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Evaluating The Effects of Education, Renewable Energy Adoption, Public Health Expenditure, Environmental Performance and Natural Resource Abundance on Sustainable Economic Growth

Dung Thi My Tran[1], Thanh Dang Nguyen[2], Cuc Thi Thu Nguyen[3]*, Thuy Thi Bich Nguyen[4], Tuan Van Nguyen[5]

[1] Nguyen Tat Thanh University, Vietnam. Email: mdung.tvm@gmail.com
[2] Thu Dau Mot University, Binh Duong, Vietnam. Email: thanhnd@tdmu.edu.vn
[3] Vinh University, Vietnam. Email: cucntt@vinhuni.edu.vn
[4] College of Economics, Vinh University, Vietnam. Email: bichthuytcnhdhv@gmail.com
[5] Foreign Trade and Technology College, Vietnam. Email: nguyentuaneducation@gmail.com

* *Corresponding Author: Email: cucntt@vinhuni.edu.vn*

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Abstract: Given the increasing challenges presented by global warming and the deterioration of the environment, Vietnam is committed to fostering sustainable economic growth, aiming to create more opportunities for future generations. This study assesses the influence of education, adoption of clean energy sources, spending on healthcare, environmental performance, and quantity of natural resources on Vietnam's sustainable economic growth. Utilizing a quantitative secondary data approach, the study spans from 2000 onwards, drawing data from the World Bank's official database. Employing statistical techniques, specifically the QARL method, the analysis reveals a significant long-term association between environmental performance and economic growth, while other factors such as FDI, NRA, PHE, REA, URB show insignificance. The study provides theoretical and practical insights, contributing to the literature on Vietnam's sustainable economic growth and offering valuable guidelines for policymakers to prioritize education, renewable energy, public health, environmental performance, and natural resources for sustainable development. The research acknowledges its limitations in the concluding section.

Author Correspondence: cucntt@vinhuni.edu.vn

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1. Introduction

In the contemporary era, numerous nations confront the formidable task of reconciling the imperative of mitigating environmental degradation with the pursuit of sustainable economic growth. Consequently, sustainable economic growth has emerged as a pivotal subject of deliberation among policymakers and scholars. This heightened attention underscores the global acknowledgment of the intrinsic value associated with fostering economic development that is concurrently environmentally sustainable (Saint Akadiri et al., 2019). Over the past decade, numerous prominent economies, including Vietnam, have undergone substantial economic expansion. Notwithstanding this economic growth, akin to other developed nations, Vietnam contends with notable challenges pertaining to resource utilization and environmental deterioration, as evident in Figure 1, illustrating pronounced environmental degradation trends in Vietnam over the years. Despite a recent decline in the costs associated with environmental degradation, it remains a salient concern. Consequently, the environmental exigencies encountered by Vietnam furnish a significant opportunity to discern pivotal dimensions linking economic advancement with environmental considerations (Arslan et al., 2022). In its capacity as an industrial powerhouse, Vietnam faces impediments stemming from the substantial requirement for clean energy to augment its enduring economic expansion (Zahoor et al., 2022). In contemporary economic paradigms, the primary aim of nations is to realize pragmatic and sustainable economic growth anchored in an environmentally sound foundation (Ge et al., 2022). Therefore, it is imperative to possess a lucid comprehension of the factors that can exert substantial influence on sustainable economic growth within the context of Vietnam.

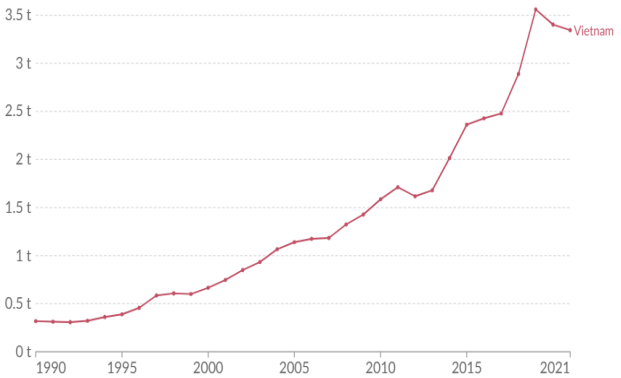

Figure 1. Carbon Emissions of Vietnam (Source: Global Carbon Budget, 2022).
Note: The reported emissions are from only fossil fuels and industry.

The variables chosen for examination in this manuscript exhibit noteworthy associations with sustainable economic performance. Given the escalating discourse on the energy-environment nexus, a notable observation has been made, indicating that adverse environmental effects emanate from non-renewable energy resources (Djellouli et al., 2022). Moreover, the interconnection between sustainable economic growth and education is pronounced, as the cultivation of awareness and the training of human capital play pivotal roles in propelling the enduring growth of a sustainable economy (Li et al., 2022). The expeditious expansion of the global population necessitates heightened health expenditures, thereby influencing the allocation of resources in the budget earmarked for renewable energy initiatives (Yang et al., 2022). Likewise, environmental performance exhibits a noteworthy connection with sustainable economic development, as contemporary organizations actively pursue strategies to augment economic performance while fostering positive environmental outcomes. Additionally, the abundance of resources from nature have a significant role in facilitating sustainable economic achievement prioritizing environmental considerations for a future characterized by sustainability (Erdoğan et al., 2021). Moreover, the ample availability of resources diminishes reliance on non-renewable energy sources, thereby mitigating adverse environmental effects and augmenting sustainable economic performance.

Diverging from extant research that predominantly explores the causal connection between determinants and sustainable economic performance, this study undertakes an in-depth investigation into the enduring influence of selected variables and their implications for sustainable economic performance throughout Vietnam. In the Vietnamese context, several scholars have delved into the impact of various crucial factors on sustainable economic performance. For instance, Song et al. (2022) scrutinize the influence of the digital economy on attaining sustainable economic growth, examining its role in fostering sustainable socio-economic development, enhancing quality of life, and fortifying environmental conservation efforts. Zheng et al. (2022) investigated the efficacy of the WDS in Vietnam, assessing the attainment of objectives pertaining to the promotion of environmentally friendly and environmentally friendly growth through the preservation of energy and reduction of emissions. Notably, a dearth of research exists in the examination of critical elements such as renewable energy adoption, public health expenditure in Vietnam. In contrast to prior studies, this paper uniquely explores the collective impact of multiple variables to comprehensively analyse their influence on development.

This study contributes in two fundamental ways: firstly, it extends the pertinent literature pertaining to sustainable economic development, thereby presenting a noteworthy theoretical implication; secondly, it sheds light on the significant factors influencing sustainable economic performance, offering practitioners an opportunity to refine policy implementation with due consideration of these aspects for the attainment of sustainable development objectives. The work is laid out as follows: The second part conducts a comprehensive analysis of previous research relevant to the phenomenon under investigation. The third part describes the approach and details of data collection and analysis. The fourth subsection presents the findings from the experiments. The fifth subsection discusses the findings and conclusions, leading to the final concluding section.

2. Literature Review

2.1. Theoretical Background and Conceptual Framework

The researcher has employed the framework based on "Green Growth Theory." This theoretical framework prosperity is possible by reducing greenhouse gas emissions and facilitated by the utilization of natural resources (Hickel & Kallis, 2020). This framework aligns with the conceptual underpinnings of the current research, as the study is fundamentally concerned with identifying pivotal factors conducive to the augmentation of sustainable

economic growth. The researcher posits that the enhancement of education, augmented public health expenditures, abundant natural resources, robust environmental performance, and the adoption of renewable energy collectively constitute pivotal factors for bolstering sustainable economic growth within a nation. Furthermore, the research endeavours to promote sustainable economic growth in Vietnam by advocating for the implementation of these practices, given that renewable energy is conducive to both improved environmental performance and economic advancement. Additionally, it is postulated that a country exhibiting enhanced environmental performance is likely to foster human health, thereby ultimately contributing to sustained economic growth. This inference is based on the premise that economic expansion and the cultivation of health-promoting practices is contingent upon individuals possessing the requisite absorptive capacity, a capacity nurtured through education.

2.2. Education and Sustainable Economic Growth

In the contemporary milieu, education emerges as a pivotal catalyst for achieving successful and sustainable economic growth. Education equips individuals with the awareness essential for fortifying economic sustainability and augmenting a nation's gross domestic product. Consequently, education has been acknowledged as a fundamental determinant contributing to sustainable economic growth across diverse developed and developing nations globally. Empirical evidence from prior research underscores the significance of education by elucidating its role in enhancing the skilled labour force within industrial sectors, thereby serving as a positive determinant in fostering the economic development of a country (Hanushek & Wößmann, 2010). This study facilitates the assessment of the significance and indispensability of education in the context of economic growth. Furthermore, education is posited as a conduit for economic advancement, serving as a mechanism for the assimilation of knowledge critical for fostering a nation's sustainable economic growth. An additional scholarly inquiry introduces the concept of absorptive capacity, and significance of novel external knowledge, and subsequently integrate it when required (Marquez-Ramos & Mourelle, 2019). Furthermore, the augmentation of absorptive capacity is intrinsically linked to education, underscoring the considerable dependence of a nation's economic growth on the educational attainment and absorptive capacity of its populace. Consequently, the present study emphasizes the significance of education, positing a positive correlation between education and economic growth, whereby educated individuals are empowered to assimilate external knowledge and contribute to the enhanced sustainability of the national economy.

Work by Afzal et al. (2013) shows the relationship among education and sustainable environmental growth. The research was grounded in data collected from South Asian countries spanning the period from 1995 to 2013 (Mammadov & Gumus, 2020). The panel model findings substantiate the assertion that population policies wield a crucial influence in augmenting the sustainable economic development of nations. Furthermore, an insightful observation emerged, indicating that the integration of education within a country. These investigations provide valuable insights into the pivotal role of education as an imperative facet for implementation to enhance a nation's sustainable economic development. Additionally, it is recommended that Vietnam directs attention toward expanding educational opportunities for its populace, particularly for the Chinese demographic, as it stands to be a significant contributor to the advancement of sustainable economic growth in Vietnam.

2.3. Renewable Energy Adoption and Sustainable Economic Growth

In recent years, numerous economies have embraced the utilization of coal as well, gas from the earth, and petroleum, as a means to expedite industrialization and bolster economic growth. However, the adoption of these energy procurement methods has precipitated heightened energy consumption, subsequently resulting in deleterious consequences such as carbon emissions, pollution, and global warming (Mahalik et al., 2021). Prior research conducted by IEA (2017) has elucidated a notable surge in the adoption of renewable energy within countries, attributed in part to the diminishing costs associated with solar and wind power. Projections indicate an anticipated by 2022, that there will be a 33% rise in the expense associated with the implementation of clean energy sources (Mohsin et al., 2021). Nonetheless, the shift of organizations operating across diverse nations from non-renewable to renewable energy sources exhibits a noteworthy and positive association with sustainable economic growth.

Numerous scholars have scrutinized the impact of renewable energy on a nation's gross domestic product (GDP), a precursor to sustainable economic growth. Research conducted by Sekrafi and Sghaier (2018) establishes a positive correlation between the adoption of renewable energy and the sustainable economic growth of a country. Furthermore, this study expounds that the integration of renewable energy into a nation's industrial sector expedites economic development while concurrently preserving environmental quality. Conversely, reliance on non-renewable energy sources diminishes economic development and sustainability by exacerbating environmental pollution. Moreover, a contemporary investigation conducted by Ozcan and Ozturk (2019) has explored the relationship between renewable energy and a country's GDP using the Autoregressive Distributed Lag (ARDL) model. The study underscores the pivotal role played by renewable energy resources and the innovative products stemming from the adoption of renewable energy in enhancing a nation's economic growth.

2.4. Public Health Expenditure and Sustainable Economic Growth

In recent centuries, the foremost challenge confronting nations has been the preservation of environmental quality and the assurance of healthful living conditions for individuals across diverse global regions. Consequently, economists, scholars, policymakers, and governments are actively engaged in formulating viable frameworks and policies aimed at fostering robust and sustainable economies. Concurrently, the escalation of greenhouse gas emissions (GHG) over time poses imminent threats to the climate, as evidenced by Danish et al. (2017), thereby jeopardizing the well-being of individuals residing in countries. Despite the recognized hazards, research has elucidated the perilous consequences associated with the mounting levels of greenhouse gas emissions, particularly carbon dioxide (CO_2), a primary contributor to global warming that exerts adverse effects on human health on a global scale (Apergis et al., 2018; Wang et al., 2018).

Henceforth, the integration of public health expenditure within nations becomes imperative to foster the wholesome development of economies and facilitate sustainable economic growth—an area of primary focus in the current research.

The augmentation of public health expenditure is imperative, as individuals in good health serve as catalysts for robust and sustainable economic development. Notably, Erçelik (2018) employed the ARDL model to analyse Turkish data from 1980- 2015, revealing a bidirectional and positive correlation between health expenditures and economic growth. Similarly, research by Picatoste et al. (2018) conducted in Spain, focusing on the economic and healthcare domains, substantiated a positive and reciprocal relationship between health expenses and economic growth. Healthcare expenditure is deemed a crucial facet aligned with governmental and practitioner perspectives on the healthcare sector. Additionally, past studies, such as that by Zaman et al. (2016) contend that the industrial sector, a major contributor to economic growth, generates elevated CO2 emissions, directly impacting human health (Wang et al., 2019). Since a nation's economic prosperity depends upon the well-being of its populace, health expenditure manifests a bidirectional association with economic growth. However, this research posits that an augmentation in public healthcare expenditure will notably and directly enhance the sustainability of economic growth, constituting an innovative contribution. Hence, there is an imperative for the Chinese government to prioritize the augmentation of public health expenditure, given its substantial contribution to the sustainability of economic growth.

2.5. Environmental Performance and Sustainable Economic Growth

Environmental performance is delineated as a pivotal determinant in the sustainable economic development of a nation, given that an optimal and healthful environmental milieu engenders a population in good health—a requisite for the sustainable economic growth witnessed across diverse developed and developing nations globally. Moreover, a nation's environmental performance not only fosters the well-being of its inhabitants but also mitigates health expenditure, thereby yielding superior, sustainable, ecologically responsible, and expeditious economic growth. This confluence of factors further elevates the nation's standing in the international business market, constituting a salient aspect of its economic growth trajectory (Khan et al., 2020b). Furthermore, it has been noted that the principal drivers of environmental pollution stem from contaminated industrialization and logistics, thereby engendering environmental degradation and adverse effects on human health within the affected nation. Such countries characterized by environmental degradation and pollution exhibit compromised environmental performance, undermining the prospect of superior and sustainable economic growth. Consequently, a nation is enjoined to bolster its environmental performance to ameliorate the sustainability of its economic standing—a primary objective of the present research.

Prior research conducted by Khan and Qianli (2017) has explicated that the sustainability of an organization is contingent upon its environmental performance, with the quality of such performance affording the firm a competitive advantage. Drawing from this study, it can be asserted that industries manifesting commendable environmental performances play a pivotal role in advancing a country's sustainable economic growth, given the instrumental role industries occupy in the economic development of nations globally. Moreover, recent scholarly inquiry conducted by Bekhet and Othman (2018) has ascertained that logistics operations in diverse developed and developing countries serve as a significant source of carbon emissions, contributing to environmental depletion by at least 1.4%, posing alarming repercussions for human health. It can be contended that logistics with environmental degradation exacerbate the challenges to sustainable economic development compared to those with environmentally conscientious practices, as the latter contributes to improved environmental performance—a critical determinant of sustainable economic growth. In light of the aforementioned literature, the researcher's perspective on the substantial and positive correlation between environmental performance and sustainable economic growth is substantiated, suggesting that Chinese industries should adopt environmentally healthier practices to attain sustainable economic growth.

2.6. Natural Resource Abundance and Sustainable Economic Growth

Numerous economists have dedicated their efforts to the exploration of sustainable economic growth, positing that nations endowed with abundant natural resources exhibit a discernible association with sustained and enhanced economic growth in comparison to those with limited natural resource availability. The present research directs its focus towards the assessment of domestic natural resource availability, as the researcher contends that natural resources bear a substantial and positive correlation with sustainable economic growth. Moreover, grounded in this perspective on the abundance of natural resources, it is hypothesized that nations endowed with ample natural resources are inclined to experience heightened economic growth in contrast to those with diminished natural resource endowments. Various antecedent studies, including those conducted by Corden (1984), have furnished empirical evidence supporting the significant nexus between sustainable and the combination of robust economic expansion and the copious availability of earth's resources (Rahim et al., 2021). According to the Redmond and Nasir (2020), the analysis elucidates the beneficial and significant influence of resources from nature on a nation's growth in economy, supporting this correlation with actual data. Concurrently, findings from a study by Shahbaz et al. (2018) underscore the pivotal role of natural resource abundance in augmenting a country's economic growth. Consequently, the imperative of abundant resources as a requisite for fortifying the sustainability of a nation's economic growth remains evident.

A recent investigation was undertaken to scrutinize and interpret the influence of abundant natural assets on the economy. The study employed panel data spanning the years 1984-2016 and applied the CS-ARDL technique, focusing on countries within the OIC (Erum & Hussain, 2019). An additional study conducted by Zallé (2019) further expounds on the substantial correlation among resource availability and growth in economy, with the research utilizing data collected from the years 2000 to 2015.

3. Methodology

3.1 Data and Variables Selection

This study assesses economic growth within the specific context of Vietnam, utilizing data spanning from the year 2000 onwards. The study incorporates five explanatory

variables, with their descriptions provided in Table 1. Foreign Direct Investment (FDI) and Urbanization (URB) are included as control variables. Data for the analysis is sourced from the official database of the World Bank (The World Bank, 2022). Following this, the annual data underwent a transformation into quarterly data using the match-sum approach. a methodology previously employed in analogous studies (Chien et al., 2021; Suki et al., 2020).

Table 1: Variable Description.

Variable	Symbol	Description (Source: The World Bank (2022))	Measurement
Economic growth	E.G.	"GDP is the entirety of gross value added by all inhabitant producers in the economy plus any product taxes and excluding any subsidies not involved in the value of the products."	Gross domestic product (current USD)
Renewable energy adoption	REA	Energy obtained from renewable sources.	% of total final energy consumption
Public health expenditure	PHE	"Consists of recurring and capital expenditure from government budgets, external borrowings and funding, and social, health insurance funds."	Government healthcare spending as % of GDP
Education	EDU	Average years of schooling above age 15	Average years of schooling above age 15
Environmental performance	E.P.	"Carbon dioxide emissions are those caused by the burning of fossil fuels and the production of cement."	CO_2 emissions (metric tons per capita)
Natural resource abundance	NRA	"Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents."	Natural resource rent % of GDP
Urbanization	URB	Refers to as " people living in urban areas. "	Individuals living in urban areas as % of the entire population
Foreign Direct Investment	FDI	Net inflows (New investment inflows excluding disinvestment)	Net inflows as % of GDP

3.2 QARL Methodology

This research study employs the QARDL model as put forth by Cho et al. (2015) to investigate the interrelationships among variables within the context of Vietnam. The Quantile ARDL model represents an extended iteration of the ARDL model and presents three distinct advantages over linear models. Firstly, the model accommodates asymmetric locations, where the parameter is contingent on the locations of the explained variable with their uncertain distributions. Secondly, the model possesses the capability to capture both long-term relationships and short-term dynamics (Sun et al., 2022). Thirdly, preceding investigations utilizing conventional econometric techniques, such as "Johansen's cointegration," have identified a deficiency of cointegration in time series data (Chien et al., 2023). Hence, the QARDL model addresses this limitation by scrutinizing the existence of quantile cointegration coefficients for both periods. Moreover, the model surpasses other non-linear econometric models, thereby establishing the QARDL model as a dependable and precise methodology for examining the quantile long-term association among various variables. The ARDL model is delineated below, where εt represents the error term, and q1, q2, q3, q4, q5, q6, and q7 denote the lag order in accordance with the "Schwartz criterion":

$$EG_t = \alpha + \sum_i^p \beta_1\ EG_{t-i} + \sum_i^{q1} \beta_2\ EDU_{t-i} + \sum_i^{q2} \beta_3\ REA_{t-i} + \sum_i^{q3} \beta_4\ PHE_{t-i} + \sum_i^{q4} \beta_5\ EP_{t-i} + \sum_i^{q5} \beta_6\ NRA_{t-i} + \sum_i^{q6} \beta_7\ FDI_{t-i} + \sum_i^{q7} \beta_8\ URB_{t-i} + \ \varepsilon_t$$

In accordance with the quantile model formulated by Cho et al. (2015), the QARDL model is articulated as follows:

$$QEG_t = \alpha\ (\tau) + \sum_i^p \beta_1\ (\tau) EG_{t-i} + \sum_i^{q1} \beta_2\ (\tau) EDU_{t-i} + \sum_i^{q2} \beta_3\ (\tau) REA_{t-i} + \sum_i^{q3} \beta_4\ (\tau)\ PHE_{t-i} + \sum_i^{q4} \beta_5\ (\tau)\ EP_{t-i} + \sum_i^{q5} \beta_6\ (\tau) NRA_{t-i} + \sum_i^{q6} \beta_7\ (\tau) FDI_{t-i} + \sum_i^{q7} \beta_8\ (\tau) URB_{t-i} + \ \varepsilon_t\ (\tau)$$

Where ε (τ) = EGt - QEGt (τ / εt -1), with 0 < τ < 1 denoting the quantile. Multiple quantiles from 0.05th to 0.95th are considered for comprehensive data analysis, enabling the assessment of diverse quantile pairs. Additionally, Equation 3 is derived below to evaluate the probability of serial correlation.

$$QEG_t = \alpha\ (\tau) + pEG_{t-i} + \varphi_1\ EDU_{t-i} + \varphi_2\ REA_{t-i} + \varphi_3\ PHE_{t-i} + \varphi_4 EP_{t-i} + \varphi_5 NRA_{t-i} + \varphi_6 FDI_{t-i} + \varphi_7 URB_{t-i} + \sum_i^{p-1} \beta_1\ (\tau) EG_{t-i} + \sum_i^{q1-1} \beta_2\ (\tau) EDU_{t-i} + \sum_i^{q2-1} \beta_3\ (\tau) REA_{t-i} + \sum_i^{q3-1} \beta_4\ (\tau)\ PHE_{t-i} + \sum_i^{q4-1} \beta_5\ (\tau)\ EP_{t-i} + \sum_i^{q5-1} \beta_6\ (\tau) NRA_{t-i} + \sum_i^{q6-1} \beta_7\ (\tau) FDI_{t-i} + \sum_i^{q7-1} \beta_8\ (\tau) URB_{t-i} + \ \varepsilon_t\ (\tau)$$

Nonetheless, the dynamic quantile equation incorporating the error correction model is as follows:

$$Q\Delta EG_t = \alpha(\tau) + p(\tau)EG_{t-i} - \varphi_1(\tau)\,EDU_{t-i} - \varphi_2(\tau)\,REA_{t-i} - \varphi_3(\tau)\,PHE_{t-i} - \varphi_4(\tau)\,EP_{t-i} - \varphi_5(\tau)\,NRA_{t-i} - \varphi_6(\tau)\,FDI_{t-i} - \varphi_7(\tau)\,URB_{t-i} + \sum_i^p \beta_1(\tau)\Delta EG_{t-i} + \sum_i^{q1} \beta_2(\tau)\,\Delta\,EDU_{t-i} + \sum_i^{q2} \beta_3(\tau)\,\Delta\,REA_{t-i} + \sum_i^{q3} \beta_4(\tau)\,\Delta\,PHE_{t-i} + \sum_i^{q4} \beta_5(\tau)\,\Delta\,EP_{t-i} + \sum_i^{q5} \beta_6(\tau)\,\Delta\,NRA_{t-i} + \sum_i^{q6} \beta_7(\tau)\,\Delta\,FDI_{t-i} + \sum_i^{q7} \beta_8(\tau)\,\Delta\,URB_{t-i} + \varepsilon_t(\tau)$$

The study examines the immediate impact of past E.G. on existing E.G using $\sum_{i=1}^{p-1}\beta_1$. It also analyses the collective a short-term influence of present and historical levels of EDU, REA, PHE, E.P., NRA, FDI, and URB is assessed by $\sum_{i=1}^{p-1}\beta_1$, $\sum_{i=1}^{q1-1}\beta_2$, $\sum_{i=1}^{q2-1}\beta_3$, $\sum_{i=1}^{q3-1}\beta_4$, $\sum_{i=1}^{q4-1}\beta_5$ $\sum_{i=1}^{q5-1}\beta_6$, $\sum_{i=1}^{q6-1}\beta_7$, respectively.

Similarly, the examination of ß, which represents longer-term values for all sequence, is carried out in the following manner:

$$\beta_{EG*} = -\frac{\beta_{EG}}{p},\ \beta_{EDU*} = -\frac{\beta_{EDU}}{p},\ \beta_{REA*} = -\frac{\beta_{REA}}{p},\ \beta_{PHE*} = -\frac{\beta_{PHE}}{p},\ \beta_{EP*} = -\frac{\beta_{EP}}{p},\ \beta_{NRA*} = -\frac{\beta_{NRA}}{p},\ \beta_{FDI*} = -\frac{\beta_{FDI}}{p},\ \beta_{URB*} = -\frac{\beta_{URB}}{p}$$

In addition, to test the non-linear and asymmetric impacts of the EDU, REA, PHE, E.P., NRA, FDI, and URB on E.G., the Wald test was employed. Granger (1969) establishing causal relationships in the realm of social science research involves determining whether a variable acts as an antecedent to another. According to this test, the current significance of the variable that depends is presumed to be contingent upon the current or previous values of the variables that are independent. The test by Troster (2018) Troster (2018)was used for the quantile-causal analysis.

4. Results

4.1. Descriptive Summary

Descriptive statistics have been presented to examine the fundamental characteristics of the data. Table 1 provides a comprehensive overview of the descriptive statistics for the variables under investigation. The table includes standard deviation, mean, kurtosis, skewness, and minimum & maximum values, "Jarque-Bera" statistics, and the associated probability for each variable. With a sample size of 22 observations, the skewness values fall within the -1 to +1 threshold, indicating normality in the data distribution. Furthermore, the Jarque-Bera statistic, exceeding 0.5 for each construct in the study, indicates that this information follows the normal distribution, thus supporting the likelihood of significant results from other tests.

Table 2: Descriptive of Studied Variables.

	EDU	EG	EP	FDI	NRA	PHE	REA	URB
Mean	9.000000	8.665288	5.874434	1.76E+11	3.484810	4.346870	15.89500	49.57695
Median	9.000000	8.412913	6.618384	1.73E+11	2.645058	4.400240	13.57000	49.86850
Maximum	9.000000	14.23086	8.730000	3.34E+11	9.648414	5.593597	29.63000	62.51200
Minimum	9.000000	2.239702	2.650409	4.21E+10	0.863775	0.000000	8.520000	35.87700
Std. Dev.	0.000000	2.487132	1.814096	8.89E+10	2.421242	1.083738	6.035804	8.336488
Skewness	NA	-0.114623	-0.510054	-0.069485	0.955427	-2.991407	1.211995	-0.070542
Kurtosis	NA	4.058570	1.989189	1.826820	3.057239	13.08414	3.185546	1.777530
Jarque-Bera	NA	1.075363	1.890493	1.279358	3.350087	126.0269	5.417639	1.388144
Probability	NA	0.584101	0.388584	0.527462	0.187300	0.000000	0.066615	0.499538
Sum	198.0000	190.6363	129.2376	3.87E+12	76.66583	95.63113	349.6900	1090.693
Sum Sq. Dev.	0.000000	129.9024	69.10980	1.66E+23	123.1106	24.66426	765.0496	1459.438
Observations	22	22	22	22	22	22	22	22

Figure 2 delineates temporal fluctuations in economic growth. Contextualizing this depiction within Vietnam, it illustrates a period of heightened economic growth from 2000 to 2007. Subsequently, stagnation is apparent in recent years, with a notable decline during the 2019-2020 pandemic. Post-2021, there is a discernible resurgence in Chinese economic growth.

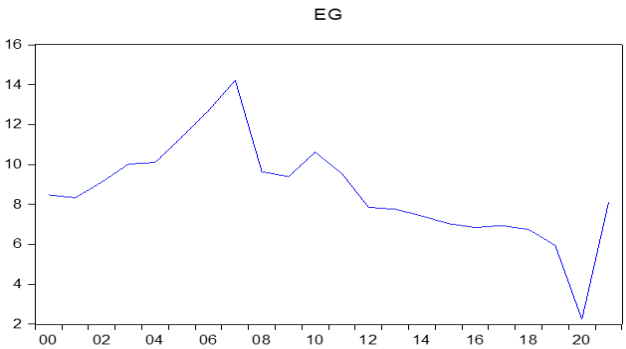

Figure 2: E.G. Graph.

4.2. Unit Root Test

Unit root test evaluates if a time series variable exhibits a unit root and is deemed "non-stationary." These evaluations are utilised to assess the "stationarity properties" of the data, a crucial consideration in time series models, given the common issue of stationarity in time series data (Cochrane, 1991). Unit roots, also termed "stationary difference processes" and "unit root processes," manifest as stochastic trends in time series data. Unit roots are present, that signifies systematic patterns introducing unpredictable and unreliable trends, potentially impacting the robustness of estimation processes. Consequently, unit root tests ascertain the non-stationarity of variables. Evaluation of unit roots has been conducted at both the level. The results indicate the significance of unit roots at both stages. If unit roots are present, the series is considered non-stationary. Additionally, researchers posit that an insignificant p-value of z(t) denotes non-stationarity in the series. The findings with the unit root test presented in Table 2 highlight the importance of the unit root.

Table 3: Unit Root Test.

	Level	First difference
EG	-1.895094	-4.748157
EP	-0.875288	-2.954768
FDI	-1.021842	-4.586166
NRA	-1.829434	-5.902354
PHE	-2.251114	-1.515986
REA	-2.789486	-3.956299
URB	-7.134244	0.345981

4.3. Quantile Regression Model for Long Run

The quantile regression model facilitates the examination of the relationship between a predictor variable or a set of specific quantiles and the response or outcome variable. Table 3 displays the outcomes of the quantile regression analysis for the long run, covering the period from 2000 to 2021. The findings indicate that E.P. & NRA exert significant impacts of 3.4 units, 0.18 units, and 0.015 units, respectively, on E.G., with corresponding p-values of 0.04 and 0.5. FDI and URB serve as control variables in the current study.

FDI, included as a control variable, exhibits a negative impact on E.G amounting to -2.5 units, with a p-value of 0.08, indicating insignificance in the association. Similarly, PHE & URB also negatively affect E.G., with magnitudes of -0.6 units each, accompanied by p-values of 0.13 and 0.02. Consequently, the influence is deemed significant for URB but insignificant for PHE.

Table 4 displays the short-run evaluation of quantile regression conducted between 2002 and 2021. The outcomes indicate that E.P exhibits an insignificant effect on E.G with a p-value of 0.86. Similarly, the control variable, FDI, also demonstrates an insignificant effect on E.G., with a p-value of 0.97. Moreover, the short-run results reveal insignificant associations between other variables such as NRA, PHE, REA, & URB.

Table 3: Long Run Evaluation of Quantile Regression.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EP	3.414653	1.566416	2.179914	0.0456
FDI	-2.52E-11	1.36E-11	-1.852471	0.0837
NRA	0.182942	0.293440	0.623440	0.5424
PHE	-0.647263	0.410791	-1.575649	0.1360
REA	0.015600	0.255371	0.061087	0.9521
URB	-0.670362	0.267572	-2.505354	0.0242
C	28.12545	13.16198	2.136871	0.0495
Pseudo R-squared	0.568201	Mean dependent var		8.665288
Adjusted R-squared	0.395482	S.D. dependent var		2.487132
S.E. of regression	1.367998	Objective		8.653128
Quantile dependent var	8.335733	Restr. objective		20.03972
Sparsity	3.886487	Quasi-LR statistic		23.43833
Prob (Quasi-LR stat)	0.000662			

Table 4: Short-Run evaluation of Quantile Regression.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (EG (-1))	0.309192	2.894323	0.106827	0.9191
D(EP)	1.950451	10.76326	0.181214	0.8633
D (EP (-1))	0.425654	21.88151	0.019453	0.9852
D(FDI)	1.37E-12	4.40E-11	0.031237	0.9763
D (FDI (-1))	-1.39E-11	8.82E-11	-0.157543	0.8810
D(NRA)	-0.571973	2.432263	-0.235161	0.8234
D (NRA (-1))	-0.075122	0.764048	-0.098321	0.9255
D(PHE)	-0.613213	3.121298	-0.196461	0.8520
D (PHE (-1))	2.505612	8.534279	0.293594	0.7809
D(REA)	0.372582	0.437653	0.851318	0.4335
D (REA (-1))	-0.414270	1.884150	-0.219871	0.8347
D(URB)	20.27589	79.55713	0.254860	0.8090
D (URB (-1))	-16.32940	91.79482	-0.177890	0.8658
ECM (-1)	0.671335	6.481983	0.103569	0.9215
C	-5.583216	26.17057	-0.213339	0.8395
Pseudo R-squared	0.688034	Mean dependent var		-0.011297
Adjusted R-squared	-0.185469	S.D. dependent var		2.089562
S.E. of regression	1.934627	Objective		4.091798
Quantile dependent var	-0.097586	Restr. objective		13.11619
Sparsity	3.233067	Quasi-LR statistic		22.33023
Prob(Quasi-LR stat)	0.072079			

The results of the Ramsey RESET Test carried out in the short run are presented in Table 5. The RAMSEY specification test evaluates the overall specifications of the linear regression model, providing insights into the stability of estimates in the short run. Data indicate that the estimates are both stable and significant in the short run. The RAMSEY test holds great importance, inferred from the probability value, with a threshold of 0.5, where a value greater than this threshold signifies significance.

Table 5: Ramsey RESET Test.

	Value	df	Probability
QLR L-statistic	3.691913	1	0.0547
QLR Lambda-statistic	3.045376	1	0.0810

L-test summary:

	Value	df
Restricted Objective	4.091798	5
Unrestricted Objective	2.816658	4
Scale	0.690775	

Lambda-test summary:

	Value	df
Restricted Log Obj.	1.408984	5
Unrestricted Log Obj.	1.035551	4
Scale	0.245246	

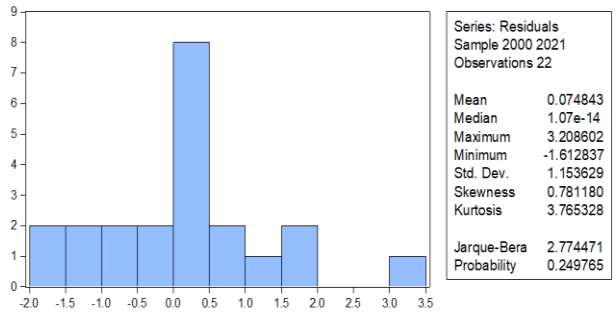

Figure 3. Normality of Error Terms.

The chart depicted in Figure 3 further illustrates that the error terms exhibit a normal distribution across 22 observations within the sample range of 2000 to 2021. Figure 3 provides visual confirmation of the observed normality in the error terms.

Table 6 presents the outcomes of the squared-residual gram, indicating the absence of heteroscedasticity. The majority of associations exhibit p-values that are deemed insignificant, surpassing the threshold limit of 0.5.

Table 6: Squared-Residual Gram.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. |* . |	. |* . |	1	0.138	0.138	0.4783	0.489
. | . |	. | . |	2	-0.024	-0.043	0.4929	0.782
. | . |	. | . |	3	0.011	0.020	0.4961	0.920
. *| . |	.**| . |	4	-0.195	-0.205	1.6138	0.806
. | . |	. | . |	5	-0.020	0.042	1.6263	0.898
. | . |	. | . |	6	0.045	0.027	1.6923	0.946
. | . |	. | . |	7	-0.026	-0.026	1.7153	0.974
. | . |	. *| . |	8	-0.065	-0.101	1.8760	0.985
. *| . |	. | . |	9	-0.079	-0.060	2.1281	0.989
. *| . |	. *| . |	10	-0.104	-0.078	2.6057	0.989
. |* . |	. |* . |	11	0.095	0.121	3.0357	0.990
. | . |	. *| . |	12	-0.044	-0.123	3.1365	0.995

Table 7 provides the findings of the residual gram for the long run, revealing the absence of autocorrelation. The insignificant probability values associated with each residual indicate the absence of observed autocorrelation.

Table 7: Residuals Gram.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
.**| . |	.**| . |	1	-0.269	-0.269	1.6806	0.195
. | . |	. *| . |	2	-0.001	-0.080	1.6806	0.432
. *| . |	. *| . |	3	-0.084	-0.115	1.8627	0.601
. |*** |	. |*** |	4	0.391	0.368	6.0668	0.194
.**| . |	. *| . |	5	-0.270	-0.096	8.2024	0.145
. | . |	. *| . |	6	-0.054	-0.144	8.2938	0.217
. *| . |	.**| . |	7	-0.186	-0.277	9.4686	0.221
. | . |	***| . |	8	-0.033	-0.399	9.5075	0.301
. | . |	. | . |	9	-0.034	-0.058	9.5532	0.388
. | . |	. | . |	10	-0.013	0.026	9.5601	0.480
. *| . |	. | . |	11	-0.106	0.046	10.110	0.521
. | . |	. |* . |	12	0.069	0.129	10.372	0.583

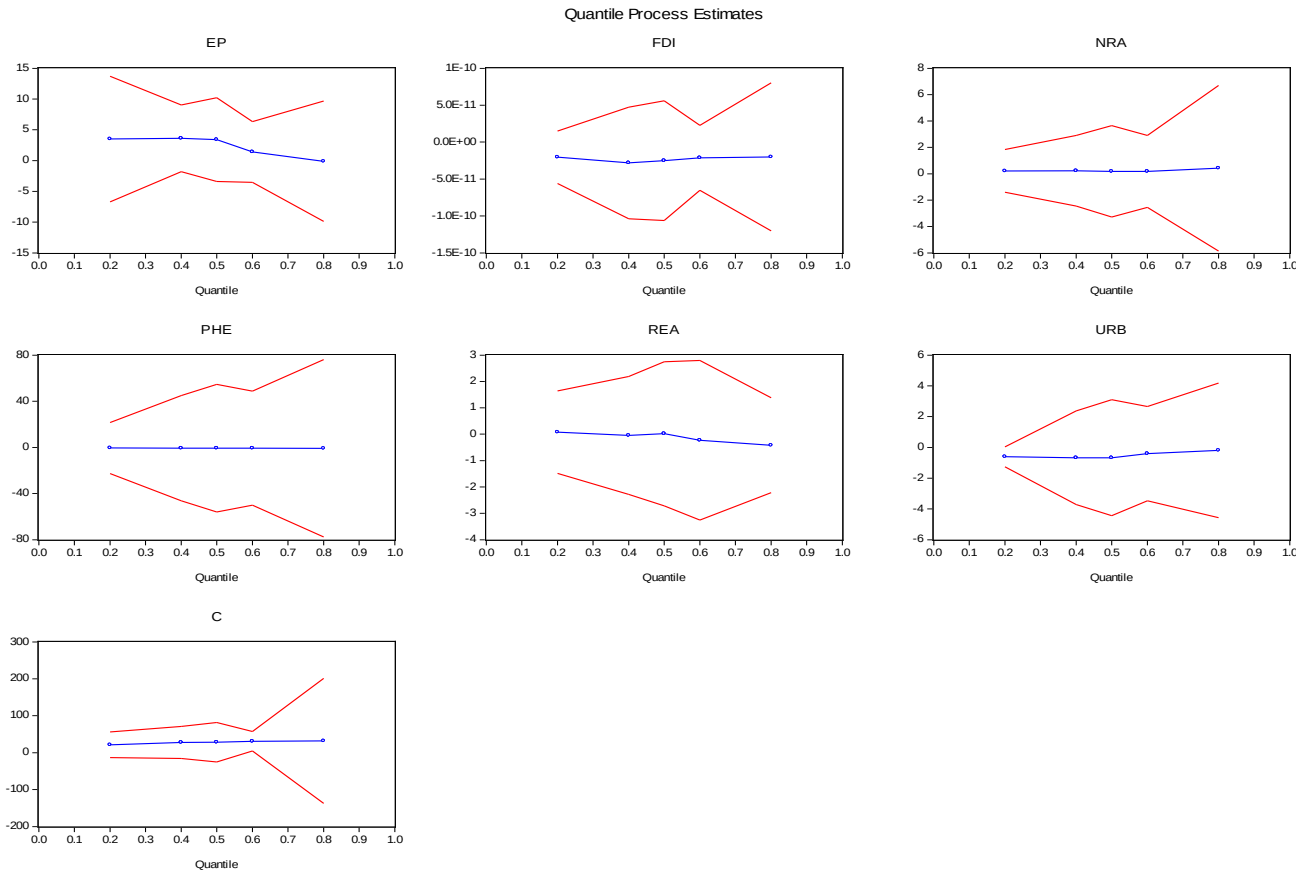

Figure 4: Quantile Process Estimates.

Figure 4 presents the graphical representation of quantile process estimates, where the blue lines illustrate the sensitivity level to changes. Notably, the blue lines exhibit fluctuations but remain relatively consistent for the variables PHE, REA, URB, E.P., FDI, and NRA.

5. Discussion

The main aim of this research includes, to assess the influence of various significant factors on Vietnam's sustainable EG. These factors EDU, the adoption of REA, PHE, EP, and the abundance of NRA. Secondary data from the WDI spanning the period from 2000 to 2022 was utilized for this study, with the analysis conducted employing the QARDL approach.

The findings derived from this study indicate that EDU exerts an insignificant influence on Vietnam's sustainable EG. This observation aligns with the findings of Ahmed et al. (2020). It plays a pivotal role in shaping various environmental policies, fostering a climate where businesses are motivated to implement essential measures that contribute to sustainable practices, a critical aspect for the EC of the country (Umar et al., 2020). Hence, insufficient EDU can contribute to the inefficacy of the country's sustainable EG, yielding suboptimal outcomes. Notably, in Vietnam, individuals residing in urban locales possess access to requisite information concerning EP, in contrast to their rural counterparts. Additionally, this investigation observes that the adoption of REA exerts an insignificant influence on Vietnam's sustainable economic growth, a viewpoint supported by Wang et al. (2022). While the adoption of renewable energy has become widespread across various sectors globally, challenges such as the elevated costs associated with renewable energy technologies and research and development may pose potential adverse effects on the EG of the country.

Nevertheless, this research demonstrates that both PHE & EP exhibit an insignificant influence on Vietnam's sustainable EG, in line with existing literature Yang (2020) and Khan et al. (2020a). The emissions of greenhouse gases (GHG) and other hazardous substances resulting from the persistent utilization of non-renewable energy (non-RE) resources have significantly affected PHE in Vietnam, consequently exerting a negative impact on the country's EG. Simultaneously, EP has been substantially compromised, contributing to an inefficient EG. Therefore, crucial measures are imperative to foster the sustainable EG of the country and achieve efficacious outcomes. Furthermore, this research indicates an insignificant correlation between NRA and sustainable EG within the Vietnamese context, consistent with findings in prior studies by Redmond and Nasir (2020). The abundance of NRA is acknowledged to have a significant role in influencing a country's sustainable EG. Consequently, the absence of an efficient supply of natural resources can adversely affect the overall economic performance of a nation, leading to unfavourable outcomes. Additionally, the elevated costs associated with renewable raw materials can also exert a negative impact on the economic growth of the country, thereby influencing Vietnam's FDI.

6. Conclusion

Vietnam's rapid economic growth positions it to make substantial contributions to environmental sustainability, providing a potential competitive advantage. This study examines the impact of rREA, EDU, PHE, NRA, and EP on the country's sustainable economic growth. Utilizing data from 2000 to 2022 sourced from the WDI, the analysis employs the QARDL model. Results indicate that REA, EP, PHE, NRA, EDU, and EG exhibit an insignificant impact on Vietnam's EG.

7. Implications of the Study

Virtually all research endeavours bear implications that enhance their overall merit. Analogously, the present study encompasses both practical and theoretical significance, augmenting its distinctiveness. Hence, several practical and theoretical implications of this research are elucidated herein.

7.1 Theoretical Implications

By conducting an examination of the literature in the present research, a noticeable gap emerges regarding the exploration of the correlation among health care spending and the long-term economic expansion of Vietnam. This research has effectively addressed this gap, contributing valuable insights to the understanding of this association. Additionally, the integration of the "Green Growth theory" in this study serves to assess the influence of renewable energy adoption on sustainable economic growth, thereby enhancing the knowledge base for stakeholders through a structured conceptual framework.

A comprehensive understanding to stakeholders regarding the depletion of natural reserves, urging them to undertake crucial measures to advance the utilization of renewable energy sources for power generation. Such an approach has the potential to create opportunities for the renewable energy sector to enhance its contribution to the overall economic growth of the country.

Additionally, this study has enhanced the discourse on the influence of environmental performance on sustainable economic growth in the country, motivating subsequent research endeavours to make valuable contributions in this area. Such an approach can shed light on various factors that may affect the sustainable economic growth of the country, yielding meaningful insights.

7.2 Practical Implications

The present study holds practical implications that can enhance the sustainable performance of diverse sectors or industries, thereby fostering the promotion of sustainable economic growth within the country. For instance, the study underscores the adoption of renewable energy by firms as a contributor to a sustainable economy. Moreover, it has the potential to disseminate knowledge to stakeholders about the influence of health care spend on long-term economic growth, prompting them to implement essential measures to fortify this connection and achieve meaningful, sustainable outcomes. This aspect adds substantial value to the current research.

This study can effectively elucidate the benchmarks for environmental performance, thereby enhancing the sustainable economic growth of the country. Consequently, firms may be encouraged to prioritize and champion sustainable practices, consequently improving environmental performance.

Moreover, the results obtained from the present research have the potential to inspire or implant a sense of responsibility among the public, inspiring them to integrate sustainable practices and resources into their daily lives for the betterment of the country's sustainable economic growth. This initiative can significantly enhance the nation's sustainable growth and development, fostering a competitive advantage. Moreover, the study's impact

extends to influencing policymakers, urging them to craft and enforce policies, thereby furthering the cause of sustainable economic growth within the country.

8. Research Limitations

While this study has effectively illuminated the influences of education, RE adoption, public health expenditure, environmental performance, considering the impact of abundant natural resources on the continued economic expansion of Vietnam, it is not without its limitations, warranting consideration for future research endeavours. Notably, the study's exclusive focus on data from Vietnam may introduce researcher bias, restricting its applicability to other developed or developing countries. Additionally, the reliance on secondary quantitative data for assessing the impact of RE adoption on sustainable economic growth, coupled with a shorter timeframe, omits the collection of primary data. Furthermore, the study neglects the exploration of diverse sustainable strategies for enhancing economic growth within its contextual scope. The research results are also affected by the researcher's bias in including a limited number of factors.

9. Suggestions for Future Research

The enumerated limitations serve as catalysts for future research endeavours. Subsequent studies may undertake a comparative analysis between Vietnam and other nations, such as the USA or the UK, to discern disparities in the adoption of renewable energy. Employing a mixed-methods approach in future research can enhance data collection by incorporating both primary quantitative and qualitative data, thereby providing a enhanced comprehension of the impacts of renewable. Furthermore, future investigations could delve into a broader array of internal factors, including organizational culture and governance, as well as extrinsic factors like trade openness, to enrich the depth and scope of findings regarding sustainable economic growth strategies.

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