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THE IMPACT FINANCIAL DEVELOPMENT ON CARBON EMISSIONS: A SYSTIMATC REVIEW OF THE LITERATURE

Mohamed Khudari [a,] *, Feras Darweesh [b], Nor Salwati Othman [c]

Master in Business Management. College of Graduate Studies, Universiti Tenaga Nasional (UNITEN). Selangor, Malaysia. Orcid: https://orcid.org/0009-0004-1639-8495

B PhD in Economics. Senior Lecturer. College of Graduate Studies, Universiti Tenaga Nasional (UNITEN). Selangor, Malaysia. Orcid: https://orcid.org/0000-0002-8953-2323

C PhD in Energy Economics. Senior Lecturer. College of Business Management and Accounting, Universiti Tenaga Nasional (UNITEN). Selangor, Malaysia. Orcid: https://orcid.org/0000-0002-5976-5484

a b s t r a c t

This research examines the complex relationship between financial development and carbon emissions. This strategy emphasises distinguishing industrialised and developing nations due to their different economic circumstances. The research assumes that carbon emissions rise as economies and financial systems grow. It is vital to understand the root reasons for this scenario. The research shows that financial development has two effects on carbon emissions. Financial institutions allow businesses that may not value environmental sustainability to grow, which can increase carbon emissions. However, financial development can reduce carbon emissions by supporting green technology and practices. The research uses a thorough literature review to synthesise and interpret the vast empirical research data. Study methods, components, and timeframes from previous studies are carefully reviewed. Although findings vary, the analysis shows that countries with well-developed financial systems perform better environmentally. Their ability to promote green technologies and pollution reduction programmes gives them this advantage. The report also finds a research gap, highlighting the need for a more comprehensive study of the complicated relationship between financial development and carbon emissions. According to this statement, green financial instruments encourage environmentally sustainable projects and investments, reduce emissions, and alleviate state development inequities. The study illuminates policy effects for policymakers. This shows that an advanced financial system could enable environmentally friendly economic growth. This shows that governments and financial organisations may boost economic growth and environmental protection by enacting intelligent policies and offering incentives. The report thoroughly examines the complex relationship between financial development and carbon emissions, offering insights into balancing economic expansion with environmental protection.

Keywords: Carbon Emissions, Financial Sector Development, Industrial Activities

1. Introduction

Jordan, a nation in the Middle East that is currently in the process of development, has experienced notable and swift economic expansion in recent times. The financial sector has emerged as a crucial catalyst in driving this advancement. Nevertheless, this expansion has been accompanied by a notable drawback: a rise in carbon emissions. Understanding the complex interplay between the development of the financial sector and carbon emissions is of utmost importance for policymakers in Jordan to tackle this challenge successfully. The financial sector in Jordan is comprised of many entities, such as banks, insurance firms, and other financial organisations, and has experienced significant growth. As an example, it can be observed that the aggregate assets of the banking industry experienced an increase from JOD 36.2 billion in 2015 to JOD 44.4 billion in 2020. The expansion has been driven by a rise in loan disbursements to diverse industries, encompassing energy-intensive sectors such as construction, manufacturing, and services.

Nevertheless, the current economic growth has resulted in an increase in carbon emissions, primarily attributed to the energy-intensive characteristics of these industries, which significantly depend on fossil fuels. Jordan relies heavily on imported fossil fuels to satisfy its energy requirements, leading to a noteworthy escalation in carbon emissions. Based on data provided by the World Bank, there was a notable increase in carbon dioxide emissions in Jordan, with levels rising from 14.2 million metric tonnes in 2010 to 24.7 million metric tonnes in 2018.

The correlation between the expansion of the financial industry and Jordan's carbon emissions is complex and multi-dimensional. Financial sector development has the potential to contribute to the mitigation of carbon emissions through funding for initiatives such as renewable energy projects, energy-efficient buildings, and green infrastructure. On the contrary, it is possible to additionally facilitate an increase in carbon emissions by providing financial support to projects that heavily rely on fossil fuels, such as coal-fired power plants, or by extending loans to enterprises with a substantial carbon footprint. Hence, achieving a harmonious equilibrium between advancing the financial sector and mitigating carbon emissions is of utmost importance. It is recommended that policymakers in Jordan actively promote investments by the financial sector in renewable energy projects and energy-efficient infrastructure while opposing investments in endeavours reliant on fossil fuels. Furthermore, adopting measures such as implementing carbon pricing mechanisms and promoting green bonds is efficacious in motivating the financial industry to give precedence to initiatives to reduce carbon emissions. Adopting a balanced approach is essential to cultivate sustainable economic growth while simultaneously addressing the environmental consequences that arise from the expansion of the financial sector in Jordan.

In conclusion, the interplay between the financial sector's expansion and Jordan's carbon emissions is characterised by an intricate and diverse nature. Policymakers endeavour to achieve a harmonious equilibrium between economic expansion and environmental sustainability by promoting low-carbon project investments within the financial sector while concurrently opposing investments in high-carbon projects. This measure will guarantee the sustainability of Jordan's economic growth while mitigating any environmental impacts. The Sustainable Development Goals (SDGs) refer to 17 worldwide objectives officially endorsed by the United Nations General Assembly in 2015. These goals were established to advance sustainable development and tackle prevalent global issues, including but not limited to poverty, inequality, climate change, and environmental degradation. The interplay between the expansion of the financial sector and carbon emissions in Jordan exhibits a strong correlation with specific Sustainable expansion Goals (SDGs), notably:

Goal 7: Affordable and Clean Energy - Jordan substantially relies on imported fossil fuels to fulfil its energy requirements, resulting in a notable escalation in carbon emissions. Hence, the promotion of renewable energy and energy efficiency within the financial sector has the potential to mitigate carbon emissions and foster the use of clean energy sources in Jordan. Goal 8, which focuses on Decent Work and Economic progress, highlights the significant contribution of the financial industry in Jordan towards the country's economic development. This sector has been pivotal in fostering job creation and facilitating overall economic progress. Nevertheless, this expansion has consequently led to a rise in carbon emissions. Hence, it is imperative to foster sustainable economic growth detached from carbon emissions to accomplish this objective. Goal 9 focuses on Industry, Innovation, and Infrastructure, intending to foster sustainable infrastructure and innovation within the financial sector. By doing so, Jordan may effectively mitigate carbon emissions and stimulate sustainable economic development. Goal 13, which focuses on Climate Action, highlights Jordan's susceptibility to the adverse effects of climate change, such as water scarcity, heat waves, and extreme weather occurrences. Hence, it is imperative to implement measures to decrease carbon emissions within the financial sector to address the consequences of climate change effectively and foster sustainable development in Jordan. Goal 17 of the United Nations Sustainable Development Goals (SDGs) focuses on establishing partnerships to achieve the various goals outlined in the SDGs. The attainment of sustainable development in Jordan necessitates establishing collaborative efforts among the government, corporate sector, and civil society. Hence, it is imperative to foster collaborations among these critical actors to advance the financial sector's sustainable growth and mitigate carbon emissions, hence facilitating the attainment of the Sustainable Development Goals (SDGs) in Jordan.

Sustainable development is commonly understood as ensuring that the utilisation of societal resources for present-day requirements is conducted at a magnitude that does not impede the ability of future generations to meet their demands. Within the framework of this particular definition, sustainable development encompasses three distinct elements, namely the economic, social, and environmental aspects. Due to this rationale, there is a growing imperative to address the escalating energy demand to attain sustainable development. This entails enhancing the quality of life for individuals, facilitating the requisite production for society, and mitigating the environmental degradation associated with utilising these resources (*Ozturk & Acaravci, 2011*). In the present day, a significant majority of nations rely on fossil fuels, namely coal and natural gas, to fulfil their energy requirements.

Consequently, the escalating energy consumption of countries has led to a corresponding rise in carbon emissions (*Elum & Momodu, 2017*). The use of fossil fuels results in the generation of residual matter comprising both solid particulates and gaseous emissions. The residue resulting from the combustion of fossil fuels is not capable of repurposing, thereby leading to environmental damage (*Dogan and Seker, 2016; Apergis et al., 2018*). In this regard, fulfilling the growing energy demand by using renewable resources such as geothermal, solar, wind, biomass, and biofuels will contribute to minimising pollution emissions from these sources, thereby promoting sustainable development. In essence, achieving sustainable development necessitates implementing enduring measures, with renewable energy sources emerging as a prevalent and efficacious answer in this regard (*Dincer, 2000*). The demand and interest in renewable energy sources have experienced notable growth due to technical advancements. This may be attributed to various factors, including the escalating levels of environmental pollution and the rapid depletion of fossil fuel reserves.

The financial system plays a crucial role in facilitating the transfer of funds from surplus spending units to the economy's productive sector, hence making substantial contributions to financial intermediation. This implies that financial instruments are employed judiciously to foster sustained prosperity and growth. Financial stability, conversely, pertains to the condition in which financial intermediaries function optimally and guarantee the seamless functioning of critical financial institutions within the economy. Environmental pollution has emerged as a significant concern during economic expansion in developing market nations. Numerous nations emphasise the finance sector as a valuable and environmentally sustainable enterprise, aiming to mitigate the adverse environmental and economic development impacts. A considerable amount of scholarly literature exists regarding the correlation between economic growth and the natural environment, yielding varied results (*Xiong et al., 2017*). *Hoffmann (2011)* asserts that in the context of developing nations, such as those in Africa, the affordability of manufacturing equipment is limited to those that are material-intensive, posing detrimental effects on the environment due to increased waste generation and carbon emissions. Recent scientific research, such as the works of *Piaggio and Padilla (2012) and Mazzanti and Musolesi (2013)*, have indicated that elevated carbon emissions harm economic development. The adverse influence of carbon emissions on economic growth is widely acknowledged in economics. However, the relationship between financial progress and carbon emissions has become a prominent subject of discussion among scholars and environmentalists, yet it remains an issue that needs more consensus. The impact of economic growth on carbon emissions can be understood through two primary theoretical frameworks: one positing that financial progress yields positive outcomes for carbon pollution and the other suggesting that it leads to negative consequences for carbon emissions. These scientific perspectives exhibit a limitation as they suggest a linear correlation between economic advancement and carbon emissions.

According to the findings of *Tamazian and Bhaskara (2010)*, the reasoning in question needs to be more efficient as it fails to consider the impact of structural changes in transitional nations on the relationship between financial progress and carbon emissions. Hao et al. (2016) provided empirical evidence supporting the assertion mentioned above, demonstrating that the impact of financial development on carbon emissions was significant solely in the context of limited economic expansion. The existing literature on the relationship between financial progress and carbon pollution and emissions is characterised by conflicting findings, a lack of agreement, and divergent perspectives. The empirical literature has identified several findings related to the impact of financial development on carbon emissions. These include the neutrality hypothesis, the feedback view, the positive effect of financial development on carbon emissions, the negative impact of financial development on carbon emissions, and the perspective that macroeconomic factors must be present before financial development (Tsaurai, 2019). The influx of international investors due to financial development in a developing country leads to an escalation in power consumption and economic activities, thus increasing carbon emissions.

Nevertheless, confident international investors invest substantially in research and development initiatives about renewable energy, therefore introducing environmentally beneficial technology characterised by minimal carbon emissions. Providing increased financial aid to domestic enterprises can enhance financial growth, leading to a rise in the quantity and magnitude of manufacturing activity within the nation. Aye, and Edoja (2017) posit a potential for an increase in soil erosion, trash generation, and carbon emissions. According to Xing et al. (2017), an expansion in consumer credit will likely result in an augmentation of the magnitude of purchases of resource-intensive products, such as machinery and vehicles.

In actuality, a nation's carbon emissions are influenced not solely by its economic level but also by its level of financial development. The increasing significance of financial development in contributing to carbon emissions remains a persistent phenomenon within an economic entity characterised by progressively complex financial systems. The facilitation of consumer loan practises by affluent and efficient financial intermediaries enables individuals to acquire high-value commodities like automobiles, residences, refrigerators, air conditioners, and washing machines, thus resulting in increased carbon dioxide emissions (Sadorsky, 2010). Moreover, the expansion of capital exchange facilitates publicly traded corporations in reducing borrowing costs, diversifying funding sources, mitigating operational risks, and optimising asset and liability arrangements. This, in turn, enables them to acquire new facilities and invest in fresh ventures, ultimately leading to heightened energy consumption and carbon emissions.

However, there needs to be more opinion among scholars considering the issues mentioned before. An illustration is shown by Tamazian et al. (2009), who argue that the advancement of finance enables specific companies to make technological advancements and embrace emerging ideas, improving energy efficiency and fostering economic development with reduced carbon emissions. Consequently, this results in a notable reduction in the rate of carbon emissions. In a study conducted by *Claessens and Feijen (2007),* it was shown that organisations with advanced governance frameworks demonstrate a greater propensity to prioritise low-carbon growth. Therefore, the opportunity exists for financial development to boost the operational efficacy of companies, resulting in decreased energy consumption and carbon emissions. Moreover, the influence of financial development on environmental quality is another significant element to consider. According to *Mishkin (2009)*, globalisation has been recognised as a catalyst for financial development. Mishkin further suggests that financial development plays a crucial role in strengthening the venture process and promoting the adoption of innovative measures to mitigate environmental emissions (*Zafar et al., 2019*). Due to this rationale, the present study has incorporated the financial development variable into the model and has examined its influence on environmental deterioration. Figure 1 illustrates the representation of carbon dioxide (CO2) emissions, financial development, and globalisation within the Middle East and North Africa (MENA) region. *Simon Kuznets (1955)* posited that income inequality initially increases and decreases with economic development. According to *Stern (2004)*, the ecological Kuznets curve postulates a theoretical relationship between several indicators of environmental degradation and per capita income. During the early stages of economic development, there is a simultaneous increase in environmental degradation and pollution. Nevertheless, over time, the increase in money fosters economic expansion, stimulating environmental enhancement. The ecological Kuznets curve frequently addresses the argument that income increases inevitably result in higher pollution levels due to the positive correlation between money and energy consumption, consequently leading to increased pollution. Theoretically, the concept of an ecological Kuznets curve acknowledges the possibility that specific causes may have the opposite effect of reducing pollution rather than increasing it. The combination of these two effects can increase pollution and subsequently decrease as income levels rise (*Carson et al., 1997*). *Grossman and Krueger (1991)* conducted a study that examined the environmental consequences of the North American Free Trade Agreement (NAFTA) and put out a hypothesis about the environmental Kuznets curve (EKC). *Shafik and Bandyopadhyay (1992)* were the first to produce a substantial paper supporting the Environmental Kuznets Curve (EKC) hypothesis.

The environmental impact of financial structure, namely the varying significance of credit and stock markets, may arise due to differential exposure or transmission pathways of industrial pollutants across different types of financing. The extant body of literature posits various factors that may contribute to banks or stock markets' relative effectiveness or ineffectiveness in mitigating environmental pollution. One prominent aspect of the existing body of research is the critical evaluation of banks' capacity to provide financial support for innovative endeavours. The existing body of literature indicates that banks have slight effectiveness in mitigating pollution, considering the significance of technical innovation as a crucial means to address environmental pollution. Multiple mechanisms may be operating. Banks often tend towards technological conservatism due to concerns that adopting new technologies, particularly potentially cleaner ones, may diminish the value of collateral supporting existing loans. This collateral typically represents older technologies considered less environmentally friendly (*Minetti, 2011*). Furthermore, financial institutions may exhibit reluctance in funding environmentally friendly technology when the associated advancements encompass intangible assets, are distinctive to a particular organization, and rely on human capital (*Hall & Lerner, 2010*). Assets of this nature pose challenges in redeployment and thus provide difficulties in collateralization (*Carpenter & Petersen, 2002*). The challenges posed by the intangibility of assets and unpredictability are particularly pronounced for start-up companies in the energy technology sector (*Nanda et al., 2015*). Furthermore, it has been argued that financial institutions may need more expertise to evaluate nascent (green) technology (*Ueda, 2004*). Aligned with the aforementioned dubious perspective about banks' role as facilitators of inventive technologies, *Hsu, Tian, and Xu (2014)* present empirical findings across many nations indicating that companies reliant on external funding and characterized by a high degree of technological sophistication exhibit reduced propensity to submit patent applications in countries boasting more advanced credit markets. Furthermore, it is worth noting that banks often operate with a shorter loan duration compared to equity investors. As a result, their level of concern regarding the potential devaluation or stranding of funded assets in the distant future may be lower.

Alternative perspectives have a more sanguine outlook regarding the capacity of banks to mitigate environmental pollution. *Levine, Lin, Wang, and Xi (2018)* demonstrate the impact of positive credit supply shocks on air pollution levels within US counties resulting from the escalated extraction of shale oil in neighbouring counties. The authors of this study provide empirical evidence to support the assertion that easing credit constraints at the firm level is associated with a reduction in the release of harmful air pollutants. Comparably, the research conducted by *Goetz (2018)* reveals that enterprises facing financial constraints exhibited a decrease in hazardous emissions when their capital costs were reduced due to the implementation of the US Maturity Extension Programme. Dasgupta, Laplante, *Wang, and Wheeler (2002)* demonstrate that financial institutions may decline to provide loans to a company if they harbour concerns regarding potential environmental liabilities. Banks' implementation of screening processes can effectively identify and eliminate the firms that exhibit the highest pollution levels. According to recent anecdotal evidence (Zeller, 2010), there is a growing indication that banks are increasingly examining industries with significant environmental impact due to concerns over potential financial and reputational consequences associated with lending to such sectors. This heightened scrutiny may be attributed to depositors holding banks accountable for their involvement in activities that visibly contribute to environmental harm (*Homanen, 2019*). The exclusive emphasis on reputational risk and environmental liability would not necessarily prevent banks with a short-term perspective from providing loans to sectors that generate significant greenhouse gas emissions despite being less visually damaging. When considering financing (green) technologies characterised by high risks and high potential returns, stock markets may be more advantageous than banks—the number 6. Equity investors may exhibit a heightened concern for prospective environmental degradation, leading to a rational adjustment of stock prices to reflect the anticipated future cash flows of industries engaged in polluting activities.

The global economy is experiencing its most severe crisis since the Great Depression of the 1930s. The influence of decreasing stock prices, global commerce, and manufacturing output on overall economic output and the labour market has thus far exhibited significantly less significance when compared to the Great Depression of the 1930s. At the onset of this crisis, there was a notable elevation in income levels and living standards. The implementation of economic policy played a significant role in mitigating the effects of the crisis. Nevertheless, tasks still need to be addressed, and the stimulus packages must be maintained (*Romer, 2009*). The duration of the crisis is uncertain and cannot be definitively determined despite the existence of empirical evidence, albeit not entirely similar to other crises. The crisis will have varying durations of impact on financial markets, the actual economy, and the job market. The time and pace of potential recovery and the necessary structural changes that may occur are yet uncertain and subject to further examination. The "post-crisis world" topic necessitates timely consideration, as it is expected to influence the selection of strategies employed to address the crisis. The prediction of financial crises (FCP) holds significant importance for financial institutions, as it seeks to mitigate future losses by assessing potential risks and refraining from extending new loan proposals when the default risk exceeds a certain threshold of acceptance. This method is sometimes called a credit default classification process, wherein a customer is categorised as "non-default" if they successfully repay the loan. In contrast, a customer is categorised as "default" if they fail to do so. The precision of the Financial Control Programme (FCP) plays a significant role in assessing the productivity and profitability of a financial organisation. For example, a slight increase in the accuracy rate of a prospective user who possesses default credit can significantly reduce the possible future losses incurred by an organisation (*Ala'raj & Abbod, 2016*).

Undoubtedly, the escalation of oil prices catalyzes the advancement of alternate energy sources. A further aspect that may elucidate this correlation is the fluctuation in the currency rate. According to *Nazlioglu and Soytas (2012)*, the devaluation of the currency rate in importing nations results in a rise in oil prices, particularly in agricultural commodity prices. This phenomenon establishes an indirect connection between the oil and commodities markets. Furthermore, the interplay between production costs in the agricultural sector and the oil-agricultural relationship may provide further insights. The escalation of oil prices directly impacts production costs, particularly in the agricultural sector, as it heavily relies on oil as a crucial input (*Mitchell, 2008; Nazlioglu, 2011*). The existing body of study about the correlation between crude oil and commodities prices has yielded diverse outcomes. One strand of the existing literature examines the relationship between crude oil price fluctuations and changes in the prices of agricultural commodities. According to *Fowowe (2016),* this strand of research suggests that crude oil price changes have no significant impact on the variations in agricultural commodity prices.

Therefore, it can be observed that Jordan possesses one of the least developed economies in the Middle East region, as evidenced by its relatively low Gross Domestic Product (GDP) of JD10.5 billion in 2019. Additionally, the country's population is approximately 6.32 million individuals, with a notable 13.3 per cent living below the poverty line (*CD-ROM, 2021*). This nation lacks significant oil production and possesses few natural resources and minerals compared to its Arab counterparts. Jordan has had significant demographic growth and an influx of migrants in recent decades, resulting in its swelling population. The country is believed to have approximately 1.5 million non-Jordanian residents.Due to a scarcity of energy resources, there exists a significant dependence on energy imports to meet the increasing energy demand of the European Commission (EC). According to The Jordanian Energy Sector Report (2012), it was projected that the EC will increase from 7.58 million tonnes of oil equivalents in 2007 to 15.08 million tonnes of oil equivalents by 2020. The escalation in oil prices has prompted the Jordanian government to revise its energy master plan. The proposed energy market master plan aims to transition the existing energy landscape, which heavily relies on oil and natural gas, towards a more diversified composition. This entails a more significant share of energy derived from nuclear power, oil shale, and renewable sources. In addition, the government of Jordan is proactively allocating funds towards various strategies, projects, and programmes to foster the development of a sustainable economy. The measures above encompassed the discontinuation of all oil subsidies in 2008, the enactment of the clean energy bill and a fiscal stimulus initiative for renewable energy and energy-efficient equipment in 2010, and the establishment of the Eco-cities platform, the Eco-financing seminar, and the Zarqa river restoration project in 2021 (*Green et al., 2020).*

2. Problem Statement

In recent decades, a notable emphasis has been placed on the formulation of measures and legislation designed to safeguard the environment and promote sustainable development. The process above entails distributing financial resources to enhance the capabilities of environmental organizations and promote collaboration among nations, with the ultimate objective of expediting and attaining sustainable development (Ismael et al., 2018). A notable illustration of such dedication is evident in the case of Jordan, which committed the 15th Conference of the Parties (COP 15) in Copenhagen in 2009 to decrease its carbon dioxide (CO2) emissions substantially. The country set a target of achieving a 40% reduction by 2020, relative to the baseline of 2005. In order to achieve this objective, the government of Jordan is now examining many policy alternatives. These include the implementation of environmental standards, the imposition of carbon taxes, the adoption of energy conservation measures, the implementation of land-use reforms, and the allocation of resources towards renewable energy projects (Othman & Jafari, 2016).

Despite the widespread recognition of climate change concerns on a global scale, the emission levels of greenhouse gases, specifically carbon dioxide, persistently escalate, exacerbating the phenomenon of global warming and precipitating environmental calamities. Academic researchers have extensively analyzed the complex correlation between economic development and carbon emissions, highlighting the prominent Environmental Kuznets Curve (EKC) theory introduced by Grossman and Krueger (1995). According to Jiang and Ma (2019), the EKC hypothesis proposes a curvilinear association between economic development and environmental quality, characterized by an inverse U-shaped pattern.

In the context of Jordan, there has been a notable rise in carbon emissions over time, even though the average emissions between 1970 and 2020 have stayed lower than the global average (*World et al., 2021*). The phenomenon mentioned above has resulted in an increasing amount of scholarly works that emphasize the existential peril presented by emissions to both human existence and the attainment of sustainable socio-economic development (*Li et al., 2019*). In response to these urgent environmental concerns, sustainability has gained significant prominence in diverse industries such as manufacturing, agriculture, and finance. The emission of carbon dioxide (CO2) has exhibited a persistent upward trend, resulting in detrimental outcomes such as the escalation of global warming, alterations in climatic patterns, contamination of water and air, and degradation of the environment (*IEA, 2015; Kazdin, 2009; Stern, 2011; Swim et al., 2011; Robertson & Barling, 2013; Al-Mulali et al., 2015)*. This phenomenon has resulted in a growing global focus on monitoring and mitigating carbon emissions and the development of low-carbon economies (Mundaca & Markandya, 2016). In this particular setting, the financial sector is crucial in promoting economic growth by facilitating capital allocation from institutions to productive sectors. According to *Shahbaz (2013),* using financial intermediation decreases processing and information expenses, hence augmenting the competitiveness of credit-seeking enterprises. The private finance industry in Jordan has exhibited notable expansion, as seen by an 8.3% surge by January 2016. Moreover, there has been a substantial rise of around 127% in private-sector funding within the country from January 2014 to January 2016. The circumstances above have resulted in a notable escalation of loan reimbursements by private enterprises and households, amounting to approximately JD 110 billion from 2014 to 2016, as reported by *BNM (2016).* Nonetheless, the expansion of private finance has inadvertently escalated carbon dioxide emissions and air pollution by promoting the acquisition of energy-intensive commodities such as machinery, automobiles, and equipment.

Conversely, the financial sector possesses the capacity to provide incentives for prominent corporations to mitigate their emissions. According to *Shahbaz (2013) and Aslan et al. (2014)*, one possible approach to achieving this goal is establishing a connection between access to financial facilities and compliance with environmental rules, as suggested by Frankel and Rose (2002). This approach incentivizes private firms to cultivate their financial sectors ecologically conscientiously, while non-compliant entities face the potential consequence of being deprived of credit resources. According to *Sardosky (2010)*, this method can foster technical innovation, mitigate energy pollution in the energy-related sector, and improve atmospheric efficiency. In order to conduct a more comprehensive investigation of the correlation between economic expansion and carbon emissions, current scholarly endeavors strive to address the need for more knowledge in the extant body of literature. This study is paramount in evaluating environmental efficacy and comprehending the broader correlation between carbon emissions and economic progress, a subject that has garnered significant attention in many scholarly publications Research.

3. Literature review

3.1 A review on the relationship between financial development and carbon emissions:

Economists have a wide range of viewpoints regarding the influence of financial development on carbon emissions. There exists a debate over the potential relationship between financial development and carbon emissions, with proponents positing a positive correlation and opponents suggesting a negative association. Moreover, a cohort of scholars posits that no substantial correlation exists between financial progress and carbon emissions (*Wen, 2022*). Prior studies examining the correlation between economic expansion and carbon dioxide emissions have produced inconclusive results. According to *Yuxiang and Chen (2019),* local enterprises' adoption of eco-friendly technologies can be facilitated through financial growth, leading to reduced emissions. The financial sector also contributes to facilitating green production technologies by providing financial resources to local firms (*Frankel & Rose, 2002*). The existing body of literature on financial sector efficiency suggests that banks play a crucial role in resource management. They function as intermediaries, facilitating the flow of funds between savers and investors.

Additionally, banks are responsible for overseeing the allocation of labour and capital, as *Gomes et al. (2017)* highlighted. Therefore, the financial sector is crucial in fostering sustainable economic development within a country (*Batten & VO, 2019*). This statement highlights the significant influence that financial institutions can exert on the environmental consequences of economic operations, contingent upon their policies and endorsement of environmentally sustainable initiatives.

According to *Zhang (2011),* financial development could potentially result in adverse environmental outcomes due to its promotion of industrialization. This industrialization process often leads to heightened carbon emissions and soil degradation levels. The process of industrialization frequently relies on the utilization of crude oil, which is a globally significant energy resource. Crude oil has a vital role in supporting the economic development of industrialized nations; nonetheless, it concurrently constitutes a significant source of carbon emissions. According to *Mehmood et al. (2021),* fluctuations in oil prices can exert substantial macroeconomic effects on both nations that export and import oil. In addition, it is worth noting that industrial energy consumption is a significant proportion of global energy utilization, as reported by the International Energy Agency (*IEA, 2023*). According to *Shoaib (2020),* empirical research has indicated a positive correlation between financial development and carbon emissions in both developed and developing nations throughout the period spanning from 1999 to 2013. This observation indicates a clear correlation between the level of financial development and the amount of carbon emissions. The Kuznets curve theory posits that during industrialization, there is an initial rise in environmental degradation, followed by a stabilization or decline. This theory complicates the connection between financial development and carbon emissions (*COLE et al., 1997)*. The correlation between financial development and carbon emissions has been a topic of continuous investigation since the seminal study conducted by Grossman and Krueger in 1991. Several studies, such as the research conducted by *Tamazian et al. (2009),* have discovered empirical evidence indicating a negative correlation between financial development and carbon dioxide emissions.

Nevertheless, it is worth noting that the introduction of novel technologies has the potential to foster a more equitable pattern of economic expansion while concurrently enhancing the state of the environment. This assertion is supported by empirical evidence showcasing pivotal moments in the Kuznets curve, as highlighted in the study conducted by Rubio et al. (2009). Bayar et al. (2020) conducted a study that examined the relationship between financial development and environmental deterioration in 11 European nations during the post-transition era. The findings of their research revealed a negative link between these two variables. This discovery implies that in specific circumstances, the advancement of financial systems can align with enhanced environmental outcomes. The discourse surrounding the correlation between economic growth and ecological sustainability remains intricate and subject to ongoing changes, requiring additional investigation and examination to understand the subtle interplay between economic progress and its environmental impacts.

3.2. Environmental Performance, Economic Growth, and financial development in Developed Countries:

The existing body of literature suggests that financial development in developed nations has been crucial in promoting economic growth, facilitating the transition to renewable energy sources, reducing carbon emissions, and improving environmental conditions. The topic of discussion pertains to nations or sovereign states. Promoting financial inclusion, conflict resolution, and financial stability can be facilitated by implementing strategies for sustainable finance, hence contributing to the Sustainable Development Goals (*Ziolo et al., 2021*). The advancement of the financial sector has the potential to mitigate poverty levels and promote financial stability by providing capital to businesses, nurturing the growth of innovative enterprises, and generating employment opportunities. According to *Ahmed et al. (2015)*, policymakers can assist innovative financial products, strengthen regulatory measures, and promote cooperation between the public and private sectors to facilitate the progression of sustainable finance policies. Through this action, the financial industry has the potential to make a significant contribution towards sustainable growth and the enhancement of the environment.

In their study, *Khan et al. (2021)* examined the correlation among Economic growth, renewable energy consumption, non-renewable energy consumption, labour, and capital in a sample of thirty-eight nations belonging to the International Energy Agency (IEA). Between 1995 and 2015, advanced econometric methodologies were employed, encompassing cross-section dependence (CD) and second-generation unit root testing. The research indicates that the energy transition process has a detrimental impact on the economic growth of the host nation. On the other hand, it positively impacts sustainability, energy consumption, labour, and capital. Economic sustainability influences long-term and short-term growth, whereas energy transitions solely affect long-term growth. The International Energy Agency (IEA) should promote research and development (R&D), eliminate subsidies for non-renewable energy sources, address carbon costs, and establish environmentally-friendly policies. *Salari et al. (2021)* utilise a range of static ordinary least squares (OLS) and dynamic generalised method of moments (GMM) estimation models to investigate the correlation between carbon dioxide (CO2) emissions, energy consumption, and economic growth in the United States of America over the period spanning from 1997 to 2016. Based on the findings of this study, it is evident that distinct energy sources have divergent impacts on carbon dioxide (CO2) emissions, whereas renewable sources demonstrate a propensity to decrease emissions. In contrast, non-renewable sources tend to elevate them. The observed patterns of GDP and pollution fluctuations among US states offer empirical support for the Environmental Kuznets Curve hypothesis. The findings of this study demonstrate a high level of resilience and generalizability since they are relevant to other states and models. As a result, policymakers seeking to mitigate emissions at the state level might derive significant insights from these results. The study conducted by *Ivanovski et al. (2021)* employed the local linear dummy variable estimate (LLDVE) to investigate the interrelationships among economic growth, non-renewable energy consumption, and their reciprocal impacts within the OECD countries over the period spanning from 1990 to 2015. The study revealed a non-linear and volatile relationship between the utilisation of renewable and non-renewable energy sources and economic growth within OECD countries. Notably, non-renewable energy sources were found to have a more significant impact on economic growth than renewable energy sources. Nevertheless, both energy sources contribute to the advancement of the economy in non-OECD nations, increasing the potential for emerging economies to transition towards renewable energy sources.

The existing body of literature about industrialised countries offers valuable insights into the interplay of several variables that connect financial development and emissions. Moreover, advancing financial systems in industrialised nations can foster economic expansion, facilitate the shift towards sustainable energy alternatives, mitigate carbon emissions, and enhance environmental circumstances. The objectives above can be attained by implementing sustainable finance policies that facilitate the involvement of individuals in the financial system, foster the resolution of conflicts, and ensure the financial sector's stability. Nevertheless, the objectives of developed nations may diverge from those of emerging countries, as the latter tend to prioritise economic expansion over the mitigation of carbon emissions. Major developed nations, previously accountable for worldwide environmental contamination, are endeavouring to find remedies to transition towards renewable energy sources and mitigate carbon emissions.

3.3. Environmental Performance, Economic Growth, and financial development in Developing Countries:

The relationship between financial development and carbon emissions in developing nations exhibits distinct frameworks and factors compared to those observed in developed countries. The variability in the form and structure of the emerging economy contributes to variations in the efficiency and development of the financial sector. Numerous scholarly investigations have explored the correlation between financial development and carbon emissions inside developing economies. Table 1 pertains to research investigations exploring the correlation between economic growth, renewable and non-renewable energy consumption, and environmental performance within developing nations.

4. Methodology

This study aims to investigate the determinants that impact carbon emissions within the Jordanian economy. A combination of contemporary time series unit root tests, cointegration approaches, and causality tests are utilised to accomplish this objective. The significance of research design is of utmost relevance, regardless of the specific field of study being examined. The essential framework in this context functions as a guiding structure that facilitates the systematic collection and analysis of data, ensuring its alignment with the study objectives. The research design process entails a deliberate and systematic series of decision-making options encompassing a range of factors, such as the type of study, the objectives, the background information, and the unit of analysis. This study initiates hypothesis testing to reveal specific relationships, incorporating both exploratory and empirical research aspects. Given the inherent characteristics of the study problem, an exploratory methodology was chosen to be the most appropriate. A structured questionnaire is employed to collect primary data, adapted and improved from a previous study by *Chitura, Chuma, Dube, and Runyowa (2007)*. The questionnaire explicitly targets the examination of organisational practice adoption. The research tool utilised in this study is based on recognised measurement scales previously employed in similar investigations. However, certain modifications were made to ensure their applicability within an educational setting.

Therefore, the predominant research methodology utilised in this work is quantitative. The methodology involves acquiring quantitative data using observation guides (*Lewis, 2015*). According to *Cresswell and Poth (2017)*, quantitative research pertains to examining data expressed in a numerical format and using statistical techniques for analysis. This perspective is reaffirmed by *Leavy (2017)*. In addition, quantitative research enables rigorous data analysis, providing statistical accuracy and dependability in measuring many phenomena. The selection of a research design, specifically quantitative analysis, is especially appropriate when the primary aim of the research is to examine correlations or disparities between multiple variables (*Turner et al., 2017*). The decision to utilise the quantitative approach in this study is based on two primary justifications. Firstly, this approach allows for the specification of correlations between variables by applying statistical techniques. Secondly, it permits analysis to be conducted on a sizable sample, allowing for the generalisation of findings to the broader population.

4.1 Data Description

In this section, the researcher has defined independent and dependent variables in the study. 1 Dependent variable and 1 independent variables. The data (annual) were collected from 1990 till 2022.

Table (A)

Variables definitions

Variables	Definition
Dependent Variables	
LNCO2	CO2 Emissions
Independent Variables	
LNEG	Economic Growth

Table (B)

Descriptive statistics for study variables

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness
LNCO2	1.034	1.104	1.252	0.358	0.201	-1.909
LNEG	1.203	1.196	2.664	-1.291	0.742	-0.879

Based on the data presented in the table you provided:

The dataset indicates that the average value of the natural logarithm of carbon dioxide (CO2) emissions, denoted as LNCO2, is roughly 1.03. The standard deviation of the natural logarithm of CO2 emissions (LNCO2) is 0.2, which measures the extent of variability or dispersion in the LNCO2 readings. A standard deviation of 0.2 implies that the observed values exhibit a comparatively small dispersion around the mean, indicating a lower variability level in the dataset. The dataset reveals that the average value of the natural logarithm of the independent variable (LNEG) is around 1.203. The standard deviation of the natural logarithm of the independent variable (LNEG) is 0.742, which represents the extent of variability or dispersion in the LNEG values. A standard deviation of 0.742 indicates a higher degree of dispersion from the mean in the LNEG data than the LNCO2 values, implying a greater level of variability in the dataset for LNEG.

4.2 Correlation Analysis

In this part, the researcher has calculated Pearson Correlation Coefficient for measuring association among study variables. Pearson correlation coefficient with sign (-) reflect negative correlation, while with sign (+) reflect positive correlation. Values from 0.1 to 0.4 reflect weak correlation, 0.4 to 0.7 reflect moderate correlation, and 0.7 to 1 reflect strong correlation.

Table (B)

Pearson Correlation Coefficients between CO2 emissions and GDP

Variables	LNCO2
LNEG	0.472

0.0056

Within this particular portion, the investigator has performed calculations to determine the Pearson Correlation Coefficient, which evaluates the association between the variables under investigation. The Pearson Correlation Coefficient quantifies the magnitude and orientation of the relationship between two variables. The presence of a negative sign (-) denotes a negative correlation, whereas a positive sign (+) signifies a positive correlation. The coefficient values span a range of -1 to 1, with values in proximity to -1 signifying a robust negative correlation, values around 0 indicating a minimal or negligible association, and values closer to 1 denoting a strong positive correlation. Based on the above table, a clear and notable association between LNCO2 (the natural logarithm of carbon dioxide emissions) and economic growth can be observed. The result is substantiated by a p-value of 0.0056, which falls below the widely acknowledged significance threshold of 0.05. A p-value lower than this predetermined threshold indicates that the observed link is unlikely to have occurred by random chance.

In addition, the Pearson correlation coefficient, a measure that measures the magnitude and direction of the association above, has been computed as 0.472. The observed value lies within the interval of 0.4 to 0.7, suggesting a moderate positive correlation. In essence, a positive correlation exists between economic growth and carbon dioxide emissions, as shown by the variable LNCO2. This implies that a corresponding increase in carbon dioxide emissions typically accompanies increased economic growth. Conversely, decreased economic growth is associated with reducing carbon dioxide emissions. The statistical findings presented in this analysis offer significant insights into the relationship between economic growth and carbon dioxide emissions, as shown in the dataset. These insights can be crucial in comprehending the intricate correlation between economic progress and its environmental ramifications, particularly about carbon emissions. Additional examination and interpretation are needed to investigate the practical ramifications of this moderate positive correlation within the context of the research investigation.

4.3 .Stationarity

In this phase of the investigation, the scholar performed the augmented Dickey-Fuller (ADF) test to evaluate the assumption of stationarity, which is an essential prerequisite for guaranteeing the precision and dependability of time series models. The ADF test consists of two main hypotheses. The null hypothesis (H0) assumes that the time series data is non-stationary, indicating the presence of trends or seasonality. On the other hand, the alternative hypothesis (Ha) suggests that the data is stationary, meaning there are no noticeable trends or seasonality. The conclusion derived from the Augmented Dickey-Fuller (ADF) test is contingent upon the p-value, which is conventionally established at a significance level of 0.05. The p-value below the designated threshold indicates compelling evidence favouring the stationarity hypothesis and supporting the alternative hypothesis.

In contrast, when the p-value is more significant than or equal to 0.05, it indicates a lack of substantial evidence supporting the presence of stationarity, supporting the null hypothesis. The attainment of stationarity can manifest in several ways, such as at the initial data level, after applying the first difference, or even following the second difference, contingent upon the specific attributes of the data and the outcomes of the conducted tests. The objective of researchers is to achieve stationarity in order to enable precise modelling and analysis of time series data.

Table (C)

Augmented Dickey Fuller (ADF) test for checking Stationarity

Variables	at level		at first difference	
	test value	P-value	test value	P-value
LNco2	2.827548	1	-4.053755	0.0038
LNEG	-4.61	0.0008	-6.11	0.0001

The table displayed provides significant insights into the stationarity of the examined variables. Firstly, it is apparent that the variable LNCO2 attains stationarity following the application of the first difference, as indicated by a p-value of 0.0038, which falls below the generally employed significance level of 0.05. Likewise, the variable LNEG exhibits stationarity when considering the first difference, as evidenced by a significantly lower p-value of 0.0001, which falls well below the conventional threshold of 0.05. The observed transformations indicate that the time series of LNCO2 and LNEG demonstrate stationarity, suggesting their appropriateness for subsequent investigation. Based on the obtained findings, the Auto-Regressive Distributed Lag (ARDL) model is suitable for investigating the impact of independent factors on the dependent variable. ARDL models are considered appropriate for analysing stationary and non-stationary time series data, thus making them a suitable methodology for investigating the associations between various variables in the research study. The table displayed provides significant insights into the stationarity of the examined variables. Firstly, it is apparent that the variable LNCO2 attains stationarity following the application of the first difference, as indicated by a p-value of 0.0038, which falls below the generally employed significance level of 0.05. Likewise, the variable LNEG exhibits stationarity when considering the first difference, as evidenced by a significantly lower p-value of 0.0001, which falls well below the conventional threshold of 0.05. The observed transformations indicate that the time series of LNCO2 and LNEG demonstrate stationarity, suggesting their appropriateness for subsequent investigation. Based on the obtained findings, the Auto-Regressive Distributed Lag (ARDL) model is suitable for investigating the impact of independent factors on the dependent variable. ARDL models are considered appropriate for analysing stationary and non-stationary time series data, thus making them a suitable methodology for investigating the associations between various variables in the research study

5. Model Estimation

5.1. Lag Selection

In this study segment, the investigator has utilised the Akaike Information Criterion (AIC) to ascertain the suitable lag length criterion for the investigation. The Akaike Information Criterion (AIC) is a statistical metric employed to determine the most suitable lag length for modelling time series data. This metric aims to measure the equilibrium between the degree of accuracy in representing the data and the level of intricacy in the model, with the objective of identifying the most concise model that sufficiently accounts for the observed data. The fundamental idea underlies the Akaike Information Criterion (AIC) is that a model with a lower AIC value indicates a superior fit. Hence, the investigator computed AIC values for various lag lengths and determined the lag length with the minimum AIC as the most appropriate criterion. The lag length selection in this context is made to strike a balance between the accuracy of the model and its simplicity, hence maximising its capacity to capture the inherent patterns present in the time series data effectively. The researcher has chosen to employ the Akaike Information Criterion (AIC) as the basis for determining the appropriate lag length in order to improve the accuracy and reliability of the time series analysis. This data-driven method contributes to generating more robust and dependable modelling outcomes.

Table (D)
Lag Length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-15.4721	NA	0.010217	1.092006	1.183615	1.122372
1	26.73348	76.49761*	0.000939*	-1.295842*	-1.021017*	-1.204746*

According to the previous table, it is notable that the best lag length to be included in the model is lag (1) where AIC = -1.29 is the lowest value.

5.2 Model Estimation

In this part, the researcher has built ARDL model for measuring association between CO2 and Economic Growth as shown in table.

Table (E):
ARDL Model Estimation for GDP Growth

Long Run Variable	Coefficient	Std. Error	t-Statistic	P-value
LNCO2(-1)	1.14	0.08	14.20	0.0001
LNEG	0.06	0.02	2.64	0.0133
LNEG(-1)	-0.02	0.02	-1.33	0.1942
C	-0.22	0.07	-2.99	0.0057
R-Square	92.7%			
Short Run				

D(LNEG)	0.06	0.02	3.41	0.002
CointEq(-1)*	0.14	0.03	4.47	0.0001

The data shown in the table provides several significant observations.

The analysis reveals a notable impact of the variable LNEG (representing economic growth) on CO2 emissions, as evidenced by a p-value of 0.0133, which falls below the conventional significance threshold of 0.05. The coefficient (B) of 0.06 indicates a positive relationship between economic growth (LNEG) and CO2 emissions, with each unit increase in economic growth being associated with a 0.06 unit rise in CO2 emissions. This observation indicates a positive correlation between economic growth and carbon dioxide (CO2) emissions. The model has a notable degree of goodness in its ability to fit the data, as seen by an adjusted R-squared value of 92.7%. The modified R-Square value, which surpasses 50%, suggests that the independent variables included in the model adequately explain 92.7% of the observed fluctuations in the dependent variable, specifically the CO2 emissions. The significant explanatory capacity of this model effectively encompasses a considerable amount of the fluctuations observed in CO2 emissions. In addition, the model demonstrates a high level of acceptability, as evidenced by the statistical significance of CointEq (-1) (Speed of Adjustment) with a p-value of 0.0001, which falls below the predetermined significance level of 0.05. This observation indicates that the model successfully represents the temporal dynamics of the relationship between the variables, suggesting a statistically significant rate of adaptation.

To summarise, the results obtained from the table indicate a notable influence of economic growth (LNEG) on CO2 emissions. The model exhibits a high level of accuracy in terms of fitting and possesses a robust explanatory capability. Furthermore, the model's overall suitability in capturing the relationship dynamics is evident. The insights above have significant value in comprehending the impact of economic growth on carbon dioxide emissions and assessing the model's efficacy in elucidating this correlation.

5.3 Serial Correlation

Breusch-Godfrey test is used for checking serial correlation assumption. Breusch-Godfrey test has two hypotheses, the null hypothesis “there is no serial correlation problem”, the alternative hypothesis “there is serial correlation problem”. Based on P-value, the researcher may accept the null hypothesis “p-value >0.05”, or reject the null hypothesis “p-value <0.05”.

Table (F):
Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.0177	Prob. F(2,26)	0.982

There is no serial correlation problem where p-value =0.982 > 0.05 so, the null hypothesis "there is no serial correlation problem" will be accepted. The condition of no serial correlation is achieved.

5.4 Heteroskedasticity

White test is used for checking heteroskedasticity problem. White test has two hypotheses, the null hypothesis "there is no heteroskedasticity problem", the alternative hypothesis "there is heteroskedasticity problem". Based on P-value, the researcher may accept the null hypothesis "p-value >0.05", or reject the null hypothesis "p-value <0.05".

Table (H)
White test for heteroskedasticity

Heteroskedasticity Test: White			
F-statistic	0.161	Prob. F(3,28)	0.921

There is no heteroskedasticity problem where p-value =0.921 > 0.05 so, the null hypothesis "there is no Heteroskedasticity problem" will be accepted. The condition of no heteroskedasticity is achieved.

5.5 Bound Test

In this part, the researcher has conducted Bound test which is used for detecting the existence of long run relationship between dependent and independent variables. Bound test has two alternatives, the null hypothesis "there is no long run relationship", the alternative hypothesis "there is long run relationship". If F- statistic > I (1) then there is long run relationship.

Table ()
Bound test for checking long run relationship for CO2

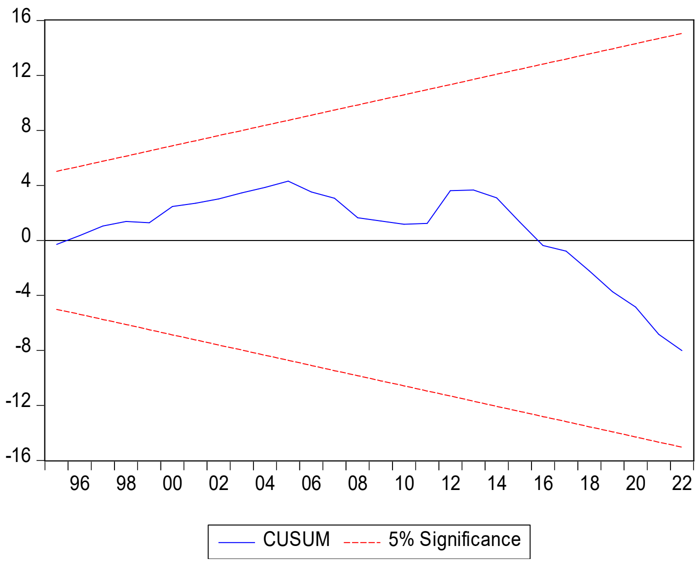
Bound test		
F- value	Lower Bound	Upper Bound
6.21	4.09	4.663

Discussing the results of a statistical analysis that suggests there is a long-run relationship between CO2 emissions and economic growth. Mentioned an F-statistic of 6.21 being greater than 4.663. Typically, in statistical analysis, an F-statistic is used to test the overall significance of a set of independent variables in a regression model.In this research, it appears that the F-statistic of 6.21 is being used to test whether the relationship between CO2 emissions and economic growth is statistically significant. The fact that the F-statistic is greater than a critical value (in this case, 4.663) suggests that there is evidence of a significant relationship between CO2 emissions and economic growth.

5.6 Structural Stability

In this part the researcher has graphed CUSUM and Squared CUSUM for checking the structural stability of the model. the blue line between the two red lines reflects good structural stability.

Graph (1): CUSUM test for structural stability



According to the previous graph, it is notable that there is structural stability in the model where the blue line in between the two red lines.

6. Conclusion

The ongoing discourse revolves around the correlation between the financial sector and the real economy (Sawyer, 2022). The complexity in question emerges from many reasons that contribute to financial globalization. These elements encompass technical improvements, the expansion of capital flows, the integration of economies and financial systems, and the looming threat of financial crises (*Lane & Milesi-Ferretti, 2008*). Significantly, a notable correlation exists between the financial sector and crises (*Rupeika-Apoga, 2010*). The argument presented is substantiated by the research conducted by Subbarao in 2020, which emphasizes the role played by disturbances in the financial industry amidst the global financial crisis 2008, hence contributing to the occurrence of the Great Financial Crisis of 2007. In addition, it is worth noting that even if there has been a relaxation of restrictions on financial markets in developing countries, a considerable segment of the population and enterprises continue to face challenges in obtaining financial services (*Culpeper, 2012*). Our research aims to examine the correlation between economic growth and carbon emissions, acknowledging its significant significance for both fiscal and economic advancement. A thorough examination of scholarly and practical literature is undertaken to accomplish this objective and elucidate the complex correlation between financial development and carbon emissions. Our analysis directly correlates with financial development, economic activity, and carbon emissions. A comprehensive understanding of this intricate interplay might provide valuable insights for formulating enhanced economic and environmental strategies.

It is essential to consider the potential negative consequences of financial expansion plans on other industries. The adverse effects of unregulated financial development on the environment and its subsequent repercussions on several aspects of the economy are apparent. Hence, we propose a need for more investigation to augment our comprehension of this complex association. There is a significant demand for quantitative research, particularly in developing nations such as Jordan, which disproportionately impact environmental degradation and climate change. Acknowledging that research findings can only be universally generalizable to some nations is crucial. The relationship between financial development and carbon emissions displays notable disparities across industrialized and developing countries and is dependent on the degree of economic advancement. In summary, our research highlights the significant influence of economic activity in moderating the connection between financial development and carbon emissions. Nevertheless, this association must be more consistent, displaying significant discrepancies across established and developing nations, depending on their relative degrees of economic advancement.

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