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NEXUS RELATIONSHIP BETWEEN ENVIRONMENTAL QUALITY, FINANCIAL DEVELOPMENT, AND ECONOMIC GROWTH IN JORDAN

Mohamed Khudari1, Bilal Almarafi 2, Azlina Abdullah3,
1College of Graduate Studies, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, 43000, Kajang, Selangor, MALAYSIA
2College of Graduate Studies, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, 43000, Kajang, Selangor, MALAYSIA
3 UNITEN Business School, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, 43000, Kajang, Selangor, MALAYSIA

Abstract
This study utilizes the Autoregressive Distributed Lag (ARDL) methodology to dynamically investigate the complex association between economic growth, its determinants, and environmental quality in Jordan. It focuses on the intricate relationship between the country's goals of economic progress and the imperative of environmental preservation, the comprehensive analysis encompasses key economic indicators such as GDP, investment, exports, population growth, and energy consumption, utilizing long-term time series data to assess their influence on economic growth. Additionally, environmental quality indicators, including carbon dioxide emissions, air pollution levels, and water quality, are incorporated to unravel their relationships with economic growth, The ARDL technique enables the examination of both short-term and long-term dynamics between these variables, providing valuable insights into the causal relationships between economic growth and environmental quality. This study significantly contributes to our understanding of economic growth in Jordan and its associated environmental consequences, Policymakers can derive insights to inform sustainable development activities, aiding in the crafting of legislation and strategies tailored to promote ecologically responsible economic growth, minimize environmental damage, and enhance overall population well-being in Jordan. The empirical evidence underscores the detrimental impact of carbon dioxide emissions (CO2) on GDP growth, emphasizing the urgency of addressing environmental issues for sustained economic growth.

This research underscores the importance of implementing targeted policies that effectively balance economic growth and environmental conservation to secure Jordan's long-term viability and prosperity
Keywords: Economic Growth; Environmental quality; Financial Development

Introduction

The study on the nexus relationship between environmental quality, financial development, and economic growth in Jordan is crucial for informing policy decisions, guiding sustainable development strategies, and fostering a balanced approach to economic progress. It addresses the interconnections between environmental conservation, financial practices, and long-term

economic viability, offering insights that can benefit policymakers, financial institutions, investors, and the general public. Additionally, the research contributes to the global discourse on sustainable development and environmental indices, potentially influencing international comparisons and rankings. Overall, the study's significance lies in its potential to shape responsible practices, raise public awareness, and contribute to the holistic well-being of Jordan, The study addresses a critical gap in understanding the intricate relationship between environmental quality, financial development, and economic growth in Jordan. This gap poses a challenge as it hinders the formulation of well-informed policies and strategies that can harmonize economic progress with environmental preservation. The absence of comprehensive insights into how financial development influences environmental quality and, in turn, impacts economic growth creates a knowledge deficit that this research seeks to address. By identifying and elucidating this gap, the study aims to contribute valuable information that can guide decision-makers and stakeholders in fostering sustainable development practices in Jordan.

The term "environmental performance" has gained widespread acceptance among environmental professionals, economists, policy analysts, and decision-makers, reflecting the growing concern for sustainable development (Neagu et al., 2017). According to Abbass et al. (2022), climate change plays a pivotal role in the realm of environmental sustainability. To measure and evaluate global environmental performance, scholars from Yale and Columbia Universities have collaboratively developed the Environmental Performance Index (EPI) since 2006. This index serves as a comprehensive tool for assessing environ-mental performance worldwide, offering valuable insights for decision-making and the formulation of effective policies (Szymczyk et al., 2021).

The Environmental Performance Indicator (EPI) serves as a comprehensive measure evaluating the effectiveness of environmental policies in achieving dual objectives: the preservation of ecological vitality and the protection of human health (Zomer, 2014). This composite index incorporates metrics that delineate environmental constraints, emphasize efficiency in resource utilization, and shed light on the economic impact on the environment (Loiseau et al., 2016). The adept and optimal utilization of natural resources is crucial for achieving sustainable economic development (Szymczyk et al., 2021).

Consequently, the nexus between environmental quality and economic development holds significant importance for policymakers and scholars globally. Recognizing the interplay between these factors is essential for formulating informed policies and strategies that promote both economic prosperity and environmental sustainability.

A pollution-free environment conducive to good health significantly enhances living conditions, creating a positive impact on overall well-being. Conversely, a population in good health can act as a catalyst for economic development, contributing to a nation's overall prosperity. The works of Chunyu et al. (2021) and Olimpia and Teodora (2021) robustly establish the interconnectedness of financial development, energy consumption, economic prosperity, and environmental conditions.

In the early 21st century, a noticeable surge in the global movement of commodities, financial resources, and services has reshaped the world profoundly. Trade, a subject extensively researched across various academic disciplines, has become a focal point of analysis. Globalization, often considered a driver of worldwide economic growth and in-creased productivity, has shown promise in reducing poverty rates. The heightened commercial activity associated with globalization is anticipated to stimulate information dissemination and the adoption of new technologies, thereby contributing to economic expansion (Raghutla, 2020; Gabriel & David, 2021).

The increased level of competitiveness in both domestic and international markets has resulted in enhanced production methods (Kong et al., 2021). Trade liberalization is widely recognized as a catalyst for economic growth, resulting in heightened energy consumption (Saleem & Shabbir, 2020). These phenomena can be observed in the shifting global trade patterns, patterns of oil consumption, and the overall economic development on a global scale. Examining the interconnections between the different elements associated with this evolutionary process is crucial and among these variables is environmental quality and its impact on economic growth both short-term and long-term.

The global demand for oil Impacts the external and internal trade of Jordan. The evaluation of economic development, market openness, and the movement of goods and services is heavily reliant on international trade. The correlation between economic expansion and the growth of the financial sector is notably significant in developing countries throughout the initial phases of their economic development trajectory.

There has been a notable increase in energy usage in recent years, facilitated by government-funded initiatives such as tax incentives and financial support. Cost competition has played a significant role in driving down the expenses associated with energy production. Adam Smith, a renowned economist of the 18th century, introduced the value dilemma concept, often referred to as the diamond vs. water paradox. The availability of clean water is a prerequisite for achieving economic progress.

The production cost of water is significantly lower compared to that of diamonds. Due to the essentiality of water for sustaining life, the issue of water pollution has emerged as a critical environmental matter. Environmental degradation and global warming are two significant and contentious worldwide challenges in recent years. Since the onset of the Industrial Revolution, nations have been diligently striving to achieve optimal levels of economic growth.

The competition has significantly increased Greenhouse Gases (GHGs), including CO2 emissions, which contribute to global warming and ozone depletion (Acheampong, 2019). The observable consequences of environmental degradation, climate change, and global warming include alterations in rainfall patterns, heightened storm strength, more extraordinary extreme weather events, and a continual rise in sea levels. The alterations above significantly impact the effective functioning of ecosystems, the survival of human beings, and the sustainability of forests.

Implementing government initiatives, such as tax refunds and subsidies, has resulted in a notable rise in energy consumption. This surge may be attributed to the affordability and competitiveness

of energy production, which has enabled it to rival conventional energy sources in several regions, including Europe, Africa, Latin America, the United States, and Asia. These initiatives have facilitated the expansion of the energy consumption technology installation and manufacturing sector, with significant investments documented, such as USD 100 billion in 2007, to enhance manufacturing facilities, capacity, and research and development. Out of this amount, USD 71 billion was allocated specifically for developing new energy consumption capabilities, as reported by the US Electricity Planning Network (Pinkse & Van den Buuse, 2012). Energy facilitates economic operations, promotes infrastructure growth, and significantly contributes to societal and economic advancements.

Nevertheless, the energy crisis in Jordan is further aggravated due to its significant dependence on imports. Approximately 97% of its energy is acquired from foreign sources, predominantly crude oil, petroleum products, and natural gas (Shahateet et al., 2021). The nation's economy is vulnerable to external energy supply disruptions and fluctuations in oil prices due to its reliance on limited local energy sources, which affects commerce and economic growth. The utilization of clean energy technologies, such as solar, wind, geothermal, tidal, biomass, and others, has been motivated by the depletion of readily available energy resources and the pressing necessity to address global warming by decreasing greenhouse gas emissions. This adoption of clean energy technologies aims to alleviate environmental harm while fostering economic growth (UNEP, 2011). The imperative of addressing climate change and mitigating reliance on fossil fuels cannot be overstated, as neglecting these actions may result in dire environmental disasters (Shahbaz et al., 2020). Green energy programmers have a dual benefit by presenting a viable alternative to carbon-intensive energy sources and generating employment prospects within the clean energy industry.

The significance of financial development in fostering economic growth cannot be overstated since it provides investment possibilities to low-income households and promotes entrepreneurial activities. Nevertheless, expanding economies in numerous developing nations have resulted in a notable rise in carbon dioxide (CO2) emissions, engendering worldwide apprehension. Rising countries in Sub-Saharan Africa, Latin America, Asia, the Middle East, and China have substantially contributed to the overall CO2 emissions (CGD, 2022). Therefore, prioritizing mitigation to mitigate carbon emissions is crucial, especially in regions such as Africa. The worldwide issue of climate change needs community effort to address the environmental degradation caused by excessive greenhouse gas emissions, particularly carbon dioxide (CO2). Furthermore, the exacerbation of atmospheric pollution, propelled by the expansion of population, improvements in technology, and the aspiration for improved quality of life in numerous nations, has resulted in detrimental shifts in weather patterns, loss of the ozone layer, and economic ramifications. Water quality issues, sometimes overshadowed by concerns over water quantity, impact both affluent and less economically privileged nations.

These challenges are characterized by an increase consistent with GDP growth. Even with these challenges, the Jordanian economy faces a slow pace of expansion, which hinders progress on economic and social issues (Al-Shehadeh et al., 2022). Therefore, the main objective of this study is to comprehensively examine the direct and long-term impacts of environmental quality and financial development on economic progress in Jordan.

This will be achieved by using time series data from 1990 to 2022 and using various statistical techniques, including cointegration analysis, error correction modeling, and Granger causality tests. This study aims to provide policy recommendations aimed at improving environmental quality, financial development, and overall economic growth in the specific context of Jordan.

2. Scope of study

This research delves into the intricate dynamics between economic growth, environmental quality, and various macroeconomic factors specific to the context of Jordan. The analytical framework employed is the Autoregressive Distributed Lag (ARDL) approach, chosen for its robustness in capturing both short-term and long-term relationships. The geographical scope of the study is confined to the physical boundaries of Jordan, while the temporal scope spans the previous three decades, allowing for a comprehensive analysis of subtle shifts and developments.

It is crucial to acknowledge the inherent limitations of the research process. The study is constrained by its geographical focus on Jordan and the selected time frame. Additionally, the accuracy of the findings depends on the quality and availability of data for the variables under consideration, despite these limitations, the study aspires to provide valuable insights for stakeholders, policy-makers, and academics in Jordan. The research is not only sectorial but also policy-oriented, aiming to inform evidence-based decision-making. By contributing to academic scholarship and offering practical recommendations, the study seeks to play a significant role in shaping policies that promote sustainable economic development in Jordan.

3. Review of Literature

Environmental quality and Economic Growth

The natural environment plays a crucial role in our economy as a direct input in production and providing various services. Minerals and fossil fuels play a crucial role in facilitating the production of products and services. Additional environmental services that support economic activity encompass carbon sequestration, filtering of air and water pollution, mitigation of flood risks, and the formation of soil. Additionally, it is vital for our overall welfare as it offers recreational prospects, enhances physical well-being, and encompasses various other benefits (Everett et al., 2010). Economic growth is pivotal in fostering the well-being and vitality of the economy and its populace, including developed nations and emerging economies. According to Akbar and Mahdi (2023), there is a notable encouragement of technological advances necessary for decoupling consumption and production from their The existing body of literature encompasses

a substantial amount of research investigating the extent to which financial development, environmental quality influence economic growth.

However, the empirical literature presents conflicting results. Nevertheless, the existing body of study has yet to extensively investigate the interrelationships between financial development, environment quality, and economic expansion. This study aims to provide further insight into the correlation between environment quality, financial development, and economic growth in industrialized and developing economies, considering their importance as energy users. The primary objective of this study is to examine the inter-connections between environment quality and financial development about the phenomenon of economic growth.

Environmental consequences, Moreover, it substantially promotes several aspects that enhance well-being, such as improvements in healthcare, education, and overall quality of life (Everett et al., 2010).

3.2 Economic Growth, its Determinants and Environmental Quality in Group Countries

Khan et al. (2021) analyzed energy transitions, consumption patterns, and the relationship with sustainable economic growth across 38 International Energy Agency (IEA) member countries in their study. The researchers employed econometric techniques to investigate these dynamics. The research revealed that economic sustainability influences economic growth in the short- and long-term. Conversely, energy transitions mainly impact economic growth in the long run, negatively affecting host nations' growth. The favorable impact of renewable and non-renewable energy consumption, labor, and capital on economic growth is evident. The report proposes that policymakers in countries belonging to the International Energy Agency (IEA) should take specific actions to achieve sustainable development. These actions include establishing carbon pricing and taxation, promoting the commercialization of low-CO2-emission technologies, reducing subsidies on non-renewable energy sources, implementing technology transfer programs, and formulating a green trade policy.

The study conducted by Salari et al. (2021) investigated the correlation between carbon dioxide (CO2) emissions, energy consumption, and gross domestic product (GDP) at the state level in the United States during the period spanning from 1997 to 2016. The study included static and dynamic models to quantify the impact of different energy consumption patterns on CO2 emissions in different states. The study revealed that the use of renewable energy sources leads to a reduction in carbon dioxide emissions. However, it also observed a concurrent increase in overall consumption of non-renewable energy, particularly in the industrial and residential sectors. Both static and dynamic models have shown a long-term correlation between energy consumption at the state level and CO2 emissions, as well as a curvilinear link between GDP and CO2 emissions. The analysis provides empirical evidence favoring the Environmental Kuznets Curve (EKC) hypothesis across all states. Furthermore, both static and dynamic models yield robust findings.

In their research, Ivanovski et al. (2021) conducted a study to examine the influence of renewable and non-renewable energy sources on the economic growth of OECD nations from 1990 to 2015. The authors employed a parameter-free modeling technique, LLDVE, to analyze the data and draw

conclusions. The results of their study indicate that the utilization of non-renewable energy sources contributes to the advancement of economic growth in all member countries of the Organization for Economic Co-operation and Development (OECD), with the coefficient function exhibiting a positive trend with time. Nevertheless, renewable energy's impact on these nations' economic development was statistically insignificant over most of the time frame. The study additionally posits that using renewable and non-renewable energy contributes to the economy's advancement in non-OECD countries. However, it highlights that growing nations can encounter technological constraints while shifting to renewable energy sources.

The study conducted by Pillo et al. (2017) examined the levels of CO2 emissions in the business turnover of 236 enterprises in Italy. The analysis spanned six years, specifically from 2008 to 2013. The study's results indicated that the energy sector exhibited the poorest performance when considering CO2 emissions adjusted for business turnover, operational efficiency, company profitability, financial viability, and corporate liquidity. This finding suggests a favorable correlation between environmental and economic-financial performance, as enterprises exhibiting superior environmental quality tended to demonstrate more robust financial performance.

The study by Salari et al. (2021) examined the correlation between CO2 emissions at the state level, energy consumption within the United States, and GDP from 1997 to 2016. The study's findings revealed a strong correlation between state-level energy consumption and CO2 emissions, as demonstrated by the results obtained from static and dynamic models. The study's results also indicated a notable and adverse correlation between the utilization of renewable energy and the emission of CO2, implying that the expansion of renewable energy resources may contribute to reducing CO2 emissions. The findings above underscore the need to include GDP and energy consumption in policy development to address climate change. The studies examined in this part highlight the significance of environmental performance and sustainability concerning attaining economic growth and development in industrialized nations. According to Khan et al. (2021), policymakers in countries belonging to the International Energy Agency (IEA) should prioritize several key measures to promote sustainable development effectively. These measures include addressing carbon costs and taxes, facilitating the commercialization of low-CO2 emissions technologies, reducing subsidies for non-renewable energy sources, implementing technology transfer programs, and formulating a green trade policy.

Salari et al. (2021) and Pillo et al. (2017) have established a positive association between economic-financial performance and environmental quality. Specifically, they have found that businesses and industries tend to have enhanced financial performance when they exhibit superior environmental performance. Additionally, they underscore the significance of incorporating considerations of carbon dioxide emissions and energy consumption into developing strategies to mitigate climate change. Ivanovski et al. (2021) emphasize the imperative of transitioning towards renewable energy sources. Based on the findings of various studies, the environment, financial development, and economic growth in developing countries are subject to critical observations. Notably, the utilization of renewable energy sources and the implementation of energy efficiency measures have the potential to effectively mitigate CO2 emissions and facilitate the attainment of

sustainable economic growth. However, it is essential to note that their immediate impact on short-term growth is inconsequential. Financial growth has intricate and perhaps paradoxical ramifications, as it can facilitate the adoption of renewable energy sources while simultaneously exacerbating emissions and environmental consequences. However, the extent to which these outcomes manifest depends on the specific country and temporal context. There is often a requirement for the implementation of more sustainable financial arrangements.

Conventional drivers of economic growth, such as energy consumption, trade, and investment, typically contribute to both short-term and long-term economic expansion. However, it is essential to note that these drivers can also lead to increased carbon dioxide (CO2) emissions and have adverse environmental consequences. Globalization, particularly in terms of economic and social aspects, has been observed to have a propensity for augmenting energy consumption and carbon dioxide (CO2) emissions. However, its impact on economic growth still needs to be conclusive. Political globalization has the potential to contribute to the moderation of energy usage.

Developing nations necessitate implementing various policy measures to transition towards a greater reliance on renewable energy sources and enhance energy efficiency. These measures include adopting carbon pricing mechanisms, reforming subsidies for fossil fuel consumption, and providing incentives for green financing initiatives. This approach has the potential to reconcile the objectives of economic growth and environ-mental sustainability effectively. Technological advancements and innovation will enable developing nations to harness the environmental and economic advantages of shifting towards renewable energy sources and sustainable development. In brief, using renewable energy sources and establishing sustainable finance systems hold promise in mitigating emissions and fostering economic quality in developing nations. However, to achieve these advantages and maintain a harmonious equilibrium between economic and environmental sustainability objectives, it will be imperative to implement efficient regulations and allocate resources towards the development and use of green technology.

Furthermore, this study investigates the interplay among carbon emissions, industrialization, energy intensity, and economic growth in Uganda spanning the years 1990 to 2014. Applying the bound test techniques of Autoregressive Distributed Lag (ARDL), Appiah, Du, Yeboah, & Appiah (2019) find that, in the long run, industrialization and GDP growth contribute to an increase in carbon emissions, indicating a positive relationship between GDP and carbon emissions. This aligns with the findings of Charfeddine & Khediri (2015) for the UAE. However, the study reveals that the escalation of energy intensity leads to a decline in carbon emissions. The combined impact of economic growth, industrialization, and energy intensity consistently reduces carbon emissions in Uganda, suggesting a need to intensify energy usage for long-term emissions mitigation.

In addition, the study extends its analysis to Pakistan, covering the period 1990 to 2014, with a focus on the impact of income and energy on carbon emissions. Utilizing the multiple linear regression estimation method and ordinary least square approach, Sasana & Aminata (2019) find that income, energy use, and population growth positively affect carbon emissions. Conversely, renewable energy use has a negative impact on carbon emissions, and globalization demonstrates

a negligible influence. In Indonesia, the study challenges the Environmental Kuznets Curve (EKC) hypothesis, as the positive association between economic growth and carbon emissions aligns with the findings of Alam, Murad, Hanifa, & Ozturk (2016) for China and India.

Similarly, the research explores the relationship between electricity use, economic growth, and carbon emissions in Cameroon spanning the years 1971 to 2014. Njoke, Wu, & Tamba (2019) employ the ARDL bound test approach and the Toda and Yamamoto causality test, aiming to elucidate the dynamics between these variables.

3.3 Economic Growth, its Determinants and Environmental Quality in Group Countries

Numerous studies have examined the links between environmental conditions and economic growth in collective nations. As per Aslan et al. (2021), it has been observed that the expansion of the banking sector has a diminishing effect on energy consumption in G-7 nations, but conversely, it leads to an increase in energy consumption in emerging market economies. Arvin et al. (2021) examined the interrelationships between environmental and economic growth determinants in the G-20 countries in the short and long term. Their findings revealed a multitude of temporal correlations among the variables under investigation. The primary policy relevance of these findings is the necessity for improved co-development and harmonization of information and communication technology (ICT) policies, foreign direct investment (FDI), and trade openness. Such measures are crucial for fostering sustained economic growth within this particular group of countries. Public policymakers should also evaluate short-term recoverable linkages.

Mitic et al. (2022) emphasize the critical importance of promoting the development of new, strategic, low-carbon businesses, with a specific focus on sectors like new and renewable energy. They underscore that significant investments are essential to support the growth of the renewable energy sector, especially given the aging infrastructure in many regions. Policies that encourage the generation and utilization of clean energy play a pivotal role in directly reducing carbon dioxide emissions.

The research and studies conducted aim to provide valuable insights for policymakers in developing nations, such as Jordan, to facilitate a transition towards sustainable energy practices and the reduction of carbon dioxide emissions. Particularly in Southern European countries, taking proactive measures to control greenhouse gas emissions becomes a crucial step towards a greener and more prosperous future.

Water quality encompasses various aspects, including physical, chemical, biological, and organoleptic characteristics, with considerations for taste-related properties. This multidimensional understanding contributes to an overall assessment of water quality. Noori et al. (2019) propose a utilization-based categorization of water bodies, linking their properties to photochemical, biological, and salinity characteristics.

In Jordan, addressing water scarcity and reducing poverty rates has become a priority. The government is actively working to provide clean water and improve sanitation infrastructure. However, challenges persist due to the aftermath of the refugee crisis, with over 750,000 refugees from diverse backgrounds residing in Jordan. This influx has in-creased the population by 2.2%,

reaching over 10.5 million by the beginning of 2020. De-spite the strain on resources; there is a heightened demand for public services, particularly in water usage, emphasizing the need for sustainable management (National Strategy for Green Growth, 2021–2025; Davis et al., 2022).

Beyond its essential role in sustaining life, the blue environment, akin to green spaces, has demonstrated positive effects on human health. This includes potential benefits such as reducing exposure to environmental hazards and promoting well-being through the calming sounds of water. Studies, including those by White et al. (2020), highlight how proximity to water bodies can inspire physical activity, reduce stress, and enhance con-centration. Recent research, represented by studies like those by Crouse et al. (2018), Elliott et al. (2020), and Georgiou et al. (2021), indicates that living near water has preventative health effects and increases the frequency of outdoor activities. Proximity to the nearest body of water is utilized as a proxy for exposure in these studies.

Jin et al. (2022) investigated the connection between renewable and nonrenewable energy consumption, economic growth, and carbon emissions in the top 28 countries that account for most global carbon emissions. The study discovered a two-way causal relationship between carbon emissions and economic growth in all economies. According to the study, there is no discernible link between economic growth and energy use in developing nations. Unlike developing nations, developed nations show a two-way causal relationship between economic growth and renewable and non-renewable energy usage. Additionally, all economies demonstrated a bidirectional causal relationship between renewable energy and carbon emissions, with apparent differences between industrialized and developing countries. Based on a nation's level of development, the study's conclusions can guide the creation of specific energy and economic policy approaches.

Data Sources And Methodology

Will focus on examining the interplay between economic growth, financial development, and environmental quality within the Jordanian context, The chosen timeframe, spanning from 1990 to 2022, holds critical significance as it encapsulates a substantial period marked by various economic, social, and environmental changes. Investigating this extensive temporal scope will provide valuable insights into the evolution and determinants of Jordan's economic landscape.

In particular, the research will scrutinize the relationship between economic growth and financial development, seeking to elucidate how these factors have influenced and shaped Jordan's economic trajectory. Additionally, the study will incorporate an environmental dimension by analyzing the impact of economic activities on carbon dioxide emissions and water quality.

The study's data will come from various places, including the World Bank Development Database (WDI, 2021) and the Central Bank of Jordan (CBJ). These databases provide extensive and trustworthy data on various economic variables, and as such, they are widely utilized and respected in economics.

The research methodology of this study involves the utilization unit root test and utilization of two widely recognized tests—the Augmented Dickey-Fuller (ADF) test and the Phillips-Peron test. These tests, initially introduced by Dickey and Fuller in 1979, are instrumental in assessing the stationary of the underlying stochastic processes within the dataset and an in-depth examination of the relationship between long-term and short-run cointegration is undertaken through the

application of an Autoregressive Distributed Lag (ARDL) testing approach. The theoretical foundations of this methodology are grounded in the works of Pesaran and Pesaran (1997), Pesaran and Shin (1999), and Pesaran et al. (2001). These scholars assert the superiority of the ARDL approach over alternative methodologies, and the study builds upon this robust foundation and using many economic methodologies

Empirical Model

The research framework for "Dynamic Linkages between Economic Growth, Environ-mental Quality, and Related Macroeconomic Variables in Jordan: An ARDL Approach" entails an investigation to understand the complex interplay between economic growth, environmental quality, and various macroeconomic factors within the specific context of Jordan. It encompasses a comprehensive literature review, the development of a theoretical framework, data collection, the application of the ARDL methodology to analyze relationships, and the formulation of hypotheses to be tested. The study seeks to shed light on the long-term and short-term dynamics among these variables and discern their policy implications, ultimately contributing to a better understanding of the sustainability challenges and opportunities faced by the Jordanian economy. Therefor To achieve the study objectives, we use the following model

$$LNGDP_t = \theta_0 + \vartheta_1 LNCO_{2t} + \vartheta_2 LNFD_t + \vartheta_3 LNWQI_t + \varepsilon_t \quad (1)$$

5. Findings and Discussion

5.1 Descriptive Results

Based on the data presented in Table 1, it is evident that the average value of LNCO2 is 1.03, with a corresponding standard deviation of 0.2. The average value of LNFD is 3.02, with a standard deviation of 0.79. The average yearly percentage growth of GDP is 1.22, with a standard deviation of 0.72.

5.2 Correlation Analysis

The researcher employs the Pearson Correlation Coefficient as a statistical metric to assess the relationships between the study variables. The Pearson correlation coefficient measures the strength and direction of the linear relationship between two variables. A negative correlation is indicated by a coefficient with a negative sign, suggesting an inverse relationship between the variables. Conversely, a positive correlation is indicated by a coefficient with a positive sign, suggesting a direct relationship between the variables. The range of 0.1–0.4 signifies a weak correlation, while 0.4–0.7 denotes a moderate correlation, and a range of 0.7–1 shows a significant connection.

Based on the data shown in the previous table, many noteworthy relationships have been identified. First and foremost, it is essential to highlight that there is no significant link between LNFD and the yearly GDP growth rate (p-value = 0.7679 > 0.05). On the other hand, a statistically significant association exists between the logarithm of carbon dioxide emissions (LNCO2) and the yearly percentage increase in GDP. This connection is sup-ported by a p-value of 0.0109, below the conventional threshold of 0.05, indicating its importance. The observed correlation exhibits a moderate positive association, as evidenced by the Pearson correlation value of 0.438, which falls

within the established range of 0.4 to 0.7. In the specific context of Jordan, it may be inferred that a positive correlation exists between higher levels of carbon dioxide emissions and enhanced economic growth. This discovery highlights the significance of simultaneously tackling environmental issues related to increased emissions and promoting economic growth. Moreover, a notable association may be observed between the Water Quality Index (LNWQI) and the annual percentage of GDP growth. This relationship is supported by a p-value of 0.0008, which falls below the conventional significance threshold of 0.05. The observed correlation demonstrates a moderate negative relationship, as indicated by a Pearson correlation coefficient of -0.555, falling within the range of -0.4 to -0.7. This suggests that improvements in water quality are linked to decreased economic growth. The result mentioned above raises concerns about the potential trade-offs that may arise when balancing environmental improvements and economic growth within the specific context of Jordan.

5.3 Stationary

The researcher assessed the stationary assumption using the Augmented Dickey-Fuller (ADF) test. In order to ensure accuracy, it is necessary to assume stationary while employing time series models. The null hypothesis posits that there is an absence of stationary, while the alternative hypothesis suggests the presence of stationary. Stationary or absence can be determined by researchers based on the P-value, which is often set at a significance level of less than 0.05. Variables can exhibit stationary at different levels, namely at the level, first difference, or second difference.

The examination of stationarity yields noteworthy results on the variables being examined. The variable LNCO2 demonstrates stationarity following a first-order differencing transformation, as evidenced by a p-value of 0.0038, which falls below the standard significance threshold of 0.05. In a similar vein, it can be shown that the variable LNFD exhibits stationarity after undergoing initial differencing, as evidenced by a notably significant p-value of 0.0001. On the other hand, it can be observed that the variable representing the annual percentage growth of GDP remains stable at its initial level, as evidenced by a p-value of 0.0005. This finding further supports the notion that GDP growth is consistent and unchanging. Finally, it can be shown that the variable LNWQI achieves stationarity upon the application of a first difference, as evidenced by a highly significant p-value of 0.0001.

The importance of these findings on stationarity resides in their implications for the selection of modeling methodology. The Auto-Regressive Distributed Lag (ARDL) model is deemed suitable for evaluating the influence of independent factors on the dependent variable. Establishing stationarity is a fundamental step in analyzing time series data since it is vital in ensuring the dependability and precision of the following modelling techniques, such as the ARDL method. By conducting stationarity tests to verify the stability of LNCO2, LNFD, LNRGDP, and LNWQI over time, we can establish a high level of trust in the resilience and reliability of our modelling system.

Table 4 shows the lag duration criterion, it is utilizing the Akaike Information Criterion AIC. The lag duration criterion that yields the lowest value of AIC is the most optimal. Based on the data presented in the preceding table, it is evident that the optimal lag length to be incorporated in the model is lag (1), as indicated by the lowest AIC value of -3.1.

The results obtained from the research using the autoregressive distributed lag (ARDL) model are of considerable significance. First and foremost, it is apparent that the variable LNCO2 exerts a substantial and adverse influence on the GDP growth rate. This is supported by a statistically significant p-value of 0.004, indicating that a unit increase in carbon dioxide emissions reduces 4.03 units in GDP growth. This statement underscores the significant correlation between environmental sustainability and economic growth, advocating for implementing environmentally conscious economic strategies. In contrast, the statistical analysis reveals that the impact of LNFD and LNWQI on the GDP growth rate is not significant, as indicated by the p-values of 0.116 and 0.277, respectively. This finding indicates that, within the context of this research, there is no evidence of immediate direct effects of financial development and water quality on economic growth.

The adequacy of the model's fit is evidenced by the adjusted R-squared value of 55.9%, which exceeds the minimum requirement of 50%. This suggests that the independent variables effectively explain 55.9% of the variance in GDP growth, hence strengthening the explanatory capability of the model. In addition, the model's general acceptability is supported by the statistically significant CointEq (-1) or Speed of Adjustment, which exhibits a p-value of 0.0001 and a coefficient of -0.71 in the negative direction. This observation suggests that the model successfully reflects the temporal dynamics of the variables' interaction, hence implying its dependability in evaluating the enduring influence of these factors on economic growth.

5.4 Structural Stability

In this section, the investigator has constructed Cumulative sum (CUSUM) and squared cumulative sum (Squared CUSUM) charts to assess the coherence of the model's framework. When the blue line is contained within the confines established by the two red lines, it indicates that the structural stability is deemed acceptable.

Figure 1. Shows that it is important to highlight that the model demonstrates structural stability when the blue line falls within the confines created by the two red lines

Based on the information presented in Figure 2 It is clear that the model is in a state of structural stability, as evidenced by the alignment of the blue line between the two red lines.

The Materials and Methods should be described with sufficient details to allow others to replicate and build on the published results. Please note that the publication of your manuscript implicates that you must make all materials, data, computer code, and protocols associated with the publication available to readers. Please disclose at the submission stage any restrictions on the

availability of materials or information. New methods and protocols should be described in detail while well-established methods can be briefly described and appropriately cited.
Research manuscripts reporting large datasets that are deposited in a publicly available database should specify where the data have been deposited and provide the relevant accession numbers. If the accession numbers have not yet been obtained at the time of submission, please state that they will be provided during review. They must be provided prior to publication.
Interventional studies involving animals or humans, and other studies that require ethical approval, must list the authority that provided approval and the corresponding ethical approval code.

Conclusion

Renewable energy and energy efficiency have the potential to facilitate sustainable economic development and mitigate CO2 emissions in developing nations, albeit their influence on immediate growth tends to be inconsequential. The impact of financial development on renewable energy utilization and environmental outcomes is multifaceted and occasionally paradoxical, contingent upon the specific country and temporal context. Traditional factors contributing to economic growth, such as energy consumption, trade, and investment, typically positively affect short-term and long-term economic development. However, it is essential to acknowledge that these drivers can also lead to increased carbon dioxide (CO2) emissions and have adverse environmental consequences. Policies to transition developing nations towards greater reliance on renewable energy sources and improved energy efficiency are imperative to achieve a harmonious equilibrium between economic growth and environmental preservation. Such policies include implementing carbon pricing mechanisms, reforms in fossil fuel subsidies, and providing incentives for green finance. The study's findings have the potential to provide valuable insights for the development of customized strategies in energy and economic policies, considering the varying levels of development across different countries.
The analyzed research collectively underscores the imperative for implementing efficient policies and substantial investments in green technology. This is crucial for achieving harmonious economic progress and environmental sustainability equilibrium. Further-more, these studies shed light on the promising prospects of renewable energy sources and sustainable finance systems in facilitating growth within developing nations. In summary, this study extensively examines the complex relationship between environ-mental performance, financial development, and economic growth in the specific setting of Jordan. The findings provide light on crucial facets of this intricate interaction. Firstly, this highlights the crucial need for environmental sustainability, indicating that carbon dioxide emissions (CO2) substantially adversely impact economic growth. These high-lights the pressing need for Jordan to embrace and execute environmentally sensitive economic policies to achieve a harmonious equilibrium between economic growth and environmental conservation.
Furthermore, the study reveals that the direct short-term influence of financial development (LNFD) on economic growth in Jordan is deemed minor. This implies that the country's economic progress is contingent upon a more comprehensive range of elements. Hence, policymakers must

adopt a comprehensive approach to augment economic growth, considering factors beyond the sole focus on expanding the financial sector.

Furthermore, the study suggests that enhancements in water quality, as measured by the LNWQI, do not impede Jordan's economic growth in the short term. This finding implies that there is potential for improving environmental quality without immediate adverse effects on the economy. The robustness and reliability of the model are confirmed by its high adjusted R-squared value and structural stability. The observations above substantially impact policymakers in Jordan, underscoring the necessity of adopting ecologically friendly approaches to economic development. To enhance the existing knowledge base, it is recommended that future research endeavors delve into the long-term consequences of these relationships and offer more comprehensive policy suggestions aimed at fostering environmentally sustainable economic growth and maintaining the well-being of the Jordanian population while concurrently assuring the nation's sustainable future.

Policy Implications

This study underscores the critical importance of recognizing the interconnectedness of economic activities and environmental well-being. As economies expand, there is often a corresponding increase in resource consumption, waste generation, and pollution. These factors can have profound and lasting effects on ecosystems, biodiversity, and human health.

To address this, policymakers should prioritize the implementation of environmentally responsible policies. This may involve creating and enforcing regulations that limit harmful emissions, promote the use of renewable energy sources, and encourage sustainable resource management. Additionally, it's crucial to incentivize industries to adopt green technologies and practices through tax breaks, subsidies, or other economic incentives.

Research Contributions

The perspective on sustainable development by emphasizing the need for a comprehensive and balanced approach The integration of various financial development factors into a single index through principal component analysis offers a nuanced understanding of the complexities involved in assessing and promoting financial development, Furthermore, this research calls for a reformation of the discourse surrounding sustainable development. Rather than viewing environmental conservation and economic growth as mutually exclusive, there is a need to explore synergies and trade-offs. Policymakers should seek solutions that optimize both environmental and economic outcomes, acknowledging that a sustainable future requires a delicate equilibrium.

In conclusion, the study prompts a rethinking of conventional wisdom by highlighting the positive effects of CO2 emissions on economic growth in Jordan. This challenges preconceived notions about the environmental-economic relationship and emphasizes the importance of tailoring policies to the specific circumstances of each region. By recognizing the interconnectedness of environmental and economic factors, policymakers can strive for a more holistic and sustainable approach to development that benefits both the economy and the environment.

6.3 Suggestions for Future Research

Moreover, future research should delve into the efficacy of specific policy measures targeted at promoting economic growth in Jordan. Analyzing the short-term and long-term effects of these policies can guide policymakers in crafting effective and sustainable strategies. This could involve assessing the impact of investment incentives, regulatory reforms, and infrastructure development initiatives on the overall economic landscape.

In conclusion, broadening the temporal scope and incorporating additional determinants into the study can enrich our understanding of the factors influencing economic growth in Jordan. Examining the impact of technology, human capital, and political stability, along with evaluating the effectiveness of specific policy measures, will provide a more nuanced and actionable perspective for policymakers seeking to foster sustainable economic development in the country.

Expanding the scope to include additional determinants, such as technological advancements, human capital development, and political stability, would provide a more comprehensive picture of the drivers behind economic expansion in Jordan, Technological progress, for instance, plays a pivotal role in modern economies, and understanding its impact on Jordan's economic growth can guide strategies for fostering innovation and competitiveness.

* In conclusion, the thesis not only contributes to the current body of knowledge but also acts as a springboard for ongoing dialogue and research. It underscores the importance of a holistic approach to policymaking that considers both economic and environmental factors. As we navigate the challenges and opportunities presented by the interplay between economic growth and environmental quality, this thesis provides a solid foundation for creating sustainable pathways towards a prosperous and ecologically responsible future for Jordan.

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Tables

Table 1. The descriptive analysis

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
$LNCO_2$	1.03	1.10	1.25	0.36	0.20	-1.91	6.23
LNFD	3.02	3.14	4.61	1.39	0.79	-0.18	2.42
LNRGDP	1.22	1.20	2.66	-1.29	0.72	-0.91	5.84
LNWQI	4.84	4.87	4.99	4.63	0.09	-0.65	2.71

Table 2. The correlation analysis

Variables	$LNCO_2$	LNFD	LNRGDP	LNWQI
$LNCO_2$	1			
LNFD	-0.053 0.7679	1		
LNRGDP	0.438* 0.0109	0.194 0.279	1	
LNWQI	-0.555* 0.0008	0.086 0.636	-0.098 0.5863	1

Table 3. Augmented Dickey-Fuller (ADF) test for checking Stationarity

Variables	$LNCO_2$	LNFD	LNRGDP	LNWQI
$LNCO_2$	1			
LNFD	-0.053	1		
	0.7679			
LNRGDP	0.438*	0.194	1	
	0.0109	0.279		
LNWQI	-0.555*	0.086	-0.098	1
	0.0008	0.636	0.5863	

Table 4. Lag selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-11.9906	NA	0.0001	1.03	1.22	1.09
1	67.74	133.7*	0.00005*	-3.1*	-2.2*	-2.8*
2	81.425	19.427	0.001	-2.931	-1.265	-2.388

Table 5. Long Run Analysis

Variable	Coefficient	Std. Error	t-Statistic	P-value
LNRGDP(-1)	0.29	0.12	2.46	0.021
$LNCO_2$	4.03	1.27	3.17	0.004
$LNCO_2(-1)$	-3.42	1.57	-2.19	0.038
LNFD	0.15	0.09	1.62	0.116
LNWQI	1.11	1.00	1.11	0.277
C	-5.45	5.07	-1.07	0.293
R-Square	55.9%			
Short Run				
$D(LNCO_2)$	4.03	0.98	4.10	0.0004
CointEq(-1)*	-0.71	0.10	-7.18	0.0001

Figures

Figure 1. CUSUM test for structural stability

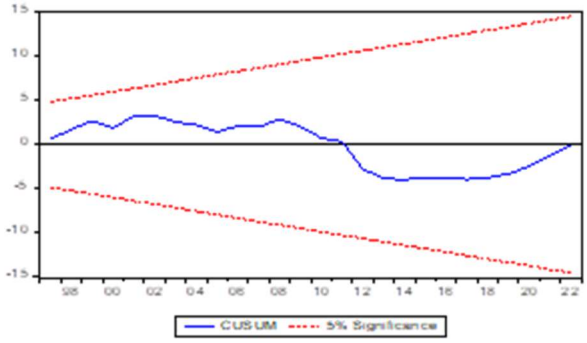

Figure 2. Squared CUSUM test for structural stability.