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Inclusive green growth in Africa: does institutionalized democracy matter?

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Abstract

The quality of institutions, especially institutionalized democracy, is an important determinant of inclusive green growth in Africa. Using data from 39 African countries over the period 2002 to 2022, this study examines the effect of institutionalized democracy on inclusive green growth. In order to address heteroscedasticity and conditional heterogeneity, we used the Driscoll-Kraay method and the Generalized Method of Moments (GMM) to address endogeneity. The main result of this study reveals that institutionalized democracy accelerates inclusive green growth. Therefore, it is essential for African countries to strengthen democratic institutions.

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1. Introduction

African states have established a long-term development plan called “The *Africa We Want.*" Agenda 2063 aims to foster shared prosperity, strengthen the continent's institutional capacity, improve environmental quality, and ensure that Africa becomes a significant global player by 2063.

Moreover, recent developments highlight the concept of inclusive green growth which means achieving an economically, socially and environmentally sustainable growth trajectory (De Pascale and Romagno 2024, Shikha *et al.* 2018). Inclusive green growth, which takes into account green growth, inclusive growth and growth, is a sustainable development model that aims to pursue a comprehensive and harmonious growth of humanity, the economy, society and the environment (Fan et *al.* 2023, Ofori *et al.* 2024).

Thus, in order to stimulate inclusive green growth, it is of crucial importance to prioritize good institutional governance and promote environmentally friendly investments to achieve sustainable and resilient economic development. These institutional factors can shape economic incentives and promote sustainable and inclusive growth (North 1990, Przeworski and Curvale 2006, Lee and Kim 2009). However, political institutions are not synonymous with democracy, as is often misunderstood; democracy is a necessary condition for political systems that cultivate the kind of values and participation needed for sustainable and inclusive green growth (Anderson and Guillory 1997; O'Brien and Leichenko 2003, Acemoglu and Robinson 2022).

In addition, having democratic elections or regimes is not enough (Anderson and Guillory 1997, Przeworski *et al.* 2000; Wittman 1995). Elections aimed at democracy, if organized in a clientelist context, in non-competitive places such as those where certain personalities dominate politics, will not be enough to target inclusive and sustainable green growth (Barber 2017).

However, several recent studies reveal contrasting effects of institutional quality on inclusive green growth (Li and Tong 2024, Liu and Zhang 2024, Ofori and Figari 2022). Specifically, to our knowledge, few studies have addressed the effect of institutionalized democracy on inclusive green growth.

According to the African Development Bank (AfDB 2016), investing 2% of global GDP in greening can ensure economic growth by 2050 at least as high as the generally accepted optimistic scenario, while creating jobs, reducing poverty, and avoiding environmental risks. Green investments in land, water, and energy of between $900 billion and $1.7 trillion (USD) could generate economic returns of between $3 and $3.7 trillion per year. Moreover, under a business-as-usual scenario, productivity levels in 2030 will be 2.4% lower than today and 7.3% lower in 2050.

This article is interesting because it not only fits into the rich literature on the relationship between governance and inclusive green growth but also specifically examines the effect of institutional democracy on inclusive green growth. Indeed, previous studies have analyzed the effect of the 6 pillars of institutional quality namely voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption on green growth (Ofori and Figari 2023). Some studies have captured good governance through democracy but have examined the effect of the latter on environmental quality (Akalin and Erdogan 2021, Nguea and Fotio 2023, Ganda 2024, Emmanuel *et al.* 2023), on economic growth (Colagrossi *et al.* 2020), on inclusive growth (Sama-lang 2024) or on green technology (Zecca and Nicolli 2021). In addition, we constructed three composite indices, namely inclusive green growth, green growth and inclusive growth. Furthermore, only the study by Ofori and Figari (2022) analyzed the effect of governance on a composite index of inclusive green growth.

Thus, our study makes three main contributions. First, it is topical and, to our knowledge, the first study to examine the effect of institutionalized democracy on inclusive green growth from an African perspective. Second, despite the fertility of the literature on the analysis of the economic effects of political governance, this study aims to test the explanatory power of the objective approach to measuring institutionalized democracy in the analysis of inclusive green growth in Africa. Third, we have constructed a composite index of inclusive green growth.

The remainder of the article is organized as follows: Section 2 presents a literature review on the link between institutionalized democracy and inclusive green growth. Section 3 presents the methodology. Section 4 presents and discusses the main results. Section 5 concludes the article.

2. Literature review

The relationship between democracy and inclusive green growth is well established. Indeed, studies have shown that democracy has an effect on environmental quality (Akalin and Erdogan 2021, Nguea and Fotio 2023, Emmanuel *et al*. 2023, Ganda 2024), on inclusive growth (Sama-lang 2024), on economic growth (Colagrossi *et al*. 2020), and on sustainable development (Rwigema 2024).

By examining the effect of foreign capital, domestic capital formation, institutional quality, and democracy on the ecological footprint in a global panel of 101 countries from 1995 to 2017, Emmanuel *et al.* (2023) showed that institutional quality systematically improves environmental quality. Furthermore, democratic activities show a mixed result with a long-term improving effect on environmental quality. Zecca and Nicolli (2021) showed that democratization plays a key role in supporting green technology change by analyzing the factors influencing the development of new environmentally friendly innovations. Using quantile regression on a panel of 45 countries between 1990 and 2019, Nguea and Fotio (2023) proved that democracy reduces CO_2 emissions in both low- and high-emitting countries. Similarly, Ganda (2024) showed by analyzing the role of factors such as democracy, economic growth, corruption, and ICT on carbon emissions in SSA. He found that democracy is negatively associated with carbon emissions. Furthermore, effective leadership and cultural democracy promote sustainable development in East Africa (Rwigema 2024).

However, democracy does not always have the expected effects in terms of inclusive green growth. Indeed, by examining the link between democracy and environmental degradation in 26 OECD countries between 1990 and 2015, Akalin and Erdogan (2021) showed that democracy has a negative effect on environmental quality. Furthermore, democracy can also reduce inclusive growth. For example, Sama-lang (2024) showed that the Freedom in the World (FIW) score has a negative association with inclusive growth in SSA. Moreover, democracy can also, to some extent, hamper economic growth (Tavares and Wacziarg 2001).

3. Methodology

3.1. Data and justification for the inclusion of variables

3.1.1. Data Description

To assess the effect of institutionalized democracy on inclusive green growth, we use a set of variables from the World Bank (2024). The study uses macroeconomic data covering the period

2002-2022 for 39 sub-Saharan African countries. The list of countries is in Table A2. The essence of the study period is to allow for a robust analysis, as it coincided with the period during which African leaders committed to multidimensional sustainability in line with the 2030 Agenda. Also, the choice of the study period and sampled countries depends on reliability, data availability, and having at least 15 annual observations on all components of X.

3.1.2. The dependent variable

Our main dependent variable is Inclusive Green Growth (IGG); it is a composite indicator that we constructed using the PCA method using 21 variables. We also use a composite Green Growth (GG) index constructed based on 11 variables and a composite Inclusive Growth (IG) index constructed using the PCA method based on 15 variables (Table A3). The construction of the composite inclusive green growth indicator requires standardization of the indicators to make them comparable. We rely on the work of the OECD (2008) and Halkos *et al*. (2021). For the steps of construction and use of composite measures. Each of the 21 indicators considered for the compilation of the inclusive green growth index is standardized in the interval [0,1] using the min-max method, where the minimum and maximum values are taken in each sample of indicators.

$$I_{ic}^{t} = \frac{x_{ic}^{t} - \underset{c}{minx_{i}^{t}}}{\underset{c}{maxx_{i}^{t}} - \underset{c}{minx_{i}^{t}}} \qquad (1)$$

$$I_{ic}^{t} = \frac{\underset{c}{maxx_{i}^{t}} - x_{ic}^{t}}{\underset{c}{maxx_{i}^{t}} - \underset{c}{minx_{i}^{t}}} \qquad (2)$$

where X represents the value of the i-th indicator for the c-th country at time t. Equation (1) holds for indicators whose higher values represent better performance, while equation (2) holds for indicators whose lower values represent better performance. Once all indicators are normalized, the inclusive green growth index is constructed as a geometric mean using equal weights for each of the k indicators and each country c as follows:

$$IGG_{c}^{t} = \left(\prod_{i=1}^{K} I_{ic}^{t}\right)^{\frac{1}{K}} \qquad (3)$$

With values varying in the range [0, 1]. The choice of equal weighting makes the index very transparent, a key feature of well-designed indices (OECD, 2008). Unlike most studies that use principal component analysis (PCA) to construct an inclusive green growth index (see Tables A4-A9), we use the normalized min-max indexing approach. This approach is useful for two main reasons: first, in the PCA methodology, the covariance matrix is difficult to evaluate accurately (Phillips and Sul 2009) and, therefore, may not be very useful for making comparisons across countries. Second, even the simplest invariance cannot be accounted for in the PCA index until the training data explicitly provide this information (Kamguia *et al*. 2025). In this context, the advantage of minimum-maximum normalization indexing is that recalibration broadens the range of an indicator, which makes it possible to differentiate between countries with similar performance levels and therefore to establish more meaningful comparisons between indices (Aslam *et al.* 2021). For this purpose, the value of Kaiser-Meyer-Olkin is equal to 0.826 (see Table A5), which is greater than 0.8; therefore, the PCA method is indeed adequate and valid for the construction of the inclusive green growth index.

3.1.3. The interest variable

The explanatory variable of interest in this study is institutionalized democracy. Democracy is conceived as three essential and interdependent elements. The first is the presence of institutions and procedures that allow citizens to effectively express their preferences regarding policies and leaders. The second is the existence of institutionalized constraints on the exercise of power by the executive. The third is the guarantee of civil liberties for all citizens in their daily lives and in their acts of political participation. It is an indicator measured on an additive scale ranging from 0 to 10 (V- dem 2023).

3.1.4. Control variables

These are Foreign Direct Investment (FDI), industries, and the internet. These variables were used in the work of Ofori and Asongu (2021), Ofori and Figari (2023), and Ndikumana and Sarr (2019) and are statistically described in Table 1. The correlation between the variables is represented in Table A1.

Table 1: descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
IGG index	819	0.518	0.199	0	1
GG index	819	0.521	0.187	0	1
IG index	819	0.565	0.218	0	1
Democracy institutionalized	819	4.375	3.378	0	10
FDI	819	3.664	5.007	-17.292	38.943
Industry	819	1.035e+10	2.137e+10	71228699	1.492e+11
Internet	819	16,652	19,255	.072	89.9
Per capita income	819	1407.628	204.208	1101.334	1727.708
Urbanization	819	41,231	2,742	36,808	45,828
Education	819	101.6	3,989	90,771	105,429

Source: authors

To ensure the absence of multicollinearity between the variables in our model, a variance inflation factor (VIF) test was performed. The largest VIF value (1.152) is less than 5, so our model is not at risk of multicollinearity (Table 2).

Table 2: Multicollinearity test (Variance inflation factor)

	Inclusive Green Growth		**Green Growth**		**Inclusive Growth**	
	VIF	1/VIF	VIF	1/VIF	VIF	1/VIF
Internet	1,152	0.868	1.152	0.868	1.152	0.868
Industry	1,142	0.876	1.142	0.876	1.142	0.876
Democracy institutionalized	1,047	0.956	1.047	0.956	1.047	0.956
FDI	1,013	0.987	1.013	0.987	1.013	0.987
Mean VIF	1,088	.	1.088	.	1.088	.

Source: authors

3.2. Model Specification

To further assess the relationship between institutional democracy and inclusive green growth, we thus first start from the functional form specification of Ofori *et al*. (2024) as shown in equation (1), where green growth is primarily determined by institutional democracy. Then, in line with the functional form specifications of Whajah et *al*. (2019), we specify the relationship between institutional democracy and socio-economic sustainability (green growth). Finally, we proceed by following the approach of Bekun *et al*. (2019), where we specify a functional form of the relationship between institutional democracy and environmental sustainability as shown in equation (3):

$$\textbf{Croissance verte incluisve}_{\textbf{it}} = \alpha_1 + \beta_2 \text{ democratie institutionnelle}_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad (1)$$

$$\textbf{Croissance incluisve}_{\textbf{it}} = \alpha_1' + \beta_2' \text{ démocratie institutionnelle}_{it} + \beta_3' X_{it} + \varepsilon_{it}' \quad (2)$$

$$\textbf{Croissance verte}_{\textbf{it}} = \alpha_1'' + \beta_2'' \text{democratie institutionnelle}_{it} + \beta_3'' X_{it} + \varepsilon_{it}'' \quad (3)$$

Where $\text{croissance verte inclusive}_{it}$ denotes the inclusive green growth of the country iat date t; $\text{croissance inclusive}_{it}$ denotes the inclusive growth of the country iat date t; $\text{croissance verte}_{it}$denotes the green growth of the country iat date t; represents the level of $\text{la démocratie institutionnelle}_{it}$ institutional democracy in particular of the country iat date t; X_{it}, X_{it}', X_{it}''denote the vector of control variables associated respectively with models (1), (2) and (3); ε_{it}, ε_{it}', ε_{it}''represent the error terms associated respectively with models (1), (2) and (3), and α_1, α_1', α_1'', β_2, β_2', $\beta_2''$and β_3, β_3', β_3'', the parameters to be estimated associated with models (1), (2) and (3).

3.3. Estimation method

Before estimating our models, it is essential to carry out preliminary tests. For a small sample size, the Pesaran test (2004) is suitable to confirm or refute the dependence between the individuals in the panel. The statistical CD test (Pesaran 2021) is used in this sense; the results of this test are grouped in Table 1:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \longrightarrow N(0,1) \quad (4)$$

Pesaran 's (2004) dependence test are as follows:

H_0: No dependency
H_1: Dependence

A unit root test is a pretest approach used to examine the order integration of data. The focus on the unit root is important because whether or not unit roots exist in time series data has implications for policymaking and econometric models. We used CIPS tests under the null hypothesis: the panel data are non-stationary, because stationarity between variables is necessary to conduct long-run cointegration analysis. The test for cross-sectional dependence and the test for stationarity are combined in Table 3. The result of the cointegration test is reported in Table 4.

Table 3: Cross-sectional dependence test and stationarity test

	Dependence cross sectional	CIPS	
	CDF	I(0)	I(1)
IGG index	103,643***	-2,693 ***	-
IG index	70,278***	-2,458 ***	-
GG index	51,749***	-3,000 ***	-
Democracy institutionalized	8,314	-0.646	-2,160 **
Industry	68,352***	-1,533	-3,415***
Internet	116,645***	-0.941	-3.082 ***
FDI	5,455***	-2,840 ***	-

Source: *Authors, *, **, ***Statistical significance at the 10, 5, and 1% levels, respectively. Robust standard errors are in parentheses.*

Table 4: Cointegration test

	Inclusive Green Growth	Green Growth	Inclusive Growth
G_T	-2,488	-3.125 ***	-2.613 *
G_a	-8.957 *	-11,878	-8.848 **
P_T	-12,944 **	-16.403 ***	-13.889 *
P_a	-7.123	-9.726 **	-8,401 **

Source: *Authors, *, **, ***Statistical significance at the 10, 5, and 1% levels, respectively. Robust standard errors are in parentheses.*

In order to deal with heteroscedasticity, endogeneity, and conditional heterogeneity, the estimation of the model is done by the method of moments on the one hand, the Driscoll-Kraay method as the main method, and the generalized method of moments (GMM) for the robustness test on a sample of 39 African countries between 2002 and 2022.

4. Results and discussion

4.1. Basic result

The results of the effects of institutional democracy are summarized in Table 5. Overall, it appears that institutional democracy increases inclusive green growth. Institutional democracy also has a positive effect on green growth. This result could be explained on the one hand by the fact that democracy improves environmental quality (Emmanuel et *al*. 2023, Nguea and Fotio 2023) and on the other hand because democracy accelerates a country's economic growth (Colagrossi et *al*. 2020). Furthermore, institutional democracy has a negative effect that is statistically significant at the 1% threshold on inclusive growth. This last result corroborates that of Sama-lang (2024). Institutional democracy allows the participation of actors, including citizens, unions, non-governmental organizations, and businesses, in the definition of climate and economic policies. It also promotes a fair distribution of ecological transition efforts such as carbon taxation (Le Quang 2020) and encourages transparency in technological and economic choices, which strengthens the legitimacy of green policies. However,

institutionalized democracy does not automatically guarantee inclusive green growth, as short electoral mandates may encourage some leaders to avoid politically costly ecological reforms.

Regarding the control variables, they are generally in line with our expectations. Foreign direct investment has a negative and statistically significant effect at the 10% and 1% thresholds, respectively, on inclusive green growth and green growth. This result is consistent with the work of Ofori et *al.* (2023) and Acheampong (2023). Access to the internet has a positive and statistically significant effect at the 1% threshold on inclusive green growth and green growth, this result corroborating the work of Ofori and Figaro (2023), Xin et *al.* (2023), and Wu et *al.* (2024). Furthermore, it has a negative and statistically significant effect at the 1% threshold on inclusive growth. Industry has a positive and statistically significant effect at the 1% threshold on inclusive green growth and green growth. Furthermore, it has a negative and statistically significant effect at the 1% threshold on inclusive growth. This result supports the work of Kamguia et *al.* (2025).

Table 5: Estimation with the Driscoll-Kraay method

	Inclusive Green Growth	**Green Growth**	**Inclusive Growth**
Democracy institutional	0. 00361***	0. 01042***	-0. 00728***
	(0.00080)	(0.00098)	(0.00057)
FDI	-0. 00212*	-0. 00422***	-0. 00024
	(0.00114)	(0.00087)	(0.00163)
Industry	0.00000***	0.00000***	-0.00000***
	(0.00000)	(0.00000)	(0.00000)
Internet access	0. 00608***	0. 00395***	-0. 00639***
	(0.00081)	(0.00061)	(0.00091)
Constant	0. 38574***	0. 40564***	0. 72644***
	(0.00598)	(0.00708)	(0.00642)
R^2	0.5107	0.3385	0.4621
Maximum Lag	2	2	2

Source: *Authors, *, **, ***Statistical significance at the 10, 5, and 1% levels, respectively. Robust standard errors are in parentheses.*

Following these results, we recommend that African countries strengthen the institutions that guarantee massive participation in decision-making and transparency through independent justice, free media, and public consultation, allowing for open debate on ecological policies. Furthermore, it is necessary to strengthen mechanisms for monitoring public policies to combat corruption. In addition, emphasis should be placed on democratic legitimacy as a condition for social acceptability, focusing on the acceptability of sometimes-restrictive reforms (carbon tax, energy transition). In addition, social inclusion facilitated by public redistribution policies, social aid, and innovation subsidies makes it possible not to exclude the most vulnerable in the ecological transition, such as green jobs, housing, and energy.

4.2. Robustness test

4.2.1. Robustness with the generalized method of moments

In order to control for endogeneity and verify the robustness of our results, we performed a robustness test using the generalized method of moments. The results are grouped in Table 6.

It appears that institutional democracy has a positive and statistically significant effect at the 1% level on inclusive green growth and green growth. Specifically, it increases inclusive green growth and green growth by 0.256% and 0.672%, respectively. Furthermore, institutional democracy significantly reduces inclusive growth by 0.287% at the 5% level.

The control variables are broadly consistent with those obtained in Table 5. Foreign direct investment has a negative and statistically significant effect at the 1% level on inclusive green growth and green growth. Internet access has a positive and statistically significant effect at the 1% level on inclusive green growth and green growth. Furthermore, it has a negative and statistically significant effect at the 1% level on inclusive growth. Industrialization has a positive and statistically significant effect at the 1% level on all three indices. Furthermore, it has a negative and statistically significant effect at the 1% level on inclusive growth.

Table 6: Estimation with the GMM method

	Inclusive Green Growth	**Green Growth**	**Inclusive Growth**
L.variable dependent	00.85295***	0.41704***	0.83050***
	(0.01100)	(0.02985)	(0.01734)
Democracy institutional	0.00256***	0.00672***	-0.00287**
	(0.00076)	(0.00148)	(0.00124)
FDI	-0.00057***	-0.00079***	-0.00029*
	(0.00006)	(0.00016)	(0.00015)
Industry	0.00000***	0.00000***	0.00000***
	(0.00000)	(0.00000)	(0.00000)
Internet access	0.00058***	0.00184***	-0.00085***
	(0.00005)	(0.00006)	(0.00009)
Constant	0.06070***	0.23423***	0.12116***
	(0.00633)	(.01541)	(0.01723)
AR1	0.000	0.000	0.000
AR2	0.561	0.159	0.930
Hansen P-value	0.170	0.258	0.133
Instruments/Countries	32/39	32/39	32/39
Observations	780	780	780

*Source: Authors, *, **, ***Statistical significance at the 10, 5, and 1% levels, respectively. Robust standard errors are in parentheses.*

4.2.2. Robustness by adding control variables

To test for possible omission bias, we add three new control variables to our model, namely urbanization, education, and per capita income, which may be important for growth. The results of this model are shown in Table 7.

It appears that institutional democracy has a positive and statistically significant effect at the 1% threshold on inclusive green growth and green growth. Specifically, it increases inclusive green growth and green growth by 0.267% and 0.974%, respectively. Furthermore, institutional democracy significantly reduces inclusive growth by 0.606% at the 5% threshold.

The control variables are broadly consistent with our expectations. Foreign direct investment has a negative and statistically significant effect at the 10% and 1% levels on inclusive green growth and green growth, respectively. Internet access has a positive and statistically significant

effect at the 1% level on inclusive green growth and green growth. Furthermore, it has a negative and statistically significant effect at the 1% level on inclusive growth. Industry has a positive and statistically significant effect at the 1% level on inclusive green growth and green growth. Furthermore, it has a negative and statistically significant effect at the 1% level on inclusive growth. Urbanization reduces green growth and inclusive green growth but also increases inclusive growth. Per capita income increases inclusive green growth and green growth but reduces inclusive growth. Education has a positive and significant effect on inclusive green growth and green growth and has a negative and statistically significant effect on inclusive growth.

Table 7: Driscoll and Kraay method with addition of control variables

	Inclusive Green Growth	**Green Growth**	**Inclusive Growth**
Democracy institutionalized	0.00267***	0.00974***	-0. 00606***
	(0.00087)	(0.00104)	(0.00090)
FDI	-0.00218*	-0.00410***	-0.00037
	(0.00120)	(0.00076)	(0.00185)
Industry	0.00000***	0.00000***	-0.00000**
	(0.00000)	(0.00000)	(0.00000)
Internet access	0.00885***	0.00610***	-0.01035***
	(0.00107)	(0.00074)	(0.00119)
Per capita income	.00020***	0.00018***	-0.00017**
	(0.00006)	(0.00005)	(0.00008)
Urbanisation	-0.04861***	-0.03755***	0.06026***
	(0.00800)	(0.00722)	(0.00841)
Education	0.01075***	0.00572***	-0.01308***
	(0.00141)	(0.00129)	(0.00150)
Constant	0.98614***	1.08904***	-0.13464
	(0.15131)	(0.12208)	(0.18743)
Observations	819	819	819
R^2	0.5776	0.3817	0.5692
Maximum lag	2	2	2

*Source: Authors, *, **, ***Statistical significance at the 10, 5, and 1% levels, respectively. Robust standard errors are in parentheses.*

5. Conclusion

The aim of this article is to examine the effect of institutionalized democracy on inclusive green growth on a set of data from 39 African countries between 2002 and 2022. On the empirical side, we use the Driscoll-Kraay method to address heteroscedasticity and conditional heterogeneity and the GMM to address endogeneity. Overall, we conclude that institutionalized democracy accelerates inclusive green growth in Africa. These results indicate that political authorities in Africa should adopt measures to strengthen democratic institutions. Institutionalized democracy offers powerful tools for building inclusive green growth by enabling citizen participation in political decisions, transparency, and redistribution. However, it is not a guarantee without political will, participatory reform innovations, and concern for

social justice. The key, therefore, lies in the ability of democracies to reinvent themselves to meet current ecological and social challenges. The article remains rich and dense since we have conducted studies only on political governance. However, it will be even more interesting to identify the contribution of economic governance to inclusive green growth.

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Appendices

Table A1: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) IGG_index	1,000									
(2) GG_index	0.844	1,000								
	(0.000)									
(3) IG_index	-0.914	-0.667	1,000							
	(0.000)	(0.000)								
(4) Democracy institutionalized	0.125	0.228	-0.176	1,000						
	(0.000)	(0.000)	(0.000)							
(5) FDI	-0.125	-0.167	0.061	-0.001	1,000					
	(0.000)	(0.000)	(0.080)	(0.969)						
(6) Industry	0.420	0.331	-0.374	-0.097	-0.103	1,000				
	(0.000)	(0.000)	(0.000)	(0.006)	(0.003)					
(7) Internet	0.675	0.509	-0.646	0.148	-0.080	0.312	1,000			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.022)	(0.000)				
(8) Per capita income	0.273	0.184	-0.205	0.096	0.020	0.088	0.626	1,000		
	(0.000)	(0.000)	(0.000)	(0.006)	(0.559)	(0.012)	(0.000)			
(9) Urbanisation	0.283	0.186	-0.215	0.096	0.009	0.091	0.684	0.947	1.000	
	(0.000)	(0.000)	(0.000)	(0.006)	(0.798)	(0.009)	(0.000)	(0.000)		
(10) Education	0.215	0.121	-0.175	0.074	0.088	0.070	0.392	0.705	0.729	1.000
	(0.000)	(0.001)	(0.000)	(0.034)	(0.011)	(0.044)	(0.000)	(0.000)	(0.000)	

Source: authors

Table A2: List of countries

Angola	Burkina Faso	Cameroon	Ivory coast	Eswatini	Gambia	Kenya	Mali	Morocco	Niger	Sierra Leone	Tanzania	Uganda
Benin	Burundi	Comoros	DR Congo	Ethiopia	Ghana	Lesotho	Mauritania	Mozambique	Rwanda	South Africa	Togo	Zambia
Botswana	Cabo Verde	Congo	Egypt	Gabon	Guinea	Madagascar	Mauritius	Namibia	Senegal	Sudan	Tunisia	Zimbabwe

Source: authors

Table A3: List of variables in the inclusive green growth index

Variables	Descriptions	Data source
	Economic Sustainability	
GDP per capita	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2015 U.S. dollars.	WDI
Trade openness (% of GDP)	Sum of exports and imports in percentage of GDP	WDI
HH market concentration Index	Measures the dispersion of trade value across an exporter's partners	World Integrated Trade
Age dependency ratio	Percentage of people younger than 15 or older than 64 to the working-age population	WDI
Adjusted net survings	Net national savings plus education spending and minus energy depletion, mineral depletion, net forest depletion, CO2, and particulate emissions damage, measured as a percentage of GNI	WDI
	Environmental sustainability	
Natural ressource rente	Ratio of the sum of oil, natural gas, coal (hard and soft), mineral, and forest rents to GDP	WDI
Renewable freshwater ressource	Annual availability of renewable water per capita	WDI
Water productivity	Constant 2010 $ GDP per cubic meter of total freshwater withdrawal	WDI
CO2 emission per GDP	Annual kilogram of CO2 emissions relative to annual production in constant 2010 $	WDI
Energy intensity of primary energy	Energy intensity level of primary energy (mega joules per GDP measured in constant 2011 PPP dollars)	WDI
Use of renewable energy (renew energy consumption)	Percentage of renewable energy consumption to total final energy consumption	WDI
	Social sustainability	
Employment population ratio	Estimated percentage by the International Labour Organization (ILO) of employed to the population aged over 15	WDI
Life expectancy at birth	Number of years a newborn infant would live if prevailing patterns of mortality at the time of their birth were to stay the same throughout their life	WDI
Primary enrollment gender gap	Percentage point difference of the proportion of male and of female enrolled in primary education	WDI
Infant mortality rate	Number of infants dying before reaching 1 year per 1,000 live births in a given year	WDI
Access to improved sanitation	Percentage of population with access to improved sanitation	WDI
Acess to improved water	Percentage of population with access to improved drinking water	WDI
Access to improved electricity	Percentage of population with access to electricity and non-solid fuel	WDI
GINI coefficient on inequality	Measures the extent to which the distribution of income (or, in some cases, consumption spending) among individuals or households within an economy deviates from a perfectly equal distribution	WDI

Primary completion rate	Percentage of total enrollment, regardless of age, to the population of the age group that officially corresponds to primary school	WDI
poverty gap	Percentage of population living on less than $3.10 a day	WDI

Source: authors

Table A4 : Eigenvector des composante IGG

Component / Variables	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
Access to Electricity	-0.325	0.015	-0.143	-0.111	-0.075	0.106	-0.029	0.036	0.105	0.107	0.082
Adjusted Net Savings	-0.136	-0.109	0.108	0.430	-0.345	-0.004	0.368	-0.481	0.069	0.303	0.101
Age dependency ratio	0.318	-0.066	-0.130	0.037	-0.025	-0.155	0.057	0.012	-0.184	0.068	0.074
CO_2 Emissions	-0.201	0.160	0.204	-0.063	0.489	0.200	0.242	-0.146	-0.069	0.050	0.443
Employment-to-Population Ratio	0.260	-0.113	0.148	-0.098	-0.263	0.169	-0.130	-0.137	0.059	-0.315	0.397
Primary Energy Intensity	0.205	0.039	0.283	-0.144	0.287	0.421	-0.195	-0.129	0.187	0.278	0.186
GDP per Capita	0.016	-0.095	0.124	0.478	-0.213	0.439	0.116	0.663	0.035	0.082	0.129
Infant Mortality Rate	0.283	0.047	-0.018	0.095	0.283	-0.078	0.230	0.192	-0.012	-0.144	-0.089
Poverty Gap	0.293	-0.020	0.289	-0.009	0.024	-0.042	-0.032	-0.025	-0.103	0.123	-0.135
Primary completion rate	-0.251	0.064	0.228	-0.174	-0.163	0.040	-0.128	0.058	0.383	-0.107	-0.166
Renewable energy consumption	0.327	0.032	-0.046	-0.086	-0.107	0.006	-0.130	0.036	0.230	0.224	-0.112
Renewable internal fresh water	0.034	0.455	-0.331	-0.043	-0.007	0.148	0.059	0.003	0.382	0.387	-0.183
Trade openness	-0.116	0.357	0.218	0.325	0.165	0.193	0.069	-0.150	0.021	-0.475	-0.422
Water Productivity	-0.025	0.515	-0.126	-0.030	-0.285	-0.153	0.118	0.007	-0.114	-0.130	0.385
GINI Index	-0.033	0.253	0.525	-0.127	-0.072	-0.305	0.213	0.175	-0.257	0.369	-0.130
Total Natural Resources Rents	0.102	0.417	-0.233	0.156	-0.035	0.219	-0.323	-0.033	-0.442	0.062	0.049
Herfindahl-Hirschman Index (HHI)	0.048	0.111	0.097	0.498	0.259	-0.512	-0.397	0.058	0.339	0.044	0.263
Improved water source	-0.278	0.061	-0.019	-0.179	0.012	-0.171	0.077	0.312	0.168	-0.098	0.230
Improved sanitation facilities	-0.277	-0.080	0.041	-0.081	0.086	0.011	-0.271	0.207	-0.324	0.163	-0.042
Labor force participation rate	-0.225	-0.257	-0.310	0.210	0.293	0.013	0.014	-0.073	-0.108	0.181	-0.039

Life Expectancy at Birth	0.235	-0.000	-0.208	-0.108	0.210	-0.031	0.488	0.160	0.123	-0.071	0.043

Component **Variables**	**C12**	**C13**	**C14**	**C15**	**C16**	**C17**	**C18**	**C19**	**C20**	**C21**	**Unexplained**
Access to Electricity	0.155	0.095	-0.003	-0.026	0.134	0.294	-0.403	-0.102	0.707	0.046	0
Adjusted Net Savings	0.079	0.115	0.271	-0.214	0.043	0.093	0.154	-0.046	-0.044	0.056	0
Age dependency ratio	-0.097	-0.196	0.285	-0.122	-0.155	-0.356	0.111	0.385	0.517	-0.285	0
CO_2 Emissions	-0.105	0.085	-0.280	-0.077	-0.140	-0.250	0.211	0.035	0.172	0.257	0
Employment-to-Population Ratio	0.262	0.379	-0.069	-0.028	-0.091	-0.002	-0.275	0.423	-0.113	0.030	0
Primary Energy Intensity	0.003	-0.306	0.382	0.035	0.196	0.149	-0.119	-0.043	-0.111	-0.255	0
GDP per Capita	-0.071	-0.051	-0.098	0.084	-0.012	-0.075	0.015	0.003	0.027	-0.010	0
Infant Mortality Rate	0.117	-0.010	-0.106	-0.600	0.380	0.366	0.058	0.181	-0.001	0.068	0
Poverty Gap	0.074	0.300	-0.119	0.470	0.054	0.385	0.468	0.049	0.279	-0.037	0
Primary completion rate	-0.628	0.152	0.136	-0.187	0.007	0.093	0.168	0.322	0.059	0.043	0
Renewable energy consumption	0.106	-0.161	0.119	0.026	0.018	-0.168	0.022	0.028	0.082	0.806	0
Renewable internal fresh water	0.232	0.232	-0.230	-0.022	-0.045	-0.163	0.081	0.215	-0.095	-0.272	0
Trade openness	0.237	-0.053	0.241	0.165	-0.015	-0.144	-0.100	0.117	0.133	0.059	0
Water Productivity	-0.136	-0.203	0.035	0.284	0.510	0.022	0.066	0.097	-0.052	0.040	0
GINI Index	0.012	-0.021	-0.038	-0.020	-0.165	0.026	-0.425	0.170	-0.098	0.017	0
Total Natural Resources Rents	-0.196	0.150	0.162	-0.204	-0.366	0.308	0.010	-0.083	-0.039	0.122	0
Herfindahl-Hirschman Index (HHI)	-0.042	0.150	0.018	0.024	-0.011	-0.031	-0.120	-0.087	0.041	-0.038	0
Improved water source	0.420	-0.171	0.347	-0.005	-0.378	0.259	0.331	0.100	-0.086	0.021	0
Improved sanitation facilities	0.204	0.424	0.334	-0.100	0.414	-0.322	0.147	0.056	-0.076	0.046	0
Labor force participation rate	-0.102	-0.099	0.007	0.319	0.025	0.231	-0.156	0.594	-0.168	0.156	0
Life Expectancy at Birth	-0.233	0.437	0.421	0.211	-0.056	-0.003	-0.212	-0.197	-0.063	0.041	0

Source: authors

Table A5: Principal component and eigenvalues for IGG

Component	Eigenvalue	Difference	Proportion	Cumulative	KMO statistics
Comp1	7.573	5.200	0.361	0.361	0.897
Comp2	2.374	0.658	0.113	0.474	0.712
Comp3	1.716	0.453	0.082	0.555	0.887
Comp4	1.263	0.134	0.060	0.616	0.726
Comp5	1.129	0.111	0.054	0.669	0.853
Comp6	1.018	0.047	0.049	0.718	0.743
Comp7	0.971	0.110	0.046	0.764	0.430
Comp8	0.861	0.204	0.041	0.805	0.910
Comp9	0.657	0.059	0.031	0.836	0.894
Comp10	0.598	0.084	0.029	0.865	0.894
Comp11	0.514	0.077	0.025	0.889	0.827
Comp12	0.437	0.077	0.021	0.910	0.487
Comp13	0.360	0.047	0.017	0.927	0.752
Comp14	0.313	0.028	0.015	0.942	0.662
Comp15	0.285	0.038	0.014	0.956	0.425
Comp16	0.246	0.046	0.012	0.967	0.624
Comp17	0.201	0.038	0.010	0.977	0.475
Comp18	0.163	0.012	0.008	0.985	0.910
Comp19	0.150	0.056	0.007	0.992	0.929
Comp20	0.095	0.017	0.004	0.996	0.782
Comp21	0.078	.	0.004	1.000	0.873
Overall	-	-	-	-	0.826

Source: authors

Table A6: Eigenvector of GG components

Component **Variables**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**Unex plained**
Adjusted Net Savings	-0.291	-0.111	0.362	-0.283	0.070	0.795	-0.009	0.141	-0.167	-0.074	0.046	0
Age dependency ratio	0.497	-0.069	0.079	-0.095	-0.056	0.161	-0.276	0.170	0.011	0.696	-0.338	0
CO2 Emissions	-0.386	0.150	-0.164	0.485	0.015	0.043	0.103	0.503	-0.084	0.440	0.317	0
Primary Energy Intensity	0.308	-0.002	0.015	0.690	0.163	0.320	-0.021	0.127	0.111	-0.395	-0.339	0
GDP per Capita	-0.004	-0.108	0.685	0.019	0.554	-0.371	0.163	0.177	0.105	0.066	-0.002	0
Renewable energy consumption	0.540	0.011	0.054	0.038	0.039	0.208	0.139	-0.125	0.196	0.024	0.765	0
Renewable internal fresh water	0.107	0.520	-0.098	-0.112	0.166	0.143	0.721	-0.162	-0.120	0.157	-0.250	0
Trade openness	-0.271	0.360	0.285	0.294	0.005	0.102	-0.317	-0.643	0.206	0.250	0.015	0
Water Productivity	-0.028	0.533	-0.042	-0.292	0.019	0.021	-0.218	0.401	0.624	-0.173	-0.027	0
Natural Resources Rents	0.206	0.500	0.109	-0.028	0.113	-0.116	-0.383	0.117	-0.676	-0.181	0.134	0
Herfindahl-Hirschman Index	0.070	0.118	0.509	0.117	-0.785	-0.111	0.228	0.143	-0.017	-0.077	-0.034	0

Source: authors

Table A7: Principal component and eigenvalues for GG

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.003	0.850	0.273	0.273
Comp2	2.154	0.988	0.196	0.469
Comp3	1,166	0.017	0.106	0.575
Comp4	1,149	0.195	0.104	0.679
Comp5	0.955	0.249	0.087	0.766
Comp6	0.705	0.158	0.064	0.830
Comp7	0.547	0.046	0.050	0.880
Comp8	0.501	0.063	0.045	0.925
Comp9	0.438	0.146	0.040	0.965
Comp10	0.292	0.202	0.026	0.992
Comp11	0.090	.	0.008	1,000

Source: authors

Table A8: Eigenvector of IG components

Component / Variables	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	Unexplained
Access to Electricity	0.366	-0.119	-0.079	-0.050	0.059	-0.018	-0.013	0.091	0.149	0.074	0.010	-0.247	-0.460	0.057	0.726	0
Adjusted Net Savings	0.143	0.046	0.504	-0.366	-0.393	-0.394	0.360	0.173	0.130	0.173	0.203	-0.019	0.075	-0.161	-0.022	0
Age dependency ratio	-0.353	-0.138	0.016	0.044	-0.053	0.020	0.190	0.021	0.051	-0.242	0.145	0.575	0.294	0.084	0.554	0
Employment-to-Population Ratio	-0.287	0.030	-0.069	-0.391	-0.204	0.211	-0.326	0.128	0.374	0.346	0.004	-0.048	0.066	0.532	-0.013	0
GDP per Capita	-0.016	0.059	0.546	-0.380	0.632	0.358	0.028	0.045	-0.047	-0.101	-0.078	0.046	-0.046	-0.005	0.012	0
Infant Mortality Rate	-0.325	0.019	0.062	0.248	0.285	-0.110	0.063	-0.016	0.083	0.024	0.608	-0.549	0.208	0.059	0.080	0
Poverty Gap	-0.326	0.227	-0.024	-0.091	-0.102	0.143	0.093	-0.282	-0.138	0.371	-0.401	-0.268	0.224	-0.414	0.322	0
Primary completion rate	0.285	0.238	-0.166	-0.141	-0.004	0.088	-0.163	0.427	-0.618	0.143	0.209	0.014	0.353	0.076	0.145	0
Trade openness	0.126	0.428	0.264	0.211	0.183	-0.478	-0.491	-0.242	0.114	0.133	-0.072	0.221	0.104	0.095	0.143	0
GINI Index	0.030	0.621	-0.196	-0.019	0.066	-0.022	0.578	-0.124	-0.000	-0.095	-0.076	-0.009	-0.121	0.436	-0.019	0
Herfindahl-Hirschman Index (HHI)	-0.054	0.220	0.418	0.595	-0.288	0.423	0.006	0.329	0.025	0.119	-0.027	0.029	-0.178	0.028	0.020	0
Improved water source	0.307	0.034	-0.186	0.135	0.237	0.056	0.147	0.359	0.568	0.033	-0.229	-0.027	0.484	-0.172	-0.026	0
Improved sanitation facilities	0.311	-0.024	-0.088	0.036	0.059	0.342	0.124	-0.437	0.106	0.489	0.444	0.318	0.003	-0.117	-0.066	0
Labor force participation rate	0.243	-0.441	0.263	0.197	-0.027	-0.022	0.178	-0.257	-0.203	0.133	-0.281	-0.169	0.342	0.505	0.036	0
Life Expectancy at Birth	-0.273	-0.195	-0.099	0.131	0.354	-0.319	0.209	0.336	-0.140	0.565	-0.128	0.224	-0.249	0.038	-0.084	0

Source: authors

Table A9: Principal component and eigenvalues for IG

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	6.159	4,475	0.411	0.411
Comp2	1,683	0.461	0.112	0.523
Comp3	1,222	0.111	0.082	0.604
Comp4	1.111	0.228	0.074	0.678
Comp5	0.884	0.062	0.059	0.737
Comp6	0.822	0.089	0.055	0.792
Comp7	0.733	0.181	0.049	0.841
Comp8	0.553	0.102	0.037	0.878
Comp9	0.451	0.089	0.030	0.908
Comp10	0.362	0.085	0.024	0.932
Comp11	0.277	0.021	0.018	0.950
Comp12	0.255	0.049	0.017	0.967
Comp13	0.207	0.037	0.014	0.981
Comp14	0.170	0.058	0.011	0.993
Comp15	0.112	.	0.007	1.000