Economic Prosperity, Asymmetric Natural Resource Income, and Ecological Demands in Resource-reliant Economies

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Research Article

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Abstract

This study extends the literature by examining the linear and nonlinear effects of natural resource income and the contribution of environmental demands to long-term economic growth in resource-reliant economies (RREs). Data was sourced from 45 RREs from 1970 to 2019 and processed using three novel methodological techniques: the mean group (MG), augmented MG, and common correlated effects MG. Empirically, the study affirmed asymmetry in the natural resources rents-economic growth nexus. Specifically, the study found that environmental demands and positive changes to natural resources income are a blessing to long-term economic growth. In contrast, adverse changes to natural resources income are growth decelerating. Globalisation and human capital development served as control variables, and while the former accelerated long-term economic growth, the latter had an irrelevant effect on the RREs. In addition, the Dumitrescu and Hurlin causality result showed a bidirectional nexus between environmental quality and economic growth and between economic growth and negative natural resource income changes. A unidirectional causal flow from positive natural resources income to economic prosperity and from the latter to human capital development was also revealed. The study proposed relevant policy measures.

Keywords: Economic growth; Natural resources rents; Environmental quality; Resource curse; Resource-reliant economies; Symmetric and asymmetric analysis.
JEL Classification: N1, N5, O13.

1. Introduction

The fall in natural resource prices, as witnessed in recent times, has significantly magnified the consequential effect of natural resource booms and bursts on economic prosperity/growth, especially for resource-reliant economies (hereafter, RREs). These economies substantially rely on natural resources revenues—which constitute their essential means of income but are naturally temporary and volatile. The result of ignoring adequate management of the volatility of resource revenue or the inability to reliably deploy it in the formation of stocks of productive assets in RREs can be severe (Tahar et al., 2021). Likewise, environmental resources constitute an integral component of economic growth. They are extensively demanded not just for primary needs (i.e., food, housing, and clothing) but also for economic advancement. Thus, economic prosperity can be said to be a function of a country's ecological resources, including cropland, forest products, carbon space, built-up land, fishing grounds, and grazing land. The abundance of these resources and their exploitation can aid the rapid growth of an economy (Aladejare, 2022a). Furthermore, the ecological demands in a country can significantly determine the domestic and foreign investment potentials of a nation and hence, impact the level of income and employment (Aladejare, 2022b). However, when these environmental resources are over-exploited, they can also jeopardise sustainable growth and trigger ecological degradation.

Although there are extant studies on the long-run impact of natural resources on economic growth, their empirical conclusion is still ambiguous. While there are studies that opine natural resources are growth-inducing (Alexeev and Conrad, 2009; Cavalcanti et al., 2011; Jalloh, 2013; Abusaaq et al., 2015; Kitous et al., 2016; Usman et al., 2022; Wen et al., 2022), and growth aversive (Sachs and Warner, 2001; Ahmed et al., 2016; Gerelmaa and Kotani, 2016;

Aladejare, 2018; Aladejare, 2020a); some others submit that the result is a function of different elements (Mehlum et al., 2006; Collier and Goderis, 2012; Ghalayini, 2011; Badeeb et al., 2017; Chekouri et al., 2017). Several theoretical expositions have been proposed for this ambiguous outcome. For instance, Badeeb et al. (2017) categorised these elements into economic and political factors. Most paramount among the economic factors are volatility issues, the 'Dutch disease', and poor human capital development. For the political factors, corruption, rent-seeking behaviour, and weak institutions were postulated.

Furthermore, the absence of consensus on the long-run impact of natural resources income on growth may be linked to methodological specification, as most extant literature dwelled mainly on the symmetric implications of natural resources on the economy while ignoring the possibility of an asymmetric effect. Nevertheless, there are a few recent studies that subscribe to the view that resource price volatility could propel an asymmetric impact on the economy (Varangis et al., 2004; Addison et al., 2016; Erdogan et al., 2020; Ampofo et al., 2021; Tahar et al., 2021). Consequently, applying a symmetric methodology to an asymmetric nexus could be misleading and produce spurious results.

This study extends the literature by investigating both the symmetric and asymmetric impact of natural resources income and environmental demands on the economic growth of 45 RREs between 1970 to 2019. The value addition of this study to the literature is in three folds. First, by having an extended analytical time frame (of 50 years), this study derived reliable long-term economic growth response to environmental demands, which is scant in the literature. Second, the data length also enabled the long-term assessment of the erratic behaviour of natural resource income on the economic prosperity of RREs. Third, this study employed three novel methodologies, which are the mean group (MG), augmented MG (AMG), and common correlated effects MG (CCEMG), consistent with treating issues of heterogeneity and cross-sectional dependence (CSD) in large panel datasets. Furthermore, the Dumitrescu and Hurlin (D-H) causality approach was applied in ascertaining causality between the study variables. It is noteworthy that this study leads in applying these techniques in the evaluation of environmental demands and the symmetric and asymmetric effects of natural resources income on economic growth for RREs.

The structure of this study is of the following: Section 2 is the literature review; Section 3 is the study's data and methodology; Section 4 provides the empirical outcomes and discussion of findings; and Section 5 contains the conclusions and policy implications.

2. Literature Review

2.1 Theoretical review

Empirical studies by Higgins and Williamson (1999) and Hausmann (2001) have revealed that the natural resource curse theory is more impactful in RREs compared to less RREs. There are three major approaches to the resource curse theory: the Dutch disease, the rent-seeking activities grounded in the existence of the associated tax revenue, and the adverse effect of volatility. It is noteworthy that the three resource curse propositions can also be theoretically linked to ecological management because natural wealth are embedded in the environment. Thus, indicating that a form of natural resource and environmental correlation impacts growth. This section provides a concise exposition of the three fronts.

2.1.1 The Dutch disease hypothesis

The Dutch disease represents an economic concept depicting the synchronicity of a growing sector and lagging sub-sectors of traded goods in the economy (Aladejare, 2018). The flourishing industry pressures the lagging sector by diverting resources from the latter, resulting in a growing relative price of non-tradable goods (Corden and Neary,1982). Stated otherwise, a rise in receipts from natural goods will trigger increased demand for foreign manufactured products (tradable products). However, there is higher demand generally for all products, including construction and services (non-tradable products), of which local production is significantly necessary since importation is brutal. Thus, the economy will have to transfer resources from the tradable sector to the non-tradable sector for expansion, implying that growth in the resource sector would produce a contraction in the manufacturing industry.

One critical premise of the Dutch disease hypothesis is the existence of three dominant sectors in the economy, which are: a tradable natural resources sector, a tradable manufacturing sector, and a non-traded sector (Aladejare, 2018). In RREs, tradable production is assigned inside the natural resources sector, while capital and labour only gain employment within the manufacturing and non-traded sectors. Hence, with growing receipts from natural resources, the manufacturing sector is inclined to shrink while the non-tradable sector enlarges. Surplus demands for non-tradable products and growing non-tradable prices originate from rising income in the natural resources sector. Given that the non-tradable products stand as inputs in manufacturing, an increase in their prices and constant foreign prices will result in declined manufacturing sector profits.

It is important to stress that this intuition is compelling but does not independently indicate any inefficiency or welfare loss. Instead, it only expatiates that booms in resource receipts correlate with contractions only in manufacturing and not general economic growth. The approach, thus, is lacking in explicating reasons a country’s economic growth retards, simply due to its resource wealth. Understanding this will need to accept that the tradable sector is essential to a country’s growth.

2.1.2 The rent-seeking approach

An alternative hypothesis to the Dutch disease theory suggests that RREs tend to be less entrepreneurial simply because of the complacency that accompanies cheap income from natural resource wealth. Hence, the government and the entrepreneurial public find it less profitable to engage in other productive ventures but depend on the rent-seeking process for wealth generation. Consequently, in RREs noted for poor non-resource taxes and enormous resource rents, the possibility of a deficit spending for growth becomes strong. Nevertheless, the rent-seeking hypothesis does not precisely capture why RREs fair better in periods of rising resource income and underperform in times of poor revenue. Karl (1997) stated that the failure of RREs to enhance their political will for better non-resource tax administration of the citizens emboldens the weakness of RREs’ inefficiency in handling volatile resource revenues without having to grapple with macroeconomic crises.

Intuitively, this postulation appears valid; however, there are other countering elements. For instance, in times of higher resource earnings, higher savings are also guaranteed. Furthermore, such income enables the RREs to reduce taxes over more mobile factors to gain a lower distortionary aggregate taxation scheme, which will create a more desirable economic environment for growth. Also, the political skills needed to distribute rents among various groups may aid the derivation of essential reallocations of wealth when income falls (Hausmann and Rigobon, 2002).

2.1.3 The volatility approach

Natural resource rents are indeed susceptible to volatility because their supply is characterised by low price elasticities (Hausmann and Rigobon, 2002). Volatility from the perspective of trade is detrimental to the economy if we assume that natural resource receipts are distributed to the entire population via government transfers. Risk-averse consumers will likely consider such income less appealing because of its volatile nature. However, this might not justify the considerable fall in economic growth usually exhibited by RREs during plummeting resource prices. It certainly does not depict what can be tagged as a curse when equated with the income it generates. For the volatility effect to be significant, the volatility in natural resource prices must have an encompassing distortionary impact on all economic sectors. Otherwise, the direct effect of natural resource revenues on household income will remain the sole source of volatility. For a resource curse, the non-oil economy must also show substantial distortion originating from natural resource price volatility.

From the above reviews, it is evident that resource income alone cannot determine the direction of economic growth in RREs. Especially given that economies worldwide are fast integrating, trade and investment policies in one country may impact the economic prosperity in another. Similarly, human capital development is another factor to consider in utilising natural wealth for economic growth. A poor level of education can result in the under-utilisation of natural resources for growth and development. Thus, globalisation and human capital development should also be considered alongside natural resources wealth as growth-inducing components in RREs.

2.2 Empirical review

The empirical review of this study is synthesised into the economic growth-natural resources nexus and the economic growth-environmental quality nexus.

2.2.1 The economic growth-natural resources nexus

Anderson and Bruckner (2012) had earlier revealed that increased volatility in agricultural prices substantially and negatively affected economic growth in sub-Saharan African (SSA) countries. Addison et al. (2016) evaluated the positive and adverse impact of agrarian price shocks on economic growth in nine SSA countries. The study showed little evidence of such asymmetry by applying the standard linear and nonlinear dynamic models. Kristjanpoller et al. (2016) used the dynamic ordinary least squares (DOLS) approach to study Latin American and Caribbean economies. Findings from the study indicated that natural resources and agricultural exports adversely impacted economic prosperity during booms. Aladejare (2018) showed using the pool mean group (PMG) approach that there is a blend of the Dutch disease and rent-seeking resource curse hypothesis in fifteen oil-exporting countries. Further results from difference and system generalised method of moment (GMM) adopted by Khan et al. (2020) validated the resource curse phenomenon in Belt and Road initiative (BRI) countries.

On the other hand, Sun and Wang (2021) adopted the wavelet power spectrum and wavelet coherence techniques. Both approaches reported an insignificant impact of volatility of natural resource prices on global economic growth. However, Rahim et al. (2021) upheld the resource curse hypothesis in the Next-11 economies using AMG and D-H causality techniques. The study further noted that human capital development could be used to achieve a positive effect of natural resources on the economy. However, a mixed outcome of resource curse and blessing, through the use of panel cointegration and Granger causality approaches, was derived by Amofo et al. (2021) in leading mineral-rich economies.

A more comprehensive study by Tahar et al. (2021) later adopted a symmetric and asymmetric PMG analysis method. The linear outcome of the study deduced that natural resource prices have short- and long-term impacts on economic growth. The asymmetric decomposition of natural resource prices further revealed a more significant response of economic growth to positive changes than negative changes in natural resource prices. Hence, this indicates the presence of asymmetric effects of resource price shocks in 63 commodity export-dependent countries. In a related study, Hayat and Tahir (2021) applied the autoregressive distributed lag (ARDL) model and reported that natural resources played a crucial positive role in the economic growth of RREs. Furthermore, Guan et al. (2021) used the PMG method to conclude that volatility in oil and gold-dependent countries negatively impacted their long-term economic performance.

Recently, Wen et al. (2022) adopted the cross-sectional augmented ARDL (CS-ARDL) and the AMG methods to conclude that volatility in resource rents promotes long-term economic growth in BRICS countries. By adopting a structural vector autoregressive (S-VAR) model, Olamide et al. (2022) reported that the economic dependence between East African countries implies that shocks to commodity prices will significantly and positively affect their economies. Zhang et al. (2022) showed by using the fully modified OLS (FMOLS), DOLS, and canonical cointegrating regression (CCR), that natural resources volatility adversely and critically impacted global economic growth. On the flip side, Musibau et al. (2022) employed the ARDL methodology and inferred that natural resource wealth enhanced economic prosperity in West African countries. The study further revealed a mixed impact of globalisation on growth. Likewise, Shittu et al. (2022) involved the ARDL approach in a study on the Middle East and North African (MENA) countries. Estimates from the study indicated a blessing effect of natural resources endowment on MENA countries' economies. However, human capital was found to have positive and adverse impacts on growth, with the negative effect being more evident. By adopting the method of moment quantile regression (MMQR), Khan et al. (2022) showed that natural resource reliance yields economic blessings in both developed and developing countries.

In contrast, Khan and Ali (2022) demonstrated by adopting the MMQR that economic growth in the lower quantile adversely impacted natural resources volatility in G-7 economies. Similarly, Liang et al. (2022) used the MG and AMG methodologies to show that seven countries' economic growth positively contributes to natural resource volatility.

2.2.2 The economic growth-environmental quality nexus

In a study by Esso and Keho (2016), the bounds cointegration and Granger causality tests were adopted for 12 selected SSA countries. Mixed empirical results emerged from the study; mainly, environmental quality was found to reduce economic prosperity in Gabon, Togo, and Nigeria. The VAR model was used by Abdouli and Hammami (2017a) to validate the bidirectional nexus between the environment and economic prosperity in MENA countries. Abdouli and Hammami (2017b) later conducted a study for MENA countries using OLS, fixed effect (FE) and random effect (RE), and dynamic and system GMM techniques. The study indicated that environmental quality worsened economic growth in MENA countries. Similarly, Abdouli and Hammami (2018) showed through the GMM technique that ecological degradation is detrimental to economic growth in MENA countries. Ilham (2018) involved the simultaneous equation technique and submitted that environmental degradation and economic development have a bidirectional nexus in the Association of Southern Asian Nations (ASEAN).

Listiono (2018) applied the three-stage least squares (3SLS) and derived a bidirectional nexus between environmental degradation and economic prosperity in lower-middle-income economies. Waheed et al. (2019) later conducted a survey analysis of empirical literature and found that ecological degradation does not relate to economic growth in developed countries. Shahbaz et al. (2019) applied a GMM approach and reported a bidirectional nexus between economic growth and environmental quality in MENA countries. Similarly, Abdouli and Hammami (2020) later demonstrated through simultaneous equation models that there is a bidirectional nexus between environmental quality and economic growth in Middle East countries.

On the other hand, Hassan et al. (2020) applied a correlated RE model to 31 OECD countries. Empirical findings from the study showed that ecologically associated taxes could enhance economic prosperity, given that the pre-level of GDP per capita is high. However, by adopting the system-GMM procedure, Verma and Mehra (2020) showed that environmental degradation negatively relates to economic prosperity in sixty-two developed and developing countries. Furthermore, the Toda-Yamamoto causality estimates derived by Aladejare (2020b) suggested the absence of an association between environmental demands and economic prosperity in West African countries. In another study, Musah et al. (2021) applied the AMG and CCEMG and inferred a bidirectional association between economic growth and environmental quality in North African countries. Alabed et al. (2021) later employed a dynamic panel threshold model and concluded that ecological quality improved economic growth in MENA countries.

Aziz et al. (2021) used the PMG, DOLS, FE and pooled OLS to infer that strict environmental policies adversely impacted economic prosperity in the short term but are a blessing in the long term. Steinbrunner (2021) found environmental tax to have significantly and positively impacted the productivity of manufacturing firms in Central Europe. Usman et al. (2021) applied the AMG and D-H causality to derive a bidirectional nexus between economic growth and environmental quality in the 15 highest emitting countries. Fakher et al. (2022) employed multiple techniques, such as the continuously updated fully modified and continuously updated bias corrected estimators, alongside D-H causality. The study found that environmental quality enhanced economic growth in high-income countries, while its effect was insignificant in low-income countries. Magazzino et al. (2022) further showed by adopting the FMOLS and D-H causality procedures that ecological improvement increases economic growth when renewable energy sources are used in five Scandinavian countries. Chen et al. (2022) employed the AMG, CCEMG, and D-H causality procedures to derive a bidirectional relationship between economic growth and environmental demands in BRICS countries.

In contrast, overwhelming studies have reported the detrimental impact of economic growth on the environment. Some of these studies include Uddin et al. (2017) for 27 highest emitting economies, Usman et al. (2021) for 15 highest polluting economies, Bhat et al. (2021) for OECD countries, Li et al. (2021) for G20 countries, Chen et al. (2022) for BRICS countries, Usman et al. (2022) for Arctic countries, Hassan et al. (2022) for 16 high-income OECD countries, etc.

In the first half of the empirical review, it is evident that mixed outcomes have trailed the effect of natural resources on economic growth. The results range from positive (blessing), negative (curse), and invalid impacts on economic prosperity. Also, little consideration has trailed the asymmetric effect of natural resource income on economic growth in the reviewed studies. In the second half of the review, there is also no consensus on the impact of environmental demands on economic prosperity. Also, the attention flow from environmental demands to economic growth is scant. Furthermore, the lack of consensus in both reviews was likely magnified by the variety of techniques applied over time. To fill these gaps, this study followed the proposition advanced by Addison et al. (2016) and Tahar et al. (2021), given the potential asymmetric response of economic prosperity to natural resources income volatility. Consequently, this study extends the literature by adopting symmetric and asymmetric MG, AMG, and CCEMG procedures. Applying such approaches highlights the decomposition of natural resources income's positive and negative effects on economic growth. In addition, the contemporaneous environmental impact on growth is robustly evaluated; hence, the value additions of this study.

3. Methodology

3.1 Data sources and variable description

By applying data observation between 1970 and 2019, this study determined the response of economic growth to symmetric and asymmetric changes in natural resources rents, synchronised with impact from environmental resources in 45 RREs. The list of the RREs used in this study is in Table 9 in the appendix. Their choice was informed based on data availability for the study length.

Economic prosperity in this study is synonymous with economic growth. The concept of economic growth denotes the increase in the market value of goods and services produced within a country annually. A conventional indicator for economic growth has been the gross domestic product (GDP), either in nominal or constant terms. GDP’s choice is rooted in its capacity to reflect the comprehensive performance of a country’s economic well-being per annum. However, this also constitutes its weakness as it does not reflect individual contributions to the economic output. Thus, researchers have often relied on the GDP per capita as a better indicator of economic growth. By dividing a country’s economic output by its population, the GDP per capita is reckoned as a better indicator of a country’s well-being and standard of living. The GDP per capita shows how prosperous a country feels to its citizens. Therefore, this study adopts the GDP per capita as an indicator of economic prosperity.

Furthermore, aggregate data for natural resource rents from oil, minerals, natural gas, coal, and the forest was used to proxy natural resource income. Countries having these resources in abundance are tagged resource-endowed. Revenue from natural resources is also expected to significantly enhance the growth of different sectors in RREs. Thus, improving the contributions of the various sectors to economic growth. Environmental demands are measured using the ecological footprint. This measure is a robust indicator of environmental quality; thus, its overwhelming adoption in recent energy and environmental-related studies (Tahar et al., 2021; Aladejare, 2022b). Ecological footprint distinctively encompasses the amount of different natural areas crucial for economic growth. These natural areas cover built-up land, grazing land, forest products, fishing grounds, cropland, and carbon space. Their contribution to the growth of an economy can also be very prominent, primarily when the country relies heavily on primary exports for revenue.

The role of globalisation is considered a crucial control measure in the subject matter. The reason is that natural resource exports represent the primary income source in RREs. Globalisation entails interaction between people from diverse backgrounds, trading ideas and information. Thus, the concept is multifarious since it extends further than trade openness and capital flows (Gygli et al., 2019). Globalisation effect can be encompassing, including technology channels from advanced to developing countries which affects economic growth.

The KOF globalisation index, which evaluates globalisation from the economic, social and political perspectives (Dreher et al., 2008), was adopted as an indicator of globalisation. Another control indicator is human capital development. Its adoption is embedded in the intuition that the nature of human capital policies and strategies prevailing in RREs, can either enhance or deter economic prosperity through its interactions with the subject matter.

Contained in Table 1 is the complete description of the study variables, their corresponding measurements and sources.

Table 1: Variable description

Variable	**Measurement**	**Sources**	**Symbol**
Economic prosperity	GDP per capita growth (%)	WDI (2022)	YGP
Resources income	Total natural resource rents % of GDP	WDI (2022)	NRR
Environmental demands	Ecological footprint global hectares (gha) per capita.	Global footprint network (2022)	EFP
Globalisation	weight in percentage	KOF globalisation index (2021)	GI
Human capital development	Human capital index	Penn World Table (2021)	HC

Source: Author's computation.

3.2 Model construction

3.2.1 Cross-sectional dependency test

As one of the conditions of ensuring reliable inferences, neglecting CSD in a panel data analysis can be grave, resulting in spurious regression estimates. Major elements responsible for CSD in panel data analysis are unobserved components, common shocks, and the possibility of residual interdependency (Aladejare, 2022b). Thus, when panel data analysis related to a phenomenon including economic or financial integration and shared economic policies are being examined, the chances of dealing with CSD issues become very realistic which demands being corrected. Four CSD tests, including Breusch and Pagan's (1980) Lagrange multiplier (LM) test, Pesaran's (2004) scaled LM test, Pesaran's (2004) CSD test and the Baltagi et al. (2012) bias-corrected scaled LM test, were employed in this study.

The Breusch-Pagan CSD test equation is expressed as follows:

$$CSD_{BP} = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\gamma}_{ij}^{2} \qquad Equ. 1$$

given that T is time unit/sample periods, N is panel cross-sectional size and $\hat{\gamma}_{ij}^{2}$ stands for the pair-wise cross-sectional correlation coefficients. The Breusch-Pagan LM test is true if the null hypothesis of no CSD for panels with $T \rightarrow$ infinity when N remains constant is validated. However, the Pesaran (2004) scaled LM CSD test was introduced for large panels where T and N → infinity and is represented thus:

$$CSD_{Plm} = \sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T\hat{\gamma}_{ij}^{2} - 1)^{\sim}N(0,1) \qquad Equ. 2$$

A significant issue with the Pesaran (2004) scaled LM CSD test is its possible bias in exposing substantial size distortions when T is small, and N is large. Therefore, represented in Equation 3 is the Pesaran (2004) which is a better adjustable CSD test that incorporates when T and N → infinity.

$$CSD_P = \sqrt{\left(\frac{2T}{N(N-1)}\right)}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N-1}\gamma_{ij}\right) \qquad Equ. 3$$

Baltagi et al. (2012) further formulated a biased-scaled LM CSD test built on the assumption that N and T → infinity. Equation 4 captures the test expressed in the context of a fixed effect homogenous panel data model.

$$CSD_B = CSD_{Plm} - \frac{2N}{2(T-1)} = \sqrt{\left(\frac{2T}{N(N-1)}\right)}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T\hat{\gamma}_{ij}^2 - 1) - \left(\frac{N}{2(T-1)}\right) \qquad Equ. 4$$

The validation of CSD in the dataset will necessitate the application of the appropriate econometric model to handle the CSD challenge.

3.2.2 Slope heterogeneity test

Slope homogeneity is another panel data issue with the potential to distort regression outcomes, which can arise from examining demographic and economic differences in cross-sections. Consequently, implementing a slope heterogeneity test is essential when dealing with panel datasets. Its essence is to establish whether the parameters of interest exhibit homogeneity or differ across cross-sections. Hence, the Swamy (1970) and the Pesaran and Yamagata (2008) adjusted version homogeneity tests were adopted in this study.

Both the Swamy (1970) and Pesaran and Yamagata (2008) test statistics are shown as follows:

$$E = \sum_{i=1}^{N}(\varphi_i - \varphi_{FEW})' \frac{W_i' H_t W_i}{\sigma_i^2}(\varphi_i - \varphi_{FEW}) \qquad Equ. 5$$

$$\tilde{\Delta} = \sqrt{N}\left(\frac{\frac{1}{N}E - R}{\sqrt{2N}}\right) \qquad Equ. 6$$

$$\tilde{\Delta}_{Adjusted\ version} = \sqrt{N}\left(\frac{\frac{1}{N}E - R}{\sqrt{\frac{2R(T-R-1}{T+1}}}\right) \qquad Equ. 7$$

where E and Δ represent test statistics, the Swamy (1970) test is depicted in Equation 6, and the Pesaran and Yamagata (2008) adjusted version in Equation 7. Pooled OLS and FE weighted pooled values are captured by φ_i and φ_{FEW}, respectively. In addition, H_t and W_i gives the identity matrix and matrix covariates, respectively, diverging from the mean. R is the number of covariates, while σ_i captures the estimator for σ_i^2.

3.2.3 Panel unit root test

Once the existence of CSD and heterogeneity in the panel dataset are established, it becomes apparent to employ a unit root test that accommodates both effects. Therefore, the first-generation Madalla and Wu (1999), the second-generation Pesaran (2003) cross-sectional augmented Dickey-Fuller (CADF), and the Pesaran (2007) cross-sectional Im Pesaran and Shin (CIPS) tests that correct for CSD and heterogeneity are employed. Their deployment was advanced by the inefficiency of conventional panel unit root tests such as the I'm, Pesaran, and Shin (IPS) and Levin-Lin and Chu (LLC) test to deal with CSD and heterogeneity issues. Equation 8 is the CADF test statistic.

$$\Delta G_{it} = \infty_{it} + \tau_i G_{i,t-1} + \delta_i \bar{G}_{t-1} + \varphi_i \Delta \bar{G}_t + \mu_{it} \qquad Equ. 8$$

where ∞_{it}, G_{it}, and μ_{it} denotes the constant, study variables, and stochastic term, respectively. Inputting the first lag expression into Equation 8 gives Equation 9.

$$\Delta G_{it} = \infty_{it} + \tau_i G_{i,t-1} + \delta_i \bar{G}_{t-1} + \sum_{j=0}^{p} \varphi_{ij} \Delta \bar{G}_{t-j} + \sum_{j=1}^{p} \tau_{ij} \Delta G_{i,t-j} + \mu_{it} \qquad Equ. 9$$

where $\bar{G}_{t-j}$, and $\Delta G_{i,t-j}$ depict the mean of lagged, and first difference operator respectively, across the unique cross-sections. Equation 10 is the CIPS test statistic.

$$CIPS = \frac{1}{N} \sum_{i=1}^{n} \tau_i \, (N, T) \qquad Equ. 10$$

where the parameter $\tau_i(N, T)$ shows the CADF test statistics, which is expressed in Equation 11.

$$CIPS = \frac{1}{N} \sum_{i=1}^{n} CADF_i \qquad Equ. 11$$

3.2.4 Panel cointegration test

The Westerlund (2007) error correction model (ECM)-based cointegration technique was adopted to validate the long-run relationship between the study variables. An advancement in this test to mainstream panel cointegration approaches such as the Kao and Pedroni tests is its ability to generate valid results regardless of CSD and heterogeneity presence (Aladejare, 2022a). Four test statistics are traditionally reported, including two group tests (G_t and G_a) and two panel statistics (P_t and P_a). Equation 12 represents Westerlund's (2007) cointegration expression.

$$\Delta y_{it} = \Gamma_l' m_t + \zeta_i y_{it-1} + \beth_i' X_{it-1} + \sum_{j=1}^{Pi} \varrho_{ij} \Delta y_{it-j} + \sum_{j=0}^{Pi} \emptyset_{ij} \Delta X_{it-j} + \epsilon_{it} \qquad Equ. 12$$

given that $\emptyset$, $\Gamma_t = (\Gamma_{1i}, \Gamma_{2i})'$, and $m_t = (1, t)'$ are the error correction parameter, vector of the long-term association between X (regressor) and y (regressand), and the deterministic components. The four Westerlund test statistics have the following equations:

$$G_t = \frac{1}{N}\sum_{i=1}^{n} \frac{\widehat{\forall_\iota}}{SE(\widehat{\forall_\iota})} \qquad Equ. 13$$

$$G_a = \frac{1}{N}\sum_{i=1}^{n} \frac{t\widehat{\forall_\iota}}{\widehat{\forall_\iota}(1)} \qquad Equ. 14$$

$$P_t = \frac{\widehat{\forall_\iota}}{SE(\widehat{\forall_\iota})} \qquad Equ. 15$$

$$P_a = (\widehat{\forall_\iota})T \qquad Equ. 16$$

where $\widehat{\forall_\iota}$ is the OLS estimator, $SE(\widehat{\forall_\iota})$ and $\widehat{\forall_\iota}(1)$ represents the standard error and semi-parametric kernel estimator of $\widehat{\forall_\iota}$ respectively.

3.2.5 Panel long-term estimations

After validating the cointegrating relationship between the variables, derivation of long-term coefficients becomes feasible. For this purpose, The MG, AMG, and CCEMG estimators suggested by Bond and Eberhardt (2013) are used. These methodologies were employed to determine the long-term effects of asymmetric natural resources income and environmental demands on economic prosperity.

The homogeneous MG estimator developed by Pesaran and Smith (1995) is known to assume the correct outcomes despite little knowledge about the weak CSD of the stochastic term. In contrast, this study adopts the heterogeneous MG estimator proposed by Chudik and Pesaran (2019). This MG procedure allows the underlying individual estimators to be weakly cross-correlated. It further has a covariance matrix robust to error serial correlation and heteroscedasticity. Equation 13 represents the heterogeneous MG estimator.

$$\hat{\vartheta}_{MG} = N^{-1}\sum_{i=1}^{N} \hat{\vartheta}_{iT}\,, \qquad i = 1, 2, \dots, N, \qquad (Equ. 13)$$

given that $\hat{\vartheta}_{MG}$ is the MG estimator, $\hat{\vartheta}_{iT}$ is an estimator of the parameter $\hat{\vartheta}_{i0}$ which is the standard mean, and $E(\vartheta_{i0}) = \vartheta_0\ for\ all\ i$ (cross-sections).

The AMG earlier introduced by Eberhardt and Teal (2010) also corrects for CSD and heterogeneity in panel data analysis. The model incorporates a standard dynamic process in a regression procedure involving two interrelated steps, expressed in Equations 14 and 15.

Step 1 AMG process:

$$\Delta y_{it} = \alpha_i + b_i \Delta x_{it} + \psi_i R_t + \sum_{w=2}^{W} \varsigma_i \Delta Q_t + \varepsilon_{it} \qquad (Equ. 14)$$

Step 2 AMG process:

$$\hat{b}_{AMG} = N^{-1} \sum_{i=1}^{N} \hat{b}_i \qquad (Equ. 15)$$

given ς_i is the parameter of the time dummies, b_i is the country-specific estimate of parameters, and R_t is the unobserved common element. x_{it} and y_{it} denote the observed common factor, and $\hat{b}_{AMG}$ represents the AMG estimator.

The CCEMG proposed by Pesaran (2006) is represented in Equations 16 and 17. It also permits for CSD, time-variant un-observables with heterogeneous effects throughout cross-sections and problems of identification.

$$\hat{b}_i = (X_i' M_{\dot{w}} X_i)' X_i' M_{\dot{w}} Y_i \qquad (Equ. 16)$$

$$\hat{b}_{CCEMG} = N^{-1} \sum_{j=1}^{pi} \hat{b}_i \qquad (Equ. 17)$$

$\hat{b}_i$ represents the unique CCEMG estimation for every cross-sectional unit. $\hat{b}_{CCEMG}$ denote the panel CCEMG estimator. Like the AMG, the CCEMG estimator is robust to CSD and heterogeneity in panel data analysis. It does this by accommodating the correlation across cross-sections and heterogeneous slope parameters, given individual country results.

3.2.6 Test for causality

Similar to empirical studies that have established causal nexus between the study variables, this research also conducted a causality test by applying the Dumitrescu and Hurlin (2012) causality method. The D-H test is adjudged superior to the traditional vector error-correction model causality because it accommodates CSD and heterogeneity in its estimation process. The D-H causality test has two standard statistics: Zbar-statistics and Wbar-statistics. While the Zbar presents the standard normal distribution, the Wbar denotes the mean. The equation of the D-H causality is given in Equation 18.

$$Y_{it} = \xi_i + \sum_{i=1}^{p} \Gamma_i^{(p)} Y_{i,t-n} + \sum_{i=1}^{p} \lambda_i^{(p)} X_{i,t-n} + \mu_{it} \qquad (Equ. 18)$$

Given that the intercept (ξ_i), and parameters ($\lambda_i = (\lambda_i^{(1)}, \dots, \lambda_i^{(p)}$) are constant, and $\Gamma_i^{(p)}$ represents the autoregressive coefficient, while $\lambda_i^{(p)}$ the regression parameter.

4. Estimated Results and Discussions

4.1 Descriptive statistic test outcome

Table 1 captures the descriptive statistics for the variables within the study period. It shows that the mean GDP per capita for the 45 RREs is 5.66%, which is approximately the same as the world's average. However, the ecological footprint mean (1.85 gha) for the RREs slightly exceeds the world average (1.75 gha) for the study period. Likewise, natural resources rent per GDP has a mean of 3.46%, above the world's average of 2.02%. The globalisation index average for the RREs is 44.83, implying that the globalisation trend is growing in RREs through enhanced globalisation policies and terms and increasing economic, political, and social integration within and outside RREs. The human capital development index average for the RREs is low (1.78), revealing that the RREs have a human capital deficit. Hence, education quality may not be contributing significantly to their income growth.

Table 1: Descriptive statistic

Variable		Mean	Std. Dev.	Min	Max	Observations
ygp	Overall	5.664	7.980	-28.647	58.650	N = 2250
	Between		6.293	-1.751	32.381	n = 45
	Within		4.994	-22.755	41.488	T = 50
efp	Overall	1.847	1.043	0.629	10.292	N = 2250
	Between		0.907	0.809	4.915	n = 45
	Within		0.532	-0.973	7.224	T = 50
nrr	Overall	3.463	6.748	-47.503	52.948	N = 2250
	Between		5.067	-0.967	26.098	n = 45
	Within		4.519	-46.542	38.497	T = 50
gi	Overall	44.825	12.045	14.149	73.414	N = 2250
	Between		8.276	25.297	59.962	n = 45
	Within		8.837	24.584	66.363	T = 50
hc	Overall	1.775	0.514	1.007	3.097	N = 2250
	Between		0.421	1.083	2.630	n = 45
	Within		0.301	0.857	2.876	T = 50

Source: Author's Estimated Output.

4.2 Correlation matrix and cross-sectional dependency test

Table 2 presents the correlation test result with weak multi-collinearity between the study variables. Further probe for multi-collinearity with the variance inflation factor (VIF) shows weak collinearity between the regressors.

Table 2: Correlation matrix

	ygp	efp	nrr	gi	hc
ygp	1				
efp	-0.224	1			
nrr	-0.212	0.095	1		
gi	-0.124	0.385	0.095	1	
hc	-0.197	0.531	0.185	0.801	1
	VIF	1/VIF			
hc	3.45	0.290			
gi	2.84	0.352			
efp	1.40	0.713			
nrr	1.04	0.958			
Mean VIF: 2.18					

Source: Author's Estimated Output

The four CSD test outcomes are revealed in Table 3, implying the invalidation of the null hypothesis of cross-sectional independence. Hence, the significance of CSD between the RREs is upheld.

Table 3: CSD test output

Variable	Breusch-Pagan LM	Pesaran scaled LM	Bias-corrected scaled LM	Pesaran CSD
ygp	3490.910***	56.204***	55.745***	22.911***

efp	11858.98***	244.260***	243.803***	13.799***
nrr	2864.805***	42.133***	41.674***	12.912***
nrr^{+}	43721.39***	960.317***	959.848***	208.926***
nrr^{-}	43905.96***	964.465***	963.996***	209.409***
gi	44409.50***	975.781***	975.322***	210.635***
hc	44756.33***	983.575***	983.116***	210.739***

Note: *** indicates statistical significance at 1%. H_o: No cross-section dependence
Source: Author's Estimated Output

4.3 Slope heterogeneity and unit root results

Table 4 captures the symmetric and asymmetric slope heterogeneity coefficients results. The result upheld the invalidation of the null hypothesis of homogenous slope parameters. Thus, aligning that there is the existence of slope heterogeneity in the parameters of economic growth, natural resources rents, ecological factors, globalisation, and human capital across the RREs.

Table 4: Slope heterogeneity Test

	Symmetric model		**Asymmetric model**	
Test-Statistics	Value	P-value	Value	P-value
$\bar{\Delta}$	24.174	0.000***	18.173	0.000***
$\bar{\Delta}_{adjusted}$	25.735	0.000***	19.565	0.000***

Note: *** indicates statistical significance at 1%. H_o: Homogenous slope parameters.
Source: Author's Estimated Output

Preliminary tests have already validated the presence of CSD and slope heterogeneity in the study variables; hence, their inclusion in the unit root process is imperative. In Table 5, the results for the panel unit root tests incorporating CSD and heterogeneity are shown. Economic growth, positive asymmetric natural resources rents, and globalisation showed stationarity at level. In contrast, ecological footprint, adverse asymmetric natural resources rents, and human capital development are stationary at first difference.

Table 5: Unit root test output

	First-generation unit root		**Second-generation unit root**				
	Maddala and Wu (1999)		Pesaran's CADF (2003)		Pesaran's CIPS (2007)		
Variable	Without trend	With trend	Without trend	With trend	Without trend	With trend	Decision
ygp	405.225***	316.454***	-3.139***[a]	-3.372***[a]	-9.769***	-7.869***	I(0)
efp	89.961	74.357	-5.288***[b]	-5.443***[b]	-0.313	-0.066	I(1)
nrr	597.348***	557.652***	-3.734***[a]	-4.252***[a]	-8.476***	-14.578***	I(0)
nrr^{+}	124.001**	98.710	-1.035	-1.504	9.028	9.726	I(1)
nrr^{-}	120.942**	96.532	-0.755	-1.245	9.831	10.409	I(1)
gi	18.087	92.765	-2.575***[a]	-2.757***[a]	-5.745***	-3.180***	I(0)
hc	36.601	88.682	-1.140	-2.598**[b]	-2.286	6.186	I(1)
H_0	Series is I(1)		Series is non-stationary		Series is I(1)		

Note: a and b represents stationarity at the level and first difference, respectively, while *, **, and *** indicate statistical significance at 10%, 5% and 1%, respectively.
Source: Author's Estimated Output.

4.4 Panel cointegration test

After confirming the stationarity status of the series, the long-term association between the variables is determined using the Westerlund CSD cointegration approach. Contained in Table 6 is the cointegration test outputs for both the symmetric and asymmetric relationship. The four test statistics rejected the null hypothesis of no cointegration, indicating the presence of a long-run association between the variables.

Table 6: Westerlund CSD cointegration Test

Symmetric model				
Statistic	Value	Z-value	p-value	Robust p-value
G_t	-3.397	-6.688	0.000***	0.000***
G_a	-16.000	-2.665	0.004***	0.000***
P_t	-24.902	-9.684	0.000***	0.000***
P_a	-19.455	-8.980	0.000***	0.000***
Asymmetric model				
Statistic	Value	Z-value	p-value	Robust p-value
G_t	-3.548	-6.349	0.000***	0.000***
G_a	-17.300	-1.892	0.029**	0.000***
P_t	-21.193	-4.879	0.000***	0.000***
P_a	-15.764	-3.581	0.000***	0.000***

Note: ** and *** indicates statistical significance at 5% and 1%, H_0: No cointegration.
Source: Author's Estimated Output

4.5 Discussion of panel estimated outputs

Evidence in Table 7 reveals the weak symmetric effect of the regressors on economic growth. The MG model shows that only globalisation significantly and positively impacted economic growth, while no effect was seen with the AMG model. On the flip side, the CCEMG model showed that environmental demands and globalisation favourably impacted economic growth, while human capital exerted a negative effect. The weak response of economic growth, particularly to the environmental demand and resource income variables, could suggest the significance of a nonlinear association in the three models.

Table 7: Symmetric results

Dependent variable: ygp						
	MG		**AMG**		**CCEMG**	
Variable	Coefficient	Std. Err	Coefficient	Std. Err	Coefficient	Std. Err
efp	2.939	2.132	2.938	1.825	5.289***	1.708
nrr	0.152	0.008	0.013	0.098	0.023	0.105
gi	0.269**	0.105	0.118	3.733	0.217*	0.115
hc	-5.351	3.624	-3.204	0.139	-13.382*	6.998
$constant$	-1.015	4.978	1.325	4.775	-12.180*	6.416
Wald test	9.82**		4.84		18.56***	
No. obs.	2250		2250		2250	
No. groups	45		45		45	
Obs. per group	50		50		50	

Note: *, **, *** indicate statistical significance at 10%, 5% and 1%, respectively.
Source: Author's Estimated Output.

Thus, the nonlinear relationship was examined to ensure the robustness of this study's inferences, and the result is presented in Table 8. Undoubtedly, the asymmetric models' outcomes are robust to the linear model; affirming that asymmetry exists in the natural resources rents' effect on economic growth as prior suggested by Varangis et al., 2004; Addison et al., 2016; Erdogan et al., 2020; Ampofo et al., 2021; Tahar et al., 2021.

Environmental quality is revealed in Table 8 to have a positive long-term effect on economic growth, which corroborates prior submission by Alabed et al. (2021). Environmental variables affect economic growth through environmental policies. The positive impact suggests that ecological policies in most RREs are favourable to economic growth. Thus, economic prosperity will also increase the more ecological resources are exploited. Ecological resources from cropland, fishing, forestry products, etc., can significantly enhance economic growth. These environmental resources also account primarily for most of the jobs in RREs. For instance, Trotsenburg (2018) noted that 70% of employment in developing or emerging countries to which most RREs belong are in the agricultural sector. The phenomenon is established on the RREs' weak capital and technical know-how required in the manufacturing industry. Thus, the less stringent environmental policies in RREs can create avenues for ecological resources to be over exploited due to their immense contribution to income growth.

Similarly, an increase in positive changes in resource income will substantially and positively impact economic prosperity in the long term. When booms in resource prices are experienced, resource income will surge in value; likewise, output and economic prosperity are anticipated to rise. However, an increase in adverse changes to resource income will significantly injure long-term economic growth. An increasing fall in resource prices will result in resources revenue declining, and likewise will output, which can shrink economic growth. Nevertheless, Table 8 reveals that economic prosperity tends to respond more in magnitude to long-term positive changes in resources income than when the change is negative. The outcome is further evidence of the asymmetric long-run behaviour in resource income and partial resilience of RREs to adverse resource price shocks. Also, the asymmetric result of natural resources income on economic prosperity affirms the volatility hypothesis in RREs; and aligns this study with Tahar et al. (2021).

Furthermore, globalisation is revealed to impact long-term economic growth in RREs positively. This outcome echoes prior submission by Huh and Park (2021) and Usman et al. (2022). Globalisation encourages interaction between countries and especially trade and investment between developed and developing countries. Hence, the abundance of resources in a country will always endear the inflow of foreign direct investment (FDI) to its resource sector. As earlier stated, most RREs are developing or emerging economies, bedevilled with insufficient technologies and capital to harness their resources potentials. Consequently, their resource abundance usually attracts a significant level of FDI inflow, especially to their resources sectors which often boost their output and economic growth. Interestingly, human capital development showed no long-term impact on economic prosperity. Thus, suggesting that the quality of education in most RREs is inadequate to realise long-term economic prosperity. Little wonder why most RREs still depend heavily on foreign expatriates to explore and extract their natural wealth. Poor human capital development can also negatively impact the long-term sustainability of environmental resources in RREs.

Table 8: Asymmetric results

Dependent variable: ygp						
	MG		**AMG**		**CCEMG**	
Variable	Coefficient	Std. Err	Coefficient	Std. Err	Coefficient	Std. Err
efp	2.035	1.680	2.604*	1.404	3.383**	1.504
nrr^{+}	1.993***	0.332	1.810***	0.297	1.687***	0.284

nrr^-	-1.281***	0.235	-1.247***	0.228	-1.055***	0.211
gi	0.252***	0.085	0.139**	0.064	0.129	0.092
hc	-4.810	3.250	-1.662	3.415	-4.567	6.042
$constant$	0.566	3.655	-1.082	3.992	-7.761	7.540
Wald test	76.11***		67.24***		54.43***	
No. obs.	2250		2250		2250	
No. groups	45		45		45	
Obs. per group	50		50		50	

Note: *, **, *** indicate statistical significance at 10%, 5% and 1%, respectively.
Source: Author's Estimated Output.

In Table 9, the causal relationship between the variables is presented, and like extant literature (Shahbaz et al., 2019; Abdouli and Hammami, 2020; Musah et al., 2021; Usman et al., 2021; Chen et al., 2022), a bidirectional association exist between environmental quality and economic prosperity. As ecological resources can impact economic growth, the latter can also affect the former. While demands on environmental resources can be a blessing to economic growth, whether or not a sustainable use of these resources is adopted will determine the reverse impact of growth on the environment. In contrast, a positive change in resource income causes economic growth with no reverse causality. Also, the causal nexus between adverse changes to resource income and economic growth is bidirectional. These causal results further corroborate earlier submissions that economic prosperity in RREs is more responsive to positive changes in resource income than negative changes. Table 9 further revealed a unidirectional causal flow from economic growth to human capital development. The insignificant causal flow from human capital development to economic growth further aligns with the study model's outcome.

Table 9: D-H causality output

Null Hypothesis: No homogenous causality between variables			
$ygp = f(efp, nrr^+, nrr^-, gi, hc)$	W-Stat.	Zbar-Stat.	Decision
$efp \rightarrow ygp$ $ygp \rightarrow efp$	2.096*** 1.489*	4.603 1.944	Bi-directional
$nrr^+ \rightarrow ygp$ $ygp \rightarrow nrr^+$	1.551** 1.372	2.205 1.423	Uni-directional
$nrr^- \rightarrow ygp$ $ygp \rightarrow nrr^+$	1.602** 1.541**	2.430 2.164	Bi-directional
$gi \rightarrow ygp$ $ygp \rightarrow gi$	1.247 1.188	0.885 0.626	No causality
$hc \rightarrow ygp$ $ygp \rightarrow hc$	1.305 5.234***	1.140 18.361	Uni-directional

Note: *, **, *** indicate statistical significance at 10%, 5% and 1%, respectively.
Source: Author's Estimated Output.

5. Concluding Remarks

In recent times, there have been growing concerns about the predictability of resource income and the role of environmental quality in the quest for economic prosperity, particularly in RREs. Consequently, this study extends the literature by examining the linear and nonlinear effects of natural resource income and the contribution of environmental demands to long-term economic growth in RREs. Data was sourced from 45 RREs from 1970 to 2019 and processed using three novel methodological techniques: the MG, AMG, and CCEMG. Empirically, the study affirmed the significance of asymmetry in the natural resources rents-economic growth nexus. Outputs from the asymmetric models demonstrated robust evidence to support positive and negative volatile effects of natural resources income on economic prosperity.

Specifically, the study found that environmental demands and positive changes to natural resources income are a blessing to long-term economic growth. In contrast, adverse changes to natural resources income are growth decelerating. Globalisation and human capital development served as control variables, and while the former accelerated long-term economic growth, the latter had an irrelevant effect on the RREs. In addition, the D-H causality result showed a bidirectional nexus between environmental demand and economic growth and between economic growth and negative natural resource income changes. A unidirectional causal flow from positive natural resources income to economic prosperity and from the latter to human capital development was also revealed.

Drawing from the above findings, RREs should strengthen their environmental policies to favour the sustainability of ecological wealth. Although extant studies have found such a move to be growth decelerating, developing the manufacturing sector and introducing ecological tax policies can be a win-win solution for both economic growth and the environment. One of the benefits of globalisation to developing or emerging economies is the transfer of technology and innovation from the developed world. RREs can adapt these technologies and innovate production techniques to suit their demands. However, RREs will first need to intentionally invest heavily in human capital development to be able to adapt existing technologies and innovations needed to drive growth in their manufacturing sector. Making a robust human capital investment will also reduce the pressure on environmental resources for jobs and curtail unsustainable ecological practices due to poor awareness. It is also opined that such measures will guarantee the long-term sustainability of ecological resources and economic prosperity in RREs.

Also, RREs' policymakers must incorporate asymmetric behaviour of natural resources income when developing policy-oriented economic documents and projects. The essence is that economic growth in RREs tends to be more responsive to booms in natural resource prices against plummeting prices. Hence, implementing sustainable medium-term macroeconomic policies in RREs will be more rewarding for long-term economic growth. However, the cost will entail solidifying the long-term connection between natural resources income and economic prosperity, and addressing short-term resources income vulnerability. A way out will be for RREs to diversify their economies, especially in the manufacturing, service, and technology sectors, through accumulated savings in periods of booming resource prices. By adopting this measure, their vulnerability to adverse shocks from resources income will reduce, likewise their reliance on natural resources income for growth. Alternatively, since RREs are known to trade in crude natural resources, they can enhance the prevailing linkages in their resources sector by boosting efficiency and productivity for a favourable contribution to economic prosperity. In this light, RREs can explore value addition to primary commodities, through value channels, as alternative means of diversifying their revenue source for growth.

Compliance with Ethical Standards

Authors' contributions

The corresponding author conceived the idea, wrote the introduction, collected and analysed the data, interpreted the results, reviewed the required literature, edited the manuscript, wrote the methodology section, provided the relevant policy directions, and read and approved the final manuscript.

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Data Availability Statement
The data that support the study's findings are available from the corresponding author upon reasonable request.

Consent to participate
Not applicable.

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Appendix

Table 9: List of study countries

Algeria	Madagascar	Bolivia
Benin	Malawi	Brazil
Botswana	Mali	Colombia
Burkina Faso	Mauritania	Costa Rica
Burundi	Morocco	Dominican republic
Cameroun	Niger	Ecuador
Congo DR	Nigeria	Guatemala
Congo	Rwanda	Honduras
Cote d'Ivoire	Senegal	Jamaica

Egypt	Sierra-Leone	Mexico
Gabon	South Africa	Nicaragua
Gambia	Togo	Paraguay
Ghana	Tunisia	Peru
Kenya	Zambia	Trinidad and Tobago
Lesotho	Argentina	Uruguay