Financial Development-Environmental Degradation Nexus in the United Arab Emirates: The Importance of Growth, Globalization and Structural Breaks

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Abstract: The financial development-environmental degradation nexus is revisited by incorporating economic growth, electricity consumption and economic globalization into the CO_2 emissions function. The study period spans $1975Q_I$-$2014Q_{IV}$ in the United Arab Emirates. We have applied structural break and cointegration tests to examine unit root and cointegration between the variables. The Toda-Yamamoto causality test is employed to investigate the causal relationship between the variables, and the robustness of causality linkages is tested by applying the innovative accounting approach.

Our empirical analysis shows cointegration between the series. Financial development increases CO_2 emissions. Economic growth is positively linked with environmental degradation. Electricity consumption improves environmental quality. Economic globalization affects CO_2 emissions negatively. The relationship between financial development and CO_2 emissions is U-shaped and inverted N-shaped. Furthermore, financial development causes environmental degradation and environmental degradation causes financial development in the Granger sense.

Keywords: Financial development, Environment, Growth, Electricity, Globalization

I. Introduction

Generally, CO_2 emissions result from human activity. Worldwide, energy is largely responsible for environmental degradation, accounting for 83% of the total volume of emissions in 2011. The relationship between economic growth and environmental quality was analyzed for the first time by Kuznets (1955), and since then, the academic community has shown a growing interest in this topic. The Environmental Kuznets Curve (EKC) hypothesis posits that the relationship between economic development and environmental quality takes the form of an inverted U-shaped. Specifically, economic growth leads to environmental degradation, followed by a reduction in degradation after a certain level of income per capita is reached. The main questions that arise concern how rich oil-exporting countries can act to reduce carbon emissions and how financial development impacts the environment. This is the case for the United Arab Emirates, where a massive investment in infrastructure has influenced the urbanization process. According to World Urbanization prospects, urbanization in the UAE has increased from 85% in 1990 to 91% in 2014 (United Nations, 2014).

In the present study, we aim to reinvestigate the relationship between economic development and environmental degradation by adding globalization to the CO_2 emissions function in the case of the United Arab Emirates. The Gulf Cooperation Council countries have experienced rapid growth mainly due to their oil and gas reserves. Therefore, the usage of these resources manifests in high per capita carbon emissions. In addition, the construction industry's pollutants have contributed to the deterioration of air and water quality. CO_2 emissions in the UAE increased from 60.809 million tons in 1990 to 94.163 million tons in 2002, while in 2013 the country reported 199.65 million tons of carbon dioxide emissions and other greenhouse gases[1]. In 2006, the government launched Masdar, a sustainability initiative designed to implement renewable and alternative energy programs. This investment of US$15 billion aimed to create infrastructure for solar, wind and hydrogen power, carbon emissions reduction, sustainability research and development, and education and manufacturing[2]. In addition, the government has established collaborations with private institutions to implement green projects, has set high standards for the efficiency of product imports (e.g., housing), and has set standards for fuel, cars, and the reduction of power consumption in its own buildings to improve environmental quality.

This paper contributes to the existing energy economics literature in five ways. (i) This paper reexamines the relationship between financial development and CO_2 emissions by adding economic globalization as a potential determinant of economic growth, energy consumption and pollutant emissions. (ii) The study generates a financial development index comprising three bank-based and two stock market-based financial indicators by using principal component analysis. (iii) This study applies structural break unit root and cointegration approaches to examine integrating properties of the variables and cointegration between the variables. (iv) The study applies Toda-Yamamoto to determine the causal relationship; and (v) the robustness of causality between financial development and CO_2 emissions is determined by the innovative accounting approach (IAA). We find the presence of cointegration between financial development and CO_2 emissions. Financial development is positively linked with CO_2 emissions but electricity consumption declines with CO_2emissions. Economic growth increases CO_2 emissions but economic

[1]Todorova, V. (2015). UAE released 200m tonnes of greenhouse gases in 2013. The National, UAE. January: http://www.thenational.ae/uae/environment/uae-released-200m-tonnes-of-greenhouse-gases-in-2013.

[2]Embassy of the UAE in Washington (2015). Energy in the UAE. http://www.uae-embassy.org/uae/energy/energy-and-climate-change.

globalization condenses emissions. The U-shaped and N-shaped relationships exist between financial development and CO_2 emissions. Moreover, the feedback effect is noted between financial development and CO_2 emissions.

The rest of the paper is organized as follows: Section-2 discusses the existing literature in terms of the relationship between financial development and CO_2 emissions and other determinants. Section-3 details the methodological framework, and the results and our interpretations are discussed in Section-4. Finally, Section-5 summarizes the conclusions and policy options.

II. Literature Review

The academic literature shows mixed results – depending on the methodology and sample sizes used – of studies that investigate the relationship between financial development and CO_2 emissions. On the one hand, a wide range of evidence suggests that financial development and economic growth are positively linked to environmental degradation, while, on the other hand, a number of empirical papers reveal a negative connection between these variables, based on different criteria used in the sample selection and the characteristics of various groups.

Many scholars (*inter alia,* Copeland and Taylor, 2004; Dasgupta et al. 2002; Dinda, 2004) indicate clear evidence of an inverted U-shaped, as follows: pollution increases and subsequently decreases as incomes reach higher levels. Barbier (1997) analyzed the rationality of economic growth as a priority given the detriment to environmental protection vs. the interaction between these two goals and the attribute of equal importance. The World Bank (2000) stated that economic development generated advantages for the population, with significant positive consequences for the environment as well. The existing literature includes a myriad of studies that focus on the connections between environmental degradation and economic growth in both the long-run and short-run. The concerns related to environmentally sustainable economic development (Meadows et al. 1992; Grove, 1992; Anderson, 1992) have been addressed through different policies, which are designed to meet the needs of various countries (Antle and Heidebrink, 1995; Grossman and Krueger, 1995; Selden and Song, 1994; Shafik, 1994). In some cases, the plan to target higher economic growth is threatened by the adoption of economic policies that negatively affect long-term environmental sustainability. A balance between resource use, economic engagement and the quality of the environment is difficult to achieve. If energy resources and activities provide economic advantages in the short-run, the effects in the long-run will be negative (Kolstad and Krautkraemer,1993).

Various scholars (e.g., Grossman and Krueger, 1995; Claessens and Feijen, 2007; Tamazian et al. 2009; Halicioglu, 2009) have highlighted the impact of financial development on environmental degradation, explaining that new financial resources and practices could be connected to environmental projects that aim to lower costs and improve the overall quality of their surroundings. Moreover, funding opportunities can lead to collaboration between governments and other institutions with high potential for engagement in environmental protection projects (Tamazian and Rao, 2010). The papers of Sadorsky (2010) and Zhang (2011) concluded that financial development generates higher CO_2 emissions. Stock market improvements can help public companies reduce financing costs, enlarge financing channels, share operational risk and find a balance between assets and liabilities; they may acquire new installations and allocate resources for the implementation of new projects, ultimately increasing both energy consumption and carbon emissions. Foreign direct investments (FDIs) generate economic growth along with new carbon emissions. In addition, financial intermediation allows the purchase of *dangerous* items (i.e., cars, houses, air conditioners and washing machines, etc.) in terms of the higher carbon dioxide emissions they produce (Zhang, 2011).

Tamazian et al. (2009) explored the relationship between financial development, economic growth and CO_2 emissions in the BRIC countries. They found that economic growth and financial development generate a reduction in environmental degradation. Furthermore, Tamazian and Rao (2010) showed, using a sample of 24 countries for the period 1993-2004, that economic development decreases environmental degradation. In addition, financial expansion positively impacts the environmental disclosure of the selected economies; specifically, the increase in FDIs generates a lower level of CO_2 emissions. Jalil and Feridun, (2011) explored the relationship between financial development and CO_2 emissions for the Chinese economy. Their findings support previous conclusions and note that financial development lowers environmental pollution. Moreover, in the long-run, carbon emissions are influenced by income, trade openness and energy consumption. According to Jalil et al. (2011), China has enjoyed a high rate of economic growth and financial development in the last two decades. However, this growth also produced evidence of consistent environmental degradation, as the annual growth rate of CO_2 emissions increased11% in the 2004-2010 period (Auffhammer and Carson, 2008).

Investigating the Sub-Saharan African countries, Al-Mulali and Sab (2012) demonstrated the significant role of energy consumption in economic growth and financial development. Their findings showed the positive link between financial development and CO_2 emissions. The policies that need to be implemented consist of energy savings projects and new investments in the region to achieve higher energy efficiency. Omri (2013) highlighted the bidirectional causal linkage between energy consumption and economic growth in 14 MENA countries during the period of 1990-2011. The geographical coverage of this study was very important, as this region has been considered the second most polluted in the world, with the highest level of CO_2 emissions. They used the Cobb-Douglas production function by rejecting the neo-classical assumption that economic growth is not impacted by energy. Their results show that energy is a major driver of GDP growth and that greater economic expansion determines new energy demand and vice versa. However, new production levels lead to increased pollution. The findings revealed the bidirectional causality between CO_2 emissions and economic growth and the interrelation between economic growth, trade openness and financial development. Additionally, Omri et al. (2015) found that the neutral effect exists between financial development and CO_2 emissions. Boutabba, (2014) emphasized the same relationship in the Indian economy and found that in the long-run, financial development has a positive influence on CO_2 emissions.

Ziaei, (2015) in the case of European, East Asian and Oceanic countries, investigated the relationship between financial development and CO_2 emissions by incorporating economic growth as an additional determinant of environmental degradation. They found a bi-directional causal relationship between economic growth and CO_2 emissions. Their empirical analysis also revealed a feedback effect between financial development and CO_2 emissions and between energy consumption and CO_2 emissions. For the Gulf Cooperation Council (GCC) countries, Salahuddin et al. (2015) noted that economic development and energy consumption positively affect CO_2 emissions in the long-run. However, financial development has a negative impact on environmental degradation. Furthermore, Jammazi and Aloui (2015) examined the relationship between energy, growth and emissions for the GCC region. They found bidirectional causality between CO_2 emissions and economic growth/energy consumption in Saudi Arabia, Oman, Bahrain, the UAE and Qatar. Over the period of 1960-2007, Ozturk and Acaravci (2013) reported that financial development has had an insignificant effect on CO_2 emissions but that the EKC hypothesis is valid. Al-Mulali et al. (2015) emphasized (using a sample of 129 countries) the determining factors affecting pollution. They found that urbanization, economic growth and petroleum consumption have positive effects on CO_2 emissions in high-income countries in the long-run. Their analysis indicated that financial development reduces environmental degradation.

In the case of the UAE, Charfeddine and Khediri (2015) examined the relationship between financial development and CO_2 emissions and found that financial development reduces CO_2 emissions and that causality runs from financial development to CO_2 emissions. Furthermore, they reported an inverted U-shaped linkage between financial development and CO_2 emissions. Recently, Javed and Sharif, (2016) investigated the validation of the EKC by incorporating financial development in the emissions function. They found that the EKC is valid but that financial development increases CO_2 emissions.

III. Model Construction and Data Collection

The relationship between financial development and CO_2 emissions gained popularity following the study of Tamazian et al. (2009), who examined the determinants of CO_2 emissions in the case of BRIC countries including USA and Japan. They used economic growth, industrial development, research and development expenditures, stock market development, foreign direct investment, ratio of deposit money bank assets to GDP, capital account openness, financial liberalization, financial openness and energy imports as determining factors of CO_2 emissions. Furthermore, Tamaziana and Rao (2010), Jalil and Feridun (2011), Omri et al. (2015), Al-mulali et al. (2015), and Shahbaz et al. (2015c) have included institutional quality, trade, capital, urbanization, coal consumption and industrial development as contributing factors to CO_2 emissions. We may note that existing studies ignored the role of globalization while investigating the finance-emissions nexus. Globalization influences CO_2 emissions *via* three distinct effects, namely the income, scale and composition effects. The growth of gross national product generated by high foreign trade and investment will determine new levels of pollution, *ceteris paribus,* the relationship is valid both ways. The scale effect of globalization on the environment includes changes driven by structural transformations dictated by foreign trade and investments. In addition, the composition effect states that pollution-intensive production increases overall pollution, and the causality is valid both ways. The technique effect of globalization refers to a lower level of pollution (per unit of output) generated by new technology/production methods implemented through foreign trade or FDI, when the scale and structure of the economic outcome do not change. According to decomposition analysis, foreign trade and investment liberalization provide both advantages and disadvantages. Therefore, there is a dynamic interaction between their determinants, and only an empirical analysis can capture the net environmental effect of globalization.

Following the existing literature on the finance-emissions nexus, we design the general form of the CO_2 emissions function as given below:

$$C_t = f(F_t, E_t, Y_t, G_t) \qquad (1)$$

We have transformed the series into a natural log-form for reliability and consistency of empirical results. This leads us to formulate the empirical form of the general CO_2 emissions function into a linear transformation, as follows:

$$\ln C_t = \beta_1 + \beta_2 \ln F_t + \beta_3 \ln E_t + \beta_4 \ln Y_t + \beta_5 \ln G_t + \mu_i \qquad (2)$$

Where, $\ln$, C_t, E_t, Y_t and G_t are natural-log, CO_2 emissions per capita, financial development index, energy consumption per capita, real income per capita measure of economic growth and economic globalization index. μ is an error term with the assumption of normal distribution.

We have included the squared (non-linear) term of financial development to examine whether the relationship between financial development and CO_2 emissions is inverted U-shaped or U-shaped (equation-3). The relationship between financial development and CO_2 emissions is inverted U-shaped if the estimates of the linear and non-linear terms have positive and negative signs, respectively. This entails the presence of the environmental Kuznets curve, which indicates that financial development initially is allied with CO_2 emissions and improves environmental quality once the financial sector achieves a certain maturity level (threshold level of financial development), otherwise the relationship between financial development and CO_2 emissions would be U-shaped.

$$\ln C_t = \alpha_1 + \alpha_2 \ln F_t + \alpha_3 \ln F_t^2 + \alpha_4 \ln E_t + \alpha_5 \ln Y_t + \alpha_6 \ln G_t + \mu_i \qquad (3)$$

We have inserted a cubic term of financial development into equation-3 to examine the polygonal relationship between financial development and CO_2 emissions following Sengupta (1996), De Bruyn and Heintz, (1999)[3]. The reason is that financial development would be allied positively with CO_2 emissions if future economic growth is stimulated by financial development as an economic tool for achieving sustainable economic development. Furthermore, the transformation of an economy from "drive to maturity" to "age of high mass consumption" is also linked to an increase in CO_2 emissions as people demand more financial services at lower cost to obtain their luxurious necessities that in return, increase CO_2 emissions. This is termed as the polygonal (N-shaped) relationship between financial development and CO_2 emissions. Following the argument raised above, the empirical equation of the relationship between financial development and CO_2 emissions is modeled as follows:

$$\ln C_t = \delta_1 + \delta_2 \ln F_t + \delta_3 \ln F_t^2 + \delta_4 \ln F_t^3 + \delta_5 \ln E_t + \delta_6 \ln Y_t + \delta_7 \ln G_t + \mu_i \qquad (4)$$

Financial development is environment-friendly if $\beta_2 < 0$, otherwise financial development deteriorates environmental quality by increasing CO_2 emissions. Electricity consumption is positively linked with CO_2 emissions if $\beta_3 < 0$, otherwise it increases CO_2 emissions. If $\beta_4 > 0$ then economic growth is accompanied by CO_2 emissions, otherwise economic growth improves environmental quality by lowering CO_2 emissions. Economic globalization improves environmental quality if the technique effect dominates the income effect by keeping the composite effect constant, i.e., $\beta_5 < 0$, otherwise economic globalization deteriorates the environment $\beta_5 > 0$. The EKC effect exists between financial development and CO_2 emissions if $\alpha_2 > 0, \alpha_3 < 0$. This relation is termed as inverted U-shaped. This relationship between financial

[3]The authors reported the N-shaped relationship between economic growth and CO_2 emissions.

development and CO_2 emissions turns out to be U-shaped if $\alpha_2 < 0, \alpha_3 > 0$, i.e., an invalidation of EKC effect. The polygonal relationship financial development and CO_2 emissions is N-shaped if $\delta_2 > 0,\ \delta_3 < 0,\ \delta_4 > 0$. Otherwise the relationship between the variables is inverted N-shaped if $\delta_2 < 0,\ \delta_3 > 0,\ \delta_4 < 0$.

The study covers the period of1975-2014. We have collected data on CO_2 emissions (metric tons), real GDP (constant prices in local currency) and electricity consumption (kWh) from the world development indicators published by the World Bank. The economic globalization index was obtained from http://globalization.kof.ethz.ch/. The data on real domestic credit to the private sector, liquid liabilities, domestic credit provided by the financial sector, stock market capitalization of listed companies and total value of stocks traded is also collected from the world development indicators (CDD-ROM, 2015). The data have been transformed into per unit values using total population, except for the economic globalization index[4]. Finally, annual data have been converted into quarter frequency following Sbia et al. (2014b) using the quadratic match-sum method.

III.I Financial Development Index

To capture the complete picture of financial sector development, we followed Shahbaz et al. (2015) and generated an index of financial development for the United Arab Emirates. We have used five indicators (three are bank-based and two are stock-market based) to generate a financial development index using PCA. The bank-based indicators are real domestic credit to the private sector, liquid liabilities, domestic credit provided by the financial sector; stock market capitalization of listed companies and total value of stocks traded are the stock market-based indicators. Charfeddine and Khediri, (2015) used domestic credit to the private sector as a measure of financial development. This indicator of financial development captures the actual level of savings disbursed to the private sector, but is totally silent about the size of the financial sector and stock market size as well as about efficiency (Shahbaz et al. 2015). This weakens the reliability of Charfeddine and Khediri's (2015) empirical findings. To overcome this issue, we have generated an index of financial development. The results are shown in Table-1 (lower segment). We find that the correlation between domestic credit to the private sector and (domestic credit provided by the financial sector) liquid liabilities (M_2) is positive and high. Stock market capitalization of listed companies and total value of stocks traded are positively correlated with domestic credit to the private sector. The positive correlation exists between stock market capitalization of listed companies and total value of stocks traded, between domestic credit provided by the financial sector and stock market capitalization of listed companies, and between domestic credit provided by the financial sector and total value of stocks traded. The high correlation between the financial indicators leads us to generate a financial development index using Principal Component Analysis (PCA) to avoid the possibility of multi-collinearity. The empirical evidence is reported in Table-1 (middle segment). The first principal component explains 50.08% of the standard deviation, but 46.57% of the standard deviation is explained by the second principal component. The standard deviation of each variable shown by principal components is minimal compared to the first principal component analysis. This suggests that we should use the first principal component

[4]We have converted real domestic credit to the private sector, liquid liabilities, domestic credit provided by the financial sector, stock market capitalization of listed companies and total value of stocks traded into per capita units before processing for generation of the financial development index.

analysis as the weight for the generation of the financial development index. The financial development index has fluctuations in nature for the period of 1975-2005.

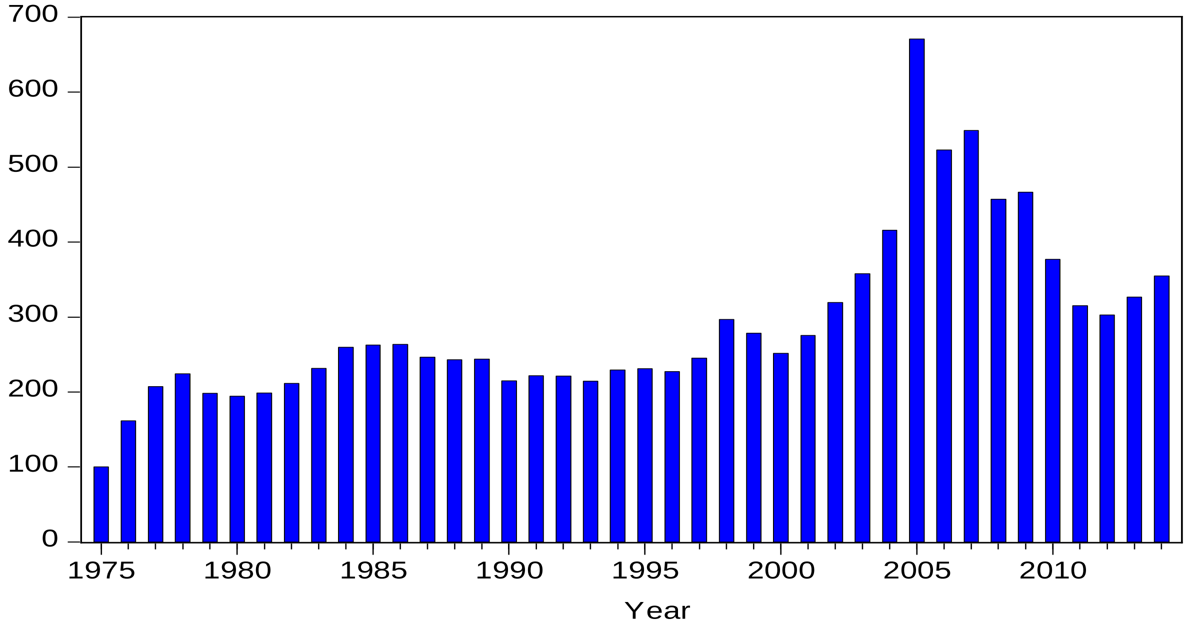
Table-1: Principal Component Analysis

Number	Value	Difference	Proportion	Cumu.Value	Cumu. Proportion
1	3.1046	1.9381	0.6209	3.1046	0.6209
2	1.1664	0.6455	0.2333	4.2710	0.8542
3	0.5209	0.3794	0.1042	4.7919	0.9584
4	0.1414	0.0748	0.0283	4.9333	0.9867
5	0.0666	---	0.0133	5.0000	1.0000
Eigenvectors or Factor Loadings					
Variable	PC 1	PC 2	PC 3	PC 4	PC 5
DC_t	0.5008	0.3636	-0.1284	-0.4973	-0.5942
M_t	0.4657	-0.1567	-0.7379	-0.0075	0.4624
DCB_t	0.3205	0.7287	0.1909	0.5228	0.2373
SM_t	0.4530	-0.5034	0.1130	0.5810	-0.4369
SP_t	0.4735	-0.2421	0.6242	-0.3764	0.4309
Pair-wise Ordinary Correlation					
Variables	DC_t	M_t	DCB_t	SM_t	SP_t
DC_t	1.0000				
M_2	0.6892	1.0000			
DCB_t	0.7486	0.2636	1.0000		
SM_t	0.4597	0.6895	0.0702	1.0000	
SP_t	0.6012	0.5027	0.3065	0.8015	1.0000
Note: DC_t, M_t, DCB_t, SM_t and SP_t refer to real domestic credit to private sector, liquid liabilities (M_2), domestic credit provided by financial sector, stock market capitalization of listed companies and total value of stocks traded. All data are in per capita units.					

The evolution of the financial development index in the UAE is evidence that a resource-backed economy associated with a solid regulatory environment has generated improvements in financial conditions and has created valuable opportunities for development (World Economic Forum, 2012). The financial expansion of the UAE has been positively impacted by foreign direct investment inflows, especially in the Dubai region. In 2012, the volume of FDI rose by 26.5%, reaching US$8 billion. In addition, the government of Dubai implemented policies to encourage free trade through the division of 10 major free zones, which currently host 19,000 firms. The major advantages consist of tax-free conditions, full foreign ownership and repatriation of capital and profits, easy entry in terms of administrative procedures and duty-free status. The government has supported the creation of start-ups and SMEs and the inflow of foreign skilled human capital through funding schemes that provide incentives to implement innovative technologies, with benefits in terms of competitiveness and new investments (Deloitte and DEC, 2014). Overall, the

UAE government has allocated massive resources to the financial sector, aiming to enhance sustained economic growth. According to data released in November 2015, the federal government engages in a commercial loan guarantee scheme for projects financed by the Ministry of Finance, within a strategic partnership with the UAE banking sector[5].

Figure-1: Financial Development Index in UAE



IV. Methodological Strategy

1. Zivot-Andrews Unit Root Test

Numerous unit root tests are available in applied economics to test the stationarity properties of the variables. These unit tests are ADF by Dickey and Fuller (1979), P-P by Philips and Perron (1988), KPSS by Kwiatkowski et al. (1992), DF-GLS by Elliott et al. (1996) and Ng-Perron by Ng-Perron (2001). These tests provide biased and spurious results due to lacking information about structural break points occurring in the series. To address this, Zivot-Andrews (1992) developed three models to test the stationarity properties of variables in the presence of a structural break point in the series: (i) this model allows a one-time change in variables at level form, (ii) this model permits a one-time change in the slope of the trend component, i.e., function, and (iii) this model has a one-time change in both the intercept and trend functions of the variables to be used for empirical purposes. Zivot-Andrews (1992) followed three models to check the hypothesis of a one-time structural break in the series, as follows:

$$\Delta x_t = a + a x_{t-1} + bt + cDU_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \qquad (5)$$

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[5]UAE Interact (2015). Environment Minister Releases first Reports on State of Green Investment for Banks and Financial Institutions in UAE. November: http://www.uaeinteract.com/docs/Environment_Minister_releases_first_report_on_state_of_green_investment_for_bank_and_financial_institutions_in_UAE/72411.htm

$$\Delta x_t = b + bx_{t-1} + ct + bDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \quad (6)$$

$$\Delta x_t = c + cx_{t-1} + ct + dDU_t + dDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \quad (7)$$

Where the dummy variable is indicated by DU_t showing a mean shift occurred at each point with a time break, while the trend in shift variables is shown by DT_t. So,

$$DU_t = \begin{cases} 1 \ldots if \quad t > TB \\ 0 \ldots if \quad t < TB \end{cases} \text{ and } DU_t = \begin{cases} t - TB \ldots if \ t > TB \\ 0 \ldots if \ t < TB \end{cases}$$

The null hypothesis of the unit roots break date is $c = 0$, which indicates that the series is not stationary, with a drift lacking information about the structural break point, while the $c < 0$ hypothesis implies that the variable is found to be trend-stationary with one unknown time break. The Zivot-Andrews unit root test fixes all points as potential points for possible time breaks and performs estimation through regression for all possible break points successively. Then, this unit root test selects that time break which decreases the one-sided t-statistic to test $\hat{c}(= c - 1) = 1$. Zivot-Andrews intimates that in the presence of end points, asymptotic distribution of the statistics is diverged to infinity. It is necessary to choose a region where the end points of the sample period are excluded. Further, Zivot-Andrews suggested that the trimming regions, i.e., (0.15T, 0.85T) be followed.

2. Gregory and Hansen Cointegration Test

We have employed the Gregory-Hansen, (1996) cointegration test, which accommodates structural breaks while investigating the cointegration relationship between the variables. This test is an augmentation of the univariate approach and considered a multivariate extension. The null hypothesis of the G-H test is H_0: no cointegration accounting for a structural break. The G-H is a two-step procedure. In the first step, we determine whether cointegration is subject to a structural break or not. This is accomplished by applying the instability (linearity) test developed by Hansen, (1992). We have used *Lc* tests to establish cointegration between financial development and CO_2 emissions. In the second step, we determine a structural break in the long run equation endogenously and cointegration simultaneously. The modified versions of the *ADF* test by Engle-Granger (1987) and Z_t and Z_α by Phillips and Ouliaris (1990) are modeled as follows:

$$ADF^* = \inf_{T_b} ADF(T_b) \quad (8)$$

$$Z_t^* = \inf_{T_b} Z_t(T_b) \quad (9)$$

$$Z_\alpha^* = \inf_{T_b} Z_\alpha(T_b) \quad (10)$$

3. The Toda-Yamamato Non-Causality Test

In the existing literature of applied economics, the Granger, (1969) causality test is used to check whether causality between variables is unidirectional, bidirectional or neutral. Gujrati, (1995) noted that the Granger causality test provides spurious and ambiguous results due to a specification problem. This issue was solved by Toda-Yamamato, (1995), who introduced a new causality approach. This test provides reliable and efficient empirical results in the absence of cointegration in the VAR system. This approach does not require information about integrating properties of the variables. The Wald test is employed to test the significance of VAR(p) parameters where p is the optimal lag length used by the system. If the statistics provided by the Wald test are statistically significant then we may reject the null hypothesis, i.e., no causality, which confirms the presence of causality that is either unidirectional or bidirectional. Following Toda-Yamamato, (1995), we examine the causality relationship among the variables by applying VAR(p+d_{max}), where the maximum order of integration is denoted by d_{max}, and p for optimal lag length. Furthermore, Rambaldi and Doran, (1996) suggested that the VAR process developed by Toda-Yamamato, (1995) can be designed following the seemingly unrelated regression (SUR) system. In doing so, using 5 variables, the VAR system can be built following SUR form:

$$\begin{bmatrix} \ln C_t \\ \ln F_t \\ \ln E_t \\ \ln Y_t \\ \ln G_t \end{bmatrix} = \forall_0 + \forall_1 \begin{bmatrix} \ln C_{t-1} \\ \ln F_{t-1} \\ \ln E_{t-1} \\ \ln Y_{t-1} \\ \ln G_{t-1} \end{bmatrix} + ... + \forall_k \begin{bmatrix} \ln C_{t-k} \\ \ln F_{t-k} \\ \ln E_{t-k} \\ \ln Y_{t-k} \\ \ln G_{t-k} \end{bmatrix} + \forall_{k+1} \begin{bmatrix} \ln C_{t-k-1} \\ \ln F_{t-k-1} \\ \ln E_{t-k-1} \\ \ln Y_{t-k-1} \\ \ln G_{t-k-1} \end{bmatrix} + ... + \forall_{k+d} \begin{bmatrix} \ln C_{t-k-d} \\ \ln F_{t-k-d} \\ \ln E_{t-k-d} \\ \ln Y_{t-k-d} \\ \ln G_{t-k-d} \end{bmatrix} \quad (11)$$

Following equation-11, we build the null hypothesis, for example, to examine the relationship between financial development and CO_2 emissions. If we want to test whether financial development causes CO_2 emissions then we follow the null hypothesis with chi-square statistics, i.e., $H_0 : \ln F^{\forall_1} = \ln F^{\forall K} = \ln F^{\forall K+1} = \ln F^{\forall_{k+d}} = 0$. If the Wald test provides statistical significance then we reject the null hypothesis and conclude that financial development causes CO_2 emissions. The alternate hypothesis test provides an inverse causality direction: $H_0 : \ln C^{\forall_1} = \ln C^{\forall K} = \ln C^{\forall K+1} = \ln C^{\forall_{k+d}} = 0$ where $\forall_s$ are estimates of $\ln F$ and $\ln C$.

V. Empirical Results

Table-2 presents the descriptive statistics and correlation analysis. The results show that the standard deviation of financial development is higher than the standard deviation of economic growth and CO_2 emissions. The variation in globalization is lower than the variations in electricity consumption. The Jarque-Bera test statistics unveil that CO_2 emissions, financial development, electricity consumption, economic growth and economic globalization have normal distribution allied with constant variance. The correlation analysis shows the positive correlation between financial development and CO_2 emissions, but electricity consumption is inversely correlated with CO_2 emissions. A positive correlation exists between economic growth and CO_2 emissions. Economic globalization is negatively associated with CO_2 emissions. The correlation of electricity consumption, economic growth and economic globalization with financial development is positive. Economic growth (economic globalization) is positively (negatively) correlated with electricity consumption. The correlation between economic globalization and economic growth is negative.

Table-2: Descriptive Statistics and Correlations

Variables	$\ln C_t$	$\ln F_t$	$\ln E_t$	$\ln Y_t$	$\ln G_t$
Mean	3.3812	5.6045	9.1115	12.2659	4.3432
Median	3.4039	5.5173	9.2425	12.2548	4.3206
Maximum	4.1526	6.5085	9.4460	12.8457	4.4837
Minimum	2.7702	4.6051	8.1988	11.6138	4.2614
Std. Dev.	0.3326	0.3563	0.3119	0.3480	0.0743
Skewness	0.1497	0.2790	-1.1634	-0.2648	0.8345
Kurtosis	3.1119	3.9779	3.8831	2.5346	2.1807
Jarque-Bera	0.1704	2.1131	0.3242	0.8286	2.7621
Probability	0.9183	0.3476	0.8557	0.6607	0.2560
$\ln C_t$	1.0000				
$\ln F_t$	0.1634	1.0000			
$\ln E_t$	-0.0640	0.2143	1.0000		
$\ln Y_t$	0.0148	0.0129	0.2790	1.0000	
$\ln G_t$	-0.0090	0.0931	-0.2051	-0.0048	1.0000

Table-3 reports the results of the unit tests, namely ADF and PP. The results show that CO_2 emissions, financial development, electricity consumption, economic growth and economic globalization are found to be non-stationary at the levels confirmed by the ADF and PP tests. With constant and trend, all the variables are stationary at first difference. This posits that CO_2 emissions, financial development, electricity consumption, economic growth and economic globalization are integrated at I(1). ADF and PP unit root tests ignore the role of structural breaks in the series, which may be the cause of non-stationarity. This leads the ADF and PP tests to show misleading unit root empirical results.

The structural breaks are outcomes of economic policies implemented by the government to improve the performance of macroeconomic variables. We have applied the ZA unit root test, which contains information about a single unknown structural break in the series. The results are reported in the lower segment of Table-3. The ZA test finds that the variables contain unit root problems in the presence of structural breaks. These breaks are 1999Q1, 2004Q2, 1996Q2, 1998Q2 and 1988Q2 in the series of CO_2 emissions, financial development, electricity consumption, economic growth and economic globalization, respectively. The ZA test results at first difference confirm the stationarity of the variables. This shows that the variables have a unique order of integration i.e., I(1).

Table-3: Unit Root Analysis

Variable	ADF Unit Root Test		PP Unit Root Test	
	Level	1st Difference	Level	1st Difference
$\ln C_t$	-2.4679(2)	-5.1497(3)*	-2.8123(3)	-7.1838(3)*

$\ln F_t$	-2.1911(3)	-4.3575(4)*	-2.4757(3)	-6.4640(3)*
$\ln E_t$	-2.8558(2)	-6.2229(3)*	-2.0106(3)	-7.2324(3)*
$\ln Y_t$	-1.7889 (1)	-3.8258(2)**	-1.5141(3)	-5.5519(3)*
$\ln G_t$	-1.3393(4)	-3.8426 (3)**	-1.2477(3)	-6.1463(3)*
Variable	**ZA Test at Level**		**ZA Test at 1st Difference**	
	T-statistic	**Break Year**	**T-statistic**	**Break Year**
$\ln C_t$	-4.610 (2)	1999Q1	-9.497 (3)*	1997Q3
$\ln F_t$	-4.560 (1)	2004Q2	-8.573 (2)*	1980Q3
$\ln E_t$	-3.665 (3)	1996Q2	-9.555 (1)*	19983Q3
$\ln Y_t$	-3.427 (3)	1998Q2	-7.105 (1)*	2006Q2
$\ln G_t$	-3.357 (2)	1988Q2	-8.504 (2)	2002Q2
Note: * and ** indicates significant at 1% and % levels, respectively.				

We investigated the long run stability of the parameters by applying Hansen, (1992) the instability test and results are shown in Table-4. We have chosen lag length by applying the unrestricted VAR approach, following AIC due to its superior properties[6]. We note that at lag 0 and 1, the null hypothesis of parameter stability is accepted. After lag 1 to 6, probability values are significant, which leads us to reject the null hypothesis. This posits that long run parameters are unstable. The next step is to examine cointegration among CO_2 emissions, financial development, electricity consumption, economic growth and economic globalization by applying the Gregory-Hansen, (1996) cointegration test accommodating structural regime shift. The G-H cointegration is an augmented version of the Engle-Granger (1987) and Phillips-Ouliaris (1990) tests. The empirical results reported in Table-5 show that the null hypothesis may be rejected at the 1% level, as confirmed by the ADF (Engle-Granger, 1987) test statistics following shift with constant, shift with trend as well as regime shift. A similar outcome is reported by Z_a^* and Z_t^* (Phillips-Ouliaris, 1990) statistics. This concludes that CO_2 emissions, financial development, electricity consumption, economic growth and economic globalization are cointegrated for the long run in the presence of structural breaks over the sampled period in the case of the United Arab Emirates.

Table-4: Hansen Instability Test

Optimal lags	$L_C - Statistic$	Prob.value
0	0.4948	0.2
1	0.6645	0.1681
2	1.0993**	0.0261
3	2.0218*	0.0100

[6]The AIC suggests that maximum lag 6 is suitable. The results are available upon request from the authors.

4	4.9027*	0.0100
5	8.6061*	0.0100
6	10.4963*	0.0100
Note: * and ** shows significance at 1% and 5% levels, i.e., rejection of hypothesis of stability of parameters. Constant and trend are used as deterministic regressors.		

Table-5: Gregory-Hansen Cointegration Test

Tests	Level Shift with Constant	Level Shift with Trend	Regime Shift
ADF	-5.587 [1999Q_1]*	-5.991 [1999Q_1]*	-7.233 [1999Q_1]*
Z_a^*	-34.495 [1999Q_1]*	-34.284 [1999Q_1]*	-34.290 [1999Q_1]*
Z_t^*	-4.469 [1999Q_1]*	-4.661 [1999Q_1]*	-4.993 [1999Q_1]*
Note: * shows significance at 1% level, i.e., rejection of hypothesis of stability of parameters. Constant and trend are used as deterministic regressors.			

The long run and short run impacts of financial development, economic growth, electricity consumption and economic globalization follow next. Table-6 shows that in the long run, financial development is positively but significantly (at 1% level) linked with CO_2 emissions, i.e., financial development deteriorates environmental quality via increasing CO_2 emissions. Keeping other factors constant, a 1% increase in financial development leads to an increase in CO_2 emissions of0.4005%. This empirical finding is similar to that of Zhang (2011) for China, Boutabba (2014) for India, Shahbaz et al. (2014a) for Bangladesh, Omri et al. (2015) for the MENA region, Al-Mulali et al. (2015) for European countries, and Ali (2015) for Pakistan; but it is contrary to Tamazian et al. (2009) for the BRIC countries, Tamazian and Rao (2010) for transitional economies, Jalil and Feridun (2011) for the Chinese economy, Shahbaz et al. (2013a,b) for South Africa and Indonesia, and Salahuddin et al. (2015) for the GCC countries, who reported that financial development lowers CO_2 emissions via liberalizing policies to improve environmental quality. The association between economic growth and CO_2 emissions is positive and significant at the 1% level. We noted that a 0.31-0.34% increase in CO_2 emissions is linked with a 1% increase in economic growth if all else remains the same. This empirical finding is consistent with Shahbaz et al. (2014b) for the United Arab Emirates and Salahuddin et al. (2015) for the GCC countries. Electricity consumption affects CO_2 emissions negatively but significantly at the 1% level. Keeping other factors constant, a 1% increase in electricity consumption lowers CO_2 emissions by 0.91-0.95%. These results are consistent with Shahbaz et al. (2014b) for the United Arab Emirates and Salahuddin et al. (2015) for the GCC countries. The relationship between economic globalization and CO_2 emissions is negative and significant at the 1% level. This shows that economic globalization improves environmental quality via lowering CO_2 emissions. A 1% increase in economic globalization is associated with a decline in CO_2 emissions of0.54-0.56% when other factors are constant. Similarly, Shahbaz et al. (2015b) reported that globalization lowers CO_2 emissions, as the technique effect dominates the scale effect by keeping the composite effect constant.

The impact of linear and non-linear (squared) terms of financial development on CO_2 emissions is negative and positive, and significant at the 1% level. We note that a 1% increase in financial development lowers CO_2 emissions by 0.42%, while the positive sign of the non-linear term corroborates the delinking of CO_2 emissions and financial development at higher levels of credit disbursement. This confirms the presence of a U-shaped association between financial development and CO_2 emissions. This finding conflicts with Charfeddine and Khediri, (2015) who noted that the relationship between financial development and CO_2 emissions is inverted U-shaped, i.e., financial development is accompanied by CO_2 emissions initially, and emissions decline after a threshold level of financial development is reached. These results are consistent with Shahbaz et al. (2015a), who reported that financial development is accompanied by lower CO_2 emissions initially but that the financial sector increases CO_2 emissions at higher levels of financial development for the Portuguese economy.

Table-6: Long Run and Short Run Analysis

Dependent Variable = $\ln C_t$						
Long Run Results						
Variables	Coefficient	T-Statistic	Coefficient	T-Statistic	Coefficient	T-Statistic
Constant	7.2725*	8.3870	7.8475*	7.787362	17.5369*	3.5617
$\ln F_t$	0.4005*	5.2686	-0.4207*	-5.5694	-21.5627**	-2.0446
$\ln F_t^2$	….	….	0.2872*	10.1172	15.8474**	2.0456
$\ln F_t^3$	….	….	….	….	-3.7767**	-2.0096
$\ln Y_t$	0.3257*	4.9441	0.3108*	4.6285	0.3401*	4.9965
$\ln E_t$	-0.9383*	-10.6688	-0.9137*	-10.0873	-0.9501*	-10.3832
$\ln G_t$	-0.5413*	-9.6602	-0.5417*	-9.6685	-0.5622*	-9.9671
D_{1999}	0.0702*	5.8568	0.0688*	5.7180	0.0614*	4.9254
R^2	0.7928		0.7944		0.7998	
$Ajd - R^2$	0.7860		0.7864		0.7905	
F-statistic	117.8605*		98.5835*		86.7552*	
Short Run Results						
Constant	-0.0016	-1.0210	-0.0017	-1.0477	-0.0020	-1.2357
$\Delta \ln F_t$	0.2772**	2.8760	-0.2659	0.5208	-0.4001	-0.7567
$\Delta \ln F_t^2$			0.2755	0.1074	1.6556	0.6004
$\Delta \ln F_t^3$					-8.1653	-1.3421
$\Delta \ln Y_t$	0.0553**	2.2640	0.0531**	2.2526	0.0602**	2.2871
$\Delta \ln E_t$	-0.2109**	-2.2372	-0.1885**	-2.1938	-0.2143**	-2.2392
$\Delta \ln G_t$	1.0931	0.9303	1.0769	.8882	0.4783	0.3710
D_{1999}	-0.0021	-0.8043	-0.0020	-0.7667	-0.0015	-0.5832
ECM_{t-1}	-0.1209*	-3.8578	-0.1222*	-3.8697	-0.1141*	-3.5594
R^2	0.1306		0.1320		0.1423	
$Ajd - R^2$	0.0963		0.0917		0.0965	
F-statistic	3.8079*		3.2811*		3.1113*	
Diagnostic Tests						

Test	F-statistic	Probability				
$\chi^2 SERIAL$	2.9500	0.2371	2.6790	0.2012	2.9781	0.2012
$\chi^2 ARCH$	2.3361	0.1323	2.0091	0.1123	2.0001	0.1210
$\chi^2 REMSAY$	1.3463	0.2427	1.4057	0.2246	1.3033	0.2467
Note: * and ** represent significance at 1% and 5% levels, respectively. $\chi^2 SERIAL$ is for the LM Serial correlation test, $\chi^2 ARCH$ for autoregressive conditional heteroskedasticity and $\chi^2 REMSAY$ for the Remsay Reset test.						

The short-run results shown in Table-6 reveal that financial development tends to increase CO_2 emissions significantly at the 5% level. Economic growth is positively but significantly associated with environmental degradation. Electricity consumption improves environmental quality by curbing CO_2 emissions at the 5% level of significance. Economic globalization increases CO_2 emissions insignificantly. The dummy variable has a negative but insignificant impact on CO_2 emissions. The impact of the linear and squared terms of financial development is U-shaped but insignificant. Similarly, the non-linear relationship between financial development and CO_2 emissions is inverted N-shaped, i.e., financial development is accompanied by a decline in CO_2 emissions, it then increases emissions, and then it lowers CO_2 emissions again at a higher level of financial development, but this relationship is statistically insignificant. The coefficient of lagged error correction (ECM_{t-1}) is -0.1209 (-0.1222, -0.1141), significant at the 5% level. The statistically significant estimate of ECM_{t-1} shows the optimal speed of adjustment towards a long-run equilibrium path. Overall, the short-run is statistically significant at the 1% level. The short-run model has no issues with serial correlation and autoregressive conditional heteroskedisticity. There is no specification problem in the short-run model.

The causal relationship between financial development and CO_2 emissions –including other determinants of CO_2 emissions – is investigated by employing the Toda-Yamamato non-causality test. The results presented in Table-7 show that financial development causes CO_2 emissions and in turn, CO_2 emissions cause financial development, i.e., a feedback effect. This finding contrasts with Charfeddine and Khediri, (2015) who documented that CO_2 emissions are both the cause and effect of financial development. Unidirectional causality exists, running from electricity consumption to CO_2 emissions. Charfeddine and Khediri, (2015) reported a feedback effect between electricity consumption and CO_2 emissions. Financial development and electricity consumption are interdependent, i.e., financial development is a cause of electricity consumption and electricity consumption is a cause of financial development. This confirms the existence of feedback between financial development and electricity consumption. Contrarily, Charfeddine and Khediri, (2015) documented the unidirectional causal relationship running from financial development to electricity consumption. A bidirectional causal association is found between globalization and CO_2 emissions, and a similar inference is drawn between globalization and electricity consumption. The feedback effect exists between economic growth and electricity consumption, revealing that electricity consumption leads economic growth and economic growth leads electricity consumption. This finding is not consistent with Charfeddine and Khediri, (2015) who supported the growth-hypothesis, i.e., economic growth causes electricity consumption, but the same is not true from the opposite side.

Table-7: Toda-Yamamato Non-Causality Analysis

Variable	$\ln C_t$	$\ln F_t$	$\ln E_t$	$\ln Y_t$	$\ln G_t$
$\ln C_t$	....	4.3858* [0.0005]	2.3302* [0.0369]	2.7265** [0.0256]	1.8759*** [0.0910]
$\ln F_t$	3.8803* [0.0051]	....	8.2737* [0.0000]	3.2763* [0.0033]	19.3355* [0.0000]
$\ln E_t$	1.4312 [0.1997]	2.8727* [0.0085]	....	4.3551* [0.0003]	2.9460* [0.0072]
$\ln Y_t$	1.3976 [0.2123]	7.5720* [0.0000]	4.9946* [0.0001]	....	5.2120* [0.0000]
$\ln G_t$	4.0105* [0.0006]	5.4661* [0.0000]	1.7696 [0.1002]	4.3484* [0.0003]	....

Table-8 illustrates the empirical results of the variance decomposition approach, and we find that almost 50%of CO_2 emissions are attributed to innovative shock. The occurrence of innovative shock in financial development explains 15% of CO_2 emissions. The contributions of economic growth and electricity consumption are minimal. Economic globalization contributes 26% of CO_2 emissions; 14% and 47% of financial development are contributed by innovative shocks in CO_2 emissions and economic growth, respectively. Electricity consumption's contribution to financial development is almost 1%, and 27% of financial development in contributed by its innovative shocks. CO_2 emissions and electricity consumption contribute to economic growth at8% and 1%, respectively. The contributions of financial development and globalization to economic growth are significant, i.e., 30% and 43%, respectively. An innovative shock occurs in CO_2 emissions, financial development explains electricity consumption by 12%, and the contribution of economic growth to electricity consumption is negligible. Economic growth (i.e., 63%) is significantly contributed by innovative shocks stemming from economic globalization. A significant contribution to economic globalization comes from financial development, while CO_2 emissions contribute 13% to globalization. The role of economic growth and electricity consumption in globalization is minimal. A significant portion, i.e., 67%, of globalization is contributed by its innovative shocks.

On the basis of these empirical results, we may conclude that financial development causes CO_2 emissions, but the same is not true from the opposite side. Unidirectional causality runs from economic globalization to electricity consumption and CO_2 emissions. Economic growth is the cause of financial development and economic globalization. Financial development causes economic globalization, and economic globalization causes financial development. The neutral effect is found between electricity consumption and CO_2 emissions, between economic growth and electricity consumption, between electricity consumption and financial development, and between financial development and economic growth.

Table-8: Variance Decomposition Analysis

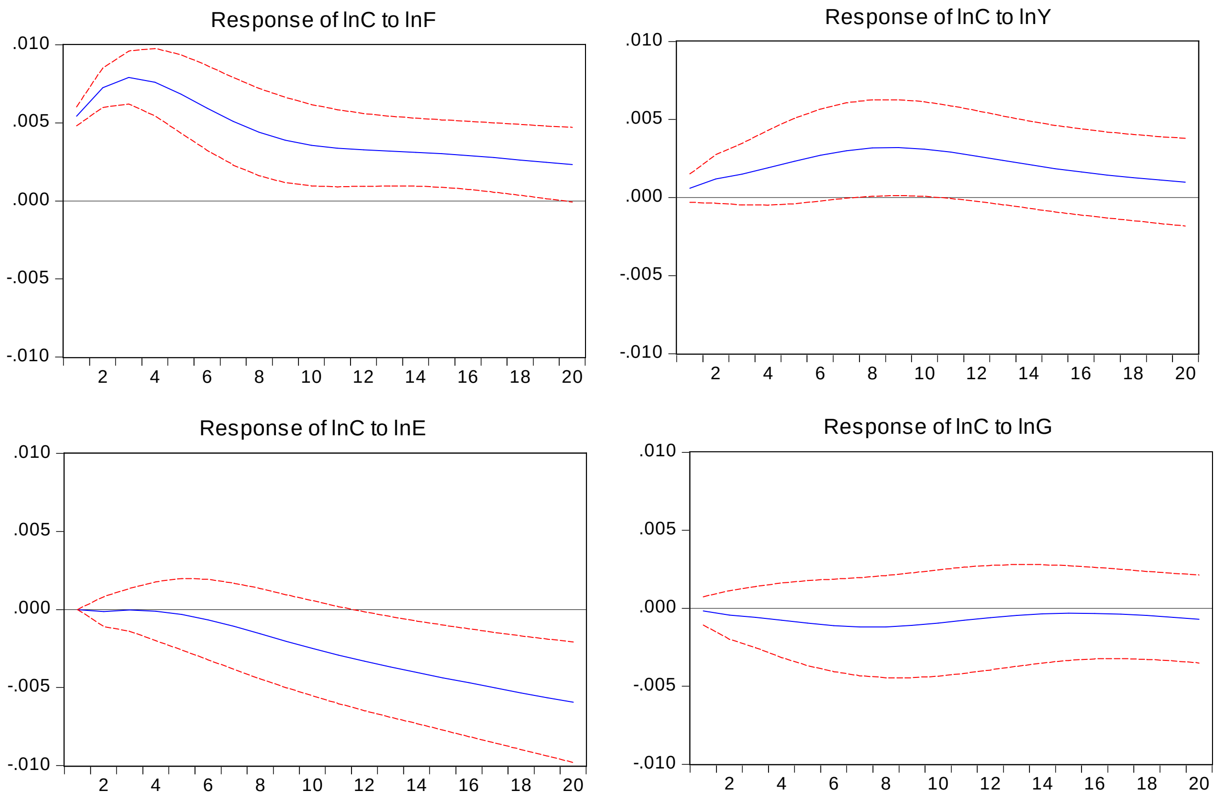
Variance Decomposition of $\ln C_t$					
Period	$\ln C_t$	$\ln F_t$	$\ln Y_t$	$\ln E_t$	$\ln G_t$
1	100.0000	0.0000	0.0000	0.0000	0.0000
5	78.8491	5.2213	4.2037	8.9236	2.8022

10	64.9481	10.9305	4.4688	7.4033	12.2491
15	54.2857	13.4591	3.7175	5.9239	22.6135
16	52.9873	13.9136	3.6233	5.7322	23.7433
17	51.9088	14.3429	3.5432	5.5715	24.6334
18	51.0193	14.7411	3.4755	5.4385	25.3254
19	50.2911	15.1046	3.4188	5.3299	25.8554
20	49.6997	15.4319	3.3716	5.2426	26.2539
Variance Decomposition of $\ln F_t$					
Period	$\ln C_t$	$\ln F_t$	$\ln Y_t$	$\ln E_t$	$\ln G_t$
1	8.9538	91.0461	0.0000	0.0000	0.0000
5	8.9124	31.0640	10.5607	0.4913	48.9714
10	14.0873	27.0966	10.0216	0.5565	48.2377
15	14.0253	27.9717	9.8308	0.7550	47.4170
16	14.0023	27.9442	9.8193	0.8024	47.4315
17	13.9836	27.8863	9.8064	0.8448	47.4786
18	13.9692	27.8086	9.7909	0.8814	47.5497
19	13.9591	27.7194	9.7722	0.9122	47.6369
20	13.9531	27.6258	9.7505	0.9373	47.7331
Variance Decomposition of $\ln Y_t$					
Period	$\ln C_t$	$\ln F_t$	$\ln Y_t$	$\ln E_t$	$\ln G_t$
1	0.0017	19.0198	80.9784	0.0000	0.0000
5	1.5482	39.0169	51.9310	4.3410	3.1627
10	3.7727	32.1522	28.3212	2.5712	33.1824
15	7.2053	29.6367	19.0700	1.7380	42.3498
16	7.5482	29.6812	18.2161	1.6573	42.8970
17	7.8202	29.7828	17.5397	1.5937	43.2634
18	8.0353	29.9198	17.0038	1.5449	43.4961
19	8.2041	30.0774	16.5803	1.5085	43.6295
20	8.3351	30.2449	16.2470	1.4827	43.6901
Variance Decomposition of $\ln E_t$					
Period	$\ln C_t$	$\ln F_t$	$\ln Y_t$	$\ln E_t$	$\ln G_t$
1	0.8040	8.9284	1.9459	88.3214	0.0000
5	1.3005	4.7545	5.0425	54.9138	33.9885
10	8.5095	3.8337	4.0487	20.3848	63.2231
15	11.5375	8.2760	3.2697	12.4705	64.4461
16	11.8099	9.0876	3.1641	11.7161	64.2221
17	12.0264	9.8373	3.0726	11.1059	63.9575
18	12.1986	10.5240	2.9936	10.6122	63.6714
19	12.3351	11.1482	2.9254	10.2134	63.3777
20	12.4423	11.7115	2.8667	9.8928	63.0864
Variance Decomposition of $\ln G_t$					
Period	$\ln C_t$	$\ln F_t$	$\ln Y_t$	$\ln E_t$	$\ln G_t$

1	0.0922	1.9023	0.4343	0.0705	97.5005
5	7.5398	5.1309	1.3901	2.0406	83.8984
10	11.4051	11.8632	1.4107	1.5731	73.7476
15	12.5378	15.7337	1.3492	1.1761	69.2029
16	12.6458	16.3062	1.3317	1.1314	68.5846
17	12.7284	16.8209	1.3145	1.0968	68.0392
18	12.7902	17.2798	1.2982	1.0712	67.5603
19	12.8350	17.6852	1.2832	1.0537	67.1426
20	12.8662	18.0394	1.2699	1.0433	66.7809

The empirical evidence of the impulse response function reported in Figure-2 reveals that CO_2 emissions respond positively to forecast errors that occur in financial development. Economic growth also positively contributes to CO_2 emissions. This shows that financial development and economic growth increase CO_2 emissions, and these results are consistent with the long-and short-run results. The response of CO_2 emissions is negative, as forecast errors stem negatively from electricity consumption and CO_2 emissions, due to forecast errors stemming from economic globalization. This reveals that electricity consumption and economic globalization improve environmental quality by lowering CO_2 emissions. These findings are also consistent with long-run and short-run empirical analyses, which confirm the robustness of the empirical results.

Figure-2: Impulse Response Function



V. Conclusion and Policy Implications

This paper offers an empirical investigation of the financial development-CO_2 emissions nexus for the United Arab Emirates for the 1975Q_I-2014Q_{IV} time period. For empirical purposes, we have applied structural break unit root and cointegration tests to examine stationarity and cointegration between the variables. The Toda-Yamamato causality test is employed to investigate the causal relationship between the variables, and the robustness of causality linkages is tested by applying the innovative accounting approach.

The results demonstrate the presence of cointegration between financial development and CO_2 emissions and other determinants of CO_2 emissions. Additionally, economic growth increases CO_2 emissions and worsens environmental quality. Financial development is positively related to CO_2 emissions. Electricity consumption improves the environment by reducing CO_2 emissions. Globalization reduces CO_2 emissions and improves environmental quality. The causality results show a feedback effect between financial development and CO_2 emissions. A bidirectional causal relationship is noted between electricity consumption and economic growth, between electricity consumption and CO_2 emissions, and between economic growth and CO_2 emissions.

This suggests that the UAE should attract investments in pollution control mechanisms to limit the negative effects of CO_2 emissions. Financial development should continue, with a special focus on projects that include incentives for the amelioration of environmental degradation. In November 2015, the Emirates Green Development (EGD) Council organized a meeting to discuss the objectives of the EGD Strategy, which aims to support the creation of a low-carbon green economy and to prepare for an initial international meeting, which will take place in 2016. The efforts of both government and the private sector towards the adoption of policies and green investments can continue the development of the national economy and improve international competitiveness (UAE Interact, 2015)

Strengthening institutional infrastructure in the short-run will lead to positive outcomes in the long-run. Investments in research and development areas play a major role in promoting a healthier environment and superior quality of life. In addition, new energy conservation policies would generate lower CO_2 emissions, and the implementation of alternative sources of energy would help to control pollution. The feedback effect between economic growth and environmental degradation shows that the UAE has experienced high environmental costs. Increased energy efficiency may be the solution to this problem.

It is very important to set priorities, in terms of both costs and investment efficiency, and to create incentives for industries to adopt environment- friendly technologies. Governments, banks and other institutions should engage in projects or activities that recognize the importance of environmental issues and embrace a code of good practices in this area. In the UAE, the development of the bond and securities market could provide multiple opportunities for the implementation of clean energy-related technologies.

Trade openness should be encouraged in the light of new knowledge transfers. Green urbanization is a concept that can have major effects on the reduction of carbon emissions, while clean intelligent transport systems and water-related technology can ensure environmentally sustainable development.

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