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# Relationship among HIV/AIDS Prevalence, Human Capital, Good Governance, and Sustainable Development: Empirical Evidence from Sub-Saharan Africa

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**Abstract:** Sub-Saharan Africa is regarded as the region that accommodates about 75% of the world HIV/AIDS prevalence as of 2016. Research on the relationship between the epidemic and sustainable development is scant in this part of the world, as available literature is dominated by studies that focus on HIV and economic growth. Therefore, this study examines the relationship between sustainable development and HIV/AIDS prevalence, along with other determinants of sustainable development, such as good governance and human capital in 26 sub-Saharan Africa countries over a 27-year period from 1990—2016. The pooled mean group (PMG) estimator was employed for analysis after it was confirmed by the Hausman test for the estimation of the relationship among the variables. The results revealed a unidirectional long-run and significant relationship between HIV/AIDS prevalence and sustainable development, human capital and good governance, and human capital and sustainable development. Also, a bidirectional long-run relationship was found between good governance and HIV/AIDS prevalence. Estimation of subgroups provides a robustness check for our findings. Therefore, the paper gives new insight to the government of sub-Saharan Africa countries and major stakeholders about how to attain sustainable development in the region, while intensifying efforts on reducing HIV/AIDS prevalence, and at the same time ensuring effective good governance and human capital development.

**Keywords:** sustainable development; HIV/AIDS; human capital; good governance; sub-Saharan Africa

## 1. Introduction

Globally, the prevalence of HIV/AIDS constitutes a hindrance to the advancement of human development and remains a major concern for researchers, stakeholders, and policymakers [1]. With reference to the report of Joint United Nations Programme on HIV/AIDS [2], it was estimated at the end of 2016 that 34.5 million adults globally have been infected with HIV/AIDS virus, while about one million died from AIDS-related diseases. In the same year, about 25.73 million (almost 75% of the world HIV/AIDS prevalence) people were HIV/AIDS carrier in Africa, out of which 741,000 died as a result of AIDS-related illnesses. [2].

Today, the HIV/AIDS epidemics remains one of the challenges facing Africa continent, as it is far more than a health issue, and still requires more efforts so as not to hinder the sustainable development of the region [3,4]. However, in order to avert the reverse of the development, the issue of sustainable

development has taken a center stage position, both in the academia and among various stakeholders and policymakers.

It was noted that the world is facing great challenges in terms of development sustainability. On one part, there is a high number of people that are living below standard, even when there is overdependence on natural resources, most especially in the developing countries. On the other part, there are an important economic (poverty, inequality, etc.), social (health), and environmental (climate change) crises, which sometimes culminate into an epidemic and result in death [5,6].

Though studies abound on the definition of sustainable development, a definition by World Bank simply put it as development path or structured principles that could be maintained to ensure that total welfare of the people does not decline along the development path [7]. An important point of reference for sustainable development is the report published in 1987 by Brundtland Commission entitled *Our Common Future* [8]. According to this report, sustainable development is conceptualized as the actions or principles put in place that will enable the people to meet their present needs without compromising the ability of future generations to meet their own needs [8].

Achieving sustainable development involves economic, social, and quality environment. These three pillars must be evenly and wholly integrated within the process of improving development. In respect of social dimension, *Our Common Future* reports argue that sustainable development requires meeting the requisite needs of the citizens and extending to them the opportunity to accomplish their aspirations for a better life [9]. It is worthy to note that the report did not limit the pillars of sustainable development to the economic, social, and environment, but also includes other aspects that were not broadly considered, for instance, good governance. It is believed that such equity in achieving sustainable development will be enhanced by an effective political system and rule of law that secure effective citizen participation in decision-making.

The sustainable development agenda for 2030 has a health issue at the center [10]. One of the goals of this agenda is "to ensure healthy lives and promote well-being for all citizens at all ages." In order to meet this target, there is a need to examine the various factors that could hinder the achievement of the goals. Among the ones highlighted which could do this is the infectious disease (e.g. HIV/AIDS) [10]. Health is as inherently significant as human rights and is also important to achieving the pillars of sustainable development (economic development, environmental sustainability, social inclusion, and good governance). Sustainable development will be elusive in the absence of health and productive population. There is a report which details that combating the spread of HIV/AIDS is critical to human progress, as this disease disproportionately affect the development potential of dozens of countries [11]. HIV/AIDS has a complex linkage with poverty and, in turn, to the larger sustainable development [12].

There is no doubt that the consequences of the epidemic in sub-Saharan Africa would have a great impact on sustainable development in the region if the scenario continues.

## 2. Literature Review

The studies on HIV/AIDS and economic growth have been prolific. Among them is the one on HIV and economic growth in 30 sub-Saharan Africa countries, which revealed that AIDS has a significant negative impact on GDP [13]. Reference [13] found that the negative impact of the epidemic will reduce the growth rate of per capital income in the average number of countries studied and concluded that the larger impact will be felt on the 10 countries with the highest HIV prevalence in those 30 sub-Saharan Africa countries. A similar study was conducted in South Africa, which is among the countries with the highest HIV prevalence in sub-Saharan Africa. The study corroborated over Reference [13] and concluded that in the presence of HIV prevalence, South Africa economic growth will decline in GDP by about 17% [14]. This finding was corroborated by subsequent studies [15,16]. In 2000, a similar study was conducted which forecasted that the situation of HIV in Lesotho will cause the GDP of the country to decline by 2010 [17]. Meanwhile, Maijama and Samusidin [16] found in their study that the current HIV prevalence in sub-Saharan Africa has a negative effect on GDP per capital

growth. A similar study was previously conducted by Augier and Yaly [18], which modeled diseases with the highest mortality rates, among which is AIDS as it affects economic growth. The result showed that poor health due to these infectious diseases has effects on decreasing economic growth of any country where the epidemic is prevalent. However, a contrary view was held by another author on HIV/AIDS. His study found no statistically significant impact of HIV/AIDS on GDP [19]. Meanwhile, Afawubo and Mathey [20] conducted a study on the factors influencing HIV/AIDS prevalence. The study found that human capital has a short-run causal impact on HIV prevalence but found a negative relationship between HIV and economic growth and concluded that GDP growth is not a driver for HIV prevalence across the West African countries [20]. Alemu et al. investigated the effect of HIV on the manufacturing sector in Lesotho and South Africa. The study concluded that there is a negative significant impact of the HIV on the productivity growth of the two countries [21]. This study was in agreement with Young, who revealed a significant impact of HIV/AIDS on human capital which, in turn, affects economic growth in sub-Saharan Africa [22]. The subsequent study established a long-term impact of HIV/AIDS on economic growth [23]. However, contrary results were found when studies were conducted on how much of a threat a mature AIDS epidemic is to economic growth. The study revealed that AIDS is not likely to threaten economic growth, either through human capital or accumulation channels. [17,19,24]. The relationship between HIV/AIDS prevalence and human capital in sub-Saharan Africa was found to be negative and statistically significant [25]. These findings were not different from the findings of other authors, who concluded in their studies that poor health as a result of an infectious disease has an impact on the economic growth of any country where it is prevalent [18,26].

In a more recent study, several authors empirically established the impact of HIV/AIDS prevalence on economic growth [15,16,27,28]. Their studies found a long-run relationship between HIV/AIDS prevalence and economic growth and argued that, in the long-run, HIV/AIDS will have a devastating impact on economic growth. In another dimension, the impact of HIV/AIDS on human capital was empirically examined and the results showed that HIV/AIDS prevalence have a long-run impact on human capital [16,20]. The argument from the studies was that as the HIV/AIDS prevalence increases, the country human capital decreases. Meanwhile, Shuaibu and Oladapo [29] were able to establish a long-run relationship between human capital economic growth and good governance in their study on Africa countries using a panel model. The study argued that economic growth and good governance are drivers for human capital development. In all the reviewed literature, none of the studies attempted to model the HIV and sustainable development.

Meanwhile, there are multiple dimension of views on sustainable economic development and good governance. Of importance to this study is the view of Brautigam on governance and economy which put it as a neutral concept, meaning "the political direction and control exercised over the actions of the members, citizens or inhabitants of communities, societies and states" [30] (p.3). The author argued in his book that the impact of good governance on a country economic growth cannot be neglected. In his view, political accountability, an effective rule of law, and transparency are some of the significant ingredients of good governance that impact on economic development. Good governance is considered to be the recent concept that recognized the functions of the state in the economy, where the involvement of all stakeholders is significant in the process of achieving sustainable economic development [7]. Stojanovic et al. noted that the central place of development policy is occupied with the model of good governance, which has become the cornerstone of sustainable development [31].

The relationship between good governance and development sustainability received great attention in scholarly enquiry [7,31]. The literature on the relationship is mixed, as there are both opposing and supporting views on the issue. An observation was made that, while few studies addressed the influence of good governance on sustainable development, some authors found that good governance is not a determinant factor for sustainable development [7]. Those studies found that relationship opined that good governance to demand voice and accountability to the citizen and

rule of law guiding economic transactions, regulatory quality, control of corruption, the ability of the government to be effective, and an environment devoid of war/terrorism.

Various studies established a relationship between sustainable economic development and good governance [7,32,33], while some show no relationship between the two variables [34,35]. Though Stojanovic et al. revealed a statistical significance, direction, and significance of the effect of good governance, the study, however, suggested that there is no "one size fits all" model of good governance [31]. In view of the mixed results on the relationship between good governance and sustainable development, it is pertinent to follow the findings of Stojanovic et al. and examine the relationship between good governance and sustainable development in different regions.

The impact of human capital on sustainable development cannot be downplayed. Various literature abound on the human capital and sustainable development. The linkage among population, economic growth, employment, education, and sustainable development was examined and the study revealed that human capital is significant to sustainable development and efforts to ensure the synergy depends on the effective approach adopted [36]. This was corroborated by another author who opined that human capital faster rate of development of the society contributes to the sustainability of the society and ensures equitable distribution of development benefits [37]. Scicchitano [38] demonstrated in his study that human capital composition (research and development), which was in the past not considered in the endogenous growth model, was found to be significant in determining economic growth rate. Also, it was found in the recent studies that human capital increase led to sustainable economic growth [39,40]. Similarly, in EU states, a study was conducted and found that human capital is directly influencing sustainable development [41]. In a reversed case, Shuaibu and Oladapo [29] found economic growth as one of the drivers for human capital development.

It is evident from the literature reviewed that studies on sustainable economic development and human capital has not been well researched in sub-Saharan Africa countries. The available ones are country-specific and are primarily focused on the traditional parameters of measuring country economic development (i.e., GDP); human development index (HDI), and educational attainment for human capital [42]. The study of Shuaibu and Oladayo was tilted study toward determining factors contributing to human capital development using 33 African countries. The study confirmed a significant long-run relationship between health and human capital development and also institutions (good governance) [29]. However, it argues that short-term gains may be achieved through enhanced institutional quality.

The idea that HIV/AIDS may have a significant impact on sustainable development is understandable, for the simple reason that "health is wealth." As a consequence, one would expect HIV/AIDS to have an influence on sustainable development. It is therefore surprising that although there is an extensive empirical literature on sustainable development, HIV/AIDS prevalence, and economic growth in developing countries, most especially African countries where the epidemic is ravaging, research on how the HIV/AIDS could impact on sustainable development are scant.

To date, however, and to the best of our knowledge, the relationship between HIV/AIDS and sustainable economic growth in sub-Saharan Africa countries has not been thoroughly dealt with in empirical literature, and this study will contribute to the literature on this important topic.

The main thrust of this paper is to analyze the relationships among HIV/AIDS, good governance, human capital, and sustainable development in sub-Saharan Africa. This study will investigate through the long and short-run dynamic relationship following the sustainable development framework proposed by World Bank. Consequently, it will contribute empirically to the literature on the relationship between HIV/AIDS and sustainable development in sub-Saharan Africa by employing a more recent panel data estimator by Pesaran et al.

## 3. Data and Methods

### *3.1. Data*

In order to achieve the objective of the study, variables such as HIV/AIDS prevalence rate, country-level governance index, and human capital index were selected to examine their relationship with sustainable economic development. The adjusted net savings was measured as the gross national savings, less the value of consumption of fixed capital. This variable was established to be a good indicator for sustainable development [43–46]. Prevalence of HIV/AIDS, measured as the percentage of people aged between 15—49 who are infected with HIV, was utilized in previous studies [1,3,13–15,19]. The country-level governance index was measured with six indices: Voice and accountability, rule of law, regulatory quality, control of corruption, government effectiveness and political stability, and absence of violence/terrorism (see Table 1). In order to compute the indices into a single variable, the average rank of each country in the panel for the six indices was computed for individual years. This index was used by previous researchers [7,31]. For measuring human capital, we employed human capital index [47]. This was employed based on the arguments in the literature on the non-consensus on the human capital index, which prompted the Penn World Table to introduce another index in PWT version 8 that was computed using the data from Barro and Lee and an assumed rate of return to education based on Mincer equation estimates [47,48].

These variables are sourced from the World Development Bank Indicator [49], Word Governance Indicator [50], and Penn World Table [47]. The data are yearly and cover the period 1990—2016. The countries included in the panel are 26 sub-Saharan African countries (see Appendix Table A1). The choice of countries in the panel was based on the availability of data for the variables included in the study during the observed period.

**Table 1.** Description of variables.

| Code Name | Variable | Proxy | Definition | Measurement Unit | Source |
|---|---|---|---|---|---|
| HPREV | HIV/AIDS | HIV/AIDS prevalence | Prevalence of HIV refers to the percentage of people ages 15—49 who are infected with HIV | Percentage | World Bank Development Indicators |
| HCI | Human Capital | Human capital index | Human capital is measured as the discounted value of earnings over a person's lifetime | Based on average years of schooling and returns to education | World Penn Table |
| CLG | Good governance | Country level governance | It is the perception on the efficiency of government in the following areas: Voice and Accountability, Rule of Law, Regulatory Quality, Control of Corruption, Government Effectiveness, and Political stability and absence of Violence/Terrorism. | Percentile Rank | World Governance Indicator |
| ANS | Sustainable development | Adjusted net saving | Adjusted net savings are equal to net national savings plus education expenditure and minus energy depletion, net forest depletion, and carbon dioxide | Percentage | World Bank Development Indicator |

### 3.2. Method

Following the sustainable development framework developed by the World Bank, this paper follows the one released by the World Bank and it's based on the crude estimate as follows:

ANS = NNS + E – R – P

where ANS is the adjusted net saving, NNS is the Net National Saving, E is the Current education expenditure, R is the Resource rents, and P is the Carbon dioxide (CO2) damage.

In the calculation of sustainable development (ANS) in this study, current expenditure is treated as saving rather than consumption, since it increases the country's human capital (human capital is being considered here as a proxy), and pollution damages seek to reflect losses of welfare in the form of human sickness (HIV/AIDS prevalence as a proxy). Energy depletion is the depletion of oil, coal, and natural gas. A measure of depletion stands for the management of the natural resources (country-level governance index as a proxy).

For the empirical analysis, the study is based on Pesaran et al. methodology, which introduced the pooled mean group (PMG) approach in the panel ARDL framework [51]. This estimator was settled as a result of its advantages in comparison with other panel estimators. First, PMG/panel ARDL does not require a formal test for cointegration. Second, PMG minimizes the endogeneity problems and all the variables are considered to be endogenous. Third, the testing for the order of variables integration is not generally required, i.e either the variable is I(0) or I(1) is not an issue in PMG. Last, the long-run and short-run variables are estimated simultaneously, lessening problems of omitted variables and autocorrelation.

Therefore, based on Pesaran et al. methodology, the panel ARDL model for this study including the long-run relationship between the variables is presented as follows:

$$\Delta ANS_{it} = \alpha_i + \sum_{j=1}^{p-1} \beta_{ij} \Delta ANS_{i,t-j} + \sum_{r=0}^{n-1} \gamma_{ir} \Delta HCI_{i,t-r} + \sum_{i=0}^{q-1} \varphi_{il} \Delta HPREV_{i,t-l} + \sum_{c=0}^{m-1} \tau_{ic} \Delta CLG_{i,t-c} + \delta_1 ANS_{i,t-1} + \delta_2 HCI_{i,t-1} + \delta_3 HPREV_{i,t-1} + \delta_4 CLG_{i,t-1} + \varepsilon_{1i,t} \quad (1)$$

$$\Delta HCI_{it} = \alpha_i + \sum_{j=1}^{p-1} \beta_{ij} \Delta HCI_{i,t-j} + \sum_{i=0}^{q-1} \varphi_{il} \Delta ANS_{i,t-l} + \sum_{r=0}^{n-1} \gamma_{ir} \Delta HPREV_{i,t-r} + \sum_{c=0}^{m-1} \tau_{ic} \Delta CLG_{i,t-c} + \omega_1 HCI_{i,t-1} + \omega_2 ANS_{i,t-1} + \omega_3 HPREV_{i,t-1} + \omega_4 HPREV_{i,t-1} + \varepsilon_{2i,t} \quad (2)$$

$$\Delta HPREV_{it} = \alpha_i + \sum_{j=1}^{p-1} \beta_{ij} \Delta HPREV_{i,t-j} + \sum_{i=0}^{q-1} \varphi_{il} \Delta HCI_{i,t-l} + \sum_{r=0}^{n-1} \gamma_{ir} \Delta ANS_{i,t-r} + \sum_{c=0}^{m-1} \tau_{ic} \Delta CLG_{i,t-c} + \pi_1 HPREV_{,t-1} + \pi_2 HCI_{i,t-1} + \pi_3 ANS_{i,t-1} + \pi_4 CLG + \varepsilon_{3i,t} \quad (3)$$

$$\Delta CLG_{it} = \alpha_i + \sum_{j=1}^{p-1} \beta_{ij} \Delta CLG_{i,t-j} + \sum_{i=0}^{q-1} \varphi_{il} \Delta HCI_{i,t-l} + \sum_{r=0}^{n-1} \gamma_{ir} \Delta ANS_{i,t-r} + \sum_{c=0}^{m-1} \tau_{ic} \Delta HPREV_{i,t-c} + \Omega_1 CLG_{,t-l} + \Omega_2 HCI_{i,t-l} + \Omega_3 ANS_{i,t-l} + \Omega_4 HPREV + \varepsilon_{4i,t} \quad (4)$$

where *ANS, HPREV, HCI,* and *CLG* are adjusted net saving (a proxy for sustainable development), HIV/AIDS prevalence rate, human capital index, and country-level governance. $\Delta$ and $\sum k_{it}$ *(k = 1, 2, 3, 4)* are the first difference operator and a white noise term. Also, in Equations (1—4), $\alpha_1$ denotes a country-specific intercept. The subscript *I* denotes a specific unit and varies from *1* to *N*. A reasonable generalization of cointegration test from time series to panel data may formulate the $H_0$ of no cointegration between the four variables in Equation (1) as follows: $H_0$: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$, while $H_1$: At least one $\delta k \neq 0$ *(k = 1,2,3,4).*

Similarly, the null hypothesis of no cointegration in Equation (2) may be written as $H_0$: $\omega_1 = \omega_2 = \omega_3 = \omega_4 = 0$. Also, in Equation (3,4), the $H_0$ of no cointegration between the four variables may be formulated as $H_0$: $\pi_1 = \pi_2 = \pi_3 = \pi_4 = 0$, *and* $\Omega_1 = \Omega_2 = \Omega_3 = \Omega_4 = 0$

Subsequently, if the null hypothesis of cointegration is rejected, we estimate the long-run relationship for the first panel ARDL described in Equation (1) is presented as follows:

$$ANS_{it} = \mu_i + \sum_{j=1}^{p-1} \lambda_{1j} ANS_{i,t-j} + \sum_{i=0}^{q-1} \lambda_{2j} HCI_{i,t-l} + \sum_{r=0}^{n-1} \lambda_{3j} HPREV_{i,t-r} + \sum_{c=0}^{m-1} \lambda_{4j} CLG_{i,t-c} + v_{1i,t} \quad (5)$$

Consequent to the above model specification, the assumption of PMG estimator of the coefficient of the long-run relationship to be the same for every country in the panel were considered. Meanwhile, the assumption is also considered in the null hypothesis of no cointegration model specification for the four models. Similarly, the remaining three models were specified in line with Equation (5).

The error correction models for the ARDL models described above are constructed as follows:

$$\Delta ANS_{it} = \alpha_i + \sum_{j=1}^{p-1} \beta_{ij} \Delta ANS_{i,t\text{-}j} + \sum_{i=0}^{q-1} \varphi_{il} \Delta HCI_{i,t\text{-}l} + \sum_{r=0}^{n-1} \gamma_{ir} \Delta HPREV_{i,t\text{-}r} + \sum_{c=0}^{m-1} \tau_{ic} \Delta CLG_{i,t\text{-}c} + aECT_{t\text{-}1} + e_{1i,t} \quad (6)$$

$$\Delta HCI_{it} = \alpha_i + \sum_{j=1}^{p-1} \beta_{ij} \Delta HCI_{i,t\text{-}j} + \sum_{i=0}^{q-1} \varphi_{il} \Delta ANS_{i,t\text{-}l} + \sum_{r=0}^{n-1} \gamma_{ir} \Delta HPREV_{i,t\text{-}r} + \sum_{c=0}^{m-1} \tau_{ic} \Delta CLG_{i,t\text{-}c} + bECT_{t\text{-}1} + e_{2i,t} \quad (7)$$

$$\Delta HPREV_{it} = \alpha_i + \sum_{j=1}^{p-1} \beta_{ij} \Delta HPREV_{i,t\text{-}j} + \sum_{i=0}^{q-1} \varphi_{il} \Delta ANS_{i,t\text{-}l} + \sum_{r=0}^{n-1} \gamma_{ir} \Delta HCI_{i,t\text{-}r} + \sum_{c=0}^{m-1} \tau_{ic} \Delta CLG_{i,t\text{-}c} + cECT_{t\text{-}1} + e_{3i,t} \quad (8)$$

$$\Delta CLG_{it} = \alpha_i + \sum_{j=1}^{p-1} \beta_{ij} \Delta CLG_{i,t\text{-}j} + \sum_{i=0}^{q-1} \varphi_{il} \Delta HCI_{i,t\text{-}l} + \sum_{r=0}^{n-1} \gamma_{ir} \Delta ANS_{i,t\text{-}r} + \sum_{c=0}^{m-1} \tau_{ic} \Delta HPREV_{i,t\text{-}c} + dECT_{t\text{-}1} + e_{4i,t} \quad (9)$$

where the error term $e_{ki,t}$ *(k = 1,2,3,4)* is independently and normally distributed with zero mean and constant variance, and $ECT_{t\text{-}1}$ is the error correction term specified from the long-run equilibrium relationship. The coefficient of a, b, c, d shows the speed of adjustment to the equilibrium level in the presence of shock.

In addition to the specified model above, Pesaran et al. proposed two other estimators that could be applied when both time and cross sections are large. Pooled mean group (PMG) and mean group (MG) difference are that MG estimator is more effective when there is variation in the slope and intercept among the countries in the panel, whereas PMG assumed homogeneity of slope and intercepts among the countries. Also, dynamic fixed effect (DFE) was proposed to be considered where the slope is constant, but the intercept could vary across the countries.

In order to enhance the robustness of our findings, the panel was subdivided into subgroups. This classification into subgroup (upper middle income –UMIC, low middle income – LMIC, and low income – LIC) was based on the 2018 World Bank country's classification according to level of economies.

Meanwhile, it is often assumed that errors in panel data are cross-sectional independent in most cases when the cross-section dimension (*N*) is large [52]. Evidence abounds in the literature that proved the presence of cross-sectional dependence (CD) in panel model. Pesaran et al. [52] argued that failing to give adequate consideration to cross-sectional dependence in estimation could give loss of estimator efficiency and insignificant test statistics. In view of these, Pesaran's CD test was employed to test for cross-sectional dependency in our data. Moreover, Westerlund [53] observed that many studies failed to reject the no-cointegration hypothesis, which was centered on the fact that most residuals-based cointegration tests require that the long-run parameters for the variables in their levels are equal to the short-run parameters for the variables. In view of the above, this study employed Westerlund's [53] error-correction-based cointegration tests that are based on structural, instead of residual, dynamic, which do not enforce any common-factor restriction to examine the existence of long-run relationship among our variables.

Having specified the models according to Pesaran et al., the next step is to give descriptive statistics on the data, which will enable us to show and explain the characteristics of each variable in the model. Subsequently, the unit root test was conducted to ascertain that no variable is integrated of order two. This is to ensure that the model does not violate the assumption of PMG [51]. Last, analysis was done and inferences from the analysis were made to draw a conclusion.

## 4. Empirical Findings

### *4.1. Descriptive Statistics*

As revealed in Table 2, while the average adjusted net savings (ANS) in the group panel is -3.62, the UMIC group has the highest mean value for ANS, followed by LIC and LMIC groups. However, greater variation was observed in LMIC, which shows a standard deviation value of 32.81 compared to the group panel, UMIC, and LIC, which have 21.96, 13.75, and 11.49, respectively.

**Table 2.** Characteristics of the variables.

| | Statistics | ANS | HIVPREV | HCI | CLG |
|---|---|---|---|---|---|
| **Group Panel** | Mean | −3.62 | 5.19 | 1.62 | −0.56 |
| | Max. | 47.93 | 29.4 | 2.91 | 0.99 |
| | Min. | −210.90 | 0.1 | 1.03 | −2.1 |
| | Std.Dev | 21.96 | 6.61 | 0.40 | 0.56 |
| | Obs. | 697 | 702 | 702 | 624 |
| **UMIC** | Mean | 11.60 | 12.34 | 2.26 | 0.24 |
| | Max. | 37.58 | 27 | 2.81 | 0.88 |
| | Min. | −26.99 | 0.6 | 1.77 | −0.67 |
| | Std.Dev. | 13.75 | 8.03 | 0.27 | 0.43 |
| | Obs. | 105 | 108 | 108 | 96 |
| **LMIC** | Mean | −9.21 | 5.25 | 1.67 | −0.81 |
| | Max. | 47.83 | 28.4 | 2.38 | 0.12 |
| | Min. | −210.90 | 0.2 | 1.14 | −1.66 |
| | Std.Dev. | 32.81 | 7.18 | 0.29 | 0.42 |
| | Obs. | 231 | 216 | 216 | 192 |
| **LIC** | Mean | −4.73 | 3.11 | 1.40 | −0.64 |
| | Max. | 36.06 | 14.9 | 2.17 | 0.05 |
| | Min. | −47.21 | 0.1 | 1.03 | −2.1 |
| | Std.Dev. | 11.49 | 3.81 | 0.24 | 0.46 |
| | Obs. | 369 | 378 | 378 | 336 |

ANS = Adjusted net savings, HIVPREV = HIV/AIDS Prevalence, HCI = Human capital index, CLG = Country-level governance. UMIC = Upper-middle income countries, LMIC = Low-middle income countries, LIC = Low income countries.

The average mean value of HIV/AIDS prevalence for the group panel is 5.19, UMIC has a 12.34 mean value for HIV/AIDS, while LMIC and LIC have 5.25 and 3.11, respectively. Meanwhile, the standard deviation shows that there is high deviation from the mean value in UMIC with a standard deviation value of 8.03 compared to 6.61, 7.18, and 3.81, which are values for group panel, LMIC, and LIC, respectively.

The average human capital index in UMIC is higher than the other groups. This is expected being an upper-middle income country. However, all the groups show a minimal standard deviation value, which could be an indication that each group possess similar characteristic in terms of human capital. The country level governance could be described to be fair in UMIC by having a mean value of 0.24 compared to the average value for the group panel, which is -0.56, while -0.81 and -0.64 are for LMIC and LIC, respectively.

### *4.2. Cross-Dependency Test*

In line with Pesaran et al. [54] cross-dependency test, the null hypothesis is that there is no cross-section dependence (correlation in residuals). The results from the test presented in Table 3, which shows that this study failed to reject the null hypothesis of no cross-sectional dependency in all the four panels. It implies that the panels are free from the cross-sectional dependency problem.

**Table 3.** Pesaran cross-sectional dependency test.

| | Statistics | Prob. |
|---|---|---|
| **Group Panel** | 1.01 | 0.31 |
| **UMIC** | −0.63 | 0.53 |
| **LMIC** | −1.58 | 0.12 |
| **LIC** | 1.06 | 0.29 |

UMIC = Upper-middle income countries, LMIC = Low-middle income countries, LIC = Low income countries.

### 4.3. Unit Root Test

Pesaran et al. commented that the variables for PMG estimator could either be integrated on *I(0)* or *I(1)* in order for the variable not to lose its predictive power [51]. However, Kumar et al. opined that panel ARDL does not generally require a knowledge of the order of integration of variables [55]. Nevertheless, we apply Im, Pesaran, and Shin (IPS) W-stat test for both levels and their first difference with an intercept and trend. This was done to ascertain the stationary properties of the variable to enhance the robustness of our results and ensure that none of the variables is integrated at order *(2)*. The results as presented in Table 4. The IPS statistics, as revealed in the table, indicate that for the group panel, three out of the four variables are integrated at order *(0)*, while country-level governance is integrated at order *(1)*. In the UMIC panel, HIVPREV and *CLG* integrated at order *(0)*, while *ANS* and *HCI* integrated at order *(1)*. However, the stationary property of the variables in the LMIC panel is a bit different, in the sense that *HCI* integrated at order *(0)* only with intercept. Last, in the LIC panel, both *ANS* and *HIVPREV* integrated at order *(0)*, while *HCI* and *CLG* integrated at order *(1)*. In summary, the variables across the four panel were tested both at intercept, an intercept and trend. The results, as presented in Table 4, indicate that none of the series are integrated at order *(2)*. Therefore, it is safe for us to employ PMG estimator.

**Table 4.** Im, Pesaran, and Shin (IPS) Panel unit root result.

| | | Level | | 1st Difference | |
|---|---|---|---|---|---|
| | **Variable** | **Intercept** | **Intercept and Trend** | **Intercept** | **Intercept and Trend** |
| **Group Panel** | ANS | −5.55* | −4.77* | - | - |
| | HIVPREV | −20.32* | −20.22* | - | - |
| | HCI | −2.05** | 2.22 | - | −5.17* |
| | CLG | −0.35 | −1.37 | −17.66* | −15.93* |
| **UMIC** | ANS | −0.79 | −0.99 | −8.42* | −15.93* |
| | HIVPREV | −16.12* | −10.29* | - | - |
| | HCI | 0.30 | 0.91 | −2.77* | −6.96* |
| | CLG | −0.39 | −2.15* | −9.94* | - |
| **LMIC** | ANS | −4.28* | −5.10* | - | - |
| | HIVPREV | −8.21* | −6.14* | - | - |
| | HCI | −2.32* | 1.87 | - | −0.66 |
| | CLG | −0.98 | −2.65* | −9.91* | - |
| **LIC** | ANS | -3.92* | −2.03** | - | - |
| | HIVPREV | −13.31* | −17.92* | - | - |
| | HCI | −1.20 | 1.10 | −5.89* | −4.71* |
| | CLG | 0.49 | 1.43 | −11.30* | −9.98* |

*, ** indicates 1% and 5% significance level respectively. UMIC = Upper-middle income countries, LMIC = Low-middle income countries, LIC = Low income countries.

### 4.4. Cointegration Analysis

The Westerlund ECM panel cointegration tests consists of four tests designed to test cointegration in panel data. The first two tests were to test the alternative hypothesis that the panel is cointegrated as whole, while the other two tests were to test that at least one unit is cointegrated. However, the results from the test, as shown in Table 5, reveals that the three tests out of four in group panel strongly reject the null hypothesis of no cointegration among the variables. Two tests accepted alternative hypothesis that there is cointegration among the variables in UMIC panel, and three tests strongly

rejected null hypothesis of no cointegration in LMIC panel. Meanwhile, the test results failed to reject the null hypothesis of no cointegration in LIC panel. In summary, there is strong evidence that there is cointegration among the variables, which was as a result of similar outcome for the cointegration found among variables in the subgroups.

**Table 5.** Westerlund ECM Panel Cointegration test.

| Test | Group Panel | UMIC | LMIC | LIC |
|---|---|---|---|---|
| **Gt** | −2.27 * | −2.73 ** | −3.27 * | −1.57 |
| **Ga** | −5.45 | −7.02 | −5.11 | −5.19 |
| **Pt** | −23.39 * | −5.26 ** | −16.29 * | −4.69 |
| **Pa** | −9.64 * | −6.61 | −9.39 ** | −3.80 |

*, ** indicate 1% and 5% significance level respectively. UMIC = Upper-middle income countries, LMIC = Low-middle income countries, LIC = Low income countries.

### *4.5. Hausman Test*

Table 6 reports the results of Hausman test statistics for all the three predictor variable used in the study. The Hausman test statistics fail to decline the homogeneity of long-run coefficients because the chi2 value is greater than 0.05 in absolute value. Hence, the model supports the PMG estimator.

**Table 6.** Hausman Test.

| | ***PMG*** | ***MG*** | ***DFE*** | ***PMG/MG*** | ***PMG/DFE*** |
|---|---|---|---|---|---|
| *HIVPREV* | 1.12 | 3.18 | 0.23 | | |
| *HCI* | −10.08 | −1.30 | −0.75 | | |
| *CLG* | 11.09 | 12.07 | 17.06 | | |
| *Hausman Test* | | | | **−0.90** | **−5.75** |

### *4.6. Long- and Short-Run Estimates*

The analysis results from Table 7 indicate that when *ANS* is the dependent variable (Equation (1)), HIVPREV has a positive and significant long-run relationship with *ANS* at 1% significance level. However, when *HIVPREV* is the dependent variable (Equation (2)), *ANS* does not show any significant relationship with *HPREV*. This implies that the relationship between sustainable development and HIV/AIDS is unidirectional, which means that there is only effect running from *HIVPREV* to sustainable development, but not vice versa. Similarly, the relationship between human capital *(HCI)* and sustainable development is unidirectional. The results in Table 7 reveal a negative and significant relationship between the two variables. However, good governance (CLG) according to the estimate shows a positive and statistically significant long-run relationship with sustainable development.

Moreover, the results, as revealed in Table 7, show that HIV/AIDS has a negative and significant long-run relationship with human capital. It also worthy to note that the relationship is bidirectional. There is also a unidirectional long-run relationship between human capital and good governance. The result also established a bidirectional long-run relationship between HIV/AIDS and good governance. Meanwhile, all the results were supported with the estimates from the subgroup estimations. Table 8 shows the coefficients for the cointegration vectors for *ANS*, *HIVPREV*, *HCI*, and *CLG*, respectively. It is sufficient to say that the signs and intervals of *ECT*s from Table 8 are consistent with theory, meaning that a negative ECT ranges between 0 and 1 and is imperative for a stable error correction mechanism [54]. A positive *ECT* implies deviation from the equilibrium, while a negative ECT is important for the restoration of equilibrium following an exogenous shock.

**Table 7.** Long-run causality estimates.

| | | Independent Variables | | | |
|---|---|---|---|---|---|
| | **Dep. Var.** | **ΔANS** | **ΔHIVPREV** | **ΔHCI** | **ΔCLG** |
| Group Panel | ΔANS | - | 1.12*(0.32) | −10.05**(4.28 | 11.11*(2.50) |
| | ΔHIVPREV | −0.001(0.004) | - | −23.11*(0.84) | 2.12*(0.23) |
| | ΔHCI | 0.0002(0.0002) | 0.01**(0.002) | - | −0.05***(0.03) |
| | ΔCLG | 0.001(0.001) | 0.01**(0.01) | 0.04(0.07) | - |
| UMIC | ΔANS | - | 1.70**(0.77) | −7.33(7.85) | 16.21***(9.17) |
| | ΔHIVPREV | −0.08**(0.04) | - | −26.81*(3.80) | 1.85(2.81) |
| | ΔHCI | −0.003**(0.002) | −0.02*(0.006) | - | 0.23***(0.13) |
| | ΔCLG | 0.001(0.002) | −0.002(0.004) | −0.42*(0.07) | - |
| LMIC | ΔANS | - | −1.04(0.65) | 37.06*(10.09) | 22.41**(7.86) |
| | ΔHIVPREV | −0.004(0.01) | - | 19.60*(4.99) | −8.96**(3.20) |
| | ΔHCI | 0.001***(0.0003) | 0.03**(0.01) | - | −0.11***(0.07) |
| | ΔCLG | 0.001(0.001) | 0.02***(0.01) | 0.19(0.16) | - |
| LIC | ΔANS | - | 1.24*(0.38) | −10.17***(5.72) | 9.90*(2.75) |
| | ΔHIVPREV | 0.08*(0.02) | - | 0.67(0.69) | 3.45*(0.75) |
| | ΔHCI | −0.02(0.01) | 0.10(0.07) | - | −1.01***(0.60) |
| | ΔCLG | −0.001(0.003) | 0.01(0.01) | 0.10(0.10) | - |

*, **, *** indicates 1%, 5% and 10% significance levels, respectively. Values in parentheses are standard error. UMIC = Upper-middle income countries, LMIC = Low-middle income countries, LIC = Low income countries.

**Table 8.** Short-run estimates (koint causality).

| | | Independent variables | | | | |
|---|---|---|---|---|---|---|
| | **Dep. Var.** | **ΔANS** | **ΔHIVPREV** | **ΔHCI** | **ΔCLG** | **ECT(-1)** |
| Group Panel | ΔANS | - | 9.82(10.16) | 12.22(38.54) | 0.94(3.04) | −0.50* |
| | ΔHIVPREV | 0.001(0.002) | - | 1.64(1.24) | −0.05(0.06) | −0.07* |
| | ΔHCI | 0.0003(0.0003) | 0.001(0.01) | - | 0.01(0.01) | −0.05* |
| | ΔCLG | −0.0002(0.001) | 0.06(0.07) | −0.25(0.70) | - | −0.36* |
| UMIC | ΔANS | - | −1.75(3.31) | 37.96(62.63) | 4.81(4.01) | −0.43** |
| | ΔHIVPREV | 0.004(0.01) | - | −5.76***(3.10) | −0.15(0.19) | −0.10** |
| | ΔHCI | −0.000**(0.001) | −0.06***(0.04) | | 0.01(0.03) | −0.11* |
| | ΔCLG | −0.0001(0.002) | 0.002(0.04) | 0.10(0.37) | - | −0.62* |
| LMIC | ΔANS | - | 38.28(33.90) | −66.22(41.21) | −5.98(8.06) | −0.53* |
| | ΔHIVPREV | 0.0004(0.001) | - | 2.19(3.82) | 0.42(0.32) | −0.01 |
| | ΔHCI | −0.0001(0.0001) | 0.02(0.02) | - | 0.02(0.02) | −0.07* |
| | ΔCLG | 0.003(0.002) | 0.17(0.13) | −1.19(1.25) | - | −0.49* |
| LIC | ΔANS | - | 0.01(3.56) | 39.80(55.81) | 1.11(3.53) | −0.52* |
| | ΔHIVPREV | −0.003(0.002) | - | 3.62**(1.62) | −0.04(0.08) | −0.03 |
| | ΔHCI | 0.001(0.001) | 0.02(0.01) | - | 0.01(0.01) | −0.01 |
| | ΔCLG | −0.001(0.002) | 0.0004(0.09) | 0.09(1.09) | - | −0.25** |

*, **, *** indicates 1%, 5% and 10% significance levels, respectively. Values in parentheses are standard error. UMIC = Upper-middle income countries, LMIC = Low-middle income countries, LIC = Low income countries.

The ECT coefficient from Table 8 shows that sustainable development, HIV/AIDS, human capital, and good governance can be restored to long-run equilibrium. The analysis of Equation (6), as presented in Table 7, indicates that there is long-run cointegration among the variables at 1% significance level, and the ECT coefficient of (–0.50) revealed in Table 8 implies that any deviation from the long-run equilibrium is corrected at 50% adjustment speed. This also indicates a strong and joint causality of the three variables on sustainable development.

From Tables 7 and 8 and Equation (7), the results show a long-run cointegration among the variables at 1% significance level. The results also reveal a strong and joint causality of sustainable development, HIV/AIDS prevalence, and good governance on human capital. Human capital could be significantly restored to its long-run equilibrium at 5% adjustment speed in the presence of a shock. Analysis for Equation (8), as presented in Table 8, indicates that sustainable development, human capital, and good governance have a joint causal effect on HIV/AIDS prevalence, while Table 7 reveals that there is long-run cointegration which is statistically significant at 1% level. In presence of a shock, *HIV/AIDS* could be significantly restored to its long-run equilibrium at 7% adjustment speed. Similarly, in reference to Equation (9), sustainable development, HIV/AIDS prevalence, and human capital have a joint and strong causal effect on good governance, which is depicted in Table 8. In case of any shock in the system, it could be adjusted at 36% adjustment speed.

For upper-middle income economies, a long-run bidirectional causal relationship was found to exist between sustainable development and HIV/AIDS and human capital, and sustainable development and country-level governance. Meanwhile, a unidirectional long-run causal relationship was found to exist between human capital and country-level governance, and human capital and sustainable development. However, a bidirectional short-run causality was found between HIV/AIDS and human capital, and a unidirectional short-run causality was found between sustainable development and human capital.

As for the joint causality, the results are summarized in Table 8. The results show that HIV/AIDS, country-level governance, and human capital have joint causality on sustainable development. The model has about 43% speed of adjustment to return back to equilibrium in the presence of shock. Similarly, sustainable development, human capital, and country-level governance show a strong joint causality on HIV/AIDS with 10% speed of adjustment. HIV/AIDS, country-level governance, and sustainable development were found to have a strong joint causal long-run relationship on human capital, while HIV/AIDS, sustainable development, and human capital were also found to have a strong long-run causal relationship with country-level governance.

In a similar result to that obtained with respect to the group panel, we found bidirectional long-run causal relationship between HIV/AIDS and human capital, sustainable development and human capital, and HIV/AIDS and country-level governance. A unidirectional long-run causal relationship was found between human capital and country-level governance, and sustainable development and country-level governance. The results are presented in Table 7. Further estimates, as shown in Table 8, reveal that HIV/AIDS, country-level governance, and human capital were found to have joint long-run causal relationship with sustainable development. Sustainable development, HIV/AIDS, and human capital also have a joint long-run causal relationship with country-level governance.

As for the low income economies, the results as shown in Tables 7 and 8 are not significantly different from the other three panesl. As summarized in Table 7, a bidirectional long-run causal relationship was found to exist between sustainable development and HIV/AIDS, while a unidirectional relationship was found to exist between sustainable development and human capital, human capital and country-level governance, country-level governance and HIV/AIDS, and country-level governance and sustainable development. Meanwhile, a joint long-run causal relationship was found between country-level governance, HIV/AIDS, and human capital on sustainable development, and between sustainable developments, HIV/AIDS, and human capital on country-level governance (Table 8).

### *4.7. Robustness Check*

We considered dividing the group panel into subgroups (upper-middle income, low-middle income, and low income countries) for analysis using PMG estimator. The results are summarized in Tables 7 and 8. First, we estimated the cointegration across the subgroup. The results, as presented in Table 5, supported our findings for the whole group panel that a long-run relationship exists among the sustainable development (ANS) and the variables considered. Meanwhile, the short-run relationship varies across the subgroups (Table 8). Human capital was found to have a short-run negative causal relationship with HIV/AIDS prevalence in upper-middle income countries (UMIC), while it was positive for low income countries (LIC). However, it has no short-run relationship in low-middle income countries (LMIC), which is similar to the results obtained for the group panel.

## 5. Summary and Conclusion

This study empirically examined the relationship among sustainable development, HIV/AIDS prevalence, human capital, and good governance in 26 sub-Saharan Africa countries using dynamic heterogeneous panel estimation. In the present globalized era, the issue of sustainable development is critical to measure the progress of any country's development, which will not only account for the economic development, but other factors that will account for the general improved welfare of the citizen. It has become essential to understand the underlying fundamental factors that influence the achievement of sustainable development in the region. Thus, variables like HIV/AIDS, which have been a great challenge to Africa countries, human capital, and country-level governance are taken as the independent variables, which are measured using yearly data from 1990 to 2016 and were analyzed using pooled mean group estimator. To ensure the robustness of the findings, the panel was subdivided into three panels based on the World Bank level of economies categorization. The three categories are upper-middle income (UMIC), low-middle income (LMIC), and low income (LIC) countries.

For the group panel, a bidirectional long-run causal relationship was found between HIV/AIDS and human capital, and HIV/AIDS prevalence and country-level governance. A unidirectional long-run causal relationship was found to exist between human capital and country-level governance, while a bidirectional long-run causal relationship was found between sustainable development and country-level governance, human capital, and sustainable development, and sustainable development and HIV/AIDS.

The positive and significant long-run causal relationship between HIV/AIDS and sustainable development is in line with some previous studies [19,24], which argued that in the future, HIV/AIDS is not likely to threaten economic growth in Africa. Sustainable development and good governance according to the estimated results reveal a positive and significant long-run relationship. This result is in line with previous studies. Previous studies found that the central place of development policy is occupied with the model of good governance [7,31–33], which has become the cornerstone of sustainable development. However, the result is in contrast to some previous studies [34,35], which found no relationship between sustainable development and good governance. The result from the estimates implies that to achieve sustainable development in sub-Saharan Africa countries, there is a need for a concerted effort on the part of the continent country's government to ensure effective good governance. However, while a unidirectional long-run causal relationship was found between sustainable development and HIV/AIDS in the group panel, a bidirectional long-run causal relationship was found between sustainable development and HIV/AIDS in UMIC and LIC respectively. The difference could be attributed to the heterogeneous nature of the countries included in the panel.

A disturbing result from the study is the coefficient sign of a human capital long-run relationship with sustainable development. The authors hypothesized a positive relationship, but the result turned out to be negative, although the significant long-run relationship found in this study is in line with some authors, who inferred human capital to have a significant long-run relationship with

the sustainable development of any country [37–40]. However, the negative sign of the result is not surprising in reference to the study of Quadri and Waheed [56], who observed that the contribution of human capital to sustainable development is more in the theoretical realm than the empirical. The study submitted that the theoretical contribution of human capital is clear, but empirical findings are mixed [56]. An interesting finding from this study is the significant strong joint causality of sustainable development, good governance, and human capital on HIV/AIDS prevalence, and in case of any shock, it could be restored back to equilibrium at 7% adjustment speed. This is an indication that, the threat of HIV/AIDS prevalence on sustainable development could be curtailed by putting effective policies and programs in place. There is also a bi-directional long-run relationship between HIV/AIDS prevalence and good governance. It is of importance to note that in sub-Saharan Africa countries, an effective good governance would enhance significant reduction in the prevalence of HIV/AIDS in the region.

The study estimated the relationship among sustainable development, HIV/AIDS prevalence, human capital, and good governance. It found that all the variables are cointegrated, which implies a long-run relationship. The estimation of the long-run slope coefficient restricted it to be homogenous across countries. This is because the authors expect that the long-run equilibrium relationship between the variables will be similar across countries in sub-Saharan Africa. Future studies can do a comparative study of countries with high HIV/AIDS prevalence in African regions to confirm the outcome of these results. Also, there is a need for a robustness test to explore the mixed result on the relationship between sustainable development and human capital. Based on the findings of this study, it is imperative for the government and stakeholders in the region to pursue policies that will enhance sustainable development with expected long-term results, rather than short-term gains. First, there is a need to improve the country-level governance policy, development of human capital, and improve on the policies and programs targeted toward the prevention and eradication of HIV/AIDS in sub-Saharan Africa countries. Second, human capital needs to be more developed to drive down the effects of HIV/AIDS prevalence. Lastly, good governance, found to have a long-run relationship with sustainable development, should be strengthened to ensure that the rule of law prevailed, transparency in their dealings, corruption to be eradicated, conducive business regulatory environment, and a country free of war/terrorism. However, sustainable development is achievable in sub-Saharan Africa countries if an adequate research grounded policy is put in place to address the challenges as revealed by this study.

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## Appendix A

**Table A1.** List of countries in the panel.

| S/No | Country | Classification | S/No | Country | Classification |
|---|---|---|---|---|---|
| 1 | Angola | LMIC | 14 | Madagascar | LIC |
| 2 | Benin | LIC | 15 | Malawi | LIC |
| 3 | Bostwana | UMIC | 16 | Mali | LIC |
| 4 | B/Faso | LIC | 17 | Mauritania | LMIC |
| 5 | Burundi | LIC | 18 | Mozambique | LIC |
| 6 | Cameroon | LMIC | 19 | Namibia | UMIC |
| 7 | Congo DR | LIC | 20 | Niger | LIC |
| 8 | Congo R | LMIC | 21 | Nigeria | LMIC |
| 9 | C/Ivoire | LMIC | 22 | Senegal | LIC |
| 10 | Eswatini | LMIC | 23 | S/Leone | LIC |
| 11 | Gabon | UMIC | 24 | S/Africa | UMIC |
| 12 | Gambia | LIC | 25 | Togo | LIC |
| 13 | Ghana | LMIC | 26 | Uganda | LIC |

UMIC = Upper-middle income countries, LMIC = Low-middle income countries, LIC = Low income countries.

## References


1. Mondal, M.N.I.; Shitan, M. Factors affecting the HIV/AIDS epidemic: An ecological analysis of global data. *Afr. Health Sci.* **2013**, *13*, 301–310. [CrossRef] [PubMed]
2. UNAIDS. UNAIDS Data 2017. 2017. Available online: www.unaids.org (accessed on 16 June 2018).
3. Djukpen, R.O. Mapping the HIV/AIDS epidemic in Nigeria using exploratory spatial data analysis. *GeoJournal* **2012**, *77*, 555–569. [CrossRef]
4. Erinosho, O.; Dike, N.; Joseph, R.; Isiugo-Abanihe, U.; Aderinto, A.A. Methodological Issues in HIV-Related Social Research in Nigeria. *Afr. J. Reprod.* **2013**, *17*, 146–155.
5. Milanovic, B. Global inequality recalculated and updated: The effect of new PPP estimates on global inequality and 2005 estimates. *J. Econ. Inequal.* **2012**, *10*, 1–18. [CrossRef]
6. UNEP (United Nations Environment Programme). *Global Environment Outlook: Environment for the Future We Want—GE05*; UNEP: Nairobi, Kenya, 2012.
7. Boţa-Avram, C.; Groşanu, A.; Răchişan, P.R.; Gavriletea, M.D. The Bidirectional Causality between Country-Level Governance, Economic Growth and Sustainable Development: A Cross-Country Data Analysis. *Sustainability* **2018**, *10*, 502. [CrossRef]
8. Mignaqui, V. Sustainable development as a goal: Social, environmental and economic dimensions. *Int. J. Soc. Qual.* **2014**, *4*, 57–77. [CrossRef]
9. World Bank. *Inclusive Green Growth: The Pathway to Sustainable Development*; World Bank: Washington, DC, USA, 2012.
10. WHO. Health in the Sustainable Development Goals. 2016. Available online: http://www.searo.who.int/entity/health_situation_trends/health_in_sustainable_devlop_goals.pdf (accessed on 12 December 2017).
11. Sustainable Development Solutions Network (SDSN). Health in the Framework of Sustainable Development. 2014. Available online: http://unsdsn.org/wp-content/uploads/2014/02/Health-For-All-Report.pdf (accessed on 17 July 2017).
12. UNAIDS. The Sustainable Development Goals and the HIV Response. 2018. Available online: www.unaids.org/sites/default/files/media_asset/SDGsandHIV_en.pdf (accessed on 6 August 2018).
13. Over, M. *The macroeconomic impact of AIDS in Sub-Saharan Africa*; AFTN Technical Working Paper 3; Population, Health and Nutrition Division, Africa Technical Department, World Bank: Washington, DC, USA, 1992.

14. Arndt, C.; Lewis, J.D. The macro implications of HIV/AIDS in South Africa: A preliminary assessment. *S. Afr. J. Econ.* **2000**, *68*, 380–392. [CrossRef]
15. Maijama'a, D.; Samsudin, S. HIV/AIDS and economic growth: Empirical evidence from sub-Saharan Africa. *Res. Appl. Econ.* **2015**, *7*, 30–47. [CrossRef]
16. Essig, A.; Kang, S.; Sellers, R. *The Relationship between HIV Infection Rates and GDP Per Capita in African Countries*; Georgia Institute of Technology: Atlanta, GA, USA, 2015.
17. Sackey, J.; Raparla, T. *Lesotho, The Development Impact of HIV/AIDS—Selected Issues and Options*; AFTMI Report, No. 21103; LSO, Macroeconomic Technical Group, Africa Region, World Bank: Washington, DC, USA, 2000.
18. Augier, L.; Yaly, A. Economic growth and disease in the OLG model: The HIV/AIDS case. *Econ. Model.* **2013**, *33*, 471–481. [CrossRef]
19. Kirigia, J.M.; Sambo, L.G.; Okorosobo, T.; Mwabu, G.M. Impact of HIV/AIDS on Gross Domestic Product (GGP) in the WHO Africa Region. *Afr. J. Health Sci.* **2002**, *9*, 27–39. [CrossRef] [PubMed]
20. Afawubo, K.; Mathey, S. Employment and education effects on HIV/AIDS prevalence rate and economic growth: Empirical investigation in ECOWAS. *Appl. Econ. Lett.* **2014**, *21*, 755–759. [CrossRef]
21. Alemu, Z.G.; Roe, T.L.; Smith, R.B. *The Impact of HIV on Total Factor Productivity*; Working Paper; Economic Development Center, University of Minnesota: Minneapolis, MN, USA, 2005.
22. Young, A. The gift of the dying: The tragedy of AIDS and the welfare of future African generations. *Q. J. Econ.* **2005**, *120*, 423–466.
23. Couderc, N.; Ventelou, B. AIDS, economic growth and the epidemic trap in Africa. *Oxf. Dev. Stud.* **2005**, *33*, 417–426. [CrossRef]
24. Cuesta, J. How much of a threat to economic growth is a mature AIDS epidemic? *Appl. Econ.* **2010**, *42*, 3077–3089. [CrossRef]
25. Fortson, J.G. Mortality risk and human capital investment: The Impact of HIV/AIDS in Sub-Saharan Africa. *Rev. Econ. Stat.* **2011**, *93*, 1–15. [CrossRef]
26. Frimpong, P.B.; Adu, G. Population health and economic growth in Sub-Saharan Africa: A panel cointegration analysis. *J. Afr. Bus.* **2014**, *15*, 36–48. [CrossRef]
27. Roy, S. The effects of HIV/AIDS on economic growths and human capitals: A panel study evidence from Asian countries. *AIDS Care* **2014**, *26*, 1568–1575. [CrossRef] [PubMed]
28. Asiedu, E.; Jin, Y.; Kanyama, I.K. The impact of HIV/AIDS on foreign direct investment: Evidence from Sub-Saharan Africa. *J. Afr. Trade* **2015**, *2*, 1–17. [CrossRef]
29. Shuaibu, M.; Oladayo, P.T. Determinants of human capital development in Africa: A panel data analysis. *Oeconomia Copernic.* **2016**, *7*, 523–549. [CrossRef]
30. Brautigam, D. *Governance and Economy: A Review*; World Bank Publications: Washington, DC, USA, 1991; Volume 815.
31. Stojanović, I.; Ateljević, J.; Stević, R.S. Good governance as a tool of sustainable development. *Eur. J. Sustain. Dev.* **2016**, *5*, 558–573. [CrossRef]
32. Wilson, R. Does governance cause growth? Evidence from China. *World Dev.* **2016**, *79*, 138–151. [CrossRef]
33. Leal Filho, W.; Platje, J.; Gerstlberger, W.; Ciegis, R.; Kääriä, J.; Klavins, M.; Kliucininkas, L. The role of governance in realizing the transition towards sustainable societies. *J. Clean. Prod.* **2016**, *113*, 755–766. [CrossRef]
34. Rodrik, D. Thinking about Governance. In *Governance, Growth and Development Decision-Making*; North, D.C., Daron, A., Francis, F., Dani, R., Eds.; The World Bank: Washington, DC, USA, 2008.
35. Khan, M.H. *Governance, Economic Growth and Development Since the 1960s*; UNDESA Working Paper No. 54, ST/ESA/2007/DWP/54; UNDESA: New York, NY, USA, 2007.
36. Šlaus, I.; Jacobs, G. Human capital and sustainability. *Sustainability* **2011**, *3*, 97–154. [CrossRef]
37. Jakimhovski, J. The human capital as a factor in the sustainable development. *Škola Biznia* **2011**, *3*, 72–85.
38. Scicchitano, S. Complementarity between heterogeneous human capital and R&D: can job-training avoid low development traps? *Empirica* **2010**, *37*, 361–380.
39. Absalyamova, S.G.; Absalyamov, T.B.; Mukhametgalieva, C.F.; Khusnullova, A.R. Management of the sustainable development of human capital in the terms of macroeconomic instability. *Procedia Econ. Financ.* **2015**, *24*, 13–17. [CrossRef]

40. Ekperiware, M.C.; Olatayo, T.O.; Egbetokun, A.A. *Human Capital and Sustainable Development in Nigeria: How Can Economic Growth Suffice Environmental Degradation?* (No. 2017-29); Economics Discussion Papers; Kiel Institute for the World Economy (IfW): Kiel, Germany, 2017.
41. Diaconu, L.; Popescu, C.C. Human capital—A pillar of sustainable development. Empirical evidences from the EU states. *Eur. J. Sustain. Dev.* **2016**, *5*, 103–112.
42. Eigbiremolen, G.O.; Anaduka, U.S. Human Capital Development and Economic Growth: The Nigeria experience. *Int. J. Acad. Res. Bus. Soc. Sci.* **2014**, *4*, 4. [CrossRef]
43. Nourry, M. Measuring sustainable development: Some empirical evidence for France from eight alternative indicators. *Ecol. Econ.* **2008**, *67*, 441–456. [CrossRef]
44. Gnègnè, Y. Adjusted net saving and welfare change. *Ecol. Econ.* **2009**, *68*, 1127–1139. [CrossRef]
45. Thiry, G.; Cassiers, I. Alternative indicators to GDP: Values behind numbers. Adjusted net savings in question. *Appl. Res. Qual. Life* **2010**, *23*, 1–23.
46. Lange, G.M.; Wodon, Q.; Carey, K. (Eds.) *The Changing Wealth of Nations 2018: Building a Sustainable Future*; The World Bank: Washington, DC, USA, 2018.
47. Feenstra, R.C.; Inklaar, R.; Timmer, M.P. The Next Generation of the Penn World Table. *Am. Econ. Rev.* **2015**, *105*, 3150–3182. [CrossRef]
48. Barro, R.J.; Lee, J.W. A new data set of educational attainment in the world, 1950–2010. *J. Dev. Econ.* **2013**, *104*, 184–198. [CrossRef]
49. Pesaran, M.H.; Shin, Y.; Smith, R.J. Pooled mean group estimation of dynamic heterogeneous panels. *J. Am. Stat. Assoc.* **1999**, *94*, 621–634. [CrossRef]
50. World Governance Indicators. 2018. Available online: www.govindicators.org (accessed on 16 June 2018).
51. World Bank. World Band Development Indicators. 2018. Available online: http://databank.worldbank.org/data/home.aspx (accessed on 16 June 2018).
52. Pesaran, M.H.; Schuermann, T.; Weiner, S.M. Modeling regional interdependencies using a global error-correcting macroeconometric model. *J. Bus. Econ. Stat.* **2004**, *22*, 129–162. [CrossRef]
53. Persyn, D.; Westerlund, J. Error-correction-based cointegration tests for panel data. *Stata J.* **2008**, *8*, 232–241. [CrossRef]
54. Asongu, S.; El Montasser, G.; Toumi, H. Testing the relationships between energy consumption, $CO_2$ emissions, and economic growth in 24 African countries: A panel ARDL approach. *Environ. Sci. Pollut. Res.* **2016**, *23*, 6563–6573. [CrossRef] [PubMed]
55. Kumar, S.; Webber, D.J.; Fargher, S. Wagner's Law revisited: Cointegration and causality tests for New Zealand. *Appl. Econ.* **2012**, *44*, 607–616. [CrossRef]
56. Qadri, F.S.; Waheed, A. Human capital and economic growth: Cross-country evidence from low-, middle-and high-income countries. *Prog. Dev. Stud.* **2013**, *13*, 89–104. [CrossRef]