quality	-1.765**	-2.508***	I (0)
Financial development	-6.296***	-26.896***	I (1)
Trade openness	-4.937***	-2.470***	I (0)
Electricity	-8.939***	-5.440***	I (0)
Industry	-7.325***	-7.269***	I (0)
Harris-Tzavalis test			
Green economic growth per capita	-0.833***	-0.832***	I (1)
Institutional quality	-0.107***	-0.044**	I (1)
Financial development	-0.130***	-0.085***	I (0)
Trade openness	-0.474***	-0.530***	I (0)
Electricity	-0.490***	-0.514***	I (0)
Industry	-0.221***	-0.233***	I (0)
Hadri LM test			
Green economic growth per capita	-1.865	2.686***	I (1)
Institutional quality	4.180***	6.646***	I (0)
Financial development	0.278	6.232***	I (0)
Trade openness	1.144	2.425***	I (0)
Electricity	-1.897	1.360*	I (0)
Industry	-1.501	2.841***	I (1)

Source: Authors computation (***)p < 0.01, **p < 0.05, *p < 0.1).

(2023) and its expected sign is mixed. Access to electricity averages 30.340, with minimum and maximum values of 0 and 65.635.

The trade openness is measured as the exports and imports of goods and services sum divided by GDP. The variable choice is supported by Bendinelli et al. (2020) and the expected sign is mixed. Trade openness ranges from 15.366 to 59.051 and averages 30.957. Industry, value added is considered as the wealth created by industries in WAEMU countries that could impact green growth. It is introduced in the model following Zahid et al. (2022) and Khan et al. (2020). The average industrial value added is 19.471. The minimum and maximum are 12.253 and 28.372.

All estimation variables used, their measurements and expected signs are summarized in Table 1 and their descriptive statistics are reported in Table 2.

3.3. Econometric techniques procedures

Due to the data nature (long-T > N panel) and potential non-stationarity, the analysis started with the diagnostic tests. The panel unit root tests of Levin-Lin-Chu (2002) and Harris-Tzavalis (1999) which assume the cross-sectional elements homogeneity were carried out. However, these tests defend the restrictive hypothesis of stationarity or not in all the transverse elements, without leaving room for variability. To this end, the tests of Im-Pesaran-Shin (2003) and Hadri (2002) allowing to consider the heterogeneity between the transversal units were carried out. These tests allow some flexibility, allowing for the possibility that some series are capable of having unit roots individually. The study used first- and second-generation panel cointegration tests; they are Pedroni's test (1999) based on residuals, Kao's test (1999) and Westerlund's test (2007) based on error correction. Pedroni's test allowed heterogeneity between cross-sectional elements by using idiosyncratic parameters, which allow differing between section units. Unlike the Pedroni tests, Kao considers the special case where the cointegration vectors are assumed to be homogeneous between individuals. As for Westerlund who developed a method based on error correction, doesn't impose a common factor restriction and is based on structural rather than residual dynamics.

Due to the inconsistency and asymptotic bias of the OLS estimator when applied to a cointegrated panel, as well as the potential endogeneity of the regressors, fully modified OLS estimators (FMOLS) (Abubakar et al., 2015; Ahmed et al., 2022; Yang, 2019) were used. FMOLS use the long-term covariance matrix to correct the dependent variable and then apply standard OLS (Ahmed et al., 2022; Kao & Chiang, 2000; Latif et al., 2018). To test non-causality, the Granger causality test developed by Dumitrescu and Hurlin (2012) is used; it allows the heterogeneity of the coefficients between the transversal units. The test takes into consideration two categories of heterogeneities, namely the heterogeneity of the causal relationship as well as that of the underlined regression model. The main advantage of this test is that it has very good properties for small samples, even when there is a cross-sectional dependence.

4. Results and discussion

4.1. Panel unit root test

The results of the Levin-Lin-Chu, Harris-Tzavalis, Im-Pesaran-Shin and Hadri stationarity tests are presented in Table 3. The Levin-Lin-Chu, Harris-Tzavalis and Im-Pesaran-Shin tests have as the null hypothesis that all panels contain a unit root. Hadri Lagrange multiplier test is a null hypothesis that all panels are (trend) stationary. The results indicated that, for all individuals, we reject the null hypothesis for the Levin-Lin-Chu, Harris-Tzavalis, and Im-Pesaran-Shin tests. The results also showed the rejection of the hypothesis of the presence of unit root for the Hadri test with trend included. Thus, for the four tests, all the variables are stationary for different orders of cointegration.

4.2. Co-integration test

Table 4 reported the cointegration tests outcome. Different cointegration test such as Pedroni (1999), Kao (1999) and Westerlund and Edgerton (2007) tests were used to test the long-run association existence. The different cointegration tests outcomes revealed at 1% significance level, the rejection of the no cointegration null hypothesis. The results reveal the existence of a long-run association amongst estimated variables.

4.3. Estimation results

FMOLS approach, which is robust to the heterogeneity and endogeneity presence was used to estimate the long-run parameters of institutional quality effect on green economic growth. It should be noted that to ensure that the results are free from heteroskedasticity and endogeneity, the FMOLS approach uses heteroscedasticity standard errors that fit a model with heteroskedastic residuals.

The institutional quality coefficient, at 1% level is negative and significant for Benin and Burkina Faso, as shown in Table 5. The plausible explanation for Benin and Burkina Faso is that the two countries didn't reach institutional quality level which allows to promote green economic growth. Also, Burkina Faso's outcome can be explained by the several military coups experienced by the country in the last years and that makes him instable while Benin's outcome can be explained by the degradation of freedom of expression. Or, when individuals are deprived from their freedom of expression, it's impossible for them to denounce irregularities. However, the effect is positive in Cote d'Ivoire, Mali, Niger, and Senegal and at 10% level in Togo. Thus, one unit increase in institutional quality reduces green economic growth level by 1.777 and 0.384 units for Benin and Burkina Faso, respectively. Furthermore, for Cote d'Ivoire, Mali, Niger, Senegal and Togo, one unit increase in institutional quality increases green economic growth by 1.013, 4.370, 0.164, 2.027 and 1.812 units, respectively. However, it should be noted that institutional quality shows no significant relationship for Guinea-Bissau. The panel evidence suggests that at 1% level, institutional quality coefficient is positive, which means that one unit rise in institutional quality increases green economic growth per capita by 1375 units in the WAEMU. This outcome suggests that green economic growth is promoted by a sound institutional framework with low levels of corruption, efficient government officials, strong credibility of government commitments and policies, an efficient judicial system, sound policies and strong regulations. The panel findings as soon as those of Cote d'Ivoire, Mali, Niger, Senegal and Togo were consistent with Ahmed et al. (2022), Bhattacharya et al. (2017), and Sarkodie and Adams (2018), which showed that institutional quality was a determining factor in encouraging long-term green economic growth in South Asian countries, developed and

Table 4
Panel cointegration tests results.

Pedroni (1999) cointegration		
	Statistic	P-value
Modified Phillips-Perron t	7.087***	0.000
Phillips-Perron t	-3.185***	0.000
Augmented Dickey-Fuller t	2.733***	0.003
Kao (1999) cointegration		
Modified Dickey-Fuller t	2.085**	0.018
Dickey-Fuller t	-1.760**	0.039
Augmented Dickey-Fuller t	-1.352*	0.088
Unadjusted modified Dickey-Fuller t	-5.889***	0.000
Unadjusted Dickey-Fuller t	-9.037***	0.000
Westerlund and Edgerton (2007)		
Variance ratio	9.941***	0.000

Source: Authors (***p < 0.01, **p < 0.05, *p < 0.1).

emerging markets, and South Africa, respectively. However, those of Benin and Burkina Faso are contrary to it.

The financial development effect, at 1% level is positive and significant for Benin, Burkina Faso, Mali, Senegal and at 10% level for Cote d'Ivoire, but for Guinea Bissau and Niger, the effect was negative and significant at the 1% level. This involves that one unit increase in financial development is likely to improve green economic growth by 3.392, 1.738, 1.481, 2.181 and 3.476 units respectively for Benin, Burkina Faso, Cote d'Ivoire, Mali, and Senegal. Conversely, one unit increase in financial development decreases green economic growth by 0,441 and 2832 units for Guinea-Bissau and Niger respectively. In Togo, however, its effect on green economic growth is insignificant. The overall estimate for all eight WAEMU countries shows that the financial development coefficient at 1% level is negative, implying that one unit rise in financial development decreases green economic growth in the WAEMU by 2.073 units. This result is therefore an indication that the financial system in the WAEMU isn't conducive to the environment quality improvement. In other words, the financial system in the WAEMU doesn't provide industries with access to advanced technology machinery that is less harmful to the environment due to the presence of constraints. It also doesn't allow the energy provision to the population, which would improve the individual life quality and thus promote social and economic sustainability. The findings of Benin, Burkina Faso, Cote d'Ivoire, Mali and Senegal were supported by Li et al. (2020) and Zakaria and Bibi (2019), who showed that financial development improves green growth in the ECOWAS countries and the economies of South Asia, respectively. But the findings of the panel as soon as those Guinea Bissau and Niger were contrary to it.

Trade openness coefficient at 1% level, is negative for Benin, Burkina Faso, Guinea-Bissau, and Togo, but shows at 1% level, a positive effect for Mali, Niger, and Senegal, and at the 5% level for Cote d'Ivoire. Thus, for Benin, Burkina Faso, Guinea Bissau and Togo, one unit increase in trade openness reduces green economic growth by 0.798, 1.561, 0.743 and 1.493 units, respectively. However, for Cote d'Ivoire, Mali, Niger, and Senegal, growth in trade openness rises green economic growth by 0.446, 2.420, 0.545, and 0.422 units, respectively. The panel outcome involves that trade openness coefficient at 1% level, is negative and significant, implying that one unit increase in trade openness is related to 1.666 unit decrease in green economic growth per capita. The plausible explanation is that countries import fossil fuel-based energy technologies, which may threaten the environment. The panel outcomes as soon as those of Benin, Burkina Faso, Guinea Bissau and Togo are related to Adedoyin et al. (2020) and Tawiah et al. (2021), who showed that trade openness deteriorates green economic growth in the most prominent European and in advanced and emerging countries, respectively. However, the findings of Cote d'Ivoire, Mali, Niger, and Senegal are contrary to it.

Electricity coefficient is negative at 1% level for Benin, Burkina Faso, and Senegal, but it has at 1% level, a positive effect for Guinea Bissau, Mali and Niger. This implies that for Benin, Burkina Faso and Senegal, one unit rise in electricity reduces green economic growth by 0.741, 1.260 and 0.800 units, respectively. In contrast, for Guinea Bissau, Mali, and Niger, one unit increase in electricity is expected to raise green economic growth by 0.568, 1.182 and 0.901 units, respectively. In Togo, electricity coefficient is negative but insignificant. The panel result suggests that electricity coefficient is, at 1% level positive, involving that one unit rise in electricity increases green economic growth per capita by 2.448 units in the WAEMU. This outcome is clarified by the fact that access to electricity can be a stimulus for new technologies adoption in the household food sector, which can reduce coal-based technologies use and environment degradation. The panel findings as soon as for Guinea Bissau, Mali and Niger are similar to those of Charfeddine and Khediri (2016) and Sarkodie and Adams (2018), who showed that electricity was key drivers of green economic growth in the United Arab Emirates (UAE) and Africa, respectively. However, the results of Benin, Burkina Faso, and Senegal are related with Tawiah et al. (2021), who exhibited that electricity negatively affects green growth in developed and emerging

Table 5
Long-run elasticity results using FMOLS technique.

Dependent variable: Green economic growth per capita					
	Institutional quality	Financial development	Trade openness	Access to electricity	Industry, value added
Benin	-1.777*** (0.063)	3.392*** (0.072)	-0.798*** (0.082)	-2.528*** (0.135)	-0.741*** (0.207)
Burkina-Faso	-0.384*** (0.019)	1.738*** (0.037)	-1.561*** (0.026)	-0.414*** (0.044)	-1.260*** (0.035)
Côte d'Ivoire	1.013*** (0.366)	1.481* (0.764)	0.446** (0.195)	0.380 (0.383)	3.111*** (1.114)
Guinea Bissau	-0.038 (0.170)	-0.441*** (0.162)	-0.743*** (0.138)	0.568*** (0.085)	-0.057 (0.358)
Mali	4.370*** (0.192)	2.181*** (0.173)	2.420*** (0.168)	1.182*** (0.178)	1.194*** (0.218)
Niger	0.164*** (0.021)	-2.832*** (0.049)	0.545*** (0.014)	0.901*** (0.048)	-0.085*** (0.028)
Senegal	2.027*** (0.137)	3.476*** (0.273)	0.422*** (0.123)	-0.800*** (0.104)	-8.523*** (0.359)
Togo	1.812* (0.940)	0.907 (0.576)	-1.493*** (0.239)	-1.215 (1.002)	2.451** (1.775)
Panel (FULL)	1.375*** (0.507)	-2.073*** (0.212)	-1.666*** (0.153)	2.448*** (0.075)	2.155*** (0.298)

Source: Authors' computation (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

countries.

The added industry coefficient is, at 1% level negative for Benin, Burkina Faso, Niger, and Senegal, but it shows at 1% level, a positive and significant effect for Cote d'Ivoire, Mali and at the 5% level for Togo. Thus, for Benin, Burkina Faso, Niger and Senegal, one unit increase in industry reduces green economic growth by 0.741, 1.2604, 0.085 and 8.523 units respectively. On the other hand, for Cote d'Ivoire, Mali and Togo, one unit increase in industry increases green economic growth by 3.111, 1.194 and 2.451 units, respectively. However, industry has no significant relationship with Guinea Bissau. The panel result suggests that industry coefficient is, at 1% level positive and significant, indicating that one unit increase in industry raises green economic growth per capita by 2.155 units in the WAEMU. This result suggests that the more wealth creation industries have, the less environmental degradation they cause. The implication is that they have sufficient resources to invest more in cleaner technologies. The panel findings as soon as those of Cote d'Ivoire, Mali and Togo corroborate [Zahid et al. \(2022\)](#) and [Khan et al. \(2020\)](#) studies who show that industry determines green economic growth levels in China. However, the findings of Benin, Burkina Faso, Niger, and Senegal are contrary to it.

[Table 6](#) below presents the results of the Dumitrescu-Hurlin panel Granger non-causality test. The results show a unidirectional causality runs from quality of institutions, access to electricity and industrialisation to green economic growth, respectively.

5. Conclusion and economic policy measures

To reach sustainable development, green economic growth is essential. Recent empirical work argues that the institutions quality has an impact on economic growth, but little of this work has examined the institutional quality role in green economic growth. This study follows this line of reasoning and analyses the institutional quality impact on green economic growth in WAEMU countries from 2002 to 2017. It is based on data from the World Bank's Development Indicators and the World Bank Governance Indicators. Cointegration techniques are used to test for long-run cointegration between the modelled variables. The paper found that the variables are co-integrated in the long run. In the same vein, the study analyses the effect of institutional quality on long-run green growth using the FMOLS approach. Across WAEMU member countries, the FMOLS results reveal that institutional quality effect is heterogeneous. For the panel group, the study found that institutional quality improves green growth. More specifically, institutional quality improves green growth in Cote d'Ivoire, Mali, Niger, Senegal, and Togo,

Table 6

Dumitrescu-hurlin panel granger non-causality test.

Null Hypothesis	W-Stat.	Z-bar-Stat.	P-value
ΔQI does not Granger-cause $\Delta GEGC$	2.014	3.028	0.004
$\Delta GEGC$ does not Granger-cause ΔQI	1.347	0.695	0.486
ΔFD does not Granger-cause $\Delta GEGC$	1.034	0.069	0.944
$\Delta GEGC$ does not Granger-cause ΔFD	0.272	-1.454	0.145
$\Delta ELEC$ does not Granger-cause $\Delta GEGC$	2.676	3.352	0.000
$\Delta GEGC$ does not Granger-cause $\Delta ELEC$	0.732	-0.534	0.593
$\Delta TRADE$ does not Granger-cause $\Delta GEGC$	0.512	-0.975	0.329
$\Delta GEGC$ does not Granger-cause $\Delta TRADE$	0.897	-0.204	0.838
ΔIVA does not Granger-cause $\Delta GEGC$	2.541	3.083	0.002
$\Delta GEGC$ does not Granger-cause ΔIVA	1.217	0.435	0.663

Source: Authors' computation.

while it worsens green growth in Benin and Burkina Faso. The justification provided for Benin and Burkina Faso is that the two countries didn't reach institutional quality level which allows to promote green economic growth. Also, Burkina Faso's outcome can be explained by the several military coups experienced by the country in the last years while Benin's outcome can be explained by the degradation of freedom of expression.

The research outcomes called for insightful policies implication both for government and policymakers. A good institutional quality is needed to reach green economic growth in developing countries, especially in WAEMU countries. The achievement of green economic growth needs an integrated policies to be efficient. Thus, WAEMU countries need to pay particular attention to developing quality institutions by ensuring a sound institutional framework with low corruption levels, effective civil servants, credible government commitments and policies, an efficient judicial system, and sound policies and regulations to achieve desired levels of green economic growth. The promotion of renewable energy is essential in the process of green economic achievement. So, WAEMU governments must take action to ensure the transition from pollutant energy to non-pollutant energy which is essential to achieve green economic growth and good for life quality. However, access to renewable energies is expensive because African countries imported them from developed countries. To lower the price of renewable energies, the African governments need to invest in education by installing engineering schools on renewable energy which is necessary to achieve an economic growth that considers environment protection. Also, scholarships can be provided to Africa's best students to learn from advanced nations on renewable energies and policies must be taken in their home country to

ease their return and to allow them to share their knowledge in the renewable energy engineering schools. To ease engineering schools building, private sector notably financial institutions must be considered to fund the installation of engineering schools. Some efforts need to be made in the domain of electricity access because in Africa electricity access remains low. Even if some countries' access to electricity is high, the permanent availability of it constitutes a challenge. Indeed, electricity is necessary to make functional industries and for the development of engineering schools. All the above actions put together will allow to reach green economic growth. The study's social impact is that it contributes to the policy dialogue for the accomplishment of the Sustainable Development Goals 3, 6, 7, 8, 11, 12, 13, 14 and 15.

Better access to finance will promote green economic growth through access to non-pollutants technologies. This study didn't study this part, so further studies can investigate the role of financial access on green economic growth.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.igd.2023.100108>.

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