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Is Carbon Neutrality Attainable with Financial Sector Expansion in Various Economies? An Intrinsic Analysis of Economic Activity on CO_2 Emissions

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Abstract: The severe effects of climate change and its anticipated negative influence on the future of the globe has prompted more research into the attainment of carbon neutrality. While carbon neutrality is a paramount issue, human socio-economic well-being which is mostly influenced by economic activities cannot be overlooked. This study investigates the effect of financial sector activities on CO_2 emission in five economic sectors and three economic bodies. The financial sector variables utilized are derived from the undertakings of institutions such as banks, stock exchanges, and insurance companies. Using a sample of 39 countries between 1989 and 2018, this paper provides a global perspective of the profound impact financial sector activities have in different economies on CO_2 emission reduction. The feasible generalized least squares (FGLS) regression model, as well as the random and fixed effects model with regards to Durbin–Wu–Hausman, are used to analyze the data. The generalized method of moments (GMM) is also adopted as the robustness method. Our findings show that for emerging economies, all major activities of the financial sector aggravated CO_2 emission levels in all major CO_2 emitting economic sectors. The developing and developed economies also show a similar trend. In the emerging economies, virtually all activities carried out by the financial sector have a significant negative impact on CO_2 emissions at the 1% or 5% significance level, thereby hampering CO_2 emission mitigation efforts. However, increased long-term bank lending to non-major economic sectors is found to alleviate CO_2 emissions in developing economies. This is also the situation with increased numbers of import insurance. Meanwhile, CO_2 emissions are found to decrease with increased net portfolio investments and numbers of insurance on exports. These findings not only imply that financial sector activities play a fundamental role in CO_2 emission mitigation but also serve as a reminder for financial policymakers that the decisions they make have an inevitable impact on the attainment of carbon neutrality in their economies.

Keywords: economic activities; financial sector; carbon neutrality; EKC hypothesis; developing economies; emerging economies; developed economies

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1. Introduction

In recent years, the development and expansion of different economies across the globe has had a significant impact on greenhouse gas emission levels [1,2]. The major GHG emission mitigation concern remains the reduction in CO_2 emissions which make up 76% of all GHG emissions [3]. The negative environmental effect of CO_2 emissions on the globe is evident with the recent climate change effect witnessed in different parts of the world. The continued rise in global temperatures and the present threat of disastrous weather patterns in different world regions are clear indicators that urgent and strategic effort must be put

into the mitigation of CO_2 in order to curb the trends [4]. As tensions rise, all countries and major world institutions are expected to positively contribute towards the achievement of global environmental sustainability and carbon neutrality [5,6]. Although it is understood that financial systems play a major role in global economics, their contribution towards carbon mitigation remains understudied.

In a financial system, fiscal decisions by the financial sector impact business practices in the short and long run, and various financial sector activities including lending, borrowing, buying, or selling often translate into financial and economic projects with varying capacity to damage the environment [7]. The main environmental concern brought on as a result of global financial and economic activities in the last few decades is the consistently increasing CO_2 emission levels. As more businesses are invested into, as more credit is provided to the private sector, and more business activities are carried out in various economic sectors, the environmental repercussions have become more evident [8,9]. With the persistence of this connection between financial sector activities and CO_2 emissions, the financial system thus renders itself to higher scrutiny and has a higher responsibility to bear where CO_2 emissions mitigation efforts are concerned.

More importantly, a global perspective of the financial sector activity and CO_2 emissions nexus is imperative as the reality of CO_2 emissions is by itself a global issue. Through the last half century, developed economies such as the United States, South Korea, Japan, Canada, Germany, Australia, and United Kingdom have been the largest contributors to global CO_2 emissions. Major emerging economies such as China, Russia, Mexico, Turkey, Indonesia, and South Africa have also increasingly contributed to global CO_2 emissions levels. For example, China had its total CO_2 emissions from fossil fuels as of 2020 at 9.90 metric gigatons, contributing 29% of global CO_2, and the United States had 4.70 gigatons, contributing 14% of global CO_2 emissions. Comparatively, the rest of the world, which comprises much of the developing world, contributed 21% to global CO_2 emissions [10]. Yet, even this contribution by the developing world has gradually increased as developing and emerging economies aspire towards economic expansion and development. More specifically, developing economies are still heavily dependent on hydrocarbon and fossil fuel energy sources, and these progressively have adverse environmental effects both locally in these countries and on a global level [11].

The overall findings regarding the financial development and CO_2 emissions nexus are discrepant. These variations, in conclusion, can be tied to reasons such as the use of different financial development definitions and thus predictors, varying econometric methods, and response variables which by themselves offer incomplete insights on the matter of CO_2 emission reduction. In some studies, financial development is interchanged with economic development indicators [12–14], while in another, the focus is primarily on domestic credit to the private sector [15]. Meanwhile, the effect on CO_2 emissions in almost every case is ascertained based solely either on total or per capita CO_2 emissions. For instance, Le et al. [16], Abokyi [17], and Radmehr et al. [18] focus just on total CO_2 emissions in their assessment of the impact financial and economic development has on CO_2 emissions. Thus, at the heart of the matter, the true impact that financial sector activities alone have on CO_2 emissions is hardly assessed.

Although the existing literature shows a general picture of the association between financial or economic development and CO_2 emissions by mainly focusing on total or per capita CO_2 emissions, the important details about the influence that financial systems have on CO_2 emissions by major economic sectors have been largely ignored. During the actualization of economic and financial activities, sectors related to transport, buildings, power, and combustion are actually major contributors to CO_2 emission, and the impact of electricity and energy consumption by households and the transport sector on CO_2 emissions is well outlined in the literature. For example, Kwakwa [19] investigated the effect of financial development, urbanization, and energy on carbon emissions and found that these apply upward pressure on emission levels. Tao and Wu [20] in their study found that energy intensity and CO_2 emission levels for road–rail transport just on the

Yiwu–Ningbo corridor were up to 81.34% of total energy in the area. For China's power industry contribution to CO_2 emissions, Yu et al. [21] suggest that continued effort must be put into attaining a synergistic effect and that energy consumption should be optimized as CO_2 emission levels are decreased. Cases where sectorial analysis has been carried out have focused just on particular aspects such as the manufacturing industry as Adom et al. [22] have done. Therefore, it is evident that focusing just on overall or per capita CO_2 emissions may not be sufficient enough in providing a clear understanding of the relationship between financial development and CO_2 emissions.

Another drawback of the literature is that with the overly broadened definitions of financial indicators, the true products of the financial systems which are centered on activities by the stock markets, and insurance and financial institutions by themselves have never really been precisely considered as regards global CO_2 emission mitigation efforts. In addition, the contributions of prior studies often overlook the reality that countries fall into different economic expansion categories: mainly developing, emerging, and developed economies. Attention to these economic groupings could have better explained the nexus effects they posit.

To address the above issues, this study takes into account different economic bodies and different economic sectors, and utilizes improved econometric methods to investigate the role financial activities play in global CO_2 emission mitigation. In doing so, three main contributions to the existing literature are made: (1) This study is among the first to truly analyze the effect that financial sector activities have on five of the major CO_2 emitting sectors besides total and per capita CO_2 emissions. The sectors considered include CO_2 emissions by the transportation sector, power industries, buildings, other sectors, and other combustion industries. (2) To provide a clearer and more realistic understanding of the financial system and CO_2 emissions nexus effect, this study utilizes three panel data sets comprising 13 developing, 12 emerging, and 14 developed economies. By so doing, the findings are not narrowed just to specific regions, economic blocs, or countries but instead provide a global picture of the nexus effect and the way forward for the financial systems in each economic type. (3) To ensure the validity and robustness of our findings, we utilize three different econometric models. These include the random and fixed effects model based on the Durbin–Wu–Hausman diagnostic test, the feasible generalized least squares (FGLS) regression estimator, as well as the system generalized method of moments estimation approach. Besides providing a way to ensure the accuracy of results, the goal is also to ensure that findings are free of all endogeneity, heteroskedasticity, multicollinearity, and autocorrelation problems that could exist or produce bias.

The remainder of the paper is organized as follows: Section 2 reports on prior developments of the financial sector development and CO_2 emissions nexus. Section 3 details the estimation procedure within which are details of the data and sources, as well as panel estimator. Section 4 provides the findings and discussions with Section 5 outlining the policy implication and conclusions.

2. Literature Review

Despite the extant literature on the effect of financial and economic development on CO_2 emissions [23–25], the matter remains inconclusive. The environmental Kuznets curve (EKC) hypothesis asserted by Grossman and Krueger [26] posits an inverted U-shaped relationship between environmental degradation and income increases. In essence, as economic expansion occurs, environmental degradation is inevitable, especially at the early stages. Several studies have tested this hypothesis using various applications. While some have been able to disprove the EKC hypothesis in their applications, some others have made findings that prove this hypothesis to be true. Leal and Marques [27] and Nasir et al. [28] in their studies find evidence that agrees with the EKC hypothesis among the high emitting members of the OECD countries as well as among the ASEAN countries. Meanwhile, others like Abokyi et al. [17] and Halliru et al. [29] find evidence to the contrary of a U-shaped relationship between CO_2 emissions and economic advancement in Ghana

and across West African economies. Perhaps the different samples have led to these different conclusions on the truthfulness of the theory. While it appears that for some countries financial development positively impacts environmental degradation, in some other instances, this is not the case. The need for more conclusive evidence must then be provided in the literature to settle this matter as the issue of environmental degradation due to GHG emissions, especially CO_2 emission increase, remains imminent.

Beneath each economic activity lies the financial system, the financial institutions, and their activities. Although there are many variables that count as economic activities, this study has narrowed these down to those financial sector activities integral to day-to-day economic activities. Activities involving the lending and borrowing of funds, investments, and offers of credit, stock trading, and insurance all provide the mechanism by which economic activities successfully take place. Kapaya [30] points out the three main roles of the financial system in the attainment of economic development in Africa: first, the facilitation of resource transfer across borders and time; second, the mobility of saving pools; and third, the competitive allocation of capital by investment. In surveying 22 emerging markets, Nguyen et al. [31] also found that financial development has a positive effect on economic growth and that their relationship is linear. Ibrahim and Alagidede [32] in their study of the impact of financial development on economic growth in 29 SSA countries found a considerable finance–economic growth effect. Song et al. [33] in their assessment of 142 economies found that financial sector development and economic growth impact each other positively. Other research on developing as well as EU countries has also examined the finance–growth association to varying degrees and found the relationship crucial towards appropriate policy adjustments [34].

When considering studies on the economic growth and CO_2 emissions nexus, it is clear that as economies expand and grow, as evidenced by economic growth indicators such as gross domestic product or gross national income, CO_2 emission levels also rise [1,35]. Nevertheless, new evidence of a more direct relationship between financial sector activities themselves and CO_2 emissions is slowly emerging, although they still provide an incomplete picture of the relationship. For instance, Chang et al. [36] found that causality exists between stock markets and CO_2 emissions. Where stock returns rise, carbon emissions from oil combustion also rises. In another case, increased lending to the private sector by the financial sector was found to negatively impact CO_2 emission mitigation [37]. Similarly, Kim et al. [38] found that bank lending to households and businesses aggravates CO_2 emission levels. Their research suggests that financial reforms are necessary and conducive towards the attainment of environmental sustainability. To attain a global picture of the relationship between financial sector activities and CO_2 emissions, it is necessary to expand the focus from specific countries or regions to the comparative analysis of developing, emerging, as well as developed economies.

When analyzing specific financial sector activities such as stocks traded, insurance, and lending activities by commercial banks, the traces of their carbon footprint can be further outlined. Several studies have attempted to provide evidence of their connection independently such as in the study by Chang et al. [36]. In their study, they found causal effects between stock market returns and CO_2 emissions in 18 countries known for their rather sophisticated financial markets. This was especially the case for CO_2 emissions from oil combustion. Similarly, banking activities such as commercial bank lending, lending rates, real interest, and deposit rates have been found to impact CO_2 emission levels around the world [9]. In the case of insurance markets, Xiaolong et al. [39] found that positive shock in insurance markets increases CO_2 emissions particularly in high polluting economies. An older study by Szalai [40] found that with increased CO_2 emission levels, various insurance sectors respond differently. While the German insurance sector responds by searching out more insurance coverage opportunities, the English insurance sector responds by taking on greater supervisory roles in transactions. Overall, with the increase in weather-related risks, the need for insurance has greatly increased. However, seeing as these opportunistic tendencies of insurance sectors are increasing, a clear link between the

activities of insurance institutions as a part of the financial system has not been expanded upon in the literature.

To test the nexus effect between financial sector development and carbon emissions in this study, the EKC hypothesis is adapted. As the issue of environmental degradation due to GHG emissions, especially CO_2 emission increase, remains imminent, it is necessary for researchers to provide more conclusive evidence about this matter. In this study, we contribute to test the EKC hypothesis by investigating the relationship between financial development and environmental sustainability. Here, the pollutant on the *y* axis is CO_2 emission from five different sectors as well as at the total and per capita emission level. On the *x* axis, we posit financial system (FS) activities as the explanatory variables. Figure 1 below gives a portrayal of the EKC hypothesis adaptation.

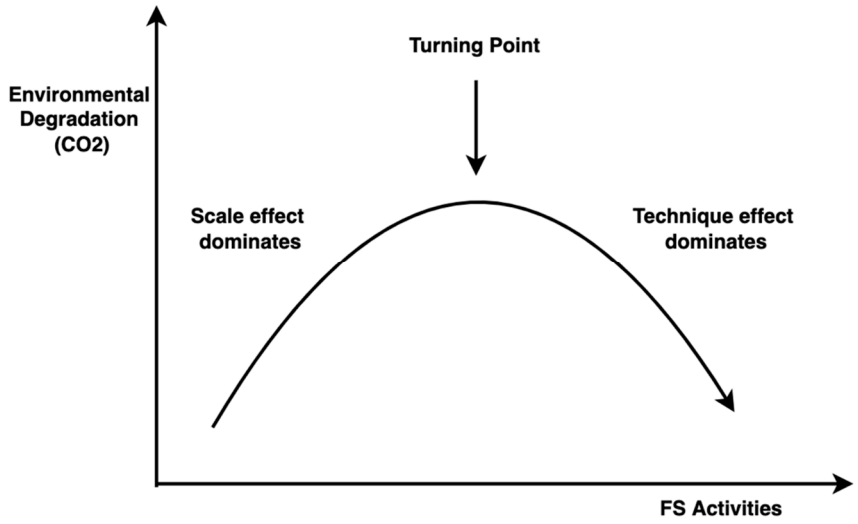

Figure 1. Adaptation of the EKC hypothesis.

Evidently, very few studies have truly carried out a study that encompasses the variables that hold true to the definition of the financial system. The financial system is standardly understood to be a set of institutions such as stock exchanges, banks, insurance, and investment institutions that exist to connect lenders, investors, and borrowers on regional and global scales [41]. Their activities, therefore, comprise the product of the financial system such as traded stocks, insurance on imported and exported goods and services, net investments, banking activities such as credit to the private sector, and commercial bank loans given out to borrowers. These count as the evidence and products of the functioning financial systems of countries and economies. Several recent studies have also adapted the EKC hypothesis or similar research approaches. Table 1 below presents a table of the relevant literature.

Table 1. Recent Studies on Financial System Development and CO_2 Mitigation.

Authors	Setting	Research Aim	Theory	Summary of Findings	Method
Z. Lv and S. Li, 2021 [12]	Global	How financial development affects CO_2 emissions: A spatial econometric analysis	NA	Financial development plays a crucial role in the mitigation of CO_2 emissions and being surrounded by countries with a high financial development can improve a country's performance environmentally.	STIRPAT model
A. Acheampong, 2021 [37]	SSA	Does environmental quality improve with financial development ?	EKC Hypothesis	Financial development measured using broad money, DCPS, and DCPS by banks increases CO_2, while FDI, liquid liabilities do not affect emissions.	System GMM

Table 1. *Cont.*

Authors	Setting	Research Aim	Theory	Summary of Findings	Method
S. Zaidi et al., 2019 [24].	Asia–Pacific countries	Dynamic links between financial development, globalization, and CO_2	EKC Hypothesis	Globalization causes financial development and energy intensity. A feedback effect exists between CO_2 and financial development. Financial development causes economic growth.	Westerlund cointegration technique
D. Zhao and W. Yang, 2020 [42]	China	Does financial development influence carbon emissions?	NA	Regional financial development has significantly lagged inhibitory effects on carbon emissions. China is recommended to focus on developing her financial sector.	Principal component analysis
R. Wang et al., 2020 [43]	N-11 countries	The carbon emissions, renewable energy consumption, and financial development nexus. Technological innovation and what should be the light CoP agreement?	NA	A positive relationship between carbon emissions, financial development, and gross domestic product exists. In contrast, technological innovation and RE consumption are negatively related to CO_2 emissions.	Common correlated effect
D. Kim et al., 2020 [38].	Developing countries	CO_2 and the finance curse.	NA	Financial reforms and development of a more competitive and less concentrated on a bank-based financial system is conducive to a better environmental quality.	General GMM
S. Obiora et al., 2020 [9]	Global	Effect of banking and financial systems on environmental sustainability. A study of developing, emerging, and developed economies	EKC Hypothesis	Increase in domestic credit to the private sector and commercial bank lending consistently contributes towards aggravated carbon emissions in all economic types.	FGLS, GMM
P. Leal and A. Marrques, 2020 [27]	OECD countries	Rediscovering EKC hypothesis in OECD highest CO_2 emitters	EKC Hypothesis	Political globalization acts as a tool for the mitigation of environmental degradation, while economic globalization is harmful for it. In addition, evidence shows different effects of de facto globalization.	Driscoll–Kraay estimator
O. Bamisile et al., 2021 [44]	Africa	Impact of economic growth on CO_2 in Africa and the role BEVs and production of hydrogen have in energy integration	NA	As national wealth grows across Africa, CO_2 emissions also increase. The proposed RE method for generating power showed that emissions from the power industry can be brought down to zero.	Time series and RE-based power generation model
D. Bui, 2020 [25]	Global	Transmission channels between CO_2 and financial development from a global perspective	NA	Results confirm a positive direct effect of financial development on environmental degradation. Development of the financial system gives rise to greater energy demand and consequently amounts to more pollutant emissions.	2SLS and 3SLS estimators
A. Samour et al., 2019 [43]	Turkey	Testing banking sector development impact on CO_2 emissions in Turkey	EKC Hypothesis	The improvements to the development of the Turkish banking sector could lead to higher investment and energy consumption, which could raise CO_2 emissions. In addition, increase in the RIN would amount to decreased carbon emissions.	ARDL

As earlier mentioned, most studies examining the effect of financial development on environmental sustainability have utilized variables such as gross domestic product among other economic indicators to be the financial variables upon which to test the nexus effect on CO_2 emissions. Thus, besides the application to varying economic groups, sample sizes, and regions, this issue of loosely specified variables for the financial system in itself continues to impede the attainment of more conclusive answers to the financial development and CO_2 emissions nexus. In our study, we set out three of the most appropriate panel data sets spanning three decades and three major economic groupings, namely developed, emerging, and developing economies. Important light is thrown on the five major sectors contributing to increasing CO_2 emissions. These are emissions by the transportation sector, power industry, buildings, other combustion industries, and other sectors in each economic type. Additionally, three different econometric tools are utilized rather than simply using one to derive findings that are comparable, robust, and free of all endogeneity, multicollinearity, autocorrelation, and heteroskedasticity bias.

3. Methodology

3.1. Data Source and Variable Definitions

Although there are many variables that count as economic activities, this study has narrowed these down to specific financial sector activities integral to day-to-day economic activities. The financial sector activities and carbon emissions nexus are examined in this study. The emphasis is placed on the 5 sectors predominantly responsible for most CO_2 emissions in all the economic types. Financial systems panel data for 39 countries between 1989 and 2018 have been collected comprising 12 emerging, 13 developing, and 14 developed countries (see Table A1), and countries in an unbalanced panel. The financial system activity panel data have been taken from the International Monetary Fund and World Bank statistics database. The CO_2 emission data have been acquired from the Publications Office of the European Union database.

The countries selected for each economic type are based on the characteristics that define them (see Table A1). First, the developing countries selected are characterized by low real income per capita levels when compared with other countries, much higher unemployment rates as well as population growth rates, higher primary sector dependence, and much lower overall standard of living. As for the emerging economies chosen, these are characterized by the ability to have seemingly comparable GDP annual growth rates to those of the developed countries. Moreover, they usually have some characteristics of both developing and developed economies. As much as 80% of the global economy is driven by these countries with some of the largest being India, China, and Russia [45]. The developed economies make up the majority of OECD countries. These can be characterized by their high standard of living, comparatively lower unemployment rates and population growth rates, high per capita income levels, and high economic contributions from the industrial and service sectors rather than primary sectors such as agriculture. Additionally, the period 1989–2018 accounts for the last 3 decades which provides a novel insight into the nexus through time compared to other studies.

As earlier discussed, various variables related to economic and financial development have been found to aggravate or alleviate carbon emissions. However, in this study, the focus is narrowed down to those variables connected to the direct definition of the financial system. The financial system by definition allows for the exchange of funds and risk between market participants such as investors, lenders, and borrowers. These systems are responsible for global resource allocation. The financial system activities are therefore those financial undertakings of institutions such as banks, stock exchanges, and insurance companies. These activities therefore serve as the explanatory variables in this study with which the EKC hypothesis is adapted and tested. Additionally, detailed panel data of carbon emissions have been derived as response variables for this study. Beyond total and per capita emissions, CO_2 data encompassing 5 other major emitting sectors have been collected. Table 2 below further expands on the definitions of each variable utilized in this study.

To obtain a better understanding of the panel data sets for each economic body, the mean and standard deviation of each data set is outlined in Table 3. As some variables have very large numbers, the simplified exponential forms have been displayed. These variables include Inv.eq, CBL.ltl, and Stocks. The same exponential levels will be applied for the values corresponding to these variables moving forward in the chapter. SD. Refers to standard deviation and Obs. The number of observations.

Table 2. Definition of Variables.

Variable	Abbreviation	Data Source/Code	Definition
Total CO_2	CO_2T	Publications Office of the European Union (POEU) Database	Yearly fossil CO_2 emissions by a country include industrial processes such as steel, cement, urea, chemical production, and flaring. Measured in Mt CO_2/y.
Per capita CO_2	$PcCO_2$	POEU	Yearly per capita CO_2 emissions.
CO_2 from the Power Industry	$PiCO_2$	POEU	Yearly CO_2 emissions by power industries in Mt CO_2/y.
CO_2 from Buildings	BCO_2	POEU	Yearly CO_2 emissions by buildings in Mt CO_2/y.
CO_2 from Transport	TCO_2		Yearly CO_2 emissions by the transport sector in Mt CO_2/y.
CO_2 from other Combustion Industries	$OCiCO_2$	POEU	Yearly CO_2 emissions by other combustion industries in Mt CO_2/y.
CO_2 from other Sectors	$OSCO_2$	POEU	Yearly CO_2 emissions by all other sectors in a country in Mt CO_2/y.
Stocks Traded	Stocks	World Federation of Exchanges Database CM.MKT.TRAD.CD	The value of traded shares both domestic and foreign multiplied by their respective matching prices. Figures are single counted. Data are end-of-year values converted to USD.
Net Portfolio Investments	Inv.eq	IMF BN.KLT.PTXL.CD	It covers transactions in equity securities and debt securities. Measured in USD.
Insurance and Financial Services on Imports	Ins.imp	IMF BM.GSR.INSF.ZS	These are insurance and financial services on imports exchanged between residents and nonresidents by insurance enterprises and financial intermediation services and auxiliary services. Measured as a percentage of all service imports.
Insurance and Financial Services on Exports	Ins.exp	IMF BX.GSR.INSF.ZS	These are insurance and financial services on exports exchanged between residents and nonresidents by insurance enterprises and financial intermediation services and auxiliary services. Measured as a percentage of service exports.
Commercial Bank Long-term Loans	CBL.ltl	World Bank International Debt Statistics DT.NFL.PNGC.CD	These are nonguaranteed long-term commercial bank loans from private financial institutions and private banks.
Domestic Credit to the Private Sector by Banks	DCPS	IMF FD.AST.PRVT.GD.ZS	These are financial resources provided to the private sector by depository corporations discounting central banks which establish a claim for repayment. It is measured as a percentage of GDP.

Table 3. Descriptive Statistics.

Variables	Developing		Developed		Emerging		All Economies		Obs.
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
CO_2T	31.5530	103.2186	854.7442	2007.7040	1039.4410	1838.5480	625.5411	1597.8020	1170
$PiCO_2$	14.8196	52.7886	318.2855	815.1779	276.9801	558.8939	194.5214	564.2215	1170
BCO_2	2.0062	6.1862	76.8479	151.0665	97.1763	152.8679	57.2790	128.8021	1170
TCO_2	4.1909	10.7299	95.7628	140.8263	192.7277	413.6449	97.6987	270.8084	1170
$OCiCO_2$	5.8364	20.0283	241.2332	597.2650	122.9754	192.3878	114.2803	350.1544	1170
$OSCO_2$	4.6998	14.6468	122.6151	325.0898	44.0154	63.0046	52.0713	182.9680	1170
$PcCO_2$	1.4471	2.7786	2.9228	1.9438	10.6790	4.2762	5.1773	5.2625	1170
Ins.Imp	5.8039	3.4860	6.5568	4.7167	5.6000	3.8400	5.9403	4.0035	1122
Ins.Exp	2.8552	4.0487	2.8863	3.2191	9.4038	9.2976	5.2641	7.0812	1097
Invest (10^8)	−5.6400	28.8000	−2.4300	1490.0000	−1990.0000	13,100.0000	−8.7400	8300.0000	1008
DCPS	18.9537	16.8157	54.3599	40.5424	101.7361	36.6723	57.4963	47.4424	1096
CBL.ltl (10^7)	8.4200	71.5000	314.0000	816.0000			147.0000	573.0000	660
Stocks (10^{10})	5.5800	10.3000	64.1000	304.0000	292.0000	775.0000	151.0000	18.6000	1170

The correlation matrix in Table 4 indicates that there are no moderate or strong correlations to be found between the predictor variables utilized in this study. The variables are found to be heterogeneous and therefore do not influence each other, which makes them good predictor variables for the response variables to be used.

Table 4. Correlation Matrix for All Economies.

	Stocks	Ins.Imp	Ins.Exp	Inv.Eq	CBL.Ltl	DCPS
Stocks	1.0000					
Ins.imp	−0.0450	1.0000				
Ins.exp	0.0160	0.4490	1.0000			
Inv.eq	0.2550	−0.1360	−0.3470	1.0000		
CBL.ltl	0.2110	0.0010	0.0760	−0.1640	1.0000	
DCPS	0.4300	−0.1320	−0.0420	0.2180	0.1290	1.0000

To obtain a visual representation of the trends and movement of the key variables over these last three decades, a plotting tool is utilized to provide sensitivity charts. Figures 2–5 show the trend lines of three countries from the three economic types. Namibia is chosen and displayed in Figure 2 from the developing economies, China from the emerging economies and displayed in Figure 3, and the United States from the developed economies is chosen and displayed in Figures 4 and 5. The variables plotted include insurance on imports and exports, DCPS, stocks traded, net portfolio investments, and per capita and total CO_2 emissions.

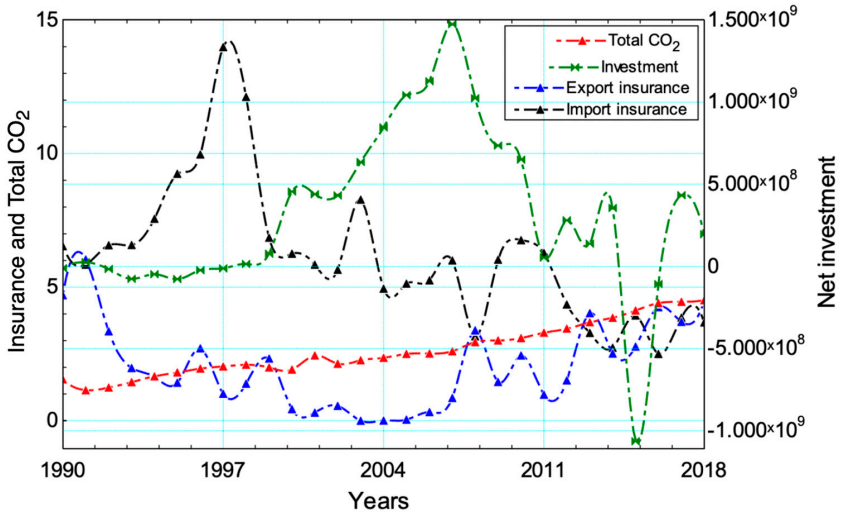

Figure 2. Total CO_2, net investment, and insurance between 1990 and 2018 in Namibia. Source: Author's illustrations.

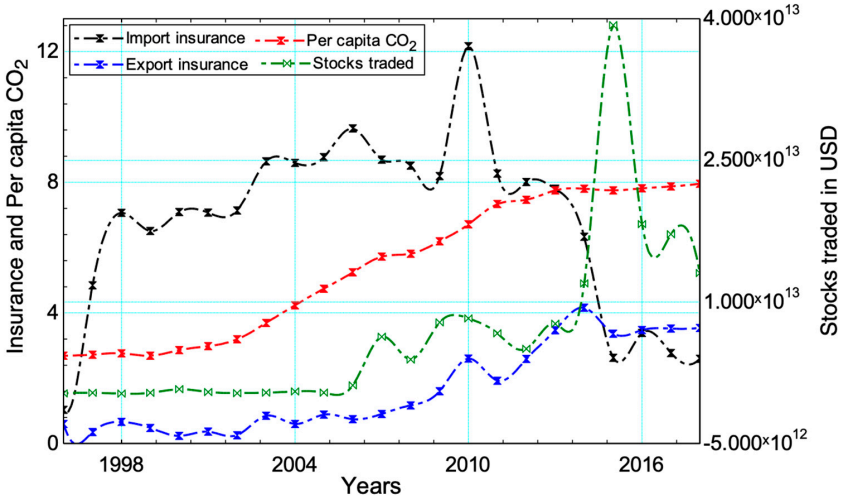

Figure 3. Per capita CO_2, stocks traded, and insurance between 1995 and 2018 in China. Source: Author's illustrations.

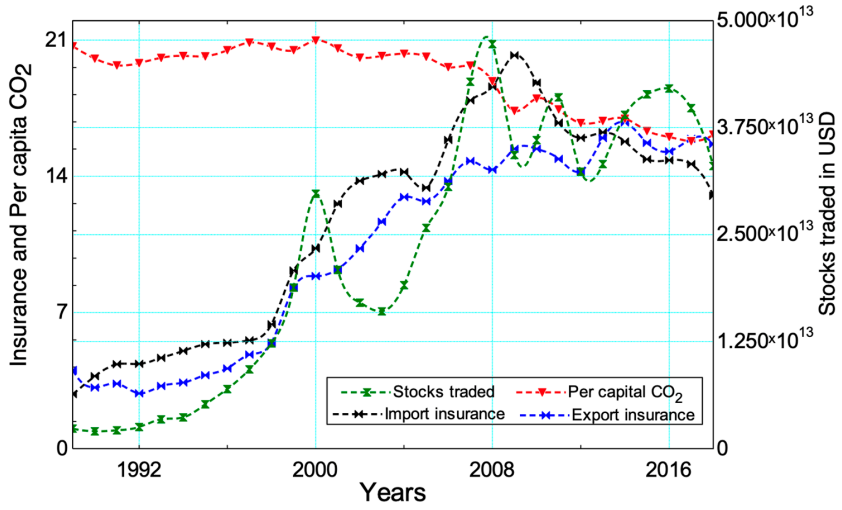

Figure 4. Per capita CO_2, stocks traded, and insurance between 1990 and 2018 in USA. Source: Author's illustrations.

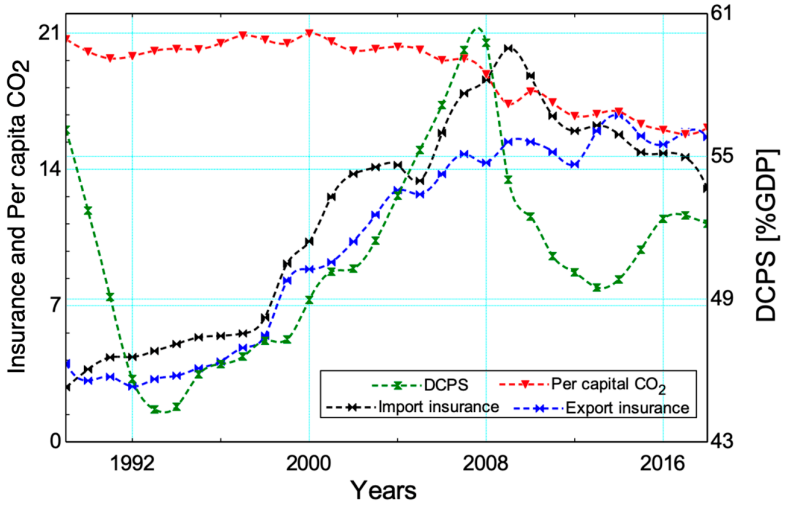

Figure 5. Per capita CO_2, DCPS, and insurance between 1990 and 2018 in USA. Source: Author's illustrations.

Considering the above graphs, several findings can be deduced. For Namibia, a sluggish but rising trend is obvious in its total CO_2 emissions. All other variables experience intense fluctuations especially in the case of net investments. However, the overall emissions of Namibia and across the developing economies are small in comparison to that of the emerging and developed economies. In China's case, per capita CO_2 emissions are seen to experience a rapid rise between 2000 and 2011; afterwards, a leveling occurs. Its stocks traded and import insurance experience more fluctuations than the in the case of export insurance, which has mostly seen a gradual increase. In the USA's case, all the financial system variables are seen to have a mostly increasing trend. Interestingly, per capita CO_2 emissions can be seen to gradually but consistently decrease. From these sensitivity graphs, one main thing can be deduced. For the developing and emerging economies considered, CO_2 emissions maintain a more upward trend, while in the USA's case, a downward trend can be seen. This is understandable as the developed world has produced the highest levels of emissions and has thus greatly prioritized the need to decrease CO_2 emissions in every sphere compared to the developing and emerging economies.

3.2. Panel Estimation

The financial system refers to those institutions such as insurance companies, banks, and stock exchanges. The financial system activity predictor variables included in the study are stocks traded, insurance and financial services on imports and exports, net portfolio investments, domestic credit to the private sector (DCPS), and long-term commercial bank loans. In estimating the effect the financial system has on CO_2 emissions, panel data on these financial activities themselves have been utilized in this study as predictor variables. These include stocks traded, long-term commercial bank loans, insurance, and other financial services on imports and exports, DCPS, and net portfolio investments. These six variables encompass the activities carried out by the major bodies that make up a country's financial system.

In investigating the effect financial sector activities have on CO_2 emissions, three current econometric models have been applied. These are the fixed and random effects selected according to the Hausman diagnostic test, feasible generalized least squares (FGLS), and, lastly, the system generalized method of moments (GMM), which is used as a robustness approach for all economies. Recent studies [2,46–48] have utilized these econometric models in empirically assessing the impact of various financial and economic variables on various test variables. The random or fixed effect model is employed according to the Hausman diagnostic test result for each economic type.

According to Aitken [49], the GLS estimator is more consistent, efficient, unbiased, and asymptotically normal compared with the OLS model. Miller [50] further presents the FGLS estimator as a preferred method as it corrects for autocorrelation and heteroscedasticity. In addition, it controls for slope heterogeneity and cross-sectional dependence. More especially, for large samples, the FGLS estimation approach is preferred over ordinary least squares due to heteroskedasticity and serial correlation concerns [51].

Several recent studies, Le and Nguyen [47], and Aluko and Kolapo [52] have utilized the FGLS econometric approach, such as in checking the effect of macroeconomic factors on stock market development in SSA or the role of economic development on carbon emission reduction in Nigeria.

For each model to be analyzed, the Durbin–Wu–Hausman test for endogeneity is recommended to decide accurately between utilizing a random or fixed effects method in that specific case. The Hausman test detects endogenous regressors in the model. The endogenous variables have values that can be determined by other variables in a system. Having these endogenous regressors can cause the least squares estimators to fail [53]. Using the Wooldridge (2010) unrelatedness assumption (RE1) approach [54] with the following auxiliary regression equation:

$$y_{it} = \alpha + x'_{it}\beta + z_i\gamma' + \overline{x}'_i\lambda + \delta_t + u_{it} \tag{1}$$

where $I = 1, \ldots, t = 1, \ldots, T$ and $\overline{x}_i = 1/T \sum_t x_{it}$ refers to the time averages of all time-varying regressors. This includes time fixed δ_t if included in the RE and FE estimation.

It is applied as such:

$$\begin{aligned} log\mathrm{CO2}_{it} = \alpha_{it} + \beta_1 Stocks + \beta_2 Ins.exp + \beta_3 Ins.imp + \beta_4 DCPS + \beta_5 CBLltl \\ +\delta_{it} + u_{it} + \varepsilon_{it} \end{aligned} \tag{2}$$

where the seven areas of CO_2 emission are the response variables for stocks traded, insurance on exports and imports, and credit to the private sector by banks, and long-term commercial bank loans are the financial system variables. This method and GLS are applied for all three economic types.

The standard FGLS formula is applied here as:

$$\hat{\beta}_{FGLS} = (X'\,\hat{\mathrm{W}}^{-1}X)^{-1}\,X'\,\hat{\mathrm{W}}^{-1}Y \tag{3}$$

where $\hat{W}$ is the diagonal matrix entries $\widehat{w_{ii}} = \widehat{u_i}^2$.

To analyze the impact of FSA on CO_2 emissions, the system GMM model is applied after making a combined panel data set of all three economic types. The GMM estimators are known to be asymptomatically normal, efficient, and consistent compared to other estimators that do not use extra information besides that contained in the moment conditions [55]. The following base formula is applied:

$$\hat{\theta} = \arg \underset{\theta e \Theta}{min} \left(\frac{1}{T} \sum_{t=1}^{T} g(Y_t, \theta) \right)^T \hat{W} \left(\frac{1}{T} \sum_{t=1}^{T} g(Y_t, \theta) \right) \quad (4)$$

The system GMM approach helps improve estimation efficiency. This two-step estimation is even better at handling heteroscedasticity, autocorrelation, and endogeneity problems than the one-step according to Roodman [56]. Stata and R have been utilized in the execution of these models.

3.3. Testing for the EKC Hypothesis Curve Using Bivariate Plots

To obtain an idea of the effect between the main response variable (total CO_2) and 6 predictor variables for financial systems, bivariate scatter plots have been created using R software 2022 July version for all 39 countries included in the panel. The predictor variables are stocks traded, insurance on imports and exports, net investments on equities, DCPS, and long-term commercial bank loans. As the developing economies do not have complete data for stock traded, and the developed economies lack data on long-term commercial bank lending, these variables will be dropped according to the economy in the multivariate regression. However, using the available data, Figure 6 provides a visual representation of the correlation effect between the financial activities and CO_2 emissions.

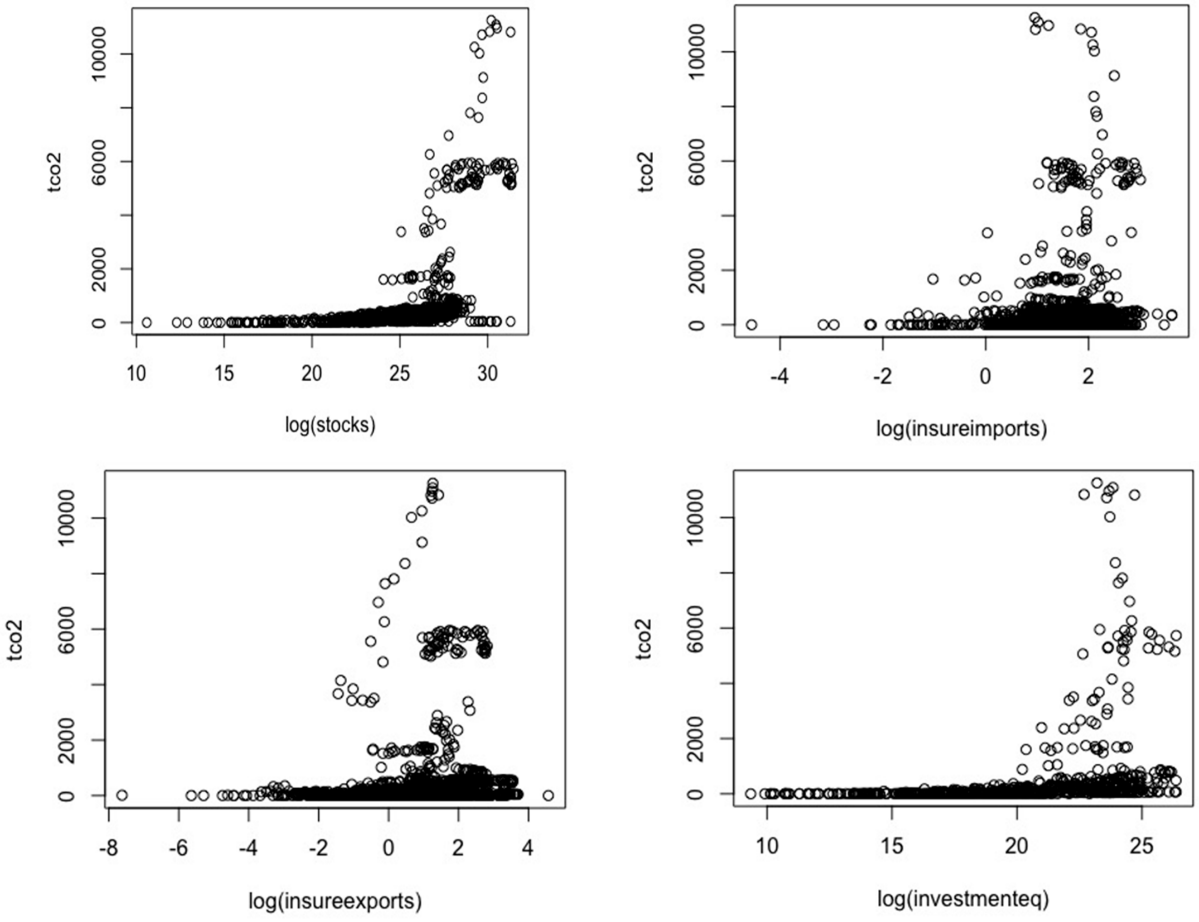

Figure 6. *Cont.*

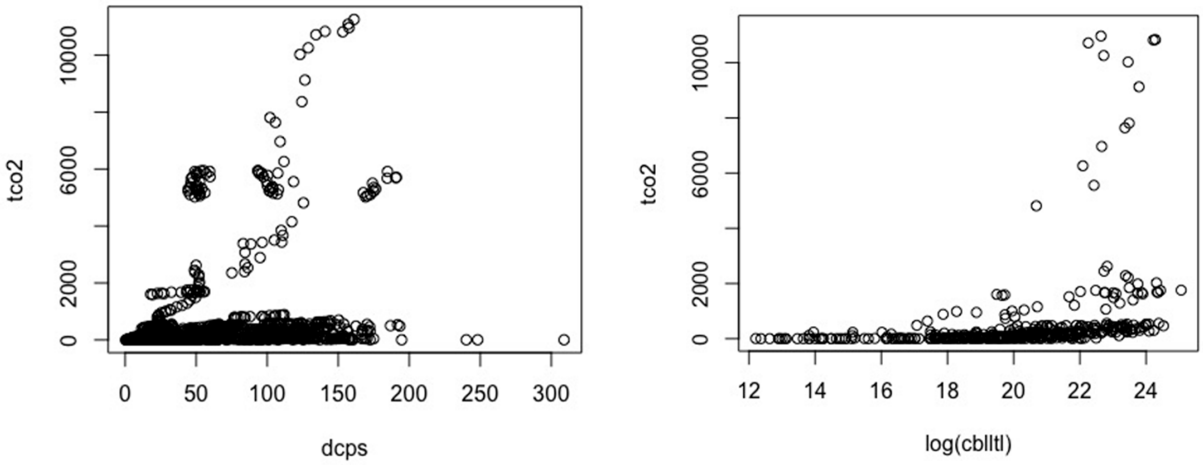

Figure 6. Effect of financial activities on total CO_2 emissions. Source: Author's illustrations based on IMF, WBS, and POEU database.

The bivariate scatter plots show signs of a positive correlation. They indicate that each of these financial sector activities results in increased total CO_2 emissions, therefore, implying that increased financial sector activities negatively impact CO_2 emission mitigation efforts. Using the adapted EKC hypothesis logic, it is evident that the scale effect rather than the technique effect predominantly dominates on a global scale.

Nevertheless, to empirically test the relationship more accurately, multivariate regression analysis in the form of feasible generalized least squares and RE/FE based on the Hausman diagnostic test for panel data analysis has been employed. In addition, system GMM dynamic panel modeling has been utilized as a robustness measure.

4. Regression Results

4.1. Total and Per Capita CO_2 Emissions across the Economic Bodies

In this study, the effect financial systems have on environmental sustainability is examined. CO_2 emissions, which are a major inhibitor to the achievement of global environmental sustainability, have been divided into seven categories. Each category is used as a response variable in the empirical analysis. Using FGLS and random effects based on the Hausman diagnostic test, Table 5 portrays the first category, which is total carbon emissions, and its response to financial systems in the three economic types being examined. The log form of the response variable is used when necessary.

From the estimation results for the effect of financial systems on total CO_2 as a response variable, insurance on imports shows a significant negative correlation with CO_2 in developing economies, while the opposite is the case for insurance on exports. This could be because the goods produced upon which the insurance is traded are obtained externally in these countries in the case of imports and internally in the case of exports. In essence, the negative environmental effects of production such as increased CO_2 become evident. Therefore, from the findings for developing economies, it can be said that CO_2 is reduced as the amount of insurance on imports increases, while the opposite is the case for the amount of insurance on exports. An important aspect about insurance to note is that the insurance systems in the developing economies when compared with the developed economies remain rather underdeveloped. This then could imply that beyond the fact that these products are not being produced within the country, the insured imports themselves may not be goods or services that actively contribute towards CO_2 emission increases in the first place. Interestingly, increased DCPS and long-term commercial bank loans are seen to agitate CO_2 mitigation efforts in developing economies, implying that an increase in DCPS amounts to an in increase in total CO_2 emissions. This is because increased investment in firms in the private sector which are already involved in increased emissions will inevitably lead to even more emissions. Understandably, increased amounts

of insurance on exports lead to increased emissions as the production processes in the developing economies remain environmentally unsustainable, with the 'grow first, clean up later' approach to economic development active [57]. As for the developed economies, a similar finding to the developing economies can be seen. An increase in the amount of insurance on imports positively impacts emissions, while increased credit to the private sectors negatively impacts CO_2 for the same reasons as the other economies. Based on these findings, banks, depository corporations, and investors in the private sector, therefore, hold a higher place of responsibility as regards the selection of the types of firms to invest in as these decisions inadvertently impact CO_2 emissions by these economies. In the case of emerging economies, all aspects of the financial systems considered amount in an aggravation of the CO_2 emission situation. This implies that increases in stocks traded, insurance (whether on imports or exports), net investments, DCPS, and commercial bank loans all lead towards the increase in CO_2.

Table 5. Estimates for the Effect of Financial Activities on Total CO_2 Emissions.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Developing		Emerging		Developed		All
	FGLS	RE	FGLS	RE	FGLS	RE	FGLS
Stocks			0.0011 ***	0.0002 ***	0.0009 ***	0.00002	
			(0.0002)	(0.0006)	(0.0002)	(0.00001)	
Ins.imp	−4.2370 ***	−1.9980 ***	0.0449 ***	0.0116 **	0.0163	−0.0158 ***	0.0771 ***
	(0.6890)	(0.4650)	(0.0142)	(0.0050)	(0.0355)	(0.0035)	(0.0179)
Ins.exp	2.2670 ***	0.4740 *	0.1170 ***	0.0345 ***	−0.0421 ***	0.0085 ***	−0.0512 ***
	(0.5800)	(0.2830)	(0.0225)	(0.0082)	(0.0116)	(0.0020)	(0.0112)
Invest			0.0015 ***	0.00003	−0.0008	0.00003	−0.0005 ***
			(0.0004)	(0.0001)	(0.00007)	(0.00005)	(0.00008)
DCPS	6.0200 ***	1.3570 ***	0.0111 ***	0.0060 ***	0.0018	0.0031 ***	0.0332 ***
	(0.1560)	(0.1720)	(0.0018)	(0.0010)	(0.0027)	(0.0003)	(0.0016)
CBL.ltl	0.0014 ***	0.1210 ***	0.0027 ***	0.0005 ***			
	(0.0325)	(0.0135)	(0.0006)	(0.0047)			
Cons	−50.4200 ***	15.1700 *	4.4210 ***	5.3540 ***	5.5050 ***	5.0610 ***	1.9550 ***
	(5.0600)	(8.7750)	(0.1380)	(0.2290)	(0.3030)	(0.4730)	(0.1550)
R^2		0.9120		0.387		0.3400	
Obs.	368	368	307	307	418	418	1093

Standard errors are in parenthesis; *, **, and *** indicate a significance level of 0.1, 0.05, and 0.01, respectively.

The second category of emissions herein considered is per capita emissions. Per capita emissions here refer to the estimation of the amount of CO_2 produced by each member of a population in each country belonging to each economic group. Table 6 portrays this category of carbon emissions by checking the effect of financial systems on CO_2 emissions in the three economic types being examined. The log form of this response variable is used when necessary.

For the developing economies, increases in amounts of insurance traded on imports result in decreased per capita CO_2. Additionally, increased amounts of insurance traded on exports and credit offered to the private sector are found to lead to the increase in per capita CO_2 in all three economic types. Emerging economies show that almost all predictor variables for financial systems significantly negatively influence per capita emissions. These results concur with Rafiq et al.'s findings which posit that rapid economic expansion, population density, and energy usage intensity are drivers of consistently increasing emissions in emerging economies [58]. In essence, compared with the two other economic types, all financial sector activities ultimately amount to an increase in per capita CO_2 emissions.

Table 6. Estimates for the Effect of Financial Activities on per capita CO_2.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Developing		Developed		Emerging		All
	FGLS	RE	FGLS	RE	FGLS	RE	FGLS
Stocks			0.0003 **	0.0002 ***	0.00001	−0.0073 ***	
			(0.0001)	(0.0004)	(0.00003)	(0.0001)	
Ins.imp	−0.0716 ***	−0.0092 **	0.0387 ***	0.00374	0.0369 ***	0.0346	0.0248 ***
	(0.0148)	(0.0043)	(0.0091)	(0.0034)	(0.0079)	(0.0323)	(0.0093)
Ins.exp	0.0567 ***	0.0015	0.0197	0.0153 ***	−0.0145 ***	−0.0792 ***	−0.0200 ***
	(0.0124)	(0.0026)	(0.0144)	(0.0056)	(0.0026)	(0.0189)	(0.0058)
Invest			0.00067 **	0.00002	−0.00004 **	−0.0001 **	−0.0002 ***
			(0.0003)	(0.00008)	(0.00002)	(0.0005)	(0.0005)
DCPS	0.1220 ***	0.0057 ***	0.0033 ***	0.0045 ***	−0.0009	0.0175 ***	0.0249 ***
	(0.0034)	(0.0012)	(0.0011)	(0.0007)	(0.0006)	(0.0024)	(0.0009)
CBL.ltl	0.0008	0.8020 ***	0.0001 ***	0.0003 ***			
	(0.0007)	(0.0385)	(0.0004)	(0.0001)			
Cons	−0.9050 ***	0.0057 ***	0.3940 ***	0.6010 ***	2.3510 ***	9.3580 ***	−0.7150 ***
	(0.1080)	(0.0002)	(0.0891)	(0.0413)	(0.0674)	(1.0660)	(0.0795)
R^2		0.8990		0.3300		0.286	
Obs.	368	368	307	307	418	418	1093

Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$.

4.2. Total CO_2 Emissions across Economic Sectors

The power industry has played a major role in the increase in CO_2 bringing about several government policies especially in emerging economies such as China. One such initiative is the carbon emissions reduction responsibility (CERR) allocation placed on China's power industry. This allocates a target to each agent on specific shares of carbon emission reduction to attain. Table 7 presents the estimation results for the effect of financial systems on CO_2 emissions by the power industry with the log form used when necessitated.

Table 7. Estimates for the Effect of Financial Activities on CO_2 by the Power Industry.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Developing		Emerging		Developed		All
	FGLS	FE	FGLS	RE	FGLS	RE	FGLS
Stocks			0.0122 ***	0.0023 **	0.0438 ***	0.0177	
			(0.0026)	(0.0009)	(0.3660)	(0.1150)	
Ins.imp	−2.2400 ***	−1.0840 ***	0.0789 ***	0.0204 ***	13.5600	6.9380 **	0.0803 ***
	(0.3520)	(0.2190)	(0.0167)	(0.0072)	(8.8500)	(2.9660)	(0.0215)
Ins.exp	1.1840 ***	0.1960	0.0688 ***	0.0440 ***	−5.0790 *	−3.4290 **	−0.0798 ***
	(0.2960)	(0.1320)	(0.0264)	(0.0118)	(2.8910)	(1.7070)	(0.0135)
Invest			0.2030 ***	0.1110	−8.2500 ***	−0.0276 ***	−0.0586 ***
			(0.0005)	(0.0016)	(0.0002)	(0.0045)	(0.0010)
DCPS	3.0810 ***	0.4330 ***	0.0117 ***	0.0067 ***	−3.5310 ***	0.4870 **	0.0385 ***
	(0.0797)	(0.0832)	(0.0022)	(0.0014)	(0.6790)	(0.2220)	(0.0020)
CBL.ltl	0.7140 ***	0.6340 ***	0.0028 ***	0.0088 ***			
	(0.1660)	(0.0626)	(0.0066)	(0.0022)			
Cons	−26.6500 ***	14.6300 ***	3.0400 ***	4.0060 ***	488.2000 ***	191.2000 ***	0.2420
	(2.5820)	(1.9650)	(0.1630)	(0.3200)	(75.5400)	(53.4500)	(0.1840)
R^2		0.8720		0.4140		0.4050	
Obs.	368	368	307	307	418	418	1093

Standard errors are in parenthesis; *, **, and *** indicate a significance level of 0.1, 0.05, and 0.01, respectively.

Emissions by the power industry are found to be negatively impacted by increased stocks traded, increased credit offered to the private sector, and long-term commercial bank loans in all the economies. However, in the developed economies, increased net investments and the amount of insurance traded on exports positively impact emissions by the power

industry. This could be as a result of the greater environmental awareness existing among investors, whereby many are more willing to invest in greener businesses [59]. Additionally, these businesses forging forward with environmentally sustainable strategies are found to be more competitive, thereby attracting higher investment [60].

While all financial system explanatory variables considered here aggravate CO_2 emission level by the power industry for emerging economies, increased levels of insurance on imports is seen to produce an alleviation effect on CO_2 emission mitigation efforts. Most economies have therefore multiplied their efforts to decrease greenhouse gas emissions by the power industry. China especially, which has the highest level of carbon emissions globally, has put into place several strategies to decrease emission levels including the earlier mentioned CERR strategy for the power industry, the Intergovernmental Panel on Climate Change (IPCC), and the 1.5 degrees Celsius limit goal implemented among several others [61].

Besides the power industries, other combustion industries functioning within each economy also play a major role in contributing to GHG emissions which often primarily include CO_2. The role that financial systems in each of these economies play in the mitigation of CO_2 emissions by the other combustion industries is examined in Table 8. The log form of emissions by the combustion industries is used where necessary.

Table 8. Estimates for the Effect of Financial Activities on CO_2 by Other Combustion Industries.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Developing		Emerging		Developed		All
	FGLS	FE	FGLS	RE	FGLS	RE	FGLS
Stocks			0.0012 ***	0.0024 ***	0.1440 ***	−0.0151 ***	
			(0.0002)	(0.00006)	(0.0141)	(0.0240)	
Ins.imp	−0.8930 ***	−0.6840 ***	0.0488 ***	0.0071	4.8300	−1.1600 *	0.1080 ***
	(0.1470)	(0.1530)	(0.0153)	(0.0050)	(3.3980)	(0.6240)	(0.0204)
Ins.exp	0.3480 ***	0.0432	0.1290 ***	0.0286 ***	−2.6740 **	−1.0700 ***	−0.0657 ***
	(0.1240)	(0.0925)	(0.0242)	(0.0082)	(1.1100)	(0.3660)	(0.0127)
Invest			0.0014 ***	0.0008	−0.0022 ***	−0.0023 **	−0.0005 ***
			(0.0005)	(0.0002)	(0.0007)	(0.0009)	(0.0010)
DCPS	1.1320 ***	0.2180 ***	0.0118 ***	0.0035 ***	−1.0120 ***	0.2470 ***	0.0356 ***
	(0.0333)	(0.0582)	(0.0020)	(0.0010)	(0.2610)	(0.0465)	(0.0019)
CBL.ltl	0.3920 ***	0.3550 ***	0.0249 ***	0.0381 **			
	(0.6920)	(0.4380)	(0.0611)	(0.0381)			
Cons	−8.8840 ***	6.3750 ***	2.8280 ***	4.0200 ***	182.1000 ***	104.3000 ***	−0.2080
	(1.0780)	(1.3750)	(0.1490)	(0.2500)	(29.0000)	(21.3900)	(0.1740)
R^2		0.8150		0.555		0.534	
Obs.	368	278	307	307	418	418	1093

Standard errors are in parenthesis; *, **, and *** indicate significance level of 0.1, 0.05, and 0.01, respectively.

Looking at the developing economies, it is evident that a strong negative correlation exists between the amount of insurance on imports and CO_2 emissions. This is a positive finding which indicates that increases in the amount of insurance on imports result in decreased carbon emissions by the other combustion industries. For the developed economies, it is the case that increases in net investment alleviates the CO_2 emission situation. However, an interesting finding here is that for the developed economies insurance on exports shows a strong negative correlation with emissions. This indicates that as developed economies increase insurance on exported goods and services, their total CO_2 emission levels decrease. This could be a result of the types of goods and services being exported by the developed economies. Compared to the developing economies which mostly export agricultural products and raw materials, the developed economies mostly export more highly skilled and technology-intensive products [62]. Merchandise exports in developing economies suffer from higher costs of production which in turn makes merchandise exports weaker in the picture of global trade [63]. The developed and emerging economies show a finding

that is in agreement with Chang et al.'s. [36] study which found that increased stock market returns lead to increased CO_2 emissions by combustion industries. As for the emerging economies, all predictor variables for financial systems applied to the analysis show strong significant negative effects on CO_2 emission mitigation efforts. As these financial activities increase, CO_2 emissions by the other combustion industries increase in tandem.

The transportation sector in every economy continues to play a critical role in the attainment of economic expansion. This is because goods and services continue to move from points of production to points of sale and production. All aspects of supply chains rely on the transportation sector for successful trading. However, this same sector remains perhaps the major culprit of increased GHG emissions, more especially CO_2 emissions globally [64]. In this study examining the role of financial systems on CO_2, the effect of the financial system on CO_2 emission mitigation efforts must be investigated as well. With the log form of this response variable utilized in the regressions, Table 9 presents the findings.

Table 9. Estimates for the Effect of Financial Activities on CO_2 by the Transportation Sector.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Developing		Emerging		Developed		All
	FGLS	FE	FGLS	RE	FGLS	RE	FGLS
Stocks			0.0007 ***	0.0003 ***	0.3360 ***	0.0001 ***	
			(0.0002)	(0.0064)	(0.0003)	(0.0002)	
Ins.imp	−0.4220 ***	−0.2650 ***	0.0181 *	0.0074	13.6600 **	−0.0093 ***	0.0689 ***
	(0.0724)	(0.0522)	(0.0109)	(0.0052)	(6.0480)	(0.0033)	(0.0156)
Ins.exp	0.2120 ***	0.0667 **	0.1440 ***	0.0368 ***	−2.5220	0.0073 ***	−0.0359 ***
	(0.0610)	(0.0316)	(0.0172)	(0.0084)	(1.9760)	(0.0020)	(0.0097)
Invest			0.0090 **	0.0029	−0.0533 ***	0.0086 *	−0.0005 ***
			(0.0003)	(0.0001)	(0.0122)	(0.0050)	(0.0076)
DCPS	0.6170 ***	0.1440 ***	0.0086 ***	0.0077 ***	−3.0530 ***	0.0032 ***	0.0281 ***
	(0.016)	(0.0199)	(0.0014)	(0.0010)	(0.4640)	(0.0002)	(0.0014)
CBL.ltl	0.0199 ***	0.1790 ***	0.0021 ***	0.0005 ***			
	(0.0341)	(0.0150)	(4.3400)	(0.0016)			
Cons	−4.3060 ***	3.2620 ***	3.1160 ***	3.6850 ***	351.2000 ***	3.5190 ***	0.8210 ***
	(0.5320)	(0.4700)	(0.1060)	(0.2000)	(51.6300)	(0.4170)	(0.1330)
R^2		0.8840		0.3890		0.4400	
Obs.	368	368	307	307	418	418	1093

Standard errors are in parenthesis; *, **, and *** indicate a significance level of 0.1, 0.05, and 0.01, respectively.

Here, a strong negative correlation can be found between insurance on goods imported and emissions by the transport sectors in the developing economies. This indicates that as the import insurance amount increases, CO_2 emissions by the transportation sector decrease. This aspect of financial sector activity is found to positively impact emission levels. Nevertheless, increased credit to the private sector, commercial bank long-term loans, significantly impact CO_2 emissions by the transport sector negatively. In the emerging and developed economies, increases in stocks traded and DCPS are found to aggravate CO_2 emissions by the transport sector, although all explanatory variables presented in the analysis are found to especially aggravate CO_2 emission levels by the transportation sector in the emerging economies. This is understandable as the transportation sector remains crucial to economic development in all economic types. More especially, the emerging economies which are at the center of global trade, from the stage of production to the supply to consumers, still have difficulties managing air pollution brought on by the transport sector [65]. This is especially the case for economic giants such as China where emissions by the transport sector remain prevalent [66,67] despite efforts to combat CO_2 emissions with the advent of electric vehicles [68].

Although a lot of focus is given to the main contributors to CO_2 emissions such as the power industry and the transportation sector, the other sectors in the economy, such as agriculture, land use, and forestry among others, when combined also make considerable

contributions to emission levels. These contributions further disrupt the GHG emission mitigation efforts in place. In Table 10, the effect of financial systems on CO_2 emissions by the other sectors in all the three economic types is considered with the application of the log form of the response variable when required.

Table 10. Estimates for the Effect of Financial Activities on CO_2 by Other Sectors.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Developing		Emerging		Developed		All
	FGLS	RE	FGLS	RE	FGLS	RE	FGLS
Stocks			0.0118 ***	0.0003 ***	0.0495 ***	−0.0059 ***	
			(0.0003)	(0.0006)	(0.0048)	(0.0095)	
Ins.imp	−0.4150 ***	0.1640 **	0.0411 ***	0.0096 *	0.2900	−1.1420 ***	0.0989 ***
	(0.1090)	(0.0682)	(0.0144)	(0.0052)	(1.1500)	(0.246)	(0.0184)
Ins.exp	0.4140 ***	0.0490	0.1150 ***	0.0233 ***	−0.9210 **	−0.1830	−0.0710 ***
	(0.0918)	(0.0415)	(0.0229)	(0.0085)	(0.3760)	(0.144)	(0.0115)
Invest			0.0014 ***	−0.0032	−0.0061 ***	0.0427	−0.0379 ***
			(0.0043)	(0.0012)	(0.0023)	(0.0037)	(0.0089)
DCPS	0.8400 ***	0.0839 ***	0.0127 ***	0.0069 ***	−0.3440 ***	0.0856 ***	0.0291 ***
	(0.0247)	(0.0252)	(0.0019)	(0.0010)	(0.0883)	(0.0183)	(0.0017)
CBL.ltl	−0.0305	−0.0054 ***	0.0263 ***	0.0021			
	(0.0051)	(0.0020)	(0.0006)	(0.0016)			
Cons	−7.9680 ***	1.5970	2.2530 ***	3.2510 ***	2.6550 ***	41.1500 ***	0.0107
	(0.8010)	(1.3320)	(0.1410)	(0.2070)	(0.322)	(7.387)	(0.157)
R^2		0.6800		0.4450		0.6880	
Obs.	368	368	307	307	418	418	1093

Standard errors are in parenthesis; *, **, and *** indicate a significance level of 0.1, 0.05, and 0.01, respectively.

From the estimation results, there are new findings for the developing economies beyond the effect whereby increased numbers of insurance on imports positively impact the CO_2 emission mitigation efforts. It is also the case that a significant negative correlation can be seen between long-term commercial bank loans and CO_2 emissions by the other sectors. In essence, banks giving out more loans to the other sectors in the economy positively impacts CO_2 emission mitigation efforts. Unlike the participants in the main sectors discussed, those in the other sectors such as agriculture and other smaller industries are more likely to seek out long-term bank loans to fund their businesses. Long-term financing plays a key role in the development of small to medium-sized enterprises and ventures [69]. Taking the agricultural sector, for instance, poor farming practices that lead to land degradation, soil, and water contamination can be often connected to low-level farming technology. With better, higher investment in acquiring the right machinery, and even water purifying technology, some farming excesses that negatively affect the environment can be minimized. In maintaining livestock as well, higher technology can sometimes enable farmers to translate toxic waste by livestock into energy sources. Branca et al. refer to this as climate-smart agriculture [70]. In this way, it is understandable that in developing economies increased commercial bank lending positively impacts CO_2 emission mitigation efforts. As for the emerging and developed economies, a similar finding is as in prior sectors whereby increases in net portfolio investments positively affect CO_2 emission mitigation efforts. However, it is also clear that in emerging economies every increase in financial system activity consistently negatively impacts CO_2 emission mitigation efforts.

Alongside emissions by the power industry and transport sector, CO_2 emission reduction in buildings has become an important topic in the last few decades. With the rapid urbanization rate of the world, buildings have become major contributors to CO_2 emissions globally. The construction and powering of buildings worldwide continue to contribute greatly to GHG emission rates. In Table 11, the effect of financial systems on CO_2 emissions by buildings as a response variable is considered.

Table 11. Estimates for the Effect of Financial Activities on CO_2 by Buildings.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Developing		Emerging		Developed		All
	FGLS	FE	FGLS	RE	FGLS	RE	FGLS
Stocks			0.0001 ***	0.0001 **	0.1130 ***	0.0086 ***	
			(0.0002)	(0.00006)	(0.0108)	(0.0016)	
Ins.imp	−0.2660 ***	−0.171 ***	0.0425 ***	0.0059	2.6090	−0.7060 *	0.0842 ***
	(0.0457)	(0.0506)	(0.0148)	(0.0047)	(2.6120)	(0.4160)	(0.0185)
Ins.exp	0.1100 ***	0.0216	0.0827 ***	0.0221 ***	−0.0884	−0.5290 **	−0.0340 ***
	(0.0385)	(0.0306)	(0.0234)	(0.0076)	(0.8530)	(0.2440)	(0.0115)
Invest			0.0014 ***	0.0030	−0.1880 ***	−0.0018 ***	−0.0051 ***
			(0.0004)	(0.0001)	(0.0053)	(0.0062)	(0.0009)
DCPS	0.3500 ***	0.0840 ***	0.0067 ***	0.0043 ***	−1.1950 ***	0.0304	0.0322 ***
	(0.0104)	(0.0193)	(0.0019)	(0.0009)	(0.2000)	(0.0310)	(0.0017)
CBL.ltl	0.1160 ***	0.1070 ***	0.0003 ***	0.0001			
	(0.0216)	(0.0145)	(0.0006)	(0.0002)			
Cons	−2.6160 ***	1.6240 ***	2.4370 ***	3.216 ***	168.3000 ***	94.1200 ***	−0.4980 ***
	(0.3360)	(0.4550)	(0.1440)	(0.2050)	(22.3000)	(16.8300)	(0.157)
R^2		0.9020		0.3060		0.494	
Obs.	368	368	307	307	418	418	1093

Standard errors are in parenthesis; *, **, and *** indicate a significance level of 0.1, 0.05, and 0.01, respectively.

Although the financial sector activities in the emerging economies consistently significantly aggravate CO_2 emissions in all aspects, the case differs for the developed and emerging economies where increased net investments are consistently found to positively impact CO_2 emissions by buildings. When all economies are considered, the majority of the predictor variables for financial sector activities tend to negatively impact CO_2 emissions by buildings. As the number of these activities increases, CO_2 emissions by buildings also significantly increase as well.

4.3. Robustness Test Using GMM Approach

To further estimate the effect of financial sector activities on all areas of CO_2 emissions for all of the economies considered, dynamic panel modeling in the form of system GMM is employed. Following the Bond, Hoeffler, and Temple [71] recommended tests for choosing between difference and system GMM, system GMM was found to be the least biased and most appropriate estimator for each model. The GMM estimation approach resolves endogeneity bias. The difference in Sargan tests of exogeneity of instruments indicates no issues of over-identification in the estimation. According to Roodman [53], the Sargan *p*-value should not be lower than 0.05, while a value over 0.25 is recommended. Our estimation satisfies all necessary clauses for utilizing system GMM. Besides these, the Arellano–Bond tests for autocorrelation AR(1) and AR(2) illustrate that first-order correlation is significant statistically, while second-order is statistically insignificant. The results portray high-level persistence in the response variables. In addition, it is ensured that the number of instruments are less than the number of groups. Table 12 reports the robust findings.

From the system GMM estimation results, DCPS has a strong positive correlation effect with total CO_2 emissions at a 1% significance level. This indicates that on a global scale, the continued financial fueling of the private sector leads to the continued increase in CO_2 emissions. In essence, this financial system activity consistently aggravates total CO_2 emissions overall. When looking at the explanatory variables across all seven areas of CO_2 emissions, the result remains positively significant. DCPS increase negatively impacts CO_2 emission mitigation efforts whether by the power industry, transport sector, or other sectors. Another key finding is that increases in net portfolio investments on the global scale amount to a decrease in CO_2 emissions by the transport sector and other sectors. These findings agree with those seen in the earlier RE/FE and FGLS model findings.

Table 12. System GMM Estimation Results for the Effect of FSA on CO_2 Emissions for All Economies.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	TCO_2	CO_2PI	CO_2OCI	CO_2T	CO_2OS	CO_2B	CO_2Pc
C02-L1	0.0016 ***	0.0032 ***	0.00551 ***	−0.1450 **	0.0072 ***	0.0145 ***	0.1800 ***
	(0.0004)	(0.0009)	(0.0016)	(0.0585)	(0.0018)	(0.0036)	(0.0283)
Ins.imp	0.1030 ***	0.9250 ***	0.1600 ***	0.0817 ***	0.1540 ***	0.0292 **	−0.0255 ***
	(0.0295)	(0.1670)	(0.0422)	(0.0184)	(0.0296)	(0.0121)	(0.0084)
Ins.exp	−0.0091	−0.0563 ***	−0.0273	−0.0298 ***	−0.0409 ***	−0.0091 **	−0.0046 **
	(0.0130)	(0.0086)	(0.0186)	(0.0042)	(0.0074)	(0.0039)	(0.0019)
Invest	0.0002 *	0.0010	−0.0003	−0.0003 ***	−0.0001 ***	0.0017	0.0001
	(0.0009)	(0.0001)	(0.0005)	(0.0005)	(0.00003)	(0.0011)	(0.0023)
DCPS	0.0147 ***	0.0267 ***	0.0220 ***	0.0366 ***	0.0198 ***	0.0197 ***	0.0115 ***
	(0.0045)	(0.0029)	(0.0046)	(0.0038)	(0.0021)	(0.0027)	(0.0018)
Cons	1.7060 ***	−0.8240 ***	−0.564 **	0.9510 ***	−0.3440 *	−0.3460 ***	−0.6000 ***
	(0.1760)	(0.2650)	(0.2560)	(0.1360)	(0.1900)	(0.0675)	(0.0661)
Grps/Inst	54/32	54/32	54/29	54/31	53/31	55/34	54/32
AR(2)	0.6250	0.2180	0.1760	0.9240	0.1270	0.5700	0.2410
Sargan	1.0000	0.9990	1.0000	0.9290	1.0000	0.3270	0.9280
Obs.	1093	1093	1093	1093	1093	1093	1093

Standard errors are in parenthesis; *, **, and *** indicate a significance level of 0.1, 0.05, and 0.01, respectively. TCO_2 is total emissions, CO_2PI is emissions by power industry, CO_2OCI is emissions by other combustion industries, CO_2T is emissions by transport sector, CO_2OS is emissions by other sectors, CO_2B is building emissions, and CO_2Pc is Per capita emissions.

Although there is strong evidence for the effect of financial system activity on carbon emissions even at the sectorial level, it is of importance to consider the control variables that could impact this relationship. These variables can include aspects such as environmental regulation and economic activity. Given the data availability issues surrounding environmental regulation data for these specific groups of countries and the fact inconsistencies exist in the level of environmental regulation in each country, particularly among the developing and emerging economies, this variable could not be controlled for directly in the model. However, past research on developed economies has shown that the environmental regulations put in place have positively impacted the carbon emission levels. However, this reduction in emissions depended on the country's technical efficiency or how many energy-intensive industries they possessed [72,73]. Other studies have touched on the relationship between specific aspects of the financial systems such as the banking system and also economic activity on carbon emissions, such as Bamisile et.al [74] and Obiora et al. [9] who found banking activity with economic activity controlled for impacts carbon emissions. However, as these studies consider different country groups, or a specific region, this present study thereby includes economic activity as a control variable in the form of GNI. GNI instead of GDP is a preferred economic development indicator in recent studies as it considers the total value a country produces from both within and without, which is not the case for GDP because it does not adequately consider the value added to the country even from agents outside that specific economy.

To therefore ensure the further robustness of our model and inferences, economic activity in the form of GNI is introduced into the model as a control variable. Table 13 shows the estimation results.

While controlling for economic activity, the findings obtained from the relationship between financial sector activities and carbon emissions still hold strong. GNI can be found to positively influence carbon emissions as the recent studies cited. However, factors such as DCPS, insurance, and investment all maintain their initial outcomes indicating that even when controlling for economic activity total carbon emissions and emissions by sector are all strongly impacted by financial system activity.

Table 13. Estimation Results with Control Variable for the Effect of FSA on CO_2 Emissions.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	TCO_2	CO_2PI	CO_2OCI	CO_2T	CO_2OS	CO_2B	CO_2Pc
Ins.imp	0.2170 *	111.4000 ***	87.7400 ***	15.6200 ***	31.1800 ***	21.2800 ***	0.0279
	(0.1230)	(27.3300)	(20.0900)	(3.5940)	(9.1670)	(5.0630)	(0.1350)
Ins.exp	−0.0556	−46.2700 ***	−44.7000 ***	−2.000	−20.2900 ***	−8.1280 **	−0.1460 *
	(0.0806)	(17.9100)	(13.1600)	(2.354)	(6.006)	(3.3170)	(0.0848)
Invest	0.0020	0.9880 ***	0.5920***	0.0890 ***	0.3280 ***	0.1830 ***	0.2090 ***
	(0.0006)	(0.1420)	(0.1040)	(0.0186)	(0.0475)	(0.0262)	(0.0353)
DCPS	0.0115 ***	2.1030 ***	2.0360 ***	0.1970 **	1.0090 ***	0.3120 **	0.0056 *
	(0.0030)	(0.6680)	(0.4910)	(0.0878)	(0.2240)	(0.1240)	(0.0033)
CBL.ltl	0.4590***	3.4230	−6.5010	8.600 ***	−6.5740 **	3.4620 **	0.1620 ***
	(0.0349)	(7.7460)	(5.6940)	(1.0180)	(2.5980)	(1.4350)	(0.0373)
GNI (10^{10})	0.0360 ***	4.4700 ***	3.2200 ***	0.7990 ***	1.8100 ***	0.6880 ***	−0.0001
	(0.0072)	(0.1590)	(0.1170)	(0.0209)	(0.0533)	(0.0294)	(0.0006)
Cons	−5.5250 ***	−269.4000 *	−62.8900	−169.2000 ***	49.0900	−92.9400 ***	−7.2850 ***
	(0.7130)	(158.4000)	(116.4000)	(20.8200)	(53.1100)	(29.3300)	(0.7830)
Obs.	1093	1093	1093	1093	1093	1093	1093

Standard errors are in parenthesis; *, **, and *** indicate a significance level of 0.1, 0.05, and 0.01, respectively. TCO_2 is total emissions, CO_2PI is emissions by power industry, CO_2OCI is emissions by other combustion industries, CO_2T is emissions by transport sector, CO_2OS is emissions by other sectors, CO_2B is building emissions, and CO_2Pc is Per capita emissions.

4.4. EKC Hypothesis Test Outcomes

To test the effect of financial development on CO_2 emissions in SSA in comparison to other economies, the environmental Kuznets curve hypothesis is utilized. Kuznets posits an inverted-U shaped curve where environmental degradation is expected to see a downturn after a certain turning point as economic development proceeds. Kuznets postulates that at the start of the curve, scale effect dominates and environmental degradation escalates as economic development progresses, while after the turning point, technique effect dominates where environmental degradation declines despite economic development.

As a key instigator of economic development, financial development is tested against CO_2 emissions in five different sectors. Table 14 summarizes the findings on the state of the EKC hypothesis as regards financial system development and CO_2 emissions, which are a major environmental degradant. The findings are divided into the stage of the posited curve whether the scale effect or technique effect is dominating in the Finance–CO_2 relationship for SSA first, then emerging economies, and then developed economies. CO_2/sector abbreviations in Table 14 have the same denotations as Tables 12 and 13.

Overall, it can be said that the EKC hypothesis is generally valid where SSA, EE, and DE are concerned. However, in most cases it can be observed that in the last three decades, the scale effect is still dominating. In essence, as financial development progresses in SSA and EE especially, environmental degradation by way of CO_2 emissions also progresses. The only area with a difference is SSA's non-major sectors where financial development is seen to positively impact environmental degradation by CO_2 emissions. Besides this instance, a turning point has not yet been reached for SSA and even more so for the emerging economies. In the developed economies, however, some signs of technique effect domination can now be seen such as in the power industry and other combustion industries. Environmental degradation is gradually declining as financial development progresses.

Table 14. Summary of the Outcomes of EKC Hypothesis Diagnosis.

FS Variable	CO_2/Sector	SSA EKC Diagnosis	EE EKC Diagnosis	DE EKC Diagnosis
FS	**TCO_2**	**Scale effect**	**Scale effect**	**Scale effect**
Stocks	CO_2pc		Scale effect	Scale effect
Insure.imp	CO_2pc	Technique effect	Scale effect	Scale effect
Insure.exp	CO_2pc	Scale effect	No effect	Technique effect
Investment	CO_2pc	Scale effect	Scale effect	Scale effect
FS	**CO_2pc**	**Scale effect**	**Scale effect**	**Scale effect**
Stocks	CO_2pi		Scale effect	Scale effect
Insure.imp	CO_2pi	Technique effect	Scale effect	Scale effect
Insure.exp	CO_2pi	Scale effect	Scale effect	Technique effect
Investment	CO_2pi	Scale effect	Scale effect	Technique effect
FS	**CO_2pi**	**Scale effect**	**Scale effect**	**Technique effect**
Stocks	CO_2oci		Scale effect	Scale effect
Insure.imp	CO_2oci	Technique effect	Scale effect	Scale effect
Insure.exp	CO_2oci	Scale effect	Scale effect	Technique effect
Investment	CO_2oci	Scale effect	Scale effect	Technique effect
FS	**CO_2oci**	**Scale effect**	**Scale effect**	**Technique effect**
Stocks	CO_2t		Scale effect	Technique effect
Insure.imp	CO_2t	Technique effect	Scale effect	Scale effect
Insure.exp	CO_2t	Scale effect	Scale effect	No effect
Investment	CO_2t	Scale effect	Scale effect	Technique effect
FS	**CO_2t**	**Scale effect**	**Scale effect**	**Scale effect**
Stocks	CO_2os		Scale effect	Scale effect
Insure.imp	CO_2os	Technique effect	Scale effect	No effect
Insure.exp	CO_2os	Scale effect	Scale effect	Technique effect
Investment	CO_2os	Scale effect	Scale effect	Technique effect
FS	**CO_2os**	**Scale effect**	**Scale effect**	**Technique effect**
Stocks	CO_2b		Scale effect	Scale effect
Insure.imp	CO_2b	Technique effect	Scale effect	No effect
Insure.exp	CO_2b	Scale effect	Scale effect	No effect
Investment	CO_2b	Scale effect	Scale effect	Technique effect
FS	**CO_2b**	**Scale effect**	**Scale effect**	**Technique effect**

5. Conclusions

The need to attain carbon neutrality across the globe with the harsh reality of climate change has become an issue more pressing than ever before. Yet, studies on the financial sector's contribution towards the attainment of this global goal remain lacking despite its role in economic expansion. Particularly, few studies have considered the nexus on a global scale, and almost none have gone beyond simply checking total carbon emissions. The major emitting sectors and the financial sector's activity contribution to carbon mitigation has been mostly neglected in the literature. Upon testing the EKC hypothesis, the findings for each economic group differ. Thus, the policy choices for each differ accordingly. For the developed economies, the trend is that increases in the amount of insurance on imports as well as on net investments positively influence CO_2 emission mitigation. In addition, increases in long-term bank lending positively affect CO_2 emission reduction efforts in the other sectors. As for the developed economies, increases in imports, as well as exports on occasion, alongside increases in net portfolio investments positively impact CO_2 emission mitigation efforts. Besides these cases, all the other explanatory variables for the financial system are found to have significant positive correlations with CO_2 emissions in all areas of emissions. They indicate that, overall, increased bank lending, credit offerings to the private sector, and stocks traded tended to aggravate CO_2 emissions, more especially in the emerging economies. In fact, for these economies, virtually all activities carried out by the financial sector significantly negatively impact CO_2 emissions at the 1% or 5% significance level, thereby hampering CO_2 emission mitigation efforts. The following policy recommendations by economic type is therefore offered.

5.1. Developing Economies: Higher Lending to Non-Major Economic Sectors

The developing economies are therefore encouraged to increase GHG emission awareness among the various financial sectors. The bodies in the financial system responsible for lending to the private sector are encouraged to begin the lending process by first investigating the green strategies employed by each firm before lending to them. As credit offered to them increases, inevitably, the CO_2 emission mitigation efforts will continually be hampered without careful selection of which types of firms in the private sector to invest in. Lending is also encouraged to those borrowers who have businesses in the other sectors of the economy. As the findings imply, higher net portfolio investments and long-term loans offered to those in other sectors positively influence CO_2 emission reduction efforts. Perhaps, the better investment allows for those working in these sectors to better arm themselves with technologies that cannot just improve processes but also reduce practices that easily lead to pollution and waste. In essence, only focusing on major CO_2 emitting culprits such as the power industry and transport sector is not enough. Financially influencing the CO_2 emission contribution by the other sectors is also beneficial towards the attainment of CO_2 emission reduction.

5.2. Developed Economies: Support for Firms Willing to Adopt Green Technology

The financial sector activities in the developed economies have also been found to positively influence CO_2 emission mitigation where insurance and net portfolio investments are concerned. Additionally, in most areas of emissions, it is also found that CO_2 emissions are reduced as insurance on exports and not just on imports is increased. As developed countries often can make use of high-quality technological products which are often greener than those exported and/or used in the developing world, these findings are understandable. Nevertheless, the financial system can further play a role in determining the types of products and firms to invest in. As the number of stocks traded increases, and credit to the private sector increases, CO_2 emissions are worsened. Institutions responsible for offering credit and investing should therefore place a higher emphasis on greener firms and attract investors towards the low emitting firms instead of those guilty of high GHG emission levels. If such approaches are put in place, even more pressure will be put on the members of high emitting industries to figure out more environmentally sustainable approaches to their business management. If the bodies of the financial sector do not take up the obligation to pressure and influence firms towards greener results financially, all firms will continue to emit with little repercussions knowing that credit and funding are always assured.

5.3. Emerging Economies: Increased Scrutiny When Lending to Private Sector

Lastly, the financial sector activities carried out by all 15 emerging economies considered in the panel for the emerging economies group were found to consistently aggravate the CO_2 emission situation. In essence, increases in the amount of stocks traded, insurance on both imports and exports, DCPS, bank lending, and net portfolio investments all increased CO_2 emission levels in the last three decades. This, therefore, raises an alarm as it seems that the financial system/sector currently is playing no evident role in the mitigation of CO_2 emissions. Perhaps these efforts are in place; however, positive evidence is marginal, and thus through the last three decades, only increases can be seen. The financial sector of the emerging economies is therefore encouraged to double down on all efforts possible in facilitating the reduction in CO_2 emissions in their economies. This could be by the effecting of more stringent processes when lending to enterprises that are culprits of higher emissions such as those in the transport sector, power industry, and other combustion industries. It could be that when investing in projects or lending to borrowers that make up part of the other sectors, careful consideration is given to those businesses with greener, more environmentally sustainable practices in place. By so doing, the financial sector activities as a whole will begin to see more positive effects where CO_2 emission mitigation efforts are concerned.

5.4. Policy Recommendations for All Economies

Upon testing the EKC hypothesis, it is clear that where the financial sector and carbon emissions are concerned, the scale effect dominates globally but more especially in the developing and emerging economies. The developed economies show some evidence of the technique effect starting to dominate areas such as the power industry, other combustion industries, transport, and building industries. As the scale effect is still the predominant effect worldwide, there is a need to increase awareness within financial sector bodies regarding the importance of carbon neutrality. Knowledge of the role that the financial sector and its bodies including banks, insurance companies, and stock exchanges play in the grand scheme of environmental sustainability must be further emphasized across its bodies. Additionally, the need to begin to proactively cut down on funding to those members of the private sector who do not have green practices or those who fundamentally make big additions to the issue of carbon emissions must be taken up as a priority. Overall, the members of the financial sectors in each country and each economic group are encouraged to introduce policies that put pressure on the private sector to create greener strategies. As green awareness is already being strongly emphasized even in the financial sector, a more beneficial move will be to enforce those policies that encourage green business practices. The members of the financial sector can also begin to present to investors those enterprises with not only profitable but green strategies in place first before those that are only profitable at the expense of environmental sustainability. As the financial sector holds the undeniable power to either fuel or not fuel various enterprises, it is now more responsible than ever before for the effects its decisions have on GHG emission levels globally.

This study is not without its limitations. The inferences made herein are limited to the data and the period upon which the findings are based. As more data sets become available, this research can be extended in other contexts. For instance, it will be relevant to see the extent to which the varying environmental regulation intensity across a region such as Africa impacts the CO_2 emission reduction efforts in the region.

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Appendix A

Table A1. Country List.

Developing Economies	Emerging Economies	Developed Economies
Congo Republic	China	Switzerland
Ethiopia	Brazil	Australia
The Gambia	India	Sweden
Kenya	Mexico	Germany
Madagascar	Turkey	Singapore
Malawi	Pakistan	Netherlands
Namibia	Thailand	Canada
Niger	Argentina	New Zealand

Table A1. *Cont.*

Developing Economies	Emerging Economies	Developed Economies
Senegal	Malaysia	United Kingdom
Seychelles	Philippines	United States
Tanzania	Morocco	Japan
Togo	South Africa	Israel
Uganda		South Korea
		France

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