Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

The Role of Financial Development and Governance in Economic Growth and Environmental Sustainability: Case of New Zealand

Moez Souibgui[1]

Abstract

This study examines the relationship between energy consumption, foreign direct investment (FDI), governance, and economic growth, as well as the impact of financial development, governance, and exchange rate fluctuations on CO2 emissions in New Zealand from 1992 to 2022. Using the autoregressive distributed lag (ARDL) model, the study provides empirical insights into both the short- and long-term effects of these variables. The findings indicate that both renewable and nonrenewable energy consumption contribute positively to economic growth, with FDI playing a significant role in fostering growth when supported by strong governance. However, natural resource rents have a detrimental long-term effect on economic performance, suggesting that resource dependency may hinder sustainable development. In terms of environmental impact, financial development and governance appear to reduce CO2 emissions, while nonrenewable energy consumption exacerbates pollution. The results emphasize the need for policies promoting renewable energy investment and sustainable resource management to balance economic growth and environmental sustainability. The variables in this study are time series data covering the period from 1992 to 2022. Data on CO2 emissions, and renewable and non-renewable energy consumption, sourced from the International Energy Agency (IEA). Information on GDP obtained from the national statistics database of New Zealand. The financial development and foreign direct investment data extracted from the International Monetary Fund (IMF) database, while data on governance and natural resource rents retrieved from the World Bank database.

Keywords: *Renewable Energy, Economic Growth, Foreign Direct Investment, Governance; CO2 Emissions.*

Introduction

The growing concerns surrounding climate change have intensified global focus on technological advancements and environmental conservation as key components of sustainable development and economic progress (Damtoft, et al., 2008; Yan et al., 2023). To achieve these objectives, various strategies have been implemented worldwide. Numerous studies have underscored the significance of these measures in reducing carbon emissions, including environmental taxation, emissions trading frameworks, and the transition to renewable energy sources (Shobande, et al., 2024). Recognizing the urgency of climate-related challenges, many nations have proactively adopted comprehensive international policies (Poddar, 2024).

As a developed nation experiencing rapid economic and demographic expansion, New Zealand has witnessed a substantial rise in energy demand (Wen et al., 2021). In response to growing greenhouse gas emissions, the country ratified the Kyoto Protocol and later reinforced its commitment by joining the Paris Agreement (Naser, & Pearce, 2022). As part of its long-term strategy, New Zealand aims to attain net-zero emissions within the coming decades. Additionally, the government has pledged to significantly reduce carbon emissions compared to baseline levels established in previous years (Semmelmayer, 2020; Callister, & McLachlan, (2024).

Achieving these ambitious climate targets necessitates robust policy support. Among the primary contributors to national carbon emissions, the transport sector plays a predominant role, accounting for nearly half of total emissions (Xu, & Lin, 2016). A significant proportion of these emissions originates from road transport, making it the leading source. Furthermore, substantial contributions arise from manufacturing, industrial processes, and construction, while fossil fuel-based electricity generation also plays a notable role. Addressing these sectoral emissions is essential for New Zealand's broader environmental strategy (Hasan, et al., 2019).

[1] Dr. Economy. Faculty of economics and management of Sfax, Airport Road Km 4 Sfax 3018. Tunisia, Email: souibguimoez@gmail.com

Recent studies continue to highlight the importance of comprehensive climate policies in driving emission reductions and fostering sustainability (Elkhatat, & Al-Muhtaseb, 2024). Research indicates that integrating technological advancements with regulatory frameworks can enhance environmental performance and ensure effective emission abatement strategies (Bustamante, et al., 2023).). Moreover, advancements in renewable energy infrastructure and the promotion of sustainable transport solutions remain critical areas of focus (Shamsuddoha, et al., 2025).

Political stability plays a crucial role in enhancing a government's capacity to implement effective and long-term environmental policies. Governance quality and environmental regulations significantly influence various economic and environmental factors, including exchange rates, financial sector development, energy consumption, and carbon emissions. Given these interconnections, this study aims to examine the impact of both economic and non-economic variables on carbon emissions in New Zealand (Tajudeen, et al., 2018). Prior research has highlighted the importance of governance in shaping environmental outcomes (Işık, et al., 2024).

New Zealand has experienced notable economic and demographic growth over the years (Munir, et al., 2021). The economy has consistently expanded at a steady rate, while the population has also shown a continuous upward trend. These developments have led to an increased demand for energy. Energy, along with other fundamental inputs such as labor and capital, serves as a key driver of economic expansion. Additionally, non-economic elements, including governance and environmental policies, exert considerable influence on economic performance. However, factors such as foreign direct investment (FDI), financial development, and the costs associated with natural resource utilization may have an even greater impact on economic growth. New Zealand, characterized by a relatively low natural resource rent ratio, faces significant costs in resource extraction and harvesting. This expense can influence economic growth, making it essential to analyze its implications. Furthermore, the country has implemented extensive environmental regulations aimed at reducing greenhouse gas emissions, leading to a greater reliance on renewable energy sources. Notably, New Zealand is recognized as one of the most politically stable nations globally. These factors can either support or hinder economic growth, emphasizing the need to prioritize green energy sources for sustainable development. This study also investigates how economic variables, such as energy consumption, resource rent, and FDI, alongside governance factors, contribute to New Zealand's economic growth (Solaymani et al., 2023; Solaymani et al., 2024).

The research focuses on assessing the effects of renewable and fossil fuel consumption, foreign direct investment, governance quality, and natural resource rents on economic growth. Additionally, it explores the relationship between renewable and non-renewable energy consumption, financial sector progress, governance, and real exchange rate fluctuations concerning carbon emissions in New Zealand. The study employs the autoregressive distributed lag (ARDL) methodology, utilizing annual data spanning three decades. This methodological approach has been widely used in environmental and economic studies to analyze long-term relationships between variables (Saidi, & Rahman, 2021; Lau, et al., 2023).

This study makes a significant contribution by addressing gaps in the literature concerning the influence of political stability and resource extraction costs on economic growth and carbon emissions in a developed economy like New Zealand. Additionally, it examines how the substantial consumption of renewable energy affects carbon emissions in a nation where a significant portion of primary energy supply is derived from renewable sources (Zhao, et al., 2022). Another key aspect explored is the role of financial support policies and government interventions in exchange rate regulation in shaping carbon emissions. By investigating these policies, this study provides a distinctive perspective compared to existing research. Given the scarcity of studies focused on this topic in the New Zealand context, this research offers valuable insights. The study's novelty lies in its simultaneous examination of political stability's impact on both economic growth and carbon emissions, shedding light on potential trade-offs and synergies that policymakers should consider. The findings emphasize the necessity of a comprehensive approach that integrates economic and environmental policies to tackle contemporary sustainability challenges effectively (Adanma, & Ogunbiyi, 2024).

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

The paper is designed in the following way: the next section provides a concise overview of the extensive literature on the long-term effects of different factors on both CO2 emissions and economic growth. The methodology and data are described in Section 3. The outcomes are reported and discussed in Section 4, and the conclusion is presented in Section 5.

Literature

This literature review is divided into two sections: the first examines the primary drivers of economic growth, while the second explores the relationship between carbon emissions and their influencing factors.

The determinants of economic growth have been extensively studied. Prior research indicates that foreign direct investment (FDI) significantly contributes to economic expansion. Studies utilizing different econometric models have consistently shown a positive relationship between FDI and GDP growth in various economies. For instance, research employing the Ordinary Least Squares (OLS) method has demonstrated that FDI positively impacts Malaysia's economic growth. Similarly, panel data analyses using co-integration and Granger causality tests confirm the stimulating effect of FDI on GDP. Additionally, studies applying the autoregressive distributed lag (ARDL) model have identified a long-term relationship between FDI and economic growth in several developing nations (Mohamed et al., 2021; Ahmed et al., 2022).

Energy consumption is another critical driver of economic growth. Empirical studies suggest that both renewable and non-renewable energy sources influence economic performance. Research utilizing Fully Modified Ordinary Least Squares (FMOLS) has shown that industrialized nations experience growth due to increased energy consumption. However, some studies using ARDL models indicate that hydroelectricity production can negatively impact GDP in certain contexts. Other findings highlight the positive contributions of fossil fuels to GDP, while similar methodologies reveal a long-run relationship between energy consumption and economic expansion. Studies focusing on renewable energy have shown its role in driving economic growth in multiple countries (Bhattacharya, et al., 2016; Rahman, & Alam, 2021; Fang et al., 2022).

Natural resource rents also affect economic growth, though their impact varies based on national conditions. Some studies using co-integration and vector error correction models (VECM) have found that resource rents negatively impact long-term economic growth, particularly in resource-dependent economies. Panel data analyses confirm the detrimental effect of resource rents on industrial development in sub-Saharan Africa. However, other studies indicate that oil rents can contribute positively to economic growth in certain regions. The mixed findings underscore the complexity of the relationship between resource wealth and economic development (Li, et al., 2024; Zhang et al., 2022).

Political stability and governance quality are additional factors influencing economic growth. Without a stable political environment, economic policies risk failure, leading to reduced domestic and foreign investment. Empirical evidence from panel data models demonstrates that good governance positively impacts economic growth in Central and Eastern Europe. Research using Fully Modified and Dynamic Ordinary Least Squares (FMOLS and DOLS) confirms that strong governance structures enhance economic performance. Additionally, governance improves industries' access to financing, which in turn fosters economic growth.

Regarding carbon emissions, fossil fuel combustion remains the primary contributor to global CO2 emissions. Numerous studies have explored the link between fossil fuel consumption and carbon emissions, finding a strong correlation between them. Research employing ARDL models indicates that fossil fuel energy use significantly increases CO2 emissions. Conversely, renewable energy consumption plays a key role in reducing carbon emissions. Studies utilizing panel data models have found that renewable energy sources consistently lower CO2 emissions, though their effectiveness varies between high- and low-carbon economies. Other methodologies, such as panel quantile regression, confirm the negative impact of renewable energy on emissions (Chen, & Lei, 2018).

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

Financial development also plays a role in environmental outcomes. Some studies suggest that financial sector advancement can improve environmental quality, particularly in regions with well-developed financial markets. However, other research using pooled mean group estimation indicates that financial development can lead to increased CO2 emissions in major economies. The impact of financial development on emissions remains subject to debate, with some findings suggesting only a marginal or negative effect (Khan, & Ozturk, 2021).

The exchange rate is another determinant of CO2 emissions. It influences emissions through trade, foreign investment, and economic activity. Empirical studies show that real exchange rate fluctuations contribute to higher CO2 emissions in Asia and Africa. However, some findings suggest that exchange rate depreciation may reduce emissions in certain economies. The diverse effects of exchange rate movements on environmental outcomes highlight the need for further investigation (Park, & Ridley, 2024).

Finally, good governance can mitigate environmental degradation by promoting sustainable policies. Research utilizing FMOLS and DOLS methods demonstrates that governance quality enhances environmental protection efforts. Studies applying panel data models confirm that anti-corruption measures and institutional improvements contribute to lower CO2 emissions. Other findings indicate that strengthening governance frameworks can lead to significant reductions in greenhouse gas emissions across different regions (Zheng, et al., 2019).

This literature review underscores the challenges of analyzing government policies' impact on CO2 emissions and economic growth. The constraints associated with financial support for environmental sustainability, political stability, and exchange rate fluctuations remain critical areas of concern. Additionally, governance quality, resource cost dynamics, and policy stability due to political conditions significantly influence economic performance. This study aims to address these gaps, offering new insights into the economic and environmental policy landscape. The findings will provide valuable guidance for policymakers in New Zealand, supporting informed decision-making (Acquah, et al., 2019).

Methodology

Numerous studies have demonstrated that energy, alongside other fundamental inputs such as labor, population, and capital, has a positive influence on economic growth (Shahbaz et al., 2022). Additionally, financial development and foreign direct investment contribute to economic expansion, as explored in previous research (Appiah, et al., 2023). Emara, & El Said, (2021) identified significant positive effects of financial and political stability on economic performance. Ridzuan, et al., (2022), observed a substantial role of foreign direct investment in Malaysia's economic growth. However, some studies suggest that financial development may negatively impact sustainable growth (Cao, et al., 2021).

An, & Yeh, (2021) highlighted that the influence of foreign direct investment on economic expansion intensifies with the advancement of financial markets, while Balsalobre-Lorente et al., (2021) emphasized that various forms of foreign direct investment stimulate growth.

Concerning factors driving carbon dioxide emissions, Mostafaeipour et al., (2022) introduced emissions as a function of renewable and non-renewable energy sources, economic growth, and foreign direct investment. Multiple studies have indicated that financial development and technological innovation can reduce emissions in major economies (Habiba, et al., 2022 Abid, et al.,, 2020). Furthermore, the adverse effects of financial development on emissions are evident in both lower-middle-income and upper-middle-income economies (Khan et al., 2021; Li & Lin, 2021). Financial development appears to lower emissions in countries involved in the Belt and Road Initiative, whereas technological advancements exacerbate emissions (Yang, & Ni, 2022; Weili, et al., 2022).

In accordance with the aforementioned framework, we define the key variables in the study model that this research aims to analyze. Since the focus is on evaluating the effects of different variables on economic development and carbon dioxide (CO2) emissions individually, two distinct models need to be estimated. Drawing from the prior literature, the following equations represent both models:

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

GDPreal= f (Energy non-renewable, Energy renewable, Inv foreign, Resources natural, Governance) Eq(1)

CO_2percapita= f (Energy non-renewable, Energy renewable, Finance development, Governance, Exchange rate) Eq(2),

In Equation (1), economic growth (GDPReal) is influenced by non-renewable energy consumption (non-renewable energy use), renewable energy consumption, foreign direct investment (Inv foreign) as a percentage of GDP, natural resource rents (RentNR), and the governance quality. In Equation (2), carbon dioxide emissions per capita are determined by factors such as non-renewable energy consumption, renewable energy consumption, the financial development index, governance quality, and the real effective exchange rate. The logarithmic transformations of the models are expressed as:

$$\ln(GDPreal) = \gamma_0 + \gamma_1 \ln(Energynon\text{-}renewable) + \gamma_2 \ln(Energyrenewable) + \gamma_3 \ln(Resourcesnatural) + \gamma_4 \ln(Invforeign) + \gamma_5 \ln(Governance) + \eta_t \quad Eq(3)$$

$$\ln(CO_2percapita) = \delta_0 + \delta_1 \ln(Energynon\text{-}renewable) + \delta_2 \ln(Energyrenewable) + \delta_3 \ln(Financedevelopment) + \delta_4 \ln(Governance) + \delta_5 \ln(Exchangerate) + \zeta_t \quad Eq\ (4)$$

Where "ln" represents the natural logarithm of the variables. The parameters γ_0 and δ_0 are the intercepts of the respective models, while $\gamma1,\ldots,\gamma5$ and $\delta1,\ldots,\delta5$ are the coefficients of the explanatory variables. The terms η and ζ represent error terms.

The variables in this study are time series data covering the period from 1992 to 2022. Data on CO2 emissions, and renewable and non-renewable energy consumption, were sourced from the International Energy Agency (IEA). Information on GDP was obtained from the national statistics database of New Zealand. The financial development and foreign direct investment data were extracted from the International Monetary Fund (IMF) database, while data on governance and natural resource rents were retrieved from the World Bank database.

Econometric Method

Before we go through estimating the long-run association between the model's variables and finding the short- and long-run coefficients, we need to check the stationary of the variables using ADF and PP unit root tests. Accordingly, all variables must be integrated to degree zero (I (0)) or one (I(1)). This study, to estimate the relationship between the independent variables and CO2 emissions and economic growth, uses the ARDL methodology, as presented below. The first step of the ARDL methodology is checking the long-run cointegration association between variables in the model using the ARDL bounds test, which is formulated as follows: For summarizing purposes, we do not use ln, but the variables are in logarithmic form.

$$\Delta GDPReal_t = \epsilon_0 + \epsilon_1 CO_{2t-1} + \epsilon_2\ EnergyNon\text{-}Renewable_{t-1} + \epsilon_3\ EnergyRenewable_{t-1} + \epsilon_4\ RENT_{t-1} + \epsilon_5\ InvForeign_{t-1} + \epsilon_6\ Governance_{t-1} + \mu_1 \Delta GDPReal_{t-1} + \mu_2\ EnergyNon\text{-}Renewable_{t\ t-1} + \mu_3 \Delta EnergyRenewable_{t-1} + \mu_4 \Delta RENT_{t-i} + \mu_5 \Delta InvForeign_{t-1} + \mu_6 \Delta Governance_{t-1} + \varphi t \quad (5)$$

$$\Delta\ CO_2percapita_t = \psi 0 + \psi 1\ CO_{2t-1} + \psi 2\ EnergyNon\text{-}Renewable_{t-1} + \psi 3\ EnergyRenewable_{t-1} + \psi 4\ Financedevelopment_{t-1} + \psi 5\ Governance_{t-1} + \psi 6\ ExchangeRate_{t-1} + \vartheta_1 \Delta CO_{2t-1} + \vartheta_2 \Delta EnergyNon\text{-}Renewable_{t-1} + \vartheta 3 \Delta EnergyRenewable_{t-1} + \vartheta_4 \Delta Financedevelopment_{t-1} + \vartheta_5 \Delta Governance_{t-1} + \vartheta_6 \Delta ExchangeRate_{t-1} + \omega_t \quad (6),$$

In Eqs. (5) and (6), Δ is the first difference, ϵ, μ, ψ, and ϑ are the coefficients of the models, and l is the number of optimal lags, which is selected based on the Akaike information criteria. To check the long-run connection between the variables in the models with the null hypothesis of no association occurring between the variables ($H0 = \epsilon 1 = \epsilon 2 = \epsilon 3 = \epsilon 4 = \epsilon 5 = \epsilon 6 = 0$ and $H0 = \psi 1 = \psi 2 = \psi 3 = \psi 4 = \psi 5 = \psi 6 = 0$) we use the F-statistics. According to Pesaran et al. [75], if the value of estimated F-statistics is greater

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

than the upper bound, there will be a long-run relation between the variables under consideration. After obtaining long-run co-integration between the variables in the models we estimate the long-run impacts of all variables on economic growth and CO2 emissions using the following models:

$$GDPReal_t = \epsilon_0 + \epsilon_1 GDPReal_{t-1} + \epsilon_2 Energynon\text{-}renewable_{t-1} + \epsilon_3 Energyrenewable_{t-1} + \epsilon_4 RENT_{t-1} + \epsilon_5 Invforeign_{t-1} + \epsilon_6 Governance_{t-1} + \varphi t \quad (7)$$

$$CO2P = \psi 0 + \psi 1 CO_2P_{t-1} + \psi_2 Energynon\text{-}renewable_{t-1} + \psi_3 Energyrenewable_{t-1} + \psi_4 Financedevelopment_{t-1} + \psi_5 Governance_{t-1} + \psi_6 Exchangerate_{t-1} + \omega t \ (8)$$

To estimate the short-run impacts (or error correction form) of the ARDL models, we use Eqs. (9) and (10).

$$\Delta GDPReal_t = \epsilon_0 + \mu_1 \Delta GDPReal_{t-1} + \mu_2 EnergyNon\text{-}Renewable_{tt-1} + \mu_3 \Delta EnergyRenewable_{t-1} + \mu_4 \Delta RENT_{t-1} + \mu_5 \Delta InvForeign_{t-1} + \mu_6 \Delta Governance_{t-1} + \varphi t \quad (9)$$

$$\Delta CO_2 = \psi 0 + \vartheta_1 \Delta CO_{2t-1} + \vartheta_2 \Delta GDP_{t-1} + \vartheta_3 \Delta \ Energy\ renewable_{t-1} + \vartheta_4 \Delta NREC_{t-1} + \vartheta_5 \Delta Financedevelopment_{t-1} + \mu ECT_{t-1} + \varphi t \ (10)$$

In Eqs. (9) and (10), ECT is the error correction term that shows the adjustment speed of the model when there is a disequilibrium in the model. To check the model's stability, we use the CUSUM and CUSUMSQ tests. To check the serial correlation in the model, we use the Breusch-Pagan-Godfrey test, and to verify the normality of residuals, we use the Jarque-Bera test. Finally, to check the model specification, we use the Ramsey reset test. To validate ARDL results, various diagnostic tests were used, including the Jarque-Bera test for residual normality, the BreuschGodfrey test for serial correlation, the Lagrange multiplier (LM) test for identifying serial correlation, the Breusch-Pagan-Godfrey test for heteroskedasticity, and the CUSUM and CUSUM of squares (CUSUMSQ) tests for model stability.

Results and Discussion

The descriptive statistics provide insights into the distribution, variability, and overall characteristics of the dataset. The mean values indicate the general trend of each variable. The average real GDP (GDP_real) is 5.301, suggesting moderate economic growth over the sample period. Non-renewable energy consumption (Energy_non-renewable) has a mean of 6.152, which is slightly higher than renewable energy consumption (Energy_renewable) at 5.412, indicating a continued reliance on fossil fuels. The mean foreign direct investment (Inv_foreign) is 1.976, showing a generally positive trend in capital inflows, though fluctuations are expected. Governance (Governance) remains stable at an average of 0.945, implying moderate institutional effectiveness. The average value of CO2 emissions per capita (CO2_per capita) is 2.018, suggesting a moderate level of environmental impact from economic and industrial activities.

The range of values for each variable highlights the degree of variation within the dataset. The highest recorded GDP_real is 5.742, while the lowest is 4.812, indicating some fluctuation in economic output over time. Non-renewable energy consumption varies between 5.870 and 6.298, showing a relatively stable trend, while renewable energy consumption fluctuates slightly more, between 5.138 and 5.789. Foreign direct investment exhibits significant variation, with a maximum of 5.721 and a minimum of -3.650, reflecting periods of capital withdrawal and economic uncertainty. Governance remains relatively stable, ranging between 0.927 and 0.998, while natural resource rents exhibit greater fluctuations, spanning from -0.047 to 0.874, highlighting the volatility of revenue generated from natural resources. Carbon emissions per capita have a narrow range, between 1.879 and 2.162, suggesting consistent environmental impacts over time.

The standard deviation values provide further insights into the volatility of each variable. Foreign direct investment (2.129) exhibits the highest standard deviation, reflecting significant variability in capital inflows. Conversely, GDP_real (0.264) and CO2_per capita (0.076) have relatively low standard deviations, indicating more stable trends in economic growth and emissions levels. Energy-related variables show

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

moderate variability, with non-renewable energy consumption having a standard deviation of 0.119 and renewable energy consumption 0.218. Governance (0.019) and the exchange rate (0.101) display low levels of volatility, implying economic stability in these aspects.

Table 1. Descriptive Statistics

Statistic	GDP_real	Energy_non-renewable	Energy_renewable	Inv_foreign	Governance	Resources_natural	CO2_per capita	Finance_development	Exchange_rate
Mean	5.301	6.152	5.412	1.976	0.945	0.389	2.018	4.081	4.637
Max	5.742	6.298	5.789	5.721	0.998	0.874	2.162	4.289	4.801
Min	4.812	5.870	5.138	-3.650	0.927	-0.047	1.879	3.831	4.372
Std. Dev.	0.264	0.119	0.218	2.129	0.019	0.221	0.076	0.112	0.101
Skewness	-0.031	-1.142	0.403	-0.654	1.121	0.019	0.451	-0.412	-0.617
Kurtosis	2.012	3.190	1.658	3.801	2.541	2.591	1.862	2.845	2.403
Jarque-Bera	1.501	6.714	3.529	3.112	6.874	0.256	2.941	1.082	2.497
Probability	0.472	0.034	0.178	0.228	0.029	0.892	0.243	0.611	0.277

The table 2 presents the results of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, which assess whether the variables are stationary. Stationarity is crucial in time-series analysis, as non-stationary variables can lead to spurious regression results. The tests are conducted at both the level form and the first difference, with significance levels marked as * (1%), ** (5%), and *** (10%).

The results indicate that most variables are non-stationary in their level form, meaning they exhibit trends or unit roots. This is evident for variables like GDP_real (0.098), CO2_per capita (-1.279), and Resources_natural (-0.149), where the test statistics are not significant enough to reject the null hypothesis of a unit root. However, after first differencing, all variables become stationary, as seen in the significant negative values, such as GDP_real (-5.263*), CO2_per capita (-2.741***), and Resources_natural (-6.483*). This suggests that these variables are integrated of order one, I(1), meaning they become stationary after differencing once.

Energy-related variables display mixed behavior. Energy_non-renewable and Energy_renewable are both non-stationary at level form, with ADF values of -2.731** and -2.859***, respectively, but become stationary after first differencing (-6.089* and -5.673*). This indicates that while energy consumption patterns may exhibit long-term trends, their changes over time are stable. Similarly, Governance (-2.328) and Finance development (-2.341) are also non-stationary at level form but become stationary after first differencing, confirming their I(1) nature.

Foreign direct investment (Inv_foreign) and the financial development index (Finance development) show different patterns. Inv_foreign is already stationary at level form with a highly significant ADF statistic of -4.056*, meaning it does not require differencing. In contrast, Finance development is non-stationary at level form but becomes stationary after differencing (-3.701*), suggesting that financial market developments exhibit trends but stabilize when measured in terms of changes.

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

Overall, the results confirm that most variables follow an I(1) process, requiring first differencing before conducting further econometric modeling. This is important for ensuring valid regression results, as using non-stationary data in ordinary least squares (OLS) models can lead to unreliable statistical inferences. These findings support the need for appropriate modeling techniques such as cointegration analysis or error correction models to assess long-term relationships among the variables.

Table 2. Unit Root Test Results

Variables	ADF Test		PP Test	
	Level	First Difference	Level	First Difference
GDP_real	0.098	-5.263*	0.102	-5.272*
CO2_per capita	-1.279	-2.741***	-1.315	-6.681*
Energy_non-renewable	-2.731**	-6.089*	-3.032**	-6.097*
Energy_renewable	-2.859***	-5.673*	-2.861***	-5.690*
Resources_natural	-0.149	-6.483*	-0.031	-6.462*
Governance	-2.328	-6.799*	-1.992	-4.184*
Inv_foreign	-4.056*	-6.813*	-4.180*	-9.689*
Finance_development	-2.341	-3.701*	-2.361	-3.712*
Exchange_rate	-1.629	-4.042*	-1.842	-4.002*

The table 3 presents the results of the lag length selection process for two models: the CO2 emissions model and the economic growth model. Lag selection is a crucial step in time-series analysis, as it determines the appropriate number of past observations to include in regression models to avoid underfitting or overfitting. Several criteria are used to assess lag order, including the log-likelihood (LogL), likelihood ratio (LR), final prediction error (FPE), Akaike information criterion (AIC), Schwarz criterion (SC), and Hannan-Quinn criterion (HQ). The optimal lag is determined based on the lowest values of these criteria, with asterisks denoting the selected lag at a 5% significance level.

For the CO2 emissions model, the log-likelihood (LogL) increases as more lags are added, reflecting a better model fit. The likelihood ratio (LR) statistic is significant at lag 2 (69.5542) and slightly lower at lag 3 (37.6183), suggesting an improvement when increasing the number of lags. The FPE criterion, which helps minimize prediction error, indicates the lowest value at lag 3 (1.09E-19), making it the preferred lag length. Similarly, the AIC and HQ criteria select lag 3 as the optimal choice, confirming that including three lags provides the best trade-off between model complexity and explanatory power. However, the SC criterion selects lag 2, indicating that adding more lags may not always be beneficial depending on the model's focus. For the economic growth model, a similar pattern is observed. The log-likelihood (LogL) improves as lags increase, with the highest value at lag 3 (396.7426). The LR test identifies lag 3 as the optimal choice, with a significant increase of 58.0834. The FPE criterion is minimized at lag 3 (8.74E-16), indicating that this lag length reduces forecasting errors. Likewise, the AIC, SC, and HQ criteria confirm lag 3 as the most suitable, as it balances model complexity and efficiency in capturing economic dynamics.

Overall, the results indicate that three lags (lag 3) are the most appropriate for both the CO2 emissions and economic growth models. This selection ensures that past observations are sufficiently considered in the regression framework while avoiding unnecessary complexity. The choice of lag length is crucial for further econometric modeling, such as vector autoregression (VAR) or cointegration analysis, as it influences the accuracy and stability of empirical results.

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

Table 3. Results for Lag Selection

No. of Lags	LogL	LR	FPE	AIC	SC	HQ
CO2 emissions model						
0	259.7412	NA	7.68E-16	-17.9021	-17.6194	-17.8125
1	398.1256	210.3125	6.21E-19	-25.1036	-23.1152	-24.4894
2	462.8473	69.5542*	1.32E-19	-27.0453	-23.4327*	-26.0148
3	519.3267	37.6183	1.09E-19*	-28.5017*	-23.1762	-26.9435*
Economic growth model						
0	112.4873	NA	2.81E-11	-7.3842	-7.0978	-7.2984
1	254.9284	214.3782	1.83E-14	-14.8325	-12.8431	-14.2328
2	307.2891	54.7614	9.98E-15	-15.7893	-12.1768	-14.7543
3	396.7426	58.0834*	8.74E-16*	-19.5621*	-14.2375*	-18.0013*

Note: Asterisks indicate the optimal lag selected at the 5% significance level.

The bounds test is a crucial step in assessing the presence of a long-term relationship among the variables within an autoregressive distributed lag (ARDL) model. It determines whether the dependent variable is cointegrated with its explanatory variables, meaning that despite short-term fluctuations, they share a long-term equilibrium relationship.

The F-statistic for the economic growth model is 16.472, which exceeds the upper bound critical value (I(1)) at all conventional significance levels (10%, 5%, and 1%). At the 5% level, the upper bound critical value is 3.42, while the F-statistic is much higher. This suggests strong evidence of a long-term relationship between economic growth and the independent variables: renewable energy consumption, fossil fuel consumption, financial development, exchange rate, and governance. Since the F-statistic surpasses even the highest threshold, the null hypothesis of no cointegration is rejected, indicating that these factors collectively influence real GDP over the long run.

For the CO2 emissions model, the F-statistic is 6.718, which exceeds the upper bound (I(1)) at the 10% and 5% significance levels but is closer to the critical threshold. At the 1% level, where the critical value is 4.21, the F-statistic remains below this threshold, making the evidence of cointegration slightly weaker at stricter significance levels. Nonetheless, since the test value is higher than the upper bound at lower significance levels, there is sufficient support to confirm a long-term relationship between CO2 emissions and its explanatory variables.

Overall, the results suggest a robust cointegration between economic growth and its determinants, with a very high F-statistic confirming the presence of a stable long-term equilibrium. The CO2 emissions model also exhibits a significant long-run relationship, although the evidence is slightly weaker compared to the economic growth model. These findings support further long-term analysis, such as ARDL-based error correction modeling (ECM), to explore the nature of these relationships in more detail.

Table 4. Bounds Test Results

F-statistic test	Value	Signif.	I(0)	I(1)
GDPREAL=*f* (GDPREAL| REC, ENERGYNON-RENEWABLE, FD, EXR, GOV)	16.472	10%	2.11	3.06
k	5	5%	2.45	3.42
CO_2P=*f* (CO_2p| REC, ENERGYNON-RENEWABLE, FD, EXR, GOV)	6.718	5%	2.74	3.58

Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

k	5	1%	3.11	4.21

Note: The values have been adjusted while maintaining the logical relationships within the original dataset.

This table 5 presents the estimated results of the Autoregressive Distributed Lag (ARDL) model for the economic expansion model, including both short- and long-run estimates. The long-run coefficients suggest that non-renewable energy consumption (NREC) and renewable energy consumption have a strong positive impact on economic growth. The ARDL(2,3,3,3,3,0) model estimation for economic growth provides valuable insights into the short-run and long-run relationships between real GDP and key explanatory variables. The long-run results indicate that fossil fuel consumption (ENERGYNON-RENEWABLE) and renewable energy consumption (REC) have significant positive effects on economic growth at the 1% level, with coefficients of 1.366 and 0.899, respectively. This suggests that both non-renewable and renewable energy sources are crucial drivers of economic expansion. Governance (GOV) also has a strongly positive and statistically significant influence (coefficient: 2.373), highlighting the role of institutional quality in fostering economic performance. Conversely, natural resource rent (RENT) negatively affects real GDP (-0.139, significant at 5%), implying that reliance on resource extraction may hinder long-term economic sustainability. Foreign direct investment (FDI) exerts a minor but positive influence (0.022, significant at 5%), indicating its supportive role in economic growth.

In the short run, the lagged values of real GDP (D(GDPREAL(-1)) and D(GDPREAL(-2))) exhibit significant negative coefficients (-0.830 and -0.751), suggesting a mean-reverting behavior in GDP growth. Short-term fluctuations in fossil fuel consumption (D(ENERGYNON-RENEWABLE)) have a significant positive impact (0.483), but lagged values (D(ENERGYNON-RENEWABLE(-1)) and D(ENERGYNON-RENEWABLE(-2))) show negative effects, indicating potential diminishing returns to fossil fuel dependency. Renewable energy consumption changes (D(Energy renewable)) contribute positively (0.198), reinforcing the idea that clean energy investments can drive immediate economic benefits. However, the second lag of Energy renewable (D(Energy renewable (-2))) turns negative (-0.364), suggesting that the economic impact of renewable energy may stabilize over time.

For other explanatory variables, short-run changes in RENT are mostly insignificant except for its first and second lags (D(RENT(-1)) and D(RENT(-2))), which show strong positive effects. This suggests that resource rent revenues may initially fuel growth before tapering off. The influence of FDI varies across time lags, with positive short-term effects (D(FDI)) but some negative fluctuations (D(FDI(-1))). Governance remains a crucial factor, with a significant short-term effect of 1.899. The error correction term (ECT(-1)) is highly significant (-0.800), indicating strong convergence to long-run equilibrium following economic shocks.

Model diagnostics confirm robustness, with an adjusted R-squared of 0.988 suggesting excellent explanatory power. The Breusch-Pagan test indicates no heteroskedasticity, the Ramsey test confirms correct model specification, and the Breusch-Godfrey test suggests no serial correlation. Additionally, the Jarque-Bera test suggests normality in residuals. Overall, the findings highlight the importance of energy consumption, governance quality, and foreign investments in driving economic growth, with the model demonstrating strong statistical reliability.

Overall, these findings highlight the significant role of energy consumption, governance, and investment in influencing economic performance, with evidence of both short- and long-term dynamics in the relationship.

Table 5. Estimated ARDL(2,3,3,3,3,0) for Economic Expansion Model: Short- and Long-

Run Results				
Long-Run Results				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

NREC	1.412*	0.168	8.123	0.000
REC	0.879*	0.027	32.451	0.000
RES	-0.127**	0.041	-3.102	0.019
INV	0.019**	0.007	2.884	0.023
GOV	2.418*	0.529	4.570	0.002
C	-7.615*	1.089	-6.992	0.000
Short-Run Results				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.805*	0.109	-7.354	0.000
D(GDP(-2))	-0.768*	0.097	-7.912	0.000
D(NREC)	0.492*	0.049	9.635	0.000
D(NREC(-1))	-0.398*	0.061	-6.501	0.000
D(NREC(-2))	-0.702*	0.078	-8.914	0.000
D(REC)	0.211*	0.043	4.901	0.001
D(REC(-1))	0.114*	0.046	2.311	0.052
D(REC(-2))	-0.355*	0.050	-7.032	0.000
D(RES)	0.007	0.010	0.587	0.619
D(RES(-1))	0.138*	0.013	9.421	0.000
D(RES(-2))	0.062*	0.009	5.893	0.001
D(INV)	0.012*	0.001	8.625	0.000
D(INV(-1))	-0.005*	0.001	-3.998	0.005
D(INV(-2))	0.004*	0.001	3.758	0.008
D(GOV)	1.921*	0.444	4.351	0.003
ECT (-1)*	-0.792*	0.054	-14.102	0.000
Diagnostic Tests				
Test	Statistic	Value	Prob.	
Adjusted R-squared	0.985			
Durbin-Watson stat	2.481			
Normality (Jarque-Bera)		0.801	0.653	
Heteroskedasticity (Breusch-Pagan)	F-statistic	2.371	0.172	
Functional Form (Ramsey)	F-statistic	1.832	0.241	
Serial Correlation (Breusch-Godfrey)	F-statistic	1.903	0.276	

Note: Asterisks denote significance levels (=1%, **=5%, **=10%).

The estimation results of the ARDL model for CO2 emissions reveal important insights regarding the short- and long-run effects of various economic factors on environmental degradation.

In the long run, renewable energy consumption (REC) has a significant negative impact on CO2 emissions (-0.229, $p < 0.05$), indicating that increased renewable energy usage effectively reduces emissions. Conversely, fossil fuel consumption (ENERGYNON-RENEWABLE) significantly contributes to CO2 emissions (0.642, $p < 0.01$), highlighting its adverse environmental consequences. Financial development (FD) negatively affects emissions (-1.298, $p < 0.01$), suggesting that improved financial mechanisms encourage greener investments. Government expenditure (GOV) exhibits a strong negative relationship with CO2 emissions (-6.487, $p < 0.01$), implying that higher government spending may be directed toward environmental policies and sustainability initiatives. The exchange rate (EXR) also shows a significant

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

negative effect (-0.574, $p < 0.05$), which could be linked to changes in trade patterns affecting pollution-intensive industries.

In the short run, CO2 emissions exhibit a degree of persistence, with lagged values (D(CO2P(-1)) = 0.372, $p < 0.01$; D(CO2P(-2)) = 0.452, $p < 0.01$) showing significant positive effects. Renewable energy consumption continues to exert a significant negative effect (-0.462, $p < 0.01$), reinforcing its role in curbing emissions. Fossil fuel consumption has an immediate positive impact (0.859, $p < 0.01$), but its lagged effect at the second difference turns negative (-0.329, $p < 0.01$), suggesting possible adjustments in energy policies or efficiency gains over time. Financial development initially reduces CO2 emissions (-0.238, $p < 0.01$), but its lagged effect turns positive (0.576, $p < 0.01$), indicating complex financial-environmental dynamics. Government expenditure follows a similar pattern, with an initial negative effect (-1.142, $p < 0.01$) but positive lagged impacts (2.621, $p < 0.01$ and 1.174, $p < 0.01$), potentially reflecting delayed policy effectiveness. The exchange rate's direct impact remains negative (-0.208, $p < 0.01$), but its lagged coefficient (0.431, $p < 0.01$) suggests exchange rate fluctuations influence environmental policies differently over time.

The error correction term (ECT) is highly significant (-0.721, $p < 0.01$), indicating a strong adjustment mechanism that corrects deviations from long-run equilibrium at a high speed of 72.1% per period.

Diagnostic tests confirm the model's robustness. The adjusted R-squared value (0.952) suggests a strong explanatory power. The Durbin-Watson statistic (2.671) indicates no significant autocorrelation. Normality and heteroskedasticity tests confirm the absence of major specification issues. The Ramsey RESET test suggests the functional form is correctly specified, and the Breusch-Godfrey test finds no evidence of serial correlation.

Overall, these findings underscore the critical role of transitioning to renewable energy and enhancing financial development to mitigate CO2 emissions. Government policies must balance immediate and lagged effects to achieve long-term environmental sustainability.

Modified Table 6. Estimated ARDL(3,1,3,2,3,2) For The CO2 Emission Model: The Short And Long-Run Results

Variable	**Coefficient (Long-run results)**	**Std. Error**	**t-Statistic**	**Prob.**
REC	-0.229**	0.079	-2.607	0.031
ENERGYNON-RENEWABLE	0.642*	0.152	4.562	0.002
FD	-1.298*	0.256	-5.412	0.001
GOV	-6.487*	1.198	-5.714	0.001
EXR	-0.574**	0.215	-2.698	0.027
C	13.542*	2.612	5.183	0.001

Short-run results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CO2P(-1))	0.372*	0.091	4.479	0.002
D(CO2P(-2))	0.452*	0.082	5.729	0.000
D(REC)	-0.462*	0.045	-10.689	0.000
D(ENERGYNON-RENEWABLE)	0.859*	0.068	12.485	0.000
D(ENERGYNON-RENEWABLE(-1))	0.009	0.071	0.091	0.935

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

D(ENERGYNON-RENEWABLE(-2))	-0.329*	0.078	-4.398	0.002
D(FD)	-0.238*	0.061	-3.942	0.004
D(FD(-1))	0.576*	0.089	6.821	0.000
D(GOV)	-1.142*	0.279	-4.157	0.003
D(GOV(-1))	2.621*	0.381	6.873	0.000
D(GOV(-2))	1.174*	0.349	3.489	0.008
D(EXR)	-0.208*	0.047	-4.704	0.002
D(EXR(-1))	0.431*	0.050	8.829	0.000
ECT(-1)	-0.721*	0.087	-8.712	0.000

Diagnostic Tests

Test	Statistic	Value	Prob.
Adjusted R-Squared	0.952		
Durbin-Watson stat	2.671		
Normality (Jarque-Bera)	1.628	0.432	
Heteroskedasticity (Breusch-Pagan)	0.551	0.609	
Functional Form (Ramsey)	2.298	0.182	
Serial Correlation (Breusch-Godfrey)	1.361	0.327	

Note: significant at the level of *= 1%, **=5% & ***=10%.

Conclusion

This study explored two key issues within the New Zealand context over the period 1992–2022. First, it analyzed the effects of renewable and nonrenewable energy consumption, foreign direct investment (FDI), governance, and natural resource rents on real gross domestic product (GDP). Second, it assessed how renewable and nonrenewable energy consumption, financial development, governance, and the real effective exchange rate influence CO_2 emissions. To achieve these objectives, the study employed the autoregressive distributed lag (ARDL) model for estimation.

The findings from the economic growth model reveal several important insights. Firstly, both renewable and nonrenewable energy consumption, along with FDI, have a net positive impact on economic growth. This suggests that FDI contributes to economic expansion, particularly when supported by strong institutional and political governance. Secondly, in the long run, natural resource rents exert a negative effect on economic growth. This outcome highlights the adverse consequences of resource dependency, as excessive reliance on natural resource rents can hinder sustainable economic development by affecting resource extraction processes.

This study aimed to investigate the relationships between economic growth, energy consumption, financial development, government intervention, and exchange rate fluctuations, with a particular focus on their impact on CO_2 emissions. By employing the Autoregressive Distributed Lag (ARDL) model, the analysis sought to determine both the short- and long-term effects of these variables on environmental sustainability. Given the increasing global emphasis on reducing carbon emissions while sustaining

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583

economic growth, this research provides valuable insights into the dynamics at play in shaping a country's environmental and economic policies.

The empirical findings reveal several crucial insights. First, fossil fuel consumption was found to be a significant driver of CO2 emissions in both the short and long run, confirming its detrimental environmental impact. Conversely, renewable energy consumption demonstrated a negative relationship with CO2 emissions, highlighting its role in mitigating environmental degradation. Additionally, financial development exhibited a long-term negative effect on emissions, suggesting that advancements in financial markets may support cleaner energy investments and promote sustainability.

Government intervention emerged as a key determinant, with results indicating that effective policies and regulations significantly reduce carbon emissions. This aligns with the broader literature, emphasizing the role of governance in enforcing environmental policies and fostering green investment. Exchange rate variations also influenced CO2 emissions, demonstrating a mixed effect depending on the economic structure and trade patterns of the country under study.

The implications of these findings are manifold. Policymakers should prioritize the transition to renewable energy sources by providing incentives for green investments and imposing stricter regulations on fossil fuel consumption. Financial institutions should be encouraged to support sustainable projects through green financing mechanisms. Furthermore, governments must play an active role in implementing environmental policies that balance economic growth with sustainability objectives. The significance of exchange rate movements suggests that trade policies should be aligned with environmental objectives to mitigate adverse effects on carbon emissions.

Looking ahead, future research should consider expanding the sample size and incorporating additional variables such as technological innovation, trade openness, and sectoral energy consumption patterns to provide a more detailed understanding of the economic-environment nexus. Moreover, employing alternative econometric techniques, such as panel data analysis, could enhance the robustness of the findings. Investigating the role of specific policy interventions, such as carbon taxes and emission trading systems, would also be a valuable avenue for further exploration.

In conclusion, this study underscores the complex interplay between economic growth, energy consumption, financial development, and environmental sustainability. The findings highlight the urgent need for policy interventions aimed at reducing carbon emissions without compromising economic progress. By promoting renewable energy, enhancing financial support for green projects, and implementing effective government regulations, countries can achieve a sustainable balance between economic development and environmental preservation. Future research should continue exploring these relationships, offering more nuanced policy recommendations to address the pressing global challenge of climate change.

References

Abid, A., Mehmood, U., Tariq, S., & Haq, Z. U. (2022). The effect of technological innovation, FDI, and financial development on CO2 emission: evidence from the G8 countries. Environmental Science and Pollution Research, 1-9.

Acquah, D., Lisek, K., & Jacobzone, S. (2019). The role of evidence informed policy making in delivering on performance: Social investment in New Zealand. OECD Journal on Budgeting, 19(1), 171-197.

Adanma, U. M., & Ogunbiyi, E. O. (2024). The public health benefits of implementing environmental policies: A comprehensive review of recent studies. International Journal of Applied Research in Social Sciences, 6(5), 978-1004.

Ahmad, M. S., Szczepankiewicz, E. I., Yonghong, D., Ullah, F., Ullah, I., & Loopesco, W. E. (2022). Does Chinese foreign direct investment (FDI) stimulate economic growth in Pakistan? An application of the autoregressive distributed lag (ARDL bounds) testing approach. Energies, 15(6), 2050.

An, T. H. T., & Yeh, K. C. (2021). Growth effect of foreign direct investment and financial development: new insights from a threshold approach. Journal of Economics and Development, 23(2), 144-162.

Appiah, M., Gyamfi, B. A., Adebayo, T. S., & Bekun, F. V. (2023). Do financial development, foreign direct investment, and economic growth enhance industrial development? Fresh evidence from Sub-Sahara African countries. Portuguese Economic Journal, 22(2), 203-227.

Bhattacharya, M., Paramati, S. R., Ozturk, I., & Bhattacharya, S. (2016). The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. Applied energy, 162, 733-741.

Bustamante, M., Roy, J., Ospina, D., Achakulwisut, P., Aggarwal, A., Bastos, A., ... & Zscheischler, J. (2023). Ten new insights in climate science 2023. Global Sustainability, 7, e19.

Callister, P., & McLachlan, R. I. (2024). Managing Aotearoa New Zealand's greenhouse gas emissions from aviation. Journal of the Royal Society of New Zealand, 54(4), 412-432.

Cao, J., Law, S. H., Samad, A. R. B. A., Mohamad, W. N. B. W., Wang, J., & Yang, X. (2021). Impact of financial development and technological innovation on the volatility of green growth—evidence from China. Environmental Science and Pollution Research, 28, 48053-48069.

Chen, W., & Lei, Y. (2018). The impacts of renewable energy and technological innovation on environment-energy-growth nexus: New evidence from a panel quantile regression. Renewable energy, 123, 1-14.

Damtoft, J. S., Lukasik, J., Herfort, D., Sorrentino, D., & Gartner, E. M. (2008). Sustainable development and climate change initiatives. Cement and concrete research, 38(2), 115-127.

Elkhatat, A., & Al-Muhtaseb, S. (2024). Climate change and energy security: a comparative analysis of the role of energy policies in advancing environmental sustainability. Energies, 17(13), 3179.

Emara, N., & El Said, A. (2021). Financial inclusion and economic growth: The role of governance in selected MENA countries. International Review of Economics & Finance, 75, 34-54.

Fang, W., Liu, Z., & Putra, A. R. S. (2022). Role of research and development in green economic growth through renewable energy development: empirical evidence from South Asia. Renewable Energy, 194, 1142-1152.

Habiba, U. M. M. E., Xinbang, C., & Anwar, A. (2022). Do green technology innovations, financial development, and renewable energy use help to curb carbon emissions?. Renewable Energy, 193, 1082-1093.

Hasan, M. A., Frame, D. J., Chapman, R., & Archie, K. M. (2019). Emissions from the road transport sector of New Zealand: Key drivers and challenges. Environmental Science and Pollution Research, 26, 23937-23957.

Işık, C., Ongan, S., Islam, H., Jabeen, G., & Pinzon, S. (2024). Is economic growth in East Asia pacific and South Asia ESG factors based and aligned growth?. Sustainable Development.

Khan, I., Han, L., & Khan, H. (2021). Renewable energy consumption and local environmental effects for economic growth and carbon emission: evidence from global income countries. Environmental Science and Pollution Research, 1-18.

Khan, M., & Ozturk, I. (2021). Examining the direct and indirect effects of financial development on CO2 emissions for 88 developing countries. Journal of environmental management, 293, 112812.

Lau, C. K., Mahalik, M. K., Rather, K. N., & Gozgor, G. (2023). The impact of green quality of the energy consumption on carbon emissions in the United States. Economic Analysis and Policy, 80, 850-860.

Li, J., He, W., & Li, G. (2024). Natural resources, economic complexity and growth nexus: Role of digital governance in addressing the resource curse. Resources Policy, 92, 105003.

Mohamed, M. M. A., Liu, P., & Nie, G. (2021). Are technological innovation and foreign direct investment a way to boost economic growth? an egyptian case study using the autoregressive distributed lag (ardl) model. Sustainability, 13(6), 3265.

Mostafaeipour, A., Bidokhti, A., Fakhrzad, M. B., Sadegheih, A., & Mehrjerdi, Y. Z. (2022). A new model for the use of renewable electricity to reduce carbon dioxide emissions. Energy, 238, 121602. Balsalobre-Lorente, D., Luzon, L. I., Usman, M., & Jahanger, A. (2023). The relevance of international tourism and natural resource rents in economic growth: fresh evidence from MINT countries in the digital era. Environmental Science and Pollution Research, 30(34), 81495-81512.

Munir, M. T., Mohaddespour, A., Nasr, A. T., & Carter, S. (2021). Municipal solid waste-to-energy processing for a circular economy in New Zealand. Renewable and Sustainable Energy Reviews, 145, 111080.

Naser, M. M., & Pearce, P. (2022). Evolution of the International Climate Change Policy and Processes: UNFCCC to Paris Agreement. In Oxford Research Encyclopedia of Environmental Science.

Park, D., & Ridley, W. (2024). How do exchange rates affect environmental quality?. Canadian Journal of Economics/Revue canadienne d'économique.

Poddar, A. K. (2024). Climate Change and Migration: Developing Policies to Address the Growing Challenge of Climate-Induced Displacement. International Journal of Climate Change: Impacts & Responses, 16(1).

Rahman, M. M., & Alam, K. (2021). Exploring the driving factors of economic growth in the world's largest economies. Heliyon, 7(5).

Ridzuan, A. R., Kumaran, V. V., Fianto, B. A., Shaari, M. S., Esquivias, M. A., & Albani, A. (2022). Reinvestigating the presence of environmental kuznets curve in Malaysia: The role of foreign direct investment. International Journal of Energy Economics and Policy, 12(5), 217-225.

Saidi, K., & Rahman, M. M. (2021). The link between environmental quality, economic growth, and energy use: new evidence from five OPEC countries. Environment Systems and Decisions, 41, 3-20.

Semmelmayer, P. (2020). The climate change response (zero carbon) amendment act-a critical analysis of New Zealand's response to climate change. NZJ Envtl. L., 24, 157.

Shahbaz, M., Song, M., Ahmad, S., & Vo, X. V. (2022). Does economic growth stimulate energy consumption? The role of human capital and R&D expenditures in China. Energy Economics, 105, 105662.

Shamsuddoha, M., Kashem, M. A., & Nasir, T. (2025). A Review of Transportation 5.0: Advancing Sustainable Mobility Through Intelligent Technology and Renewable Energy. Future Transportation, 5(1), 8.

Volume: 4, No: 2, pp. 1916 – 1931
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6583
Shobande, O. A., Ogbeifun, L., & Tiwari, A. K. (2024). Extricating the impacts of emissions trading system and energy transition on carbon intensity. Applied Energy, 357, 122461.
Solaymani, S., Villamor, G., Dunningham, A., & Hall, P. (2023). The relationship between energy and non-energy factors and CO2 emissions in New Zealand. Environmental Science and Pollution Research, 30(47), 104270-104283.
Tajudeen, I. A., Wossink, A., & Banerjee, P. (2018). How significant is energy efficiency to mitigate CO2 emissions? Evidence from OECD countries. Energy Economics, 72, 200-221.
Weili, L., Khan, H., Khan, I., & Han, L. (2022). The impact of information and communication technology, financial development, and energy consumption on carbon dioxide emission: evidence from the Belt and Road countries. Environmental Science and Pollution Research, 1-16.
Wen, L., Guang, F., & Sharp, B. (2021). Dynamics in Aotearoa New Zealand's energy consumption between 2006/2007 and 2012/2013. Energy, 225, 120186.
Xu, B., & Lin, B. (2016). Differences in regional emissions in China's transport sector: determinants and reduction strategies. Energy, 95, 459-470.
Yan, H., Qamruzzaman, M., & Kor, S. (2023). Nexus between green investment, fiscal policy, environmental tax, energy price, natural resources, and clean energy—a step towards sustainable development by fostering clean energy inclusion. Sustainability, 15(18), 13591.
Yang, L., & Ni, M. (2022). Is financial development beneficial to improve the efficiency of green development? Evidence from the "Belt and Road" countries. Energy Economics, 105, 105734.
Zhang, C., Waris, U., Qian, L., Irfan, M., & Rehman, M. A. (2024). Unleashing the dynamic linkages among natural resources, economic complexity, and sustainable economic growth: Evidence from G-20 countries. Sustainable Development.
Zhao, Y., Su, Q., Li, B., Zhang, Y., Wang, X., Zhao, H., & Guo, S. (2022). Have those countries declaring "zero carbon" or "carbon neutral" climate goals achieved carbon emissions-economic growth decoupling?. Journal of Cleaner Production, 363, 132450.
Zheng, X., Streimikiene, D., Balezentis, T., Mardani, A., Cavallaro, F., & Liao, H. (2019). A review of greenhouse gas emission profiles, dynamics, and climate change mitigation efforts across the key climate change players. Journal of Cleaner Production, 234, 1113-1133.