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Unlocking the relationship between domestic investment, environmental quality, and economic growth: Fresh insights from the USA

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Abstract: This study aims to analyze the dynamic relationships among domestic investment, environmental quality, and economic growth in the United States from 1990 to 2022, providing insights into how these variables interact to shape sustainable development. The research employs cointegration estimation and a Vector Error Correction Model (VECM) to examine long-term and short-term relationships. Data on gross domestic product (GDP), gross fixed capital formation (domestic investment), and CO_2 emissions (environmental quality) were sourced from the World Bank and the World Resources Institute. Stationarity tests, lag selection, and diagnostic checks were conducted to ensure robust results. The long-term results reveal a positive bidirectional relationship between domestic investment and economic growth, as well as between environmental quality and economic growth. However, a negative bidirectional relationship exists between environmental quality and domestic investment. Short-term dynamics show unidirectional causality from domestic investment to economic growth, bidirectional causality between domestic investment and environmental quality, and between environmental quality and economic growth. The findings underscore the need for integrated policies that balance economic growth with environmental sustainability. Policymakers should channel investments into environmentally friendly sectors, implement incentives for responsible natural resource management, and strengthen regulations to mitigate environmental degradation. Such measures can promote inclusive and sustainable economic development while preserving environmental quality for future generations.

Keywords: *Domestic investment, Economic growth, Environmental quality, United States, VECM.*

1. Introduction

The pursuit of sustainable development goals (SDGs) is paramount for global prosperity, and economic growth stands as a cornerstone in this endeavor, as outlined by the United Nations in its 2030 Agenda. Economic growth not only alleviates poverty by creating job opportunities and enhancing individual incomes but also facilitates access to crucial services like education and healthcare, essential for human well-being and social equity. Moreover, a thriving economy enables increased investments in sustainable infrastructure, contributing to the fight against climate change. However, for economic growth to be truly sustainable, it must be inclusive and environmentally friendly, as unsustainable practices can deplete natural resources and compromise the well-being of future generations. Hence, a comprehensive approach that integrates economic, environmental, and social dimensions is imperative to achieve the SDGs effectively.

Economic growth plays a crucial role in achieving the Sustainable Development Goals (SDGs), defined by the United Nations in 2015 as part of the 2030 Agenda. First of all, sustained economic

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growth can help reduce poverty by creating employment opportunities and increasing the income of individuals. Indeed, a study conducted by Dollar and Kraay [1] showed that in developing countries, a 10% increase in per capita income is associated with a 20 to 30% reduction in the poverty rate. In addition, economic growth can promote access to education and health services, two essential elements for improving human well-being and reducing social inequalities [2]. Furthermore, a growing economy can mobilize more resources to invest in sustainable infrastructure, such as renewable energy and green public transport, thereby contributing to the fight against climate change [3]. However, it is important that this growth is inclusive and environmentally friendly to be truly sustainable [4]. Indeed, unsustainable growth can lead to overexploitation of natural resources and environmental deterioration, thus compromising the ability of future generations to meet their own needs [5]. Therefore, to achieve the SDGs effectively, it is necessary to promote economic growth that is inclusive, environmentally friendly and focused on human development [6].

Environmental quality plays a crucial role in achieving sustainable development goals. Indeed, healthy and balanced ecosystems provide a multitude of ecosystem services essential to human survival and well-being. These services include climate regulation, water purification, soil fertility, crop pollination, and disease regulation, among many others. A deterioration in environmental quality compromises these services, endangering the stability of ecosystems and the ability of human societies to meet their basic needs. Studies such as those conducted by Congressional Budget Office [5] and Millennium Ecosystem Assessment [7] demonstrated the economic importance of ecosystem services for human well-being, thus highlighting the imperative to preserve environmental quality. In addition, environmental degradation has considerable socio-economic repercussions, particularly affecting the most vulnerable populations [8]. In this context, sustainable management of natural resources and a reduction of the ecological footprint are essential to achieve the objectives of sustainable development, as defined by the United Nations in their 2030 Agenda. This requires an integrated approach taking into account the dimensions environmental, social and economic aspects of development [9]. In short, environmental quality is not only a sine qua non condition for the sustainability of human societies, but it is also intrinsically linked to their long-term prosperity and well-being.

Domestic investments play a crucial role in achieving the Sustainable Development Goals (SDGs) set by the United Nations. These investments, whether public or private, are essential to catalyze economic growth, reduce inequality, promote social inclusion and ensure long-term environmental sustainability. First of all, domestic investments are an engine of economic growth by creating jobs, stimulating innovation and promoting trade. Studies such as those by World Bank [10] and Rodrik [11] highlight the importance of investments in local infrastructure and industries to support economic growth. Furthermore, investments in education and health, notably through public spending, are essential to reduce inequalities and promote social inclusion, as Stiglitz, et al. [12] highlights in his work on redistribution policies. In addition, domestic investments can contribute to the achievement of environmental objectives by promoting a transition towards a more sustainable economy. Research such as that conducted by Acemoglu and Robinson [13] shows how investment policies in renewable energy and clean technologies can support sustainable development. However, it is crucial that these investments are aligned with the principles of sustainable development, as defined in the 2030 Agenda, in order to avoid negative externalities and ensure long-term sustainable results [14]. Domestic investments play a fundamental role in achieving the SDGs by contributing to economic growth, social inclusion and environmental sustainability, but they must be guided by a comprehensive and integrated vision of sustainable development to maximize their positive impact.

According to the Bureau of Economic Analysis (BEA), the United States' gross domestic product (GDP) has been growing steadily in recent years. For example, in 2020, despite the challenges posed by the COVID-19 pandemic, the nominal GDP of the United States was approximately $21.43 trillion, up from the previous year [15]. This economic growth was also accompanied by an increase in industrial production. In 2020, industrial production increased 1.5% from the previous year, despite disruptions caused by the pandemic [16]. This increase demonstrates the resilience of the American industrial sector in the face of major economic challenges. Additionally, the job market in the United States has also shown signs of recovery. The unemployment rate, although increasing due to the pandemic, has gradually declined over the past few years. In 2020, the average unemployment rate in the United States stood at approximately 8.1%, down from the previous year [15]. However, despite these positive trends, inequalities persist in the distribution of wealth. According to a study by the Congressional Budget Office (CBO), the richest 20% of the American population hold nearly 52% of the country's total wealth, while the poorest 20% hold only 3.2% of the total wealth [5]. These economic inequalities pose significant challenges to social inclusion and economic mobility.

According to the Bureau of Economic Analysis (BEA), domestic investment in the United States has shown steady growth in recent years. For example, in 2020, non-residential fixed investment spending increased by 3.6%, while equipment investment increased by 1.7% [15]. This growth in domestic investment is supported by several factors, including economic stability, tax incentives and technological innovation. For example, the Tax Cuts and Jobs Act of 2017 introduced tax cuts for businesses, which encouraged many economic actors to invest in new projects and equipment in the United States [17]. Additionally, the information and communications technology (ICT) sector has been a major driver of domestic investment. According to an analysis by the Information Technology Industry Council (ITI), technology companies in the United States invested more than $776 billion in 2020, representing approximately 5.5% of the country's GDP [18]. These investments have helped drive innovation, create jobs, and strengthen U.S. economic competitiveness. However, despite these positive trends, challenges persist in certain sectors. For example, the manufacturing sector in the United States has faced increasing competitive pressures due to globalization and international competition. According to the National Association of Manufacturers (NAM), investment in the manufacturing sector has stagnated in recent years, impacting job creation and economic growth in some regions of the country [19].

Environmental quality in the United States is a critically important topic because it affects the health and well-being of citizens as well as the long-term sustainability of the country. One of the most significant aspects is air quality. Over the past few decades, considerable progress has been made in reducing emissions of regulated air pollutants. For example, between 1990 and 2018, emissions decreased by 74%, despite significant economic growth of 275%. These figures highlight the effectiveness of environmental regulations and emissions control technologies [20]. However, water quality remains a major challenge in many parts of the United States. Although the vast majority of the population has access to drinking water that meets federal safety standards, nearly a third of lakes, rivers and estuaries do not meet these standards due to agricultural, industrial and urban. The protection and restoration of water quality therefore remains an essential priority to preserve public health and aquatic ecosystems [21]. These environmental challenges also impact U.S. biodiversity. Despite the richness of ecosystems and species, approximately one-third of American species are threatened with extinction or are already extinct. Habitat loss, urbanization and other human activities contribute to this alarming decline in biodiversity, endangering ecosystems and the services they provide to society [22]. Additionally, climate change is exacerbating these already existing environmental challenges. Average temperatures in the United States have increased by about 1.8°F (1°C) over the past century, with noticeable effects such as more frequent extreme weather events and rising sea levels. Mitigation of climate change and adaptation to its impacts have become urgent imperatives to ensure the resilience of communities and ecosystems to future changes [23].

The importance of our topic, which examines the causal links between economic growth, environmental quality and domestic investments, lies in its relevance for sustainable development and long-term prosperity. These three areas are closely linked and their interaction shapes not only a country's economy, but also its environment and its ability to meet the future needs of its population. We chose to focus on this question because it is at the heart of contemporary concerns in terms of economic and environmental policy. While economic growth is often seen as the engine of progress and development, it can also lead to excessive exploitation of natural resources and environmental degradation if not managed sustainably. Domestic investments, whether public or private, are key levers for stimulating economic growth and can have a significant impact on the environment, depending on their orientation and their compatibility with sustainability objectives. Therefore, understanding the connections between these three areas is essential for designing policies that promote inclusive and environmentally friendly economic growth. The choice of the United States as a country of study is motivated by several factors. First, as one of the world's largest economies, the United States has significant influence on global economic trends and environmental policies. Their experience in economic growth and environmental management can provide valuable lessons for other countries. Additionally, the United States faces significant environmental quality challenges, including air pollution, ecosystem degradation, and the effects of climate change. Studying the interactions between economic growth, domestic investments and environmental quality in this context will provide a better understanding of the challenges and opportunities for sustainable development at national and global scales.

The significance of our research lies in its advancement of scholarly inquiry into this pivotal subject matter. While numerous studies have individually scrutinized the correlations between economic growth, investment, and environmental factors, our distinctive approach lies in the holistic examination of these variables, acknowledging the intricate interdependencies between them. Through the utilization of empirical data and methodological rigor, our study endeavors to offer fresh insights into the design of economic and environmental policies aimed at fostering sustainable and ecologically sound economic growth. At the heart of our inquiry is the exploration of how decisions regarding domestic investment impact both the trajectory of economic growth and the state of environmental quality within the United States. We endeavor to elucidate the mechanisms through which investments exert influence on these dual facets, while also identifying policy interventions and strategic frameworks conducive to fostering inclusive and environmentally sustainable economic development. By delving into these multifaceted inquiries, our study aspires to furnish invaluable guidance for policymakers and practitioners alike, as they navigate the complexities of achieving sustainable development objectives. To do this, this study will be organized as follows. First, we will undertake a comprehensive review of the existing literature, focusing specifically on the most recent work that has examined the relationship between domestic investments, environmental quality and economic growth. This section aims to provide a comprehensive overview of previous studies, highlighting key findings, gaps and discrepancies in conclusions. Then, in the third section, we will detail our empirical methodology. We will explain in detail the nature of the database we collected, as well as the model specification we used, and the relevant variables incorporated into our analysis. We will also describe the different empirical strategies we adopted to examine the relationships between domestic investments, environmental quality and economic growth. In the fourth section, we will present our empirical results and provide in-depth interpretations of these results. We will analyze the links identified between the variables studied and discuss their implications for economic and environmental policy. Finally, in the fifth and final section, we will present our conclusions and recommendations. We will highlight the main findings of our study, highlight methodological limitations, and identify areas for future research to deepen our understanding of the interactions between domestic investments, environmental quality, and economic growth.

2. Literature Survey

The literature review thoroughly investigates the complex and interconnected dynamics among environmental quality, domestic investment, and economic growth, all of which are pivotal in molding the course of sustainable development. The initial segment scrutinizes the intricate relationship between environmental concerns and economic advancement, underscoring not only the potential drawbacks associated with environmental deterioration but also the prospects brought forth by sustainable methodologies. Subsequently, the following section delves into the critical role of domestic investment in propelling economic growth, elucidating the mechanisms by which investments stimulate productivity and foster innovation. Lastly, the third paragraph synthesizes these discussions by delving into the dynamic interplay between environmental quality and domestic investment, elucidating how environmental variables sway investment decisions and consequently affect economic outcomes.

2.1. Environmental quality and Economic Growth

In recent years, the discourse surrounding the relationship between environmental quality and economic growth has garnered significant attention from researchers and policymakers alike. This attention stems from the realization that environmental degradation poses formidable challenges to sustainable development and the well-being of societies globally. Scholars have extensively explored the intricate dynamics between economic activities, resource utilization, and their impacts on the environment. Through empirical studies spanning various regions and time periods, researchers have attempted to unravel the complex interplay between economic growth and environmental quality. By investigating factors such as natural resource exploitation, energy consumption, trade openness, and institutional quality, scholars aim to elucidate the mechanisms driving this relationship. Understanding these mechanisms is crucial for devising effective policies that reconcile economic development goals with environmental sustainability objectives.

Ghazouani and Maktouf [24] delved into the impact of natural resource exploitation, trade openness, and economic growth on CO_2 emissions in oil-exporting countries for the period 1971-2014. They utilized the panel autoregressive distributed lag model and econometric techniques to study this relationship, notably finding a long-term negative impact of natural resource exploitation and trade openness on environmental quality. Magazzino [25] examined the relationship between ecological footprint, electricity consumption, and GDP in China for the period 1960-2019. The study used quantile regression techniques to assess the impact of these variables on environmental degradation, finding that electricity consumption and GDP contribute to degradation, while trade and urbanization may reduce the ecological footprint. Mitić, et al. [26] modeled the relationship between CO_2 emissions, economic growth, electricity consumption, and trade openness in Serbia for the period 1995-2019. Their study confirmed the existence of an inverted U-shaped relationship between these variables, with policy implications such as promoting sustainable economic growth and long-term programs to reduce CO_2 emissions.Ritu and Kaur [27] studied the impact of GDP per capita, energy consumption, human capital, and trade openness on ecological footprint in India for the period 1997-2019. Their analysis revealed a positive relationship between GDP, energy consumption, and ecological footprint, highlighting the importance of education in promoting pro-environmental behavior. Somoye [28] examined the link between energy intensity, renewable energy, economic growth, and CO_2 emissions in Turkey for the period 1970-2021. Their study underscored the importance of energy efficiency standards and clean energy initiatives to reduce CO_2 emissions and address climate challenges. Zhang, et al. [29] explored the associations between financial technology, natural resource rents, renewable energy consumption, and environmental quality in BRICS economies for the period 2016-2023. Their study revealed that financial technology and natural resource rents may foster economic growth while deteriorating environmental quality, emphasizing the importance of strict environmental policies and renewable energy consumption to promote sustainable economic growth. Nguyen [30] investigates the impact of economic globalization, including international trade, foreign direct investment, and passenger air transport, on economic growth and environmental quality in Southeast Asia for the period 1990-2019. The results of their analysis confirm the long-term impact of these factors on economic growth and environmental quality in the region, highlighting different effects based on the income levels of countries. Olaoye [31] examines the link between environmental quality, energy consumption, and economic growth in Africa for the period 1981-2019. Their results show a positive and significant relationship between environmental quality, measured by CO_2 emissions, and economic growth, as well as between energy consumption and economic growth, emphasizing the importance of sustainable measures to promote economic development in Africa. Bakari, et al. [32] examine the impact of pollution on economic growth in Tunisia for the period 1971-2015, considering domestic investment, energy consumption, and trade openness. Their results show a negative but not significant long-term

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effect of pollution on economic growth, highlighting the importance of environmental policies to protect future economic growth. Bakari [33] analyzes the impact of domestic investment and CO2 emissions on economic growth in Sub-Saharan Africa for the period 1990-2022. Their results indicate a positive and significant influence of domestic investment and CO2 emissions on economic growth, emphasizing the need for economic policies that promote appropriate levels of domestic investment and sustainable management of CO2 emissions. Bakari and El Weriemmi [34] examines the impact of natural resources, CO2 emissions, energy consumption, domestic investment, innovation, trade, and digitization on economic growth in Africa for the period 1996-2021. Their results highlight the importance of policies promoting domestic investment, exports, and final consumption to stimulate economic growth, while also emphasizing the need to effectively manage energy consumption and CO2 emissions to promote sustainable development. Yameogo and Dauda [35] examine the impact of income inequality, carbon emissions, and economic growth in Burkina Faso and Nigeria for the period 1980-2016. Their results show an inverted U-shaped relationship between environmental degradation and economic growth in both countries, underscoring the importance of policies aimed at reducing income inequality and promoting economic growth while preserving environmental quality. Wang, et al. [36] investigate the impact of economic growth, nuclear energy, renewable energy, and environmental quality in BRICS countries for the period 1990-2018. Their results indicate a complex relationship between economic growth, CO2 emissions, and renewable energy use, highlighting the importance of policies promoting efficient use of energy resources and mitigating adverse effects on the environment. Zhang, et al. [37] explore the role of institutional quality in the relationship between environmental quality and economic growth in tropical countries for the period 1971-2014. Their results show that institutional quality plays a crucial role in achieving the environmental Kuznets curve, emphasizing the importance of governance policies to reconcile economic development and environmental protection. Shokoohi, et al. [38] analyze the impact of energy intensity, economic growth, and environmental quality in three Middle Eastern countries for the period 1971-2015. Their results highlight an inverted U-shaped relationship between per capita income and environmental degradation, emphasizing the importance of policies aimed at reducing energy intensity and promoting sustainable environmental practices. Donkor, et al. [39] examine the link between economic growth, public expenditure, and CO2 emissions on environmental quality in North Africa and Southern Africa for the period 2000-2016. Their results underscore the importance of public expenditure in improving environmental quality, highlighting the need for policies aimed at promoting sustainable development in the region. Gafsi and Bakari [40] examine macroeconomic determinants of growth in African countries, revealing that while domestic investment and exports drive economic expansion, CO_2 emissions also correlate positively with growth, raising concerns about environmental sustainability. This suggests that rapid economic development in Africa may come at the cost of environmental degradation, necessitating policies that balance growth with ecological preservation.

In the context of advanced economies, Gafsi and Bakari [41] analyze G7 nations, finding that renewable energy adoption and CO_2 emissions positively influence long-term economic growth. However, no short-term relationship was detected, indicating that green energy transitions require sustained policy commitment rather than immediate economic returns. Their study underscores the importance of aligning energy policies with long-term sustainability goals, as outlined in the Paris Agreement. Further research by Gafsi and Bakari [42] explores how environmental taxes, digitalization, and renewable energy impact sustainability in G7 countries. Their findings suggest that well-designed green taxation and technological innovation can enhance environmental quality without stifling economic progress. This supports the argument that decoupling growth from emissions is achievable through policy-driven structural changes. Finally, Gafsi and Bakari [43] investigate Asia-Pacific economies, showing that agricultural CO_2 emissions hinder growth, whereas agricultural exports and financial development stimulate it. This highlights the sector-specific nature of environmental-economic interactions, emphasizing the need for sustainable agricultural practices to ensure long-term prosperity.

The nexus between environmental quality and economic growth represents a multifaceted and nuanced relationship that demands careful consideration from policymakers and researchers. The studies reviewed shed light on the diverse factors influencing this relationship, ranging from natural resource exploitation to institutional quality and public expenditure. While some findings indicate a negative impact of certain economic activities on environmental quality, others reveal potential pathways for achieving sustainable development objectives. Moving forward, it is imperative to adopt a holistic approach that integrates environmental considerations into economic policymaking frameworks. By doing so, societies can strive towards achieving economic prosperity while safeguarding the integrity of the natural environment for future generations.

2.2. Domestic Investment and Economic Growth

Investment, whether domestic or foreign, is a critical determinant of economic growth in nations worldwide. The intricate relationship between investment and economic growth has been a focal point of extensive scholarly inquiry, with researchers employing diverse methodologies and investigating various dimensions of this interaction. In this review, we delve into a range of studies conducted across different regions and timeframes, each offering insights into the complex dynamics between investment and economic development. These studies explore not only the relationship between domestic investment and economic growth but also the impact of factors such as government policies, energy sources, foreign aid, and institutional quality on economic performance. By examining these diverse perspectives, we gain a comprehensive understanding of the multifaceted nature of investment and its implications for economic growth.

Kurbanov [44] specifically examines the relationship between foreign direct investment (FDI), GDP, and domestic investment (DI) using a Vector Error Correction Model (VECM) for quarterly data from 2010 to 2019 in Uzbekistan. The results indicate the existence of a long-term relationship between these variables. Granger causality tests reveal a significant bidirectional relationship between GDP and domestic investment, with GDP causing FDI. Additionally, variance decomposition analysis shows that fluctuations in FDI are primarily explained by shocks in GDP, highlighting the importance of domestic investment for economic growth. Abbas, et al. [45] study the impact of fixed capital formation, renewable and non-renewable energies on economic growth and carbon emissions within the framework of the Belt and Road Initiative (BRI) project. Their analysis, based on panel data from twenty-four emerging economies participating in the BRI project from 1995 to 2014, highlights the existence of an Environmental Kuznets Curve (EKC) in these countries. They find that fossil energy consumption contributes to environmental degradation, while the use of renewable energies can promote sustainable environmental conditions without compromising economic growth.Ozegbe and Yussuff [46] examine the relationship between domestic investment, export expansion, and economic growth in Nigeria from 1981 to 2018. Their results reveal an insignificant relationship between domestic investment and export expansion, but a significant bidirectional relationship between domestic investment and economic growth. This suggests that policies aimed at accelerating domestic investment are necessary to foster export expansion. Magdalena and Suhatman [47] focus on the effect of government spending, domestic investment, and foreign investment on the economic growth of the primary sector in Central Kalimantan. Their results indicate that government spending, domestic investment, and foreign investment have a significant and positive effect on the economic growth of the primary sector. Govdeli [48] analyzes the long-term relationship between gross domestic savings, fixed capital investments, and economic growth in seven Caucasus and Central Asian countries from 1993 to 2017. The results suggest a cointegration relationship in the model where economic growth is the dependent variable. Granger causality analyses show that domestic savings cause economic growth, while economic growth causes fixed capital investments, and domestic savings also cause fixed capital investments. These results underscore the importance of policies aimed at encouraging domestic savings to foster investment and sustainable economic growth in these countries. Sijabat [49] examines the causality between Gross Domestic Product (GDP), foreign aid, foreign direct investments (FDI), and gross capital formation in Indonesia from 1970 to 2019. The results indicate a positive one-way causality between foreign aid and GDP as well as between FDI and GDP. However, despite a long-term relationship, the study fails to prove a causal relationship between foreign aid and gross capital formation in Indonesia, highlighting the need for more optimal management of foreign aid to attract FDI. Kobayakawa [50] explores the link between capital formation and carbon footprint, highlighting the importance of understanding how capital formation by developing countries affects their carbon footprint. The study shows that countries investing in more carbon-intensive capital formation achieve faster economic growth, underscoring the need to improve energy efficiency to pursue carbon-neutral growth. Nguyen, et al. [51] analyze the dynamic links between different types of FDI, domestic investment, and economic growth in Vietnam. Their results reveal that greenfield foreign direct investments complement domestic investment, thus fostering long-term economic growth, while cross-border mergers and acquisitions have a negative effect on growth, highlighting the importance of policies aimed at attracting FDI to promote sustainable growth. Amjed and Shah [52] examine the relationship between financial system development, capital formation, economic growth, and trade diversification. Their results show that financial system development and economic growth have a positive impact on trade diversification, while capital formation has a negative impact, highlighting the challenges countries face in their quest for economic diversification. Miao, et al. [53] focus on the role of domestic governance quality in the relationship between Chinese FDI, domestic investment, and economic growth in Africa. Their results indicate that the impact of Chinese FDI on economic growth is conditioned by improvements in institutional quality, while governance environment improvement enhances the effect of Chinese FDI on domestic investment, highlighting the importance of governance quality in attracting FDI and promoting economic growth and domestic investment in Africa. Mkadmi, et al. [54] examined the impact of tax revenues and domestic investments on economic growth in Tunisia from 1976 to 2018. Their results suggest that in the long term, domestic investments have a negative effect on economic growth, while tax revenues positively contribute to economic well-being. Furthermore, there is a positive reciprocal influence between domestic investments, economic growth, and tax revenues. Fakraoui and Bakari [55] examined the relationship between domestic investment, exports, and economic growth in India from 1960 to 2017. Their analyses revealed that there was no significant long-term relationship between exports, domestic investment, and economic growth. However, in the short term, only exports exerted a causal impact on economic growth. Bakari [56] studied the relationship between domestic investment and economic growth in Algeria from 1969 to 2015. The results indicated a negative effect of domestic investment on economic growth in the long term, although domestic investment was a causal factor for economic growth in the short term. Bakari [57] explored the relationship between exports, imports, domestic investment, and economic growth in Egypt from 1965 to 2015. The results showed that in the long term, domestic investment and exports had a negative impact on economic growth, while imports had a positive effect on economic growth. Bakari [58] analyzed the relationship between domestic investment and economic growth in Canada from 1990 to 2015. The results indicated a weak relationship between domestic investment and economic growth in the short term, but no long-term relationship was observed. Osiobe [59] examined the relationship between human capital, capital formation, and economic growth in a panel of 14 Latin American countries. The results showed a strong causal relationship between real gross domestic product per capita and human capital, as well as a bidirectional relationship between human capital and the trade balance.

The relationship between investment and economic growth is multifaceted and influenced by a myriad of factors. While domestic investment is crucial for driving economic development, the effectiveness of investment policies is contingent upon broader macroeconomic conditions, institutional quality, and external factors such as foreign aid and energy sources. The studies reviewed in this analysis contribute valuable insights into the nuanced interplay between investment and economic growth across different contexts. From highlighting the importance of sustainable energy policies to underscoring the role of institutional quality in attracting foreign investment, these findings offer valuable guidance for policymakers seeking to promote sustainable development and prosperity. Ultimately, fostering economic growth requires a holistic approach that encompasses not only investment promotion but also the creation of an enabling environment conducive to sustainable development. By integrating insights from these diverse studies, policymakers can formulate more effective strategies to harness the potential of investment for driving inclusive and sustainable economic growth.

2.3. Environmental quality and Domestic Investment

The interaction between domestic investments and environmental quality constitutes a crucial subject of study in the contemporary context of sustainable development. Investment decisions made at the national level have direct and indirect impacts on the environment, thereby influencing the trajectory of environmental degradation or ecological preservation. Domestic investments, whether public or private, are often seen as drivers of economic growth, but they can also put pressure on ecosystems, thereby increasing greenhouse gas emissions, air pollution and water, and deforestation, among others. Understanding the nature of this relationship between domestic investments and environmental quality is essential to guide economic policies towards sustainable and environmentally resilient trajectories.

Iyer, et al. [22] addressed the issue of assessing CO_2 mitigation patterns, emphasizing the importance of considering real-world factors such as institutions that influence investment decisions. They focused on how national institutions affect investment risks and consequently the cost of financing in the electricity generation sector. Using an integrated assessment model, they represented the variation in investment risks across technologies and regions and examined the impact on the magnitude and distribution of mitigation costs. Their findings revealed that achieving emissions mitigation goals is more expensive due to varying investment risks, with industrialized countries mitigating more and developing countries mitigating less. They suggested that institutional reforms aimed at lowering investment risks could be crucial for cost-effective climate mitigation strategies. Emmanuel, et al. [60] investigated the ecological footprint within a global perspective, focusing on the role of domestic investment, foreign direct investment (FDI), democracy, and institutional quality. They examined data from 101 countries spanning from 1995 to 2017 and employed various estimation techniques to analyze the effects of these factors on ecological footprint. Their results consistently showed that domestic capital formation contributes to environmental degradation by increasing ecological footprint, while institutional quality enhances environmental quality. They found that foreign capital inflow initially improves the environment in the short run but leads to degradation in the long run. Additionally, they observed mixed effects of democratic activities on environmental quality, with short-run degradation and long-run enhancement. Zhang, et al. [61] conducted an interprovincial comparative analysis in China to assess the impact of foreign capital and domestic capital on carbon dioxide emissions. Using data from 30 provinces over the period 2001-2015, they employed panel vector autoregressive models along with impulse response functions, variance decomposition, and panel causality tests. Their findings suggest that, overall, foreign direct investment (FDI) does not significantly influence China's carbon dioxide emissions. Instead, they found that domestic investment and economic growth are the primary drivers of carbon dioxide emissions. However, sub-regional analysis based on different energy intensities revealed that FDI does have a significant impact on CO_2 emissions in areas of low to medium energy intensity, contributing between 12.2% and 14.1% to emissions. The panel causality test indicated that in the short term, both FDI and domestic capital have significant predictive effects on carbon dioxide emissions across various regions. Bekoe, et al. [62] examined the energy-CO_2 emission-growth nexus in Ghana, focusing on the role of domestic investment. Employing Autoregressive Distributed Lag (ARDL) bounds tests and Granger causality techniques with data spanning from 1983 to 2014, they found that all variables were cointegrated in the long run. The Granger causality test revealed a unidirectional causality from energy consumption to CO_2 emissions and economic growth, as well as from CO_2 emissions to economic growth in Ghana.

Their results from the error correction model and bounds tests indicated that while energy consumption increases carbon emissions by more than 44%, lagged values of domestic investment were found to reduce CO_2 emissions by more than 41% in both the short and long run. Based on these findings, they recommended policymakers to focus on increasing domestic capital as opposed to relying on FDI, which has been shown to exacerbate environmental degradation in host countries. Liu, et al. [63] conducted an empirical study on the environmental impacts of domestic investment in China. They highlighted the increasing contradiction between environmental quality and economic development since the late 1970s, particularly driven by China's rapid fixed asset investment (FAI) growth. This surge in FAI facilitated the development of energy- and pollution-intensive industries, leading to significant energy-related pollution. However, there was also growing investment in environmental protection expected to mitigate environmental deterioration. The study quantitatively investigated the relationship between domestic investment and environmental quality in China, considering spatial dependence and using CO_2 and SO_2 as representative pollutants. The estimation results indicated the existence of spatial dependence, and the total effects of FAI on pollutant emissions were found to be positive. Interestingly, the study found no evidence that environmental protection investment effectively curbed pollutant emissions in China. Adejumo and Asongu [64] explored the impacts of foreign direct investment (FDI) and domestic investment on green growth in Nigeria from 1970 to 2017. They used Auto-regressive Distributed Lag (ARDL) and Granger causality estimates to analyze the data. Their findings revealed that domestic investment increased CO_2 emissions in the short run, while foreign investment decreased CO_2 emissions in the long run. Decomposing the dataset into three sub-samples, they found that both types of investments decreased CO_2 emissions in the long run, but only domestic investment had a negative effect on CO_2 emissions in the short run. Consequently, they concluded that despite short-run distortions, FDI and domestic investments have prospects for sustainable development in Nigeria through green growth. Xiao and Qamruzzaman [65] investigated the nexus between green investment, domestic investment, environmental sustainability, and technological innovation in Belt and Road Initiative (BRI) nations from 2000 to 2021. The study employed various econometric techniques such as cross-sectional dependency test, unit root test, error correction-based panel cointegration test, ARDL, CS-ARDL, and nonlinear ARDL. Their findings revealed a positive connection between green investment, domestic investment, and technological innovation in BRI nations. Conversely, environmental sustainability showed a negative and statistically significant correlation with technological innovation. The study also highlighted asymmetric effects, where positive and negative shocks of green and domestic investment exhibited positive and significant links with technological innovation, while asymmetric shocks in environmental sustainability showed adverse ties to technological innovation. Additionally, the study documented unidirectional causal effects from green investment to technological innovation and bidirectional causality between domestic investment, foreign direct investment (FDI), financial development, and technological innovation. The study recommended promoting domestic capital formation and environmental protection in BRI nations to accelerate technological innovation, along with encouraging investment in research and development with incentives for technological innovation. Ge, et al. [66] examined the extent to which foreign private investment (FPI) affects the clean industrial environment and sustainable economic growth through investments in China by developed countries. The study also explored the association among FPI, CO_2 emissions, energy consumption, trade openness, and sustainable economic growth. Employing random effects and generalized least squares (GLS) and panel VAR estimators for data analysis, the study found that China's economy has a significant positive impact on investment choices in domestic markets in both emerging and developed countries. Furthermore, investment in emerging and developed economies increased the contribution of domestic enterprises and environmental sustainability to the national economy. The results also indicated that both foreign private investment and gross domestic investment positively impact sustainable economic growth. Zubair, et al. [67] investigated the impact of gross domestic income, trade integration, foreign direct investment (FDI) inflows, GDP, and capital on carbon dioxide (CO_2) emissions in Nigeria from 1980 to 2018. Employing

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Autoregressive Distributed Lag (ARDL) bounds testing to cointegration and improved Vector Autoregressive (VAR) approaches, they found a long-term relationship between CO_2 emissions, income, trade integration, FDI inflows, GDP, and capital. The study revealed that an increase in FDI inflows, GDP, and capital resulted in reduced carbon dioxide emissions in Nigeria. Granger causality analysis indicated two-way impacts between CO_2 emissions and FDI inflows, while causality occurred unidirectionally from capital to CO_2 emissions. Based on their empirical findings, the authors suggested that the Government of Nigeria should continue to enhance incentives for economic agents, both local and foreign, under climate-friendly guidelines. Liu, et al. [68] explored the environmental consequences of domestic and foreign investment in China. Using a panel dataset of 112 Chinese cities from 2002 to 2015, the study distinguished and separately estimated the direct and indirect effects of fixed asset investment (FAI) and foreign indirect investment (FDI) on China's environmental quality. Accounting for spatial correlations in economic development and pollutant emissions, the study found significant differences in the environmental effects of FAI and FDI. The direct effects of FAI on SO_2 emissions were significantly positive and dominated the negative indirect effects. Conversely, the direct, indirect, and total effects of FDI on pollutant emissions were all negative. The study concluded that well-designed and targeted policies should be formulated to reduce the negative environmental impacts of FAI and enhance the positive influences of FDI on the environment. Khan, et al. [69] investigated the impact of technological innovation and public-private partnership (PPP) investment on sustainable environment in China, focusing on consumption-based carbon emissions from 1990Q1 to 2017Q2. They utilized various econometric techniques such as GLS-based unit root test, Maki cointegration test, FMOLS, DOLS, CCR, and frequency domain causality test. Their findings indicated that there exists a cointegrating relationship among PPP investment in energy, technological innovation, renewable energy consumption, exports, imports, and consumption-based carbon emissions. They found that exports, renewable energy consumption, and technological innovation are beneficial in reducing consumption-based carbon emissions. Conversely, both PPP investment in energy, GDP, and imports were associated with increased consumption-based carbon emissions. Furthermore, in the long term, PPP investment and technological innovation were found to cause consumption-based carbon emissions in China. The study recommended focusing on technological innovation for cleaner production processes and promoting PPP investment in renewable energy to mitigate carbon emissions. Shahbaz, et al. [70] explored the relationship between public-private partnerships investment in the energy sector and carbon emissions in China, emphasizing the role of technological innovations. They employed bootstrapping autoregressive distributed lag modeling (BARDL) to examine the cointegration between carbon emissions and its determinants. The empirical results revealed that public-private partnerships investment in energy contributed to increased carbon emissions, indicating a negative impact on environmental quality. In contrast, technological innovations were found to have a negative effect on carbon emissions. The relationship between economic growth and carbon emissions followed an inverted-U shaped curve, supporting the environmental Kuznets curve hypothesis. Additionally, exports were positively linked with carbon emissions, while foreign direct investment was found to impede environmental quality by stimulating CO_2 emissions. The findings suggested directing public-private partnerships investment in energy towards improving environmental quality in China. Muhammad and Khan [71] examined the factors contributing to economic growth in Asian countries, with a focus on bilateral foreign direct investment (FDI), energy consumption, CO_2 emissions, and capital. They employed various econometric techniques such as generalized method of moments (GMM), OLS regression, fixed effect, and random effect estimators using cross-country data for 34 host countries in Asia and 115 source countries over the period 2001–2012. Their empirical findings indicated that energy consumption, FDI inflows and outflows, CO_2 emissions, and capital play significant roles in the economic growth of Asian countries. They suggested implementing policies to improve energy utilization, promote the use of clean energy, adopt appropriate and advanced energy technologies, and encourage foreign investors to invest in Asian countries. They emphasized that economic growth is influenced by both FDI inflows and outflows, energy consumption, CO_2 emissions, and capital of both host and source countries. Zhao, et al. [72] investigated the decoupling of CO_2 emissions and industrial growth in China from 1993 to 2013. They utilized an extended logarithmic mean Divisia index (LMDI) model focusing on energy-related and process-related CO_2 emissions and introduced three novel investment factors: investment scale, investment share, and investment efficiency. Their results showed that China's industrial sector experienced weak decoupling during the period studied. They identified investment scale as the most important factor contributing to the increase in CO_2 emissions and inhibiting decoupling. Investment efficiency had the most significant role in reducing CO_2 emissions, followed by energy intensity and process carbon intensity effects. They highlighted specific industrial sub-sectors, such as raw chemical materials and chemical products, nonmetal mineral products, and smelting and pressing of ferrous metals, which had significant effects on decoupling and suggested policy recommendations to achieve emission reduction targets in China's industrial sector.

The analysis of the relationship between domestic investments and environmental quality reveals a complex dynamic with profound implications for sustainable development. While domestic investments are essential for economic growth, their impact on the environment requires careful and thoughtful management. Policymakers face the challenge of reconciling the need to stimulate investment to drive economic progress with the imperative to protect and restore fragile ecosystems. Appropriate policies and incentives must be implemented to encourage green and sustainable investments, strengthen environmental regulations and promote technological innovation focused on environmental preservation. By adopting an integrated and holistic approach, nations can hope to forge development pathways that preserve natural resources while promoting long-term economic and social well-being.

3. Data and Methodology

In the quest to unravel the intricate nexus between environmental quality, domestic investment, and economic growth, our analytical journey is guided by a synthesis of theoretical underpinnings and empirical insights drawn from the realms of environmental economics, development economics, and growth theory. Anchoring our approach within the neoclassical framework, we draw upon seminal works that have laid the foundation for understanding the dynamics of economic growth and its relationship with environmental sustainability and investment. The seminal work of Solow [73] particularly his groundbreaking contribution to growth theory in the form of the Solow growth model, serves as a cornerstone of our analytical framework. Solow's model, with its emphasis on the role of capital accumulation and technological progress in driving economic growth, provides valuable insights into the determinants of long-term prosperity. Building upon Solow's insights, subsequent extensions and modifications of the neoclassical model have sought to incorporate additional factors such as human capital, institutional quality, and environmental considerations into the growth framework Barro and Sala-i-Martin [74].

In our endeavor to incorporate environmental quality into the neoclassical growth framework, we draw inspiration from the burgeoning literature on environmental economics and sustainable development. The works of authors such as Dasgupta and Mäler [75] have provided seminal contributions to our understanding of the economic implications of environmental degradation and the importance of accounting for natural capital in economic decision-making. By integrating insights from this literature, we aim to enrich our analytical framework with a nuanced understanding of the role of environmental quality as both a driver and an outcome of economic growth. Furthermore, our analytical approach is informed by the burgeoning literature on the role of domestic investment in fostering economic development. Building upon the insights of authors such as Lucas Jr [76] and Romer [77] who have emphasized the importance of investment in human and physical capital as drivers of economic growth, we seek to elucidate the mechanisms through which domestic investment interacts with environmental quality to shape the trajectory of economic development. Through a synthesis of these diverse strands of literature, our analytical framework seeks to contribute to a deeper understanding of the complex interplay between environmental quality, domestic investment, and

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economic growth. By drawing upon insights from seminal works in growth theory, environmental economics, and development economics, we aim to develop a comprehensive analytical framework capable of capturing the multifaceted dynamics of sustainable economic development.

3.1. Model Specification

In the pursuit of understanding the intricate interplay between environmental quality, domestic investment, and economic growth, we embark upon our analytical journey by anchoring our approach within the framework of the neoclassical model. This established theoretical foundation provides us with a solid starting point from which to explore and elucidate the causal relationships inherent within our research objectives. However, recognizing the need for customization and refinement to suit the specific nuances of our investigation, we undertake a process of modification to tailor the neoclassical model to our particular context. At the core of our modified framework lies the formulation of an equation encapsulating the relationships among economic growth, domestic investment, and environmental quality. This pivotal equation, denoted as equation (1), serves as the cornerstone of our analytical structure, encapsulating the essence of our research inquiry.

$$Y = F\,(K, L) \qquad (1)$$

Here, the variable Y symbolizes economic growth, representing the overarching objective and outcome of interest within our analysis. It serves as a fundamental metric through which we assess the vitality and prosperity of the economy under examination, capturing the aggregate effects of various contributing factors. Meanwhile, DI, standing for domestic investments, embodies the critical engine driving economic expansion and development within a nation's borders. As a key determinant of capital formation and productive capacity, domestic investment plays a pivotal role in fostering long-term economic growth and prosperity. In parallel, EQ emerges as a crucial factor influencing the trajectory of economic development, encapsulating the broader concept of environmental quality. As concerns over sustainability and ecological stewardship continue to gain prominence on the global stage, the environmental dimension assumes ever-increasing significance within the discourse of economic growth and development. By integrating these pivotal elements into equation (1), we aim to elucidate the intricate relationships and causal linkages that exist among economic growth, domestic investment, and environmental quality.

Through rigorous analysis and empirical examination, we endeavor to unravel the complex dynamics at play, shedding light on the mechanisms through which these variables interact and influence one another. In doing so, we aspire to contribute to a deeper understanding of the drivers and determinants of economic growth within the broader context of sustainable development and environmental stewardship. Within the framework of our analysis, we articulate an augmented production function that encapsulates the intricate interplay among multiple variables, denoted as follows:

$$Y = A\, DI^{\alpha_1} EQ^{\alpha_2} \qquad (2)$$

Herein, the symbol ‘A’ represents the level of technology inherent in the economic system under consideration, presumed to remain constant over the analytical period. The coefficients α_1 and α_2 denote the returns to scale associated with domestic investment (DI) and environmental quality (EQ), respectively. These coefficients serve to quantify the extent to which changes in domestic investment and environmental quality influence overall output. To facilitate analysis, we transform all variables into logarithmic form, thereby linearizing the originally nonlinear Cobb-Douglas production function. The resulting linear functional form, known as equation (3), is expressed as:

$$\mathrm{Ln}\,(Y)_t = \mathrm{Ln}\,(A) + \alpha_1 \mathrm{Ln}\,(DI)_t + \alpha_2 \mathrm{Ln}\,(EQ)_t + \varepsilon_t \qquad (3)$$

In this equation, ‘$\mathrm{Ln}\,(Y)_t$’ represents the natural logarithm of economic output at time ‘t’, while ‘$\mathrm{Ln}\,(DI)_t$’ and ‘$\mathrm{Ln}\,(EQ)_t$’ denote the natural logarithms of domestic investment and environmental quality, respectively. The term ‘ε_t’ captures the error or disturbance in the model at time ‘t’.

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With the empirical focus centered on exploring the influence of domestic investment and environmental quality on economic growth, while holding technology constant, our analysis delves into the linear model specified in equation (4). In this model, the effects of domestic investment and environmental quality on economic growth are examined, controlling for variations in technological factors:

$$\mathrm{Ln}\ (\mathrm{Y})_t = \alpha_0 + \alpha_1 \mathrm{Ln}\ (\mathrm{DI})_t + \alpha_2 \mathrm{Ln}\ (\mathrm{EQ})_t + \varepsilon_t \qquad (4)$$

Here, 'α_0' represents the intercept term, capturing the baseline level of economic output independent of domestic investment and environmental quality. The coefficients 'α_1' and 'α_2' quantify the respective contributions of domestic investment and environmental quality to economic growth, while 'ε_t' accounts for residual variations not explained by the model at time 't'. In undertaking this empirical investigation, our aim is to discern the potency of domestic investment and environmental quality as determinants of economic growth, elucidating their individual and collective impacts within the framework of a controlled technological environment. Through meticulous analysis of the linear model outlined in equation (4), we endeavor to shed light on the nuanced relationships that underpin the dynamics of economic growth, offering valuable insights for policymakers and practitioners alike.

3.2. Estimation Period and Source of Data

In order to traverse the intricate relationship among domestic investment, environmental quality, and economic growth within the United States, we will undertake an empirical investigation utilizing a comprehensive time series database spanning the period from 1990 to 2022. This database will be meticulously curated from annual statistical reports sourced from esteemed institutions such as the World Bank and the World Resources Institute, ensuring robustness and reliability in our analysis. The variables under scrutiny, along with their succinct descriptions, are outlined in Table 1 below.

Table 1.
Description of Variables.

No	Variable	Description	Sources
1	EQ	CO2 emissions (kt)	The World Resources Institute
2	Y	GDP (constant 2015 US$)	The World Bank
3	DI	Gross fixed capital formation (constant 2015 US$)	The World Bank

In this tableau, variable 'Y' represents the Gross Domestic Product (GDP) measured in constant US dollars, serving as a key indicator of the economic output and productivity within the United States. Variable 'DI' denotes Gross Fixed Capital Formation, measured in constant 2015 US dollars, encapsulating the aggregate investment in physical assets such as infrastructure, machinery, and equipment, which plays a pivotal role in driving economic expansion and development. Meanwhile, variable 'EQ' captures CO2 emissions, measured in kilotons, providing insights into the environmental dimension of the economic system. As concerns over climate change and environmental sustainability continue to mount, CO2 emissions serve as a critical indicator of the environmental footprint associated with economic activities, shedding light on the intersection between economic growth and environmental degradation. By leveraging this comprehensive dataset encompassing three decades of economic activity, we aim to elucidate the complex interplay among domestic investment, environmental quality, and economic growth within the United States. Through rigorous empirical analysis and econometric techniques, we seek to uncover the underlying relationships and causal linkages that govern these pivotal variables, offering valuable insights for policymakers, researchers, and practitioners alike in their quest for sustainable and inclusive economic development.

3.3. Empirical Strategy

Our selection of the Sijabat [49] model stems from a careful consideration of its multifaceted advantages, which make it an optimal choice for our analytical framework. One of its key strengths lies

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in its versatility, particularly its effectiveness in discerning relationships among macroeconomic variables over both extended time horizons and shorter intervals. By leveraging this model, we aim to delve deep into the intricate dynamics of economic phenomena, exploring not only their long-term trends but also the transient fluctuations that shape their evolution. Central to our empirical strategy is the meticulous process of establishing the stationarity of variables, a crucial prerequisite for robust analysis. To this end, we employ the Augmented Dickey-Fuller (ADF) stationary test, which allows us to ascertain the order of integration for each variable. This meticulous step ensures that our subsequent analyses are built upon a solid foundation, free from the confounding effects of non-stationarity. It is imperative that all variables in our model exhibit stationarity, thereby laying the groundwork for the subsequent stages of our analysis. Specifically, we mandate that at least two variables demonstrate stationarity in their first differences, signifying a level of stability conducive to further investigation. This stringent criterion ensures that our subsequent analyses are underpinned by a robust statistical framework, capable of capturing the nuances of real-world economic interactions. Upon confirming the stationarity of variables, we advance to the pivotal stage of conducting cointegration analysis using the Johansen Test. This sophisticated technique enables us to explore the presence of long-term relationships among the variables, shedding light on the underlying structural dynamics of the economic system under scrutiny. Should cointegration relationships be detected, it signifies the existence of equilibrium relationships that warrant specialized modeling techniques. In instances where cointegration relationships are absent, we pivot to employing the Vector Autoregression (VAR) Model, a flexible and widely used tool for analyzing dynamic interactions among variables. This approach allows us to capture the complex interplay of economic forces, offering valuable insights into the short-term dynamics of the system. Conversely, when cointegration relationships are present, we adopt the Vector Error Correction Model (VECM), a sophisticated framework specifically designed to account for the long-term equilibrium relationships identified through cointegration analysis. By incorporating error correction mechanisms, the VECM enables us to model both short-term dynamics and the adjustment process towards long-term equilibrium, providing a comprehensive understanding of the underlying economic relationships. Our methodological approach is characterized by a meticulous and systematic progression, guided by the rigorous principles of econometric analysis. By leveraging the Sijabat [49] model and employing a suite of advanced statistical techniques, we endeavor to unravel the complexities of the macroeconomic landscape, offering valuable insights into the dynamics that shape economic phenomena.

4. Empirical Results

This section embarks on an empirical exploration of the intricate relationship among domestic investment, environmental quality, and economic growth within the United States. To systematically unravel this relationship, we divide our analysis into five distinct steps, each serving a specific purpose and contributing to our overarching objectives. In the initial step, we focus on determining the order of integration for each variable under consideration. By employing appropriate statistical tests such as the Augmented Dickey-Fuller (ADF) test, we assess the stationarity properties of the variables. This crucial step lays the groundwork for subsequent analyses by ensuring that our time series data is properly preprocessed and conducive to robust econometric modeling. Building upon the insights gained from Step 1, our next objective is to determine the optimal lag length for our estimation. Through techniques such as the Akaike Information Criterion (AIC) or the Schwarz Information Criterion (SIC), we identify the lag length that strikes a balance between model complexity and explanatory power, thereby enhancing the accuracy of our estimates. In the third step, we delve into the examination of cointegration relationships among the three variables. Utilizing methodologies such as the Johansen cointegration test, we assess whether long-term equilibrium relationships exist between domestic investment, environmental quality, and economic growth. This critical analysis sheds light on the underlying structural dynamics governing the interactions among these key economic variables. Moving forward, our analysis progresses to the estimation of the Sims model, which serves as a cornerstone of our empirical framework. Drawing upon the insights gleaned from the preceding steps, we employ appropriate time series regression techniques to quantify the relationships among domestic investment, environmental quality, and economic growth. Through rigorous estimation procedures, we seek to elucidate the causal linkages and dynamics driving the observed patterns in our data. In the final step, we undertake diagnostic tests to evaluate the quality and stability of our estimated model. These tests encompass a range of diagnostic procedures, including residual analysis, goodness-of-fit tests, and stability tests, aimed at assessing the robustness and reliability of our empirical findings. By subjecting our model to rigorous scrutiny, we ensure that our conclusions are well-founded and statistically sound, providing valuable insights into the nexus between domestic investment, environmental quality, and economic growth in the United States. Through the systematic execution of these five steps, our empirical exploration aims to contribute to a deeper understanding of the complex interactions shaping the economic landscape of the United States, offering valuable insights for policymakers, researchers, and practitioners alike.

4.1. Analysis of Stationarity

According to Dickey and Fuller [78] the Dickey and Fuller [78] (ADF) test is a statistical test used to determine the presence of a unit root in a time series, thereby assessing the stationarity of the series. Mathematically, the ADF test is based on a regression of the first difference of the series on its lagged values and a time trend term. Here is the regression specification for the ADF test:

$$\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \gamma_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \qquad (5)$$

In equation (5):

- 'Δy_t' represents the first difference of the variable y_t.
- 't' is the time trend.
- 'α, β, γ, δ_i' are coefficients to be estimated.
- 'ε_t' is the error term.

Table 2.
Test for Unit Test ADF.

Order of Integration		**At Level**			**At First Difference**		
Variables		**Ln (Y)**	**Ln (DI)**	**Ln (EQ)**	**Ln (Y)**	**Ln (DI)**	**Ln (EQ)**
With Constant	t-Statistic	-1.6150	-2.0557	-1.4549	-5.2219	-3.5207	-2.1569
	Prob.	0.4636	0.2630	0.5416	0.0002	0.0140	0.2254
With Constant & Trend	t-Statistic	-1.2881	-2.8460	-2.1641	-5.7614	-3.6549	-6.3571
	Prob.	0.8729	0.1928	0.4913	0.0003	0.0412	0.0001
Without Constant & Trend	t-Statistic	7.2610	2.2015	-0.1153	-1.2062	-2.5708	-2.1963
	Prob.	1.0000	0.9918	0.6354	0.2034	0.0119	0.0293

The null hypothesis of the ADF test is that the time series has a unit root, meaning it is non-stationary. The alternative hypothesis is that the series is stationary. The test then compares the calculated test statistic with critical values to determine if the null hypothesis can be rejected. By subjecting our variables to the ADF test, we aim to determine whether they exhibit unit roots, indicating non-stationarity, or if they are stationary in their levels or first differences. Table 2 provides an overview of the results obtained from applying the ADF test to our variables. Notably, all variables demonstrate stationarity in their first differences, as evidenced by the absence of unit roots. This implies that the variables are integrated of order 1, indicating that they exhibit a stable behavior over time after differencing once. This means that we have applied the ADF test to our variables and found that all variables are stationary after the first difference. In other words, they do not exhibit trend or systematic behavior over time once we have taken the first difference. This allows us to consider the data as stationary and confidently use them in our subsequent econometric analyses.

4.2. Determination of the Number of Lags

To ascertain the appropriate number of lags incorporated into our model and according to Hannan and Quinn [79]; Burnham and Anderson [80]; Sachs [6] and Akaike [81] we utilize a selection of information criteria including Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn Criterion (HQ), and Schwarz Criterion (SC). Table 3 provides an overview of the results obtained from employing these criteria. Notably, the optimal lag length is determined to be 2 according to the FPE, AIC, and HQ criteria.

Table 3.
VAR Lag Order Selection Criteria.

VAR Lag Order Selection Criteria						
Endogenous variables: Ln (Y) Ln (DI) Ln (EQ)						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	214.8584	NA	1.47e-10	-14.12390	-13.98378*	-14.07907
1	225.1720	17.87682	1.36e-10	-14.21147	-13.65099	-14.03216
2	237.2070	18.45367*	1.13e-10*	-14.41380*	-13.43296	-14.10002*

Note: * indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion.

In our case, the consistent selection of a lag length of 2 across the FPE, AIC, and HQ criteria suggests that this lag length strikes an optimal balance between model complexity and explanatory power, thereby enhancing the accuracy of our model estimates. This systematic approach to lag length selection ensures that our model is appropriately specified and robust to potential biases or overfitting, thereby enhancing the reliability and validity of our econometric analyses. Through careful consideration of these information criteria, we can confidently determine the optimal number of lags to incorporate into our model, facilitating accurate and insightful analysis of the relationships among our variables of interest.

4.3. Cointegration Analysis

In this phase of our analysis, we employ the Johansen test to examine the presence of cointegration among the variables incorporated in our model, namely Ln (Y), Ln (DI), and Ln (EQ). Cointegration signifies the existence of long-term equilibrium relationships among these variables, which is crucial for understanding their interconnected dynamics. The Johansen Trace test is used to test the null hypothesis of non-cointegration in a system of variables. According to Akaike [81] mathematically, the Johansen Trace test is based on the eigenvalues of the covariance matrices between the variables in an estimated VAR (Vector Autoregression) model. The Johansen Trace test statistic is calculated as follows:

$$\Lambda = -T \sum_{i=k+1}^{r} \mathrm{Ln}\,(1-\lambda_i) \qquad (6)$$

Where:

- 'Λ' is the Johansen Trace test statistic.
- 'T' represents the sample size (number of observations).
- 'k' is the number of lags used in the VAR model.
- 'r' is the number of cointegrating vectors tested.
- 'λ_i' are the eigenvalues of the estimated VAR model.

The sum is taken over the eigenvalues from 'k+1' to 'r', where 'r' is the maximum number of cointegrating vectors tested. These eigenvalues are derived from the estimation of the VAR model. The test statistic is then multiplied by '-T' to obtain the final value. This test statistic is compared to critical values from the chi-squared distribution to determine the significance of cointegration in the system. If the test statistic exceeds the critical values, it indicates the rejection of the null hypothesis of no cointegration, suggesting the presence of cointegration in the system.

Table 4.
Johansen Test.

Trend assumption: Linear deterministic trend				
Series: Ln (Y) Ln (DI) Ln (EQ)				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob****
None *	0.708110	55.59254	29.79707	0.0000
At most 1 *	0.287346	18.65117	15.49471	0.0162
At most 2 *	0.246439	8.488369	3.841466	0.0036

Note: Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
** Kakar and Khilji [82]p-values

Upon conducting the Johansen test, the results presented in Table 4 affirm the presence of 3 cointegration relationships among the variables. This indicates that there are linear combinations of Ln (Y), Ln (DI), and Ln (EQ) that exhibit stable, long-term relationships, implying a shared stochastic trend among them. Because of the identified cointegration relationships, we opt to retain the Vector Error Correction Model (VECM). The VECM is particularly suited for modeling systems with cointegrated variables, as it captures both short-term dynamics and long-run equilibrium adjustments. By incorporating the error correction mechanism, the VECM allows us to analyze the deviations from long-term equilibrium and the subsequent adjustments towards it. Thus, based on the evidence from the Johansen test indicating the presence of cointegration among our variables, we proceed with the utilization of the VECM framework. This ensures that our model appropriately accounts for the long-term relationships among Ln (Y), Ln (DI), and Ln (EQ), facilitating a comprehensive analysis of their interdependencies and dynamics over time.

4.4. Estimation of VECM Models

The Vector Error Correction Model (VECM) serves as a powerful tool in econometrics for analyzing the dynamic relationships between multiple time series variables. In this context, we present the cointegration equations for long-term relationships and the error correction equations for short-term adjustments within the VECM framework. These equations offer insights into the interdependencies among Ln (Y) (logarithm of gross domestic product), Ln (DI) (logarithm of gross fixed capital formation), and Ln (EQ) (logarithm of CO2 emissions) over time. The cointegration equations provide a framework for understanding the long-term equilibrium relationships among the variables. They depict how changes in one variable affect the others over extended periods.

$$\Delta Y_t = \beta_{1,0} + \beta_{1,1}\Delta DI_t + \beta_{1,2}\Delta EQ_t + \varepsilon_{1,t} \qquad (7)$$

$$\Delta DI_t = \beta_{2,0} + \beta_{2,1}\Delta Y_t + \beta_{2,2}\Delta EQ_t + \varepsilon_{2,t} \qquad (8)$$

$$\Delta EQ_t = \beta_{3,0} + \beta_{3,1}\Delta Y_t + \beta_{3,2}\Delta DI_t + \varepsilon_{3,t} \qquad (9)$$

The error correction equations complement the cointegration equations by incorporating short-term adjustments towards long-term equilibrium. These equations, represented by (10), (11), and (12), highlight how deviations from equilibrium in the previous period are corrected over time.

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$$\Delta Y_t = \alpha_{1,0} + \sum_{i=1}^{p} \alpha_{1,i}\, \Delta Y_{t-i} + \gamma_{1,1}\left(Y_{t-1} - \widehat{Y}_{t-1}\right) + \gamma_{1,1}\left(DI_{t-1} - \widehat{DI}_{t-1}\right) + \gamma_{1,1}\left(EQ_{t-1} - \widehat{EQ}_{t-1}\right) + \varepsilon_{1,t} \quad (10)$$

$$\Delta DI_t = \alpha_{2,0} + \sum_{i=1}^{p} \alpha_{2,i}\, \Delta DI_{t-i} + \gamma_{2,1}\left(Y_{t-1} - \widehat{Y}_{t-1}\right) + \gamma_{2,2}\left(DI_{t-1} - \widehat{DI}_{t-1}\right) + \gamma_{2,3}\left(EQ_{t-1} - \widehat{EQ}_{t-1}\right) + \varepsilon_{2,t} \quad (11)$$

$$\Delta EQ_t = \alpha_{3,0} + \sum_{i=1}^{p} \alpha_{3,i}\, \Delta EQ_{t-i} + \gamma_{3,1}\left(Y_{t-1} - \widehat{Y}_{t-1}\right) + \gamma_{3,2}\left(DI_{t-1} - \widehat{DI}_{t-1}\right) + \gamma_{3,3}\left(EQ_{t-1} - \widehat{EQ}_{t-1}\right) + \varepsilon_{3,t} \quad (12)$$

In these equations:

- ΔY_t, $\Delta DI_t$and ΔEQ_t represent the first differences of Ln (Y), Ln (DI), and Ln (EQ) respectively.
- Y_{t-1}, DI_{t-1} and EQ_{t-1} are the lagged values of Ln (Y), Ln (DI), and Ln (EQ).
- $\widehat{Y}_{t-1}$, $\widehat{DI}_{t-1}$ and $\widehat{EQ}_{t-1}$ are the projected values of Ln (Y), Ln (DI), and Ln (EQ) respectively.
- $\alpha_{i,j}$ and $\gamma_{i,j}$ are the coefficients to be estimated.
- $\boldsymbol{\varepsilon}_{1,t}$, $\boldsymbol{\varepsilon}_{2,t}$ and $\boldsymbol{\varepsilon}_{3,t}$ represent the error terms.

The presented VECM equations offer a comprehensive framework for analyzing both long-term relationships and short-term adjustments among Ln (Y), Ln (DI), and Ln (EQ). By incorporating cointegration and error correction mechanisms, the model enables a nuanced understanding of the dynamic interactions between these key economic variables. This analytical approach is invaluable for policymakers, researchers, and practitioners seeking to gain deeper insights into the complex dynamics of economic growth, investment, and environmental quality.

Table 5.
Estimation of VECM Model in the long run.

	Ln (Y)	**Ln (DI)**	**Ln (EQ)**
Ln (Y)	-	3.442968**	1.760281**
Ln (DI)	0.000290***	-	-0.000511**
Ln (EQ)	0.568091***	-1.955920**	-
C	0.023566***	8.113854**	0.041484**
ECT	-1.554511***	-0.001281**	-0.606155**

Note: ***; ** and * indicate significance at 1%, 5% and 10%, respectively
ECT : Error Correction Term.

To ascertain the existence of long-term relationships among the variables included in our model, we rely on stringent econometric criteria. According to these criteria, the presence of significant long-term relationships is typically characterized by negative coefficients for the error correction terms, with a probability of occurrence below 5%. This condition is pivotal to affirm the robustness and significance of the long-term equilibrium equations. In our analysis, Table 5 reveals that all three long-term equilibrium equations exhibit negative error correction term coefficients, all statistically significant at the 5% probability level or lower. This finding clearly indicates the presence of long-term relationships among the examined variables.

In the context of the United States, the results from estimating the long-term VECM model, as presented in Table 5, reveal significant economic implications. Firstly, it is observed that the variable representing domestic investments, Ln (DI), has a positive effect on economic growth, Ln (Y). Specifically, a 1% increase in domestic investments leads to a 0.0002% increase in economic growth. This finding underscores the importance of domestic investments in driving long-term economic growth in the United States. Policymakers may consider policies aimed at encouraging domestic investments to foster sustainable economic growth in the country. Secondly, the results also indicate that the variable representing environmental quality, Ln (EQ), has a positive effect on economic growth, Ln (Y). Specifically, a 1% increase in environmental quality leads to a 0.568091% increase in economic growth. This suggests that efforts to improve environmental quality may have positive long-term economic ramifications in the United States. Policies focused on environmental protection and pollution reduction could thus contribute to supporting economic growth while preserving natural resources and promoting citizen well-being.

Within the framework of estimating the long-term VECM model, an important observation emerges when domestic investments, represented by Ln (DI), are considered as the variable to be explained. Firstly, it is observed that economic growth, Ln (Y), has a positive effect on domestic investments. Specifically, a 1% increase in economic growth leads to a 3.442968% increase in domestic investments. This suggests that economic growth can stimulate domestic investments in the long term, reflecting a pattern where an expanding economy encourages businesses to invest more to capitalize on growth opportunities. Furthermore, it is also noted that environmental quality, Ln (EQ), has a negative effect on domestic investments. Specifically, a 1% increase in environmental quality leads to a 1.955920% decrease in domestic investments. This observation highlights a potential dilemma between environmental preservation goals and economic investment stimulation. Stricter environmental regulations, while essential for preserving natural resources and mitigating climate change impacts, may also exert downward pressure on domestic investments by increasing compliance costs and limiting development opportunities.

In the analysis of the long-term VECM model, when considering environmental quality, represented by Ln (EQ), as the variable to be explained, significant observations emerge. Firstly, it is noted that economic growth, Ln (Y), positively affects environmental quality. Specifically, a 1% increase in economic growth leads to a 1.760281% increase in environmental quality. This suggests a positive link between economic growth and environmental quality improvement, potentially resulting from increased investments in clean technologies and environmentally friendly policies favored by a growing economy. Moreover, it is also observed that domestic investments, Ln (DI), negatively affect environmental quality. Specifically, a 1% increase in domestic investments leads to a 0.000511% decrease in environmental quality. This observation highlights a potential trade-off between economic growth objectives and environmental preservation. High levels of domestic investments may be associated with increased exploitation of natural resources and higher pollution emissions, which can have a negative impact on environmental quality.

The results of the long-term VECM model estimation highlight the significance of domestic investment and environmental quality in fostering long-term economic growth in the United States. These findings provide valuable insights for crafting economic and environmental policies aimed at promoting sustainable and balanced growth in the country. These results underscore the complex interactions among economic growth, domestic investment, and environmental quality over the long term, while also highlighting the potential challenges associated with reconciling these objectives. An integrated approach that promotes sustainable economic growth while preserving and enhancing environmental quality is essential for ensuring viable and balanced long-term economic development.

In the Vector Error Correction Model (VECM), understanding the short-term dynamics among variables is fundamental to grasping the system's behavior. To achieve this understanding, we rely on the WALD test, a widely recognized tool in econometrics. This test plays a critical role in identifying causal links between variables, which are essential for uncovering the intricate interactions within the model. As per established econometric principles, the significance level of the WALD test carries significant implications: When the probability associated with the WALD test drops below 5%, it signifies a statistically significant causal relationship between the variables being studied. Conversely, probabilities exceeding 5% indicate the absence of a substantial causal connection between the variables. Analyzing the findings presented in Table 6 through the lens of these principles' sheds light on the short-term dynamics within our model. Specifically, for each dependent variable ‘Ln (Y), Ln (DI), and Ln (EQ)’, the outcomes of the WALD test offer valuable insights into the causal relationships with the explanatory variables ‘Ln (DI), Ln (EQ), and Ln (Y)’, respectively.

Table 6.
Estimation of VECM Model in the short run.

VEC Granger Causality/Block Exogeneity Wald Tests			
Dependent variable: Ln (Y)			
Excluded	**Chi-sq**	**df**	**Prob.**
Ln (DI)	8.477982	2	0.0144
Ln (EQ)	7.083573	2	0.0290
All	21.11127	4	0.0003
Dependent variable: Ln (DI)			
Excluded	Chi-sq	df	Prob.
Ln (Y)	2.110983	2	0.3480
Ln (EQ)	10.62107	2	0.0049
All	14.89347	4	0.0049
Dependent variable: Ln (EQ)			
Excluded	Chi-sq	df	Prob.
Ln (Y)	10.48448	2	0.0053
Ln (DI)	16.85963	2	0.0002
All	18.97216	4	0.0008

In the context of the United States, the short-term dynamics between variables, as revealed by the WALD test outcomes in Table n°6, hold significant economic implications. For the dependent variable Ln (Y), the probabilities of 0.0144 for Ln (DI) and 0.0290 for Ln (EQ) indicate statistically significant causal relationships at the 5% significance level. This suggests that changes in domestic investment (DI) and environmental quality (EQ) have significant short-term effects on economic growth (Y) in the US. Such findings are crucial for policymakers and investors alike, as they highlight the importance of considering both investment and environmental factors when assessing short-term economic prospects. Conversely, when examining the dependent variable Ln (DI), the probabilities of 0.3480 for Ln (Y) and 0.0049 for Ln (EQ) offer valuable insights. While the probability associated with Ln (EQ) suggests a significant short-term causal relationship, the higher probability for Ln(Y) implies a lack of significant short-term causality between domestic investment and economic growth. This underscores the nuanced nature of economic relationships, where certain variables may exert more immediate influence than others. Similarly, exploring the dependent variable Ln (EQ) uncovers probabilities of 0.0053 for Ln (Y) and 0.0002 for Ln (DI), indicating significant short-term causal relationships at the 5% significance level. This implies that changes in both economic growth and domestic investment can have notable short-term impacts on environmental quality in the US, highlighting the interconnectedness of economic and environmental factors.

4.5. Checking the Credibility of Empirical Results

Incorporating diagnostic tests into the analysis, as outlined in Table 7, represents a commendable approach aimed at evaluating the robustness of VECM (Vector Error Correction Model) frameworks and ensuring the reliability of the derived results. These diagnostic procedures encompass a range of tests, including those for heteroscedasticity such as the Breusch-Pagan-Godfrey, Harvey, Glejser, and ARCH tests, alongside the Breusch-Godfrey Serial Correlation LM Test, collectively forming a pivotal stage in the validation process of the econometric model. The outcomes of these diagnostic assessments, which indicate that the associated probabilities from both the heteroscedasticity tests and the Breusch-Godfrey LM serial correlation test surpass the 5% threshold, suggest that the estimation results are deemed acceptable. Such findings imply the absence of substantial evidence to refute the null hypotheses pertaining to homoscedasticity and the absence of serial correlation, respectively. Essentially, these results affirm that the model exhibits satisfactory performance in adhering to assumptions related to consistent error variance and the lack of serial correlation. By undergoing this robustness verification process, the credibility of our findings is significantly bolstered, thereby ensuring that the efficacy of the model remains uncompromised by potential issues such as heteroscedasticity or serial correlation.

Table 7.
Diagnostics Tests.

Dependent variable: Ln (Y)			
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.311091	Prob. F(12,16)	0.3012
Heteroskedasticity Test: Harvey			
F-statistic	1.011023	Prob. F(12,16)	0.4817
Heteroskedasticity Test: Glejser			
F-statistic	1.506917	Prob. F(12,16)	0.2187
Heteroskedasticity Test: ARCH			
F-statistic	0.040056	Prob. F(2,24)	0.9608
Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.276937	Prob. F(2,19)	0.3018
Dependent variable: Ln (DI)			
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.350912	Prob. F(12,16)	0.2824
Heteroskedasticity Test: Harvey			
F-statistic	1.908479	Prob. F(12,16)	0.1133
Heteroskedasticity Test: Glejser			
F-statistic	1.770970	Prob. F(12,16)	0.1417
Heteroskedasticity Test: ARCH			
F-statistic	2.327110	Prob. F(2,24)	0.1192
Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	2.561712	Prob. F(2,19)	0.1035
Dependent variable: Ln (EQ)			
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.691711	Prob. F(12,16)	0.1614
Heteroskedasticity Test: Harvey			
F-statistic	2.399659	Prob. F(12,16)	0.0520
Heteroskedasticity Test: Glejser			
F-statistic	2.230092	Prob. F(12,16)	0.0677
Heteroskedasticity Test: ARCH			
F-statistic	0.493029	Prob. F(2,24)	0.6168
Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.916769	Prob. F(2,19)	0.1745

We will evaluate the normality of the residuals of our VECM models using the Jarque-Bera test, a statistical method commonly used for this purpose. According to a well-established econometric rule, if the probability associated with the Jarque-Bera test exceeds 5%, this confirms the robustness of the results of our model. In other words, a probability above this threshold suggests that the residuals follow a normal distribution, which is crucial to ensure the validity of the underlying assumptions of our VECM model. Thus, by performing this normality check, we will ensure that our econometric results are reliable and precise, thus strengthening the credibility of our conclusions.

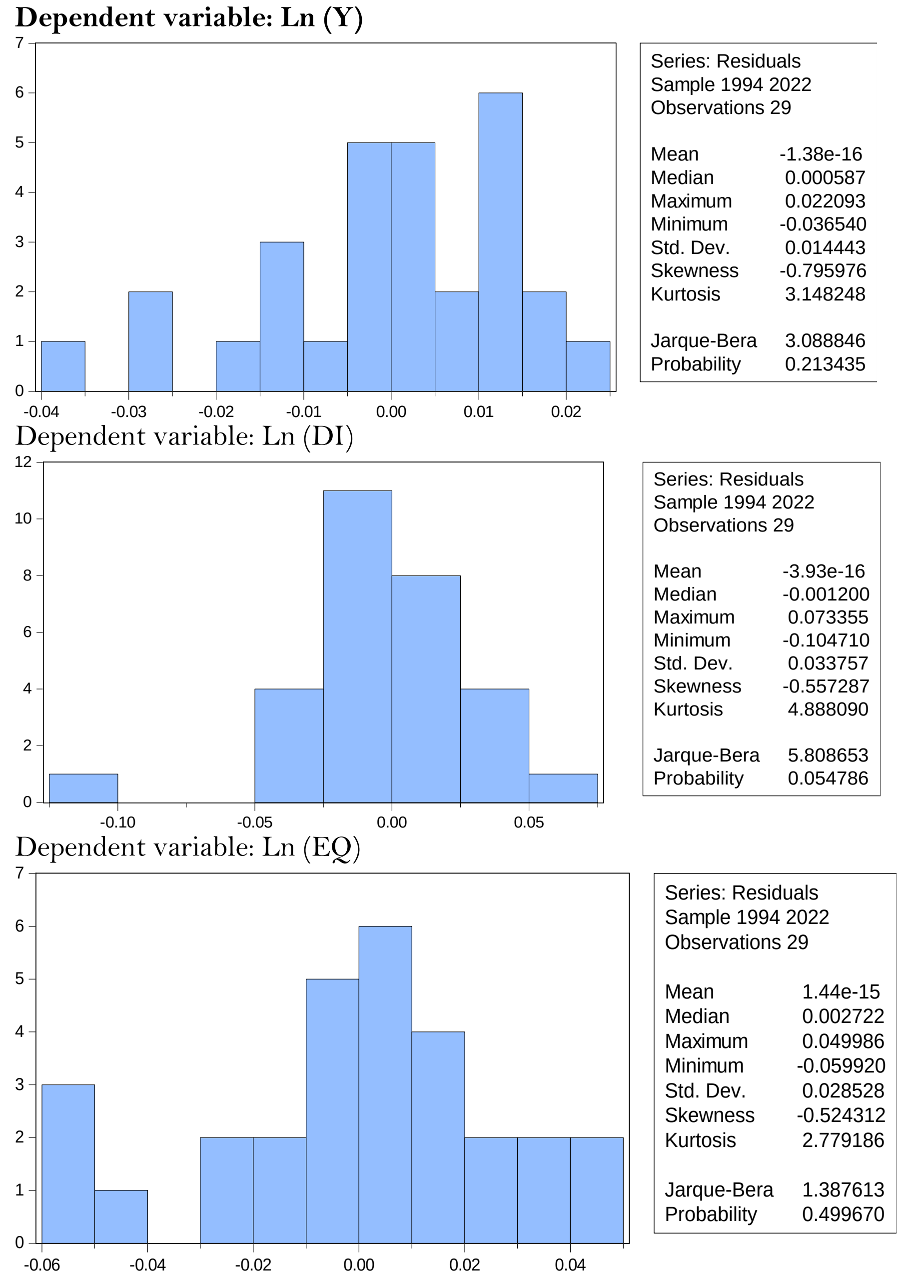

Figure 1.
Normality Tests.

Figure 1 presents the conclusions drawn from the normality tests conducted on our data. It is evident to us that all probabilities from the Jarque-Bera test exceed the 5% threshold. This observation is significant as it confirms the robustness of our estimations and enhances the confidence we can place in our results. Indeed, in accordance with the well-established econometric rule, probabilities exceeding 5% in the Jarque-Bera test indicate that our data exhibit a normal distribution of residuals, which is essential for validating the fundamental assumptions of our econometric analysis. Thus, this confirmation of residual normality reinforces the reliability of our estimations and the credibility of the conclusions we can draw from them, thereby strengthening the robustness of our analysis.

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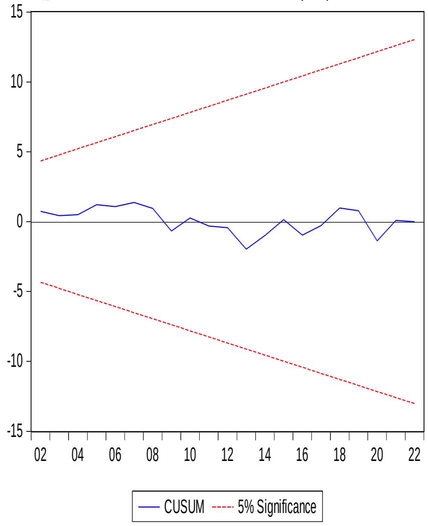
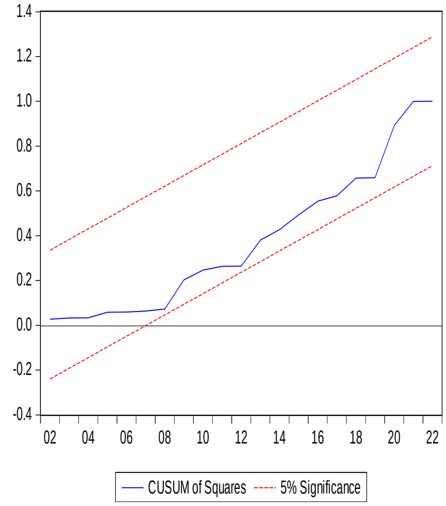
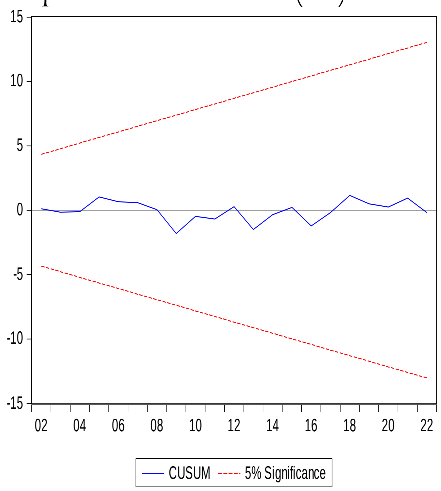
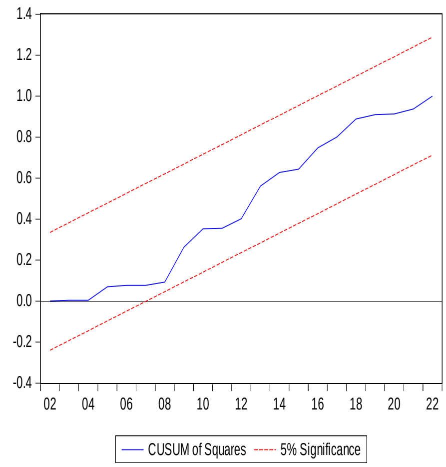
Dependent variable: Ln (Y)





Dependent variable: Ln (DI)





Dependent variable: Ln (EQ)

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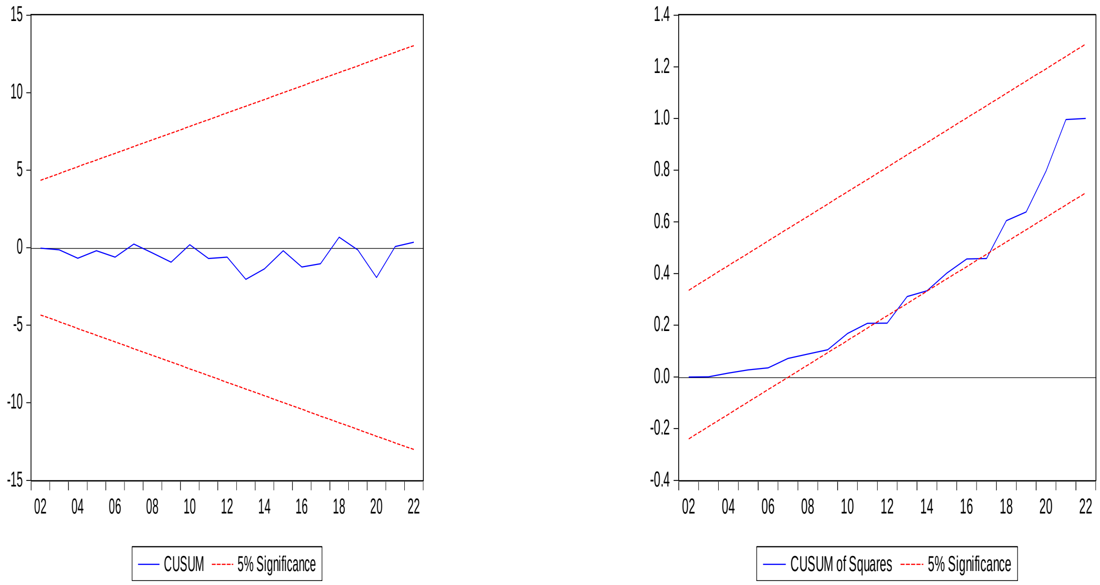


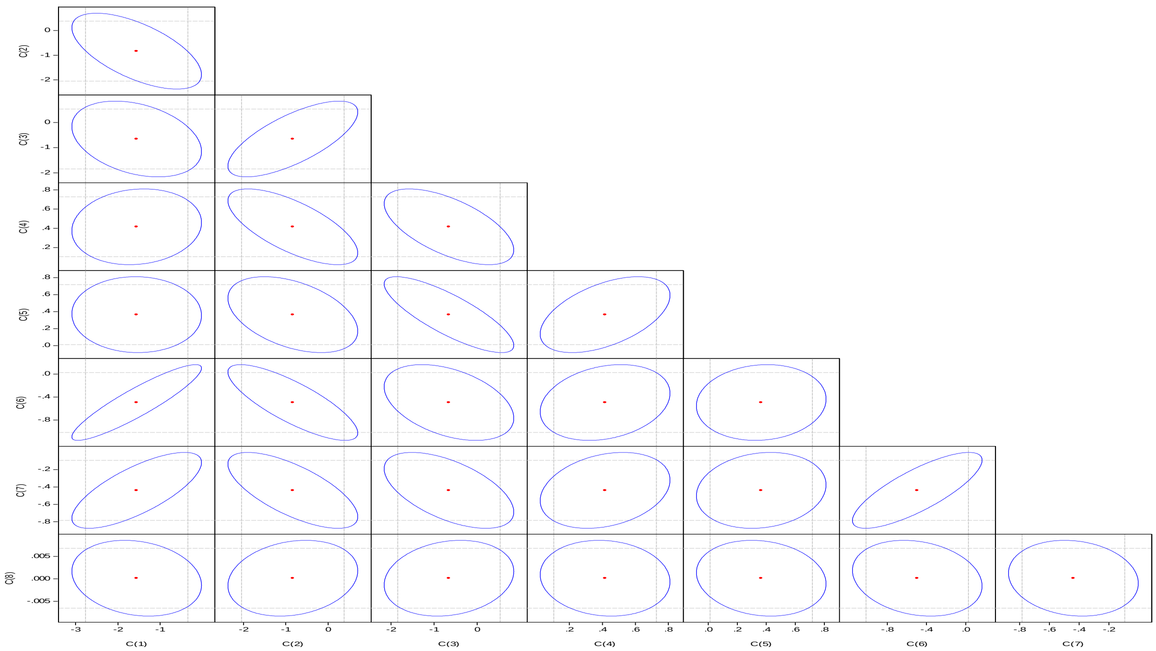
Figure 2.
Stability Models.

Checking the stability of the VECM model is a crucial step in econometric analysis, often conducted using tests such as the Cumulative Sum (CUSUM) test and the CUSUM Square test. These tests are widely recognized in econometric literature for their ability to detect structural changes in the relationships between variables over time. According to Hamilton [83] verifying the stability of model parameters is essential to ensure the validity of econometric conclusions. The CUSUM test cumulatively evaluates deviations of model coefficients from their expected mean values, while the CUSUM Square test examines the squares of these deviations, providing a more sensitive analysis to structural changes Bai and Perron [84]. An appropriate interpretation of the results of these tests is crucial for assessing the stability of underlying economic relationships. If the CUSUM or CUSUM Square graph shows significant fluctuations or pronounced trends, it suggests instability in the model coefficients, which can compromise the validity of estimations and econometric conclusions [85]. Verifying the stability of the VECM model through CUSUM and CUSUM Square tests provides assurance regarding the reliability of econometric estimations and helps researchers detect potential structural changes in the relationships between variables over time. These tests thus offer a valuable tool for robust analysis of economic data and evidence-based decision-making.

Figure 2 illustrates the findings derived from the stability tests, namely the Cusum Test and the Cusum square test. It is evident to us that all these tests yield significant results, allowing us to conclude that our models are stable. These tests were carefully selected to assess the stability of our VECM models, as they are widely recognized in the econometric literature for their ability to detect structural changes in the relationships between variables over time. Analyzing the results of these tests provides us with additional assurance regarding the robustness of our models and the validity of our econometric conclusions. Indeed, significant results indicate that our models are capable of effectively capturing the underlying economic relationships and are less likely to be influenced by unforeseen changes in the data. Thus, these findings bolster our confidence in the reliability of our analyses and support the relevance of our results for informed decision-making.

According to Morrison [86]; Johnson and Wichern [87]; Cook and Weisberg [88]; Hand and Taylor [89] and Everitt [90] and in the context of Vector Error Correction Models (VECM), confidence ellipses graphically represent the dispersion of parameter estimates around their estimated mean values. They serve as tools to assess the precision and reliability of estimates in econometric analyses. The significance of confidence ellipses lies in various aspects: Firstly, they offer a visual depiction of estimate dispersion, showcasing how estimates may vary and providing insights into precision. Secondly, the size of the confidence ellipse indicates precision, with smaller, tighter ellipses suggesting greater precision and larger ellipses indicating more uncertainty in estimates.

Dependent variable: Ln (Y)



Dependent variable: Ln (DI)

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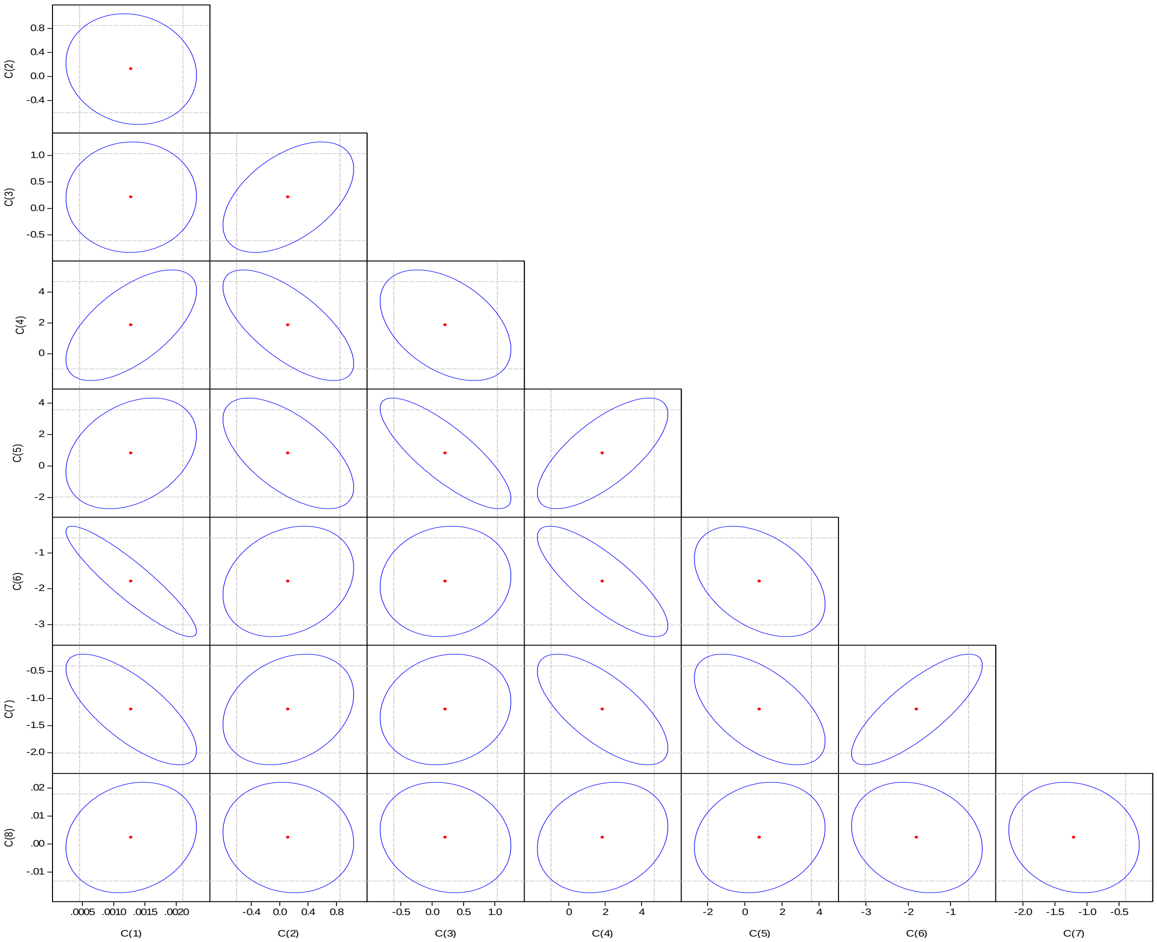

Dependent variable: Ln (EQ)

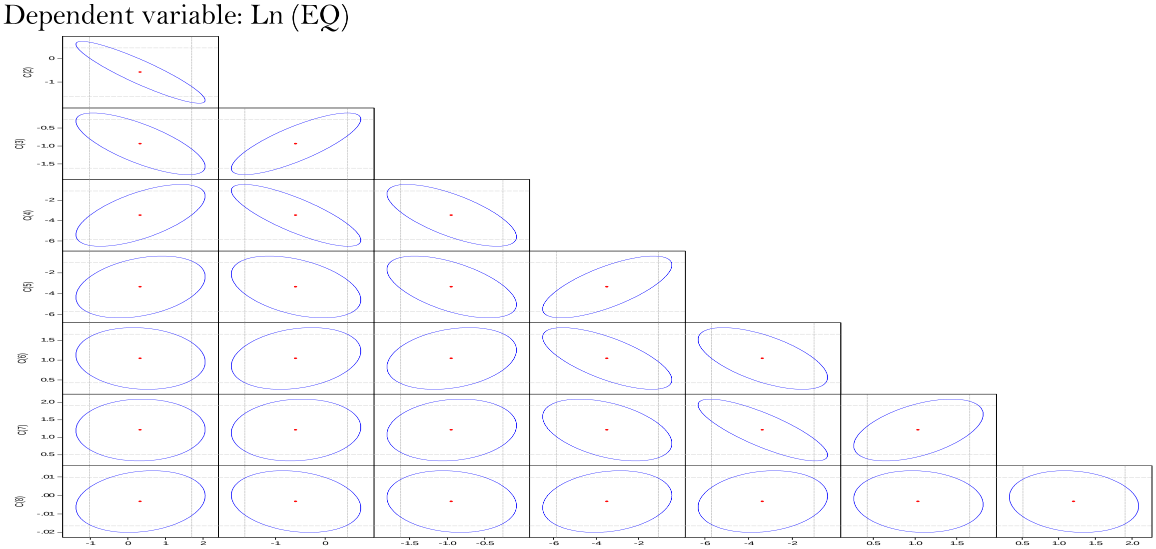

Figure 3.
Confidence Ellipse.

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Additionally, confidence ellipses assist in identifying influential or outlier observations that could impact model validity, enabling analysts to evaluate their relevance and potential inclusion or exclusion from the model based on economic significance. Furthermore, parameter estimates typically need to fall within confidence ellipses to be considered statistically significant, with estimates outside the ellipses indicating potential lack of precision or uncertainty, thereby questioning their reliability. It is evident to us from Figure 3 that the confidence ellipses are significant, indicating that the parameter estimates of the model are statistically reliable. By confirming the significance of the confidence ellipses, we validate the accuracy of the estimates and strengthen the credibility of our econometric results. Thus, these findings confirm that the parameter estimates of the VECM model are robust and trustworthy for informing economic decisions and future analyses.

5. Conclusions and Recommendations

Our research delves into the complex interplay among domestic investments, environmental quality, and economic growth within the United States over the extensive period spanning from 1990 to 2022. Employing a robust methodology grounded in cointegration estimation and the vector error correction model (VECM), our investigation has unearthed several pivotal insights into the dynamics governing these relationships. Primarily, our longitudinal analysis illuminates a symbiotic relationship between domestic investments and economic growth. This revelation underscores the pivotal role of investments in propelling economic expansion, facilitating job creation, and nurturing innovation – all critical components for fostering sustainable growth trajectories. Furthermore, our examination reveals a mutually reinforcing bidirectional relationship between environmental quality and economic growth over the long term. This discovery underscores the intrinsic linkage between environmental sustainability and economic prosperity. It suggests that endeavors aimed at enhancing environmental quality can yield positive economic outcomes, including bolstered public health, augmented ecosystem services, and heightened resilience against the adverse impacts of climate change. However, a noteworthy revelation from our study is the concerning negative bidirectional relationship observed between environmental quality and domestic investments over the long term. This finding underscores the urgency for policy interventions aimed at mitigating the deleterious environmental repercussions stemming from economic activities. Failing to address this issue could entail detrimental consequences for both the environment and the economy in the long run. In the short term, our empirical findings illuminate a unidirectional relationship from domestic investments to economic growth, indicating a positive impact on short-term economic performance. Additionally, we discern a bidirectional causality between domestic investments and environmental quality, as well as between environmental quality and economic growth in the short term. Our study underscores the imperative of embracing integrated policies that foster inclusive and sustainable economic growth while safeguarding environmental quality. Achieving this necessitates a comprehensive approach that acknowledges the interdependence of economic, social, and environmental factors, thereby paving the way for a resilient and thriving future.

Drawing from the insights gleaned from our study, we proffer a series of innovative and strategic recommendations tailored to policymakers, aimed at navigating the intricate nexus between domestic investments, environmental quality, and economic growth. Firstly, policymakers should prioritize the implementation of Green Stimulus Packages. These packages should be meticulously crafted to incentivize investments in environmentally friendly sectors such as renewable energy, clean transportation, and sustainable agriculture. By injecting capital into these sectors, policymakers can stimulate economic growth while simultaneously advancing environmental sustainability objectives. Moreover, it is imperative for policymakers to fortify Environmental Regulations. Stringent measures must be enacted and rigorously enforced to curtail the deleterious effects of economic activities on environmental quality. Comprehensive regulations should encompass strategies to mitigate pollution, conserve natural resources, and combat climate change, thus safeguarding ecological integrity for present and future generations. In pursuit of sustainable economic development, fostering robust Public-Private Partnerships is indispensable. Policymakers should actively cultivate collaborations

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between the public and private sectors, harnessing their collective expertise and resources to finance and execute projects that foster economic growth while upholding environmental sustainability goals. Such partnerships hold the potential to catalyze innovation and drive progress across diverse sectors of the economy. Furthermore, redirecting investments towards Green Infrastructure initiatives represents a prudent course of action. Prioritizing investments in energy-efficient buildings, sustainable transportation systems, and green spaces not only creates employment opportunities but also bolsters economic growth while concurrently enhancing environmental quality. By investing in infrastructure that aligns with sustainability principles, policymakers can lay the foundation for resilient and thriving communities. Lastly, policymakers must actively promote Sustainable Consumption and Production practices. By incentivizing businesses to adopt environmentally friendly technologies and practices, policymakers can mitigate resource consumption, reduce waste generation, and alleviate environmental degradation. This proactive approach not only fosters economic efficiency but also cultivates a culture of sustainability that resonates across society. By embracing these multifaceted recommendations, policymakers can chart a course towards long-term harmonious and sustainable economic development in the United States. By fostering innovation, collaboration, and responsible stewardship of resources, policymakers can usher in an era of prosperity that is inextricably linked with environmental resilience, ensuring a vibrant and sustainable future for generations to come.

While our study offers valuable insights into the complex dynamics between domestic investments, environmental quality, and economic growth in the United States, it is essential to acknowledge its inherent limitations, which warrant consideration for future research and policy development. Firstly, the temporal scope of our analysis spanning from 1990 to 2022 may impose constraints on the generalizability of our findings. Economic and environmental conditions are subject to dynamic fluctuations over time, influenced by a myriad of factors such as policy changes, technological advancements, and global economic trends. Thus, our study's reliance on data from this specific timeframe may not fully capture the nuances of contemporary economic and environmental dynamics, necessitating further research incorporating more recent data. Secondly, while we employed rigorous econometric methodologies, including cointegration estimation and vector error correction models (VECM), to analyze the relationships between variables, our study is not immune to methodological limitations. Assumptions inherent in these methodologies, such as linearity and stationarity, may not fully capture the complex and nonlinear nature of the interactions between domestic investments, environmental quality, and economic growth. Additionally, our study may be susceptible to omitted variable bias or endogeneity issues, which could potentially influence the accuracy and robustness of our empirical results. Furthermore, our study primarily focuses on examining the relationships between key variables at the national level, overlooking potential regional disparities and heterogeneities within the United States. Economic and environmental dynamics may vary significantly across different regions due to varying industrial compositions, regulatory frameworks, and socio-economic conditions. Consequently, our findings may not fully capture the nuanced complexities present at the regional level, highlighting the importance of future research that adopts a more granular approach to analysis. Additionally, while our study emphasizes the importance of adopting integrated policies to promote sustainable economic growth and environmental preservation, the translation of these recommendations into actionable policy measures poses practical challenges. Policymaking involves navigating intricate political, social, and economic considerations, and the implementation of comprehensive policies may encounter resistance from vested interests or face feasibility constraints. Thus, the real-world applicability and efficacy of our recommendations necessitate careful consideration of institutional capacities, stakeholder engagement, and policy feasibility.

Our study offers significant contributions to the understanding of the relationships between domestic investments, environmental quality, and economic growth in the United States. However, it is crucial to recognize the inherent limitations of our research, which underscore the need for future investigations to further enhance our understanding of these complex dynamics. One avenue for future research involves incorporating more recent data to provide a comprehensive and up-to-date analysis of the relationships under study. Economic and environmental conditions are subject to continuous change, influenced by evolving policies, technological advancements, and global trends. By utilizing recent data, researchers can capture the latest developments and trends, enabling a more accurate assessment of the dynamics between domestic investments, environmental quality, and economic growth. Additionally, future studies should focus on refining methodological approaches to address potential limitations and enhance the robustness of findings. This may entail exploring alternative econometric techniques, such as panel data analysis or structural equation modeling, to provide a deeper understanding of the causal relationships between variables. By employing rigorous methodological frameworks, researchers can mitigate biases and uncertainties, thereby strengthening the validity and reliability of their analyses. Furthermore, research efforts should consider the spatial heterogeneity and regional disparities that exist within the United States. Economic and environmental dynamics may vary significantly across different regions due to variations in industrial structures, resource endowments, and policy contexts. Future studies could adopt a regional approach to analysis, examining how local factors influence the relationships between domestic investments, environmental quality, and economic growth. By considering regional nuances, researchers can develop targeted policy recommendations tailored to specific geographical contexts, thus enhancing the effectiveness and relevance of policy interventions. Moreover, future research should pay closer attention to the practical challenges of policy implementation and stakeholder engagement. While theoretical frameworks and empirical analyses provide valuable insights, translating these findings into actionable policy measures requires careful consideration of institutional capacities, political dynamics, and stakeholder interests. Researchers should collaborate with policymakers, industry stakeholders, and civil society organizations to ensure that research findings inform evidence-based decision-making and facilitate the implementation of effective policy interventions.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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References

[1] D. Dollar and A. Kraay, "Growth is Good for the Poor," *Journal of economic growth*, vol. 7, pp. 195-225, 2002. https://doi.org/10.1023/A:1020139631000
[2] R. J. Barro, "Human capital and growth," *American Economic Review*, vol. 91, no. 2, pp. 12-17, 2001.
[3] N. Stern, *The economics of climate change: The Stern review*. Cambridge: Cambridge University Press, 2007.
[4] J. E. Stiglitz, *The price of inequality: How today's divided society endangers our future*. New York: W. W. Norton & Company, 2012.
[5] Congressional Budget Office, "The distribution of household income," Retrieved: https://www.cbo.gov/publication/56379, 2021.
[6] J. D. Sachs, *The age of sustainable development*. Columbia University Press. https://doi.org/10.7312/sach17314-014, 2015.
[7] Millennium Ecosystem Assessment, *Ecosystems and human well-being*. Synthesis: Island Press, 2005.
[8] W. N. Adger, S. Huq, K. Brown, D. Conway, and M. Hulme, "Adaptation to climate change in the developing world," *Progress in development studies*, vol. 3, no. 3, pp. 179-195, 2003. https://doi.org/10.1191/1464993403ps060oa
[9] World Commission on Environment and Development, *Our common future*. Oxford: Oxford University Press, 1987.
[10] World Bank, *World development report 2018: Learning to realize education's promise*. Washington, DC: World Bank, 2018.
[11] D. Rodrik, "Industrial development: Stylized facts and policies," Working Paper 2. Centre for the Study of African Economies, University of Oxford. https://drodrik.scholar.harvard.edu/sites/scholar.harvard.edu/files/dani-rodrik/files/industrial-development.pdf, 2013.

[12] J. E. Stiglitz, A. Sen, and J. P. Fitoussi, "Report by the commission on the measurement of economic performance and social progress commission on the measurement of economic performance and social progress," Retrieved: https://www.cbs.nl/-/media/imported/documents/2011/36/stiglitzsenfitoussireport_2009.pdf, 2009.
[13] D. Acemoglu and J. A. Robinson, *Why nations fail: The origins of power, prosperity, and poverty*. New York: Crown Business, 2012.
[14] UICN (Union internationale pour la conservation de la nature), "More than 500 newly endangered species described in North America," Retrieved: https://www.iucn.org/fr/news/north-america/201909/plus-de-500-especes-nouvellement-en-danger-d%C3%A9crites-en-am%C3%A9rique-du-nord, 2019.
[15] Bureau of Economic Analysis, "Gross domestic product, fourth quarter and year 2020 (Advance Estimate)," Retrieved: https://www.bea.gov/sites/default/files/2021-01/gdp4q20_adv_0.pdf, 2021.
[16] Federal Reserve, "Industrial production and capacity utilization," Retrieved: https://www.federalreserve.gov/releases/g17/current/default.htm, 2021.
[17] Internal Revenue Service (IRS), "Tax cuts and jobs act," Retrieved: https://www.irs.gov/newsroom/tax-cuts-and-jobs-act, 2021.
[18] Information Technology Industry Council (ITI), "IT industry contribution to U.S. GDP surpasses $1.3 trillion in 2020," Retrieved: https://www.itic.org/news-events/news-releases/it-industry-contribution-to-us-gdp-surpasses-1-3-trillion-in-2020, 2021.
[19] National Association of Manufacturers (NAM), "Manufacturing institute releases new data on investment in American manufacturing," Retrieved: https://www.nam.org/press-releases/manufacturing-institute-releases-new-data-on-investment-in-american-manufacturing/, 2021.
[20] EPA (Agence de protection de l'environnement des États-Unis), "Clean watersheds needs survey 2018 report to congress," Retrieved: https://www.epa.gov/sites/default/files/2020-12/documents/ow-infrastructure-2020.pdf, 2020.
[21] EPA (Agence de protection de l'environnement des États-Unis), "Inventory of U.S. Greenhouse gas emissions and sinks: 1990-2018," Retrieved: https://www.epa.gov/sites/default/files/2020-01/documents/emissions_inventory_2020_annual_report-prepublication.pdf, 2020.
[22] G. C. Iyer *et al*., "Improved representation of investment decisions in assessments of CO2 mitigation," *Nature Climate Change*, vol. 5, no. 5, pp. 436-440, 2015. https://doi.org/10.1038/nclimate2553
[23] NASA (National Aeronautics and Space Administration), "NASA, NOAA analyses reveal 2019 second warmest year on record," Retrieved: https://www.nasa.gov/press-release/nasa-noaa-analyses-reveal-2019-second-warmest-year-on-record, 2020.
[24] T. Ghazouani and S. Maktouf, "Impact of natural resources, trade openness, and economic growth on CO2 emissions in oil-exporting countries: A panel autoregressive distributed lag analysis. In Natural Resources Forum (Vol. 48, No. 1, pp. 211-231)." Oxford, UK: Blackwell Publishing Ltd, 2024.
[25] C. Magazzino, "Ecological footprint, electricity consumption, and economic growth in China: Geopolitical risk and natural resources governance," *Empirical Economics*, vol. 66, no. 1, pp. 1-25, 2024. https://doi.org/10.1007/s00181-023-02460-4
[26] P. Mitić, M. Kojić, J. Minović, S. Stevanović, and M. Radulescu, "An EKC-based modelling of CO2 emissions, economic growth, electricity consumption and trade openness in Serbia," *Environmental Science and Pollution Research*, vol. 31, no. 4, pp. 5807-5825, 2024. https://doi.org/10.1007/s11356-023-31617-y
[27] R. K. Ritu and A. Kaur, "Towards environmental sustainability: nexus of ecological footprint, human capital, economic growth and energy consumption in India," *Management of Environmental Quality: An International Journal*, vol. 35, no. 1, pp. 179-200, 2024. https://doi.org/10.1108/MEQ-06-2023-0172
[28] O. A. Somoye, "Assessing the link between energy intensity, renewable energy, economic growth, and carbon dioxide emissions: Evidence from Turkey," *Environmental Quality Management*, vol. 34, no. 1, p. e22220, 2024. https://doi.org/10.1002/tqem.22220
[29] Y. Zhang, K. Zheng, F. Xia, and Z. Cheng, "Fintech, natural resource rents, renewable energy consumption and environmental quality: A perspective of green economic recovery from BRICS economies," *Resources Policy*, vol. 89, p. 104604, 2024. https://doi.org/10.1016/j.resourpol.2023.104604
[30] Q. H. Nguyen, "The influence of key economic globalization factors on economic growth and environmental quality: An empirical study in Southeast Asian countries," *The Journal of International Trade & Economic Development*, vol. 33, no. 1, pp. 57-75, 2024. https://doi.org/10.1080/09638199.2022.2159060
[31] O. Olaoye, "Environmental quality, energy consumption and economic growth: evidence from selected African countries," *Green and Low-Carbon Economy*, vol. 2, no. 1, pp. 28-36, 2024. https://doi.org/10.47852/bonviewGLCE3202802
[32] S. Bakari, A. Othmani, and M. Mabrouki, "Pollution and economic growth: a new vision for the tunisian economy," *Journal of Smart Economic Growth*, vol. 6, no. 2, pp. 1-17, 2021.
[33] S. Bakari, *Assessing the impact of domestic investments and co2 emissions on economic growth in sub-saharan africa: A comprehensive study (1990-2022) (No. 120370)*. Germany: University Library of Munich, 2024.
[34] S. Bakari and M. El Weriemmi, *Causality between domestic investment and economic growth in Arab countries (No. 113077)*. Germany: University Library of Munich, 2022.

[35] C. E. Yameogo and R. O. Dauda, "The effect of income inequality and economic growth on environmental quality: A comparative analysis between Burkina Faso and Nigeria," *Journal of Public Affairs*, vol. 22, no. 3, p. e2566, 2022. https://doi.org/10.1002/pa.2566

[36] S. Wang, M. W. Zafar, D. G. Vasbieva, and S. Yurtkuran, "Economic growth, nuclear energy, renewable energy, and environmental quality: Investigating the environmental Kuznets curve and load capacity curve hypothesis. Gondwana Research," Retrieved: https://doi.org/10.1016/j.gr.2023.06.009. [Accessed 2023.

[37] H. Zhang, P. Wang, and J. Wood, "Does institutional quality matter for the nexus between environmental quality and economic growth?: A tropics perspective in business, industry, and trade in the tropics." Abingdon, UK: Routledge, 2022, pp. 33-52.

[38] Z. Shokoohi, N. K. Dehbidi, and M. H. Tarazkar, "Energy intensity, economic growth and environmental quality in populous Middle East countries," *Energy*, vol. 239, p. 122164, 2022. https://doi.org/10.1016/j.energy.2021.122164

[39] M. Donkor, Y. Kong, E. K. Manu, A. H. Ntarmah, and F. Appiah-Twum, "Economic growth and environmental quality: analysis of government expenditure and the causal effect," *International Journal of Environmental Research and Public Health*, vol. 19, no. 17, p. 10629, 2022. https://doi.org/10.3390/ijerph191710629

[40] N. Gafsi and S. Bakari, "Unveiling the influence of green taxes, renewable energy adoption, and digitalization on environmental sustainability in g7 countries," *International Journal of Energy Economics and Policy*, vol. 15, no. 3, pp. 735-757, 2025.

[41] N. Gafsi and S. Bakari, "Unlocking the green growth puzzle: Exploring the nexus of renewable energy, CO2 emissions, and economic prosperity in G7 countries," *International Journal of Energy Economics and Policy*, vol. 15, no. 2, pp. 236-247, 2025.

[42] N. Gafsi and S. Bakari, "Macroeconomic determinants of economic growth: Empirical validation on the case of African countries," *International Journal of Innovative Research and Scientific Studies*, vol. 8, no. 3, pp. 643–666, 2025. https://doi.org/10.53894/ijirss.v8i3.6590

[43] N. Gafsi and S. Bakari, "Impacts of agricultural CO2 emissions, agricultural exports and financial development on economic growth: insights from East Asia and Pacific countries," *International Journal of Energy Economics and Policy*, vol. 14, no. 6, pp. 136-153, 2024.

[44] O. Kurbanov, "Foreign direct investment and domestic investment on the economic growth of the Uzbekistan-A VECM Analysis," *Scientific Research Archive*, vol. 1, no. 4, 2020.

[45] Q. Abbas, M. Nurunnabi, Y. Alfakhri, W. Khan, A. Hussain, and W. Iqbal, "The role of fixed capital formation, renewable and non-renewable energy in economic growth and carbon emission: A case study of Belt and Road Initiative project," *Environmental Science and Pollution Research*, vol. 27, pp. 45476-45486, 2020. https://doi.org/10.1007/s11356-020-10413-y

[46] A. E. Ozegbe and R. O. Yussuff, "Assessment of domestic investment, export expansion and economic performance in Nigeria: A vector autoregression approach," *Journal of Economics, Management and Trade*, vol. 28, no. 7, pp. 29-46, 2022. https://doi.org/10.9734/jemt/2022/v28i730423

[47] S. Magdalena and R. Suhatman, "The effect of government expenditures, domestic invesment, foreign invesment to the economic growth of primary sector in Central Kalimantan," *Budapest International Research and Critics Institute-Journal*, vol. 3, no. 3, pp. 1692-1703, 2020. https://doi.org/10.33258/birci.v3i3.1101

[48] T. Govdeli, "Economic growth, domestic savings and fixed capital investments: analysis for Caucasus and central asian countries," *Montenegrin Journal of Economics*, vol. 18, no. 3, pp. 145-153, 2022. http://doi.org/10.14254/1800-5845/2022.18-3.12

[49] R. Sijabat, "The association of economic growth, foreign aid, foreign direct investment and gross capital formation in Indonesia: Evidence from the Toda–Yamamoto approach," *Economies*, vol. 10, no. 4, p. 93, 2022. https://doi.org/10.3390/economies10040093

[50] T. Kobayakawa, "The carbon footprint of capital formation: An empirical analysis on its relationship with a country's income growth," *Journal of Industrial Ecology*, vol. 26, no. 2, pp. 522-535, 2022. https://doi.org/10.1111/jiec.13199

[51] H. T. Nguyen, H. N. Luu, and N. H. Do, "The dynamic relationship between greenfield investments, cross-border M&As, domestic investment and economic growth in Vietnam," *Economic Change and Restructuring*, vol. 54, no. 4, pp. 1065-1089, 2021. https://doi.org/10.1007/s10644-020-09292-7

[52] S. Amjed and I. A. Shah, "Does financial system development, capital formation and economic growth induces trade diversification?," *Journal of Economics and Development*, vol. 23, no. 3, pp. 222-237, 2021. https://doi.org/10.1108/JED-06-2020-0073

[53] M. Miao, D. G. Borojo, J. Yushi, and T. A. Desalegn, "The impacts of Chinese FDI on domestic investment and economic growth for Africa," *Cogent Business & Management*, vol. 8, no. 1, p. 1886472, 2021. https://doi.org/10.1080/23311975.2021.1886472

[54] J. E. Mkadmi, S. Bakari, and A. Othmani, *The impact of tax revenues and domestic investments on economic growth in Tunisia (No. 108387)*. Germany: University Library of Munich, 2021.

[55] N. Fakraoui and S. Bakari, "Tie among domestic investment, exports and economic growth: Empirical analysis from India," *Journal of Smart Economic Growth*, vol. 4, no. 1, pp. 1-15, 2019. https://jseg.ro/index.php/jseg/article/view/55

[56] S. Bakari, "The impact of domestic investment on economic growth new policy analysis from Algeria," *Bulletin of Economic Theory and Analysis*, vol. 3, no. 1, pp. 35-51, 2018. https://doi.org/10.25229/beta.337367
[57] S. Bakari, "The relationship between export, import, domestic investment and economic growth in Egypt: Empirical analysis," *Euro Economica*, vol. 36, no. 02, pp. 34-43, 2017.
[58] S. Bakari, "Does domestic investment produce economic growth in Canada: Empirical analysis based on correlation, cointegration and causality," *International Academic Journal of Science and Engineering*, vol. 5, no. 1, pp. 56-72, 2016. https://doi.org/10.9756/IAJSE/V5I1/1810006
[59] E. U. Osiobe, "Human capital, capital stock formation, and economic growth: A panel granger causality analysis," *Journal of Economics and Business*, vol. 3, no. 2, 2020.
[60] O. N. B. Emmanuel, D. C. Fonchamnyo, M. A. Thierry, and G. D. Dinga, "Ecological footprint in a global perspective: the role of domestic investment, FDI, democracy and institutional quality," *Journal of Global Responsibility*, vol. 14, no. 4, pp. 431-451, 2023. https://doi.org/10.1108/JGR-09-2022-0091
[61] K. Zhang, J. Dong, L. Huang, and H. Xie, "China's carbon dioxide emissions: An interprovincial comparative analysis of foreign capital and domestic capital," *Journal of Cleaner Production*, vol. 237, p. 117753, 2019. https://doi.org/10.1016/j.jclepro.2019.117753
[62] B. B. Bekoe, J. Chen, T. O. Tougem, E. Nketiah, and K. Sakuwunda, "Does domestic investment matter? A multivariate time series analysis of the energy-CO2 emission-growth nexus in Ghana," *Environmental Science and Pollution Research*, vol. 30, no. 17, pp. 49536-49550, 2023. https://doi.org/10.1007/s11356-023-25347-4
[63] Y. Liu, Y. Gao, and Y. Hao, "Gospel or disaster? An empirical study on the environmental influences of domestic investment in China," *Journal of Cleaner Production*, vol. 218, pp. 930-942, 2019. https://doi.org/10.1016/j.jclepro.2019.01.333
[64] A. V. Adejumo and S. A. Asongu, "Foreign direct investment, domestic investment and green growth in Nigeria: Any spillovers?," Springer International Publishing. https://doi.org/10.1007/978-3-030-26759-9_50, 2020, pp. 839-861.
[65] Z. Xiao and M. Qamruzzaman, "Nexus between green investment and technological innovation in BRI nations: What is the role of environmental sustainability and domestic investment?," *Frontiers in Environmental Science*, vol. 10, p. 993264, 2022. https://doi.org/10.3389/fenvs.2022.993264
[66] M. Ge *et al.*, "Does foreign private investment affect the clean industrial environment? Nexus among foreign private investment, CO2 emissions, energy consumption, trade openness, and sustainable economic growth," *Environmental Science and Pollution Research*, vol. 29, no. 18, pp. 26182-26189, 2022. https://doi.org/10.1007/s11356-022-18814-x
[67] A. O. Zubair, A.-R. A. Samad, and A. M. Dankumo, "Does gross domestic income, trade integration, FDI inflows, GDP, and capital reduces CO2 emissions? An empirical evidence from Nigeria," *Current Research in Environmental Sustainability*, vol. 2, p. 100009, 2020. https://doi.org/10.1016/j.crsust.2020.100009
[68] Y. Liu, Y. Hao, and Y. Gao, "The environmental consequences of domestic and foreign investment: Evidence from China," *Energy Policy*, vol. 108, pp. 271-280, 2017. https://doi.org/10.1016/j.enpol.2017.05.055
[69] Z. Khan, M. Ali, D. Kirikkaleli, S. Wahab, and Z. Jiao, "The impact of technological innovation and public-private partnership investment on sustainable environment in China: Consumption-based carbon emissions analysis," *Sustainable Development*, vol. 28, no. 5, pp. 1317-1330, 2020. https://doi.org/10.1002/sd.2086
[70] M. Shahbaz, C. Raghutla, M. Song, H. Zameer, and Z. Jiao, "Public-private partnerships investment in energy as new determinant of CO2 emissions: the role of technological innovations in China," *Energy Economics*, vol. 86, p. 104664, 2020. https://doi.org/10.1016/j.eneco.2020.104664
[71] B. Muhammad and S. Khan, "Effect of bilateral FDI, energy consumption, CO2 emission and capital on economic growth of Asia countries," *Energy Reports*, vol. 5, pp. 1305-1315, 2019. https://doi.org/10.1016/j.egyr.2019.09.004
[72] X. Zhao, X. Zhang, and S. Shao, "Decoupling CO2 emissions and industrial growth in China over 1993–2013: The role of investment," *Energy Economics*, vol. 60, pp. 275-292, 2016. https://doi.org/10.1016/j.eneco.2016.10.008
[73] R. M. Solow, "A contribution to the theory of economic growth," *The quarterly journal of economics*, vol. 70, no. 1, pp. 65-94, 1956. https://doi.org/10.2307/1884513
[74] R. J. Barro and X. Sala-i-Martin, *Economic growth*. New York: McGraw-Hill, 1995.
[75] P. Dasgupta and K.-G. Mäler, "Net national product, wealth, and social well-being," *Environment and development economics*, vol. 5, no. 1, pp. 69-93, 2000. https://doi.org/10.1017/S1355770X00000061
[76] R. E. Lucas Jr, "On the mechanics of economic development," *Journal of monetary economics*, vol. 22, no. 1, pp. 3-42, 1988. https://doi.org/10.1016/0304-3932(88)90168-7
[77] P. M. Romer, "Endogenous technological change," *Journal of political Economy*, vol. 98, no. 5, Part 2, pp. S71-S102, 1990. https://doi.org/10.1086/261725
[78] D. A. Dickey and W. A. Fuller, "Distribution of the estimators for autoregressive time series with a unit root," *Journal of the American statistical association*, vol. 74, no. 366a, pp. 427-431, 1979. https://doi.org/10.1080/01621459.1979.10482531
[79] E. J. Hannan and B. G. Quinn, "The determination of the order of an autoregression," *Journal of the Royal Statistical Society: Series B (Methodological)*, vol. 41, no. 2, pp. 190-195, 1979. https://doi.org/10.1111/j.2517-6161.1979.tb01072.x

[80] K. P. Burnham and D. R. Anderson, *Model selection and multimodel inference: A practical information-theoretic approach*, 2nd ed. New York: Springer-Verlag, 2002.
[81] H. Akaike, "A new look at the statistical model identification," *IEEE transactions on automatic control*, vol. 19, no. 6, pp. 716-723, 2003. https://doi.org/10.1007/978-1-4612-1694-0_16
[82] Z. K. Kakar and B. A. Khilji, "Impact of FDI and trade openness on economic growth: A comparative study of Pakistan and Malaysia," *Theoretical and Applied Economics*, vol. 11, no. 11, p. 53, 2011.
[83] J. D. Hamilton, *Time series analysis*. Princeton, NJ: Princeton University Press, 1994.
[84] J. Bai and P. Perron, "Estimating and testing linear models with multiple structural changes," *Econometrica*, pp. 47-78, 1998. https://doi.org/10.2307/2998540
[85] W. Enders, *Applied econometric time series*. John Wiley & Sons, 2015.
[86] D. F. Morrison, *Multivariate statistical methods*. New York: McGraw-Hill, 1967.
[87] R. A. Johnson and D. W. Wichern, *Applied multivariate statistical analysis*. Upper Saddle River: Pearson Education, 2007.
[88] R. D. Cook and S. Weisberg, *An introduction to regression graphics*. New York: John Wiley & Sons, 1994.
[89] D. J. Hand and C. C. Taylor, *Multivariate analysis of variance and repeated measures: A practical approach for behavioural scientists*. Chapman and Hall, 1987.
[90] B. S. Everitt, *An R and S-Plus companion to multivariate analysis*. New York: Springer, 2006.