



Exploring The Nexus Between Economic Growth, Financial Development and Co2 Emission in Gulf Countries: An Application of Environmental Kuznets Curve

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Abstract

The main objective of the current study is to investigate the impact of economic growth, financial development (both the development and shock), and energy consumption on the CO₂ emission in the selected Gulf Countries. This research study incorporates financial development as the measurement of environmental quality. In this way, it will add to the existing literature. The use of NARDL has been made in this research, which is an advanced econometric approach. An efficient way of dealing with the component of asymmetry in financial development on emissions of CO₂ has been provided by NARDL with reference to the economy of Gulf countries for time 1980–2014. According to the findings, there is a positive and statistically significant association between GDP growth, energy consumption, financial development, and CO₂ emissions. As a result, the findings support the paper's thesis that CO₂ emissions are linked to financial development, energy consumption, and economic expansion. This groundbreaking study will assist policymakers, environmental economists, and academics in explaining the influence of economic expansion and financial development on environmental concerns such as CO₂ emissions.

Keywords: Financial development, Energy consumption, CO₂, Environment Economics, Gulf

Introduction

In this global era, it is aimed to attain economic growth, which is environment friendly rather than keeping the focus on growth only. The economic activities can create adverse influences on the environmental quality or standards. Literature supports that the environmental quality can be influenced through various economic activities. Some of the researchers consider economic activities to result in the degradation of environment (Kolk, 2016). Huge efforts are being made by developed and developing countries for resolving the issue of Carbon Dioxide emissions. The increase in global warming over the past some years has become a key issue, which is debated. For making economic and political choices, a special concern for public has been the environmental issue (Heidari, Katircioğlu et al. 2015). It is the focus of every country to limit the emissions of carbon dioxide, which has become a global strategic aim as well for lowering the global environmental change (Schädel et al. 2016).

In order to deal with the issue of increasing carbon emissions, 20 countries including Australia, US, Gulf, India, and UAE collaborated in the recent Paris agreement in 2016, for dealing with the issue of carbon emissions through making investments in some major areas (Sanchez & Sivaram, 2017). The degradation of environment in Gulf has influenced the lives of thousands because of floods in the rural areas. For this, Gulf has been criticized and the livelihood as well as land has been destroyed there. In order to secure the environment through reduction of CO₂ emissions, the government of Gulf is making immense efforts by implementing policies, which create a balance of economic in relation with the environment. Efforts are being made to lower carbon emissions by 40–45% per unit of GDP of the country by the coming year 2020 (Al-Mulali & Ozturk 2015). However, almost two third of the total world emissions of CO₂ have been contributed by Gulf, as it is one of the leading countries in this respect. In this way, the country contributes about 24% of total global emissions of carbon dioxide. The increase in carbon emissions along with income level has become a key concern for the government of Gulf. However, the outcomes are not yet resulted as expected. The country has not reached any viable solution (Liu et al., 2018).

Due to the general money generated by the oil and gas industries, the GCC nations have been able to achieve amazing and rapid progress in many areas of life. These nations are a prominent hub of geopolitical, military, economic, industrial, construction, and tourism activity. Even though oil and gas have been extensively used, Significant damage to the environment has resulted from this. Water scarcity and quality, air pollution, and the depletion of natural resources like oil and natural gas are only some of the "classic" environmental concerns that the GCC states are facing today. Air pollution is another major problem. New environmental problems, such as those involving waste from development and destruction and violent conflicts, have arisen in recent years. A country that exemplifies this phenomenon is the United States of America. The issue of climate change will take up the bulk of this Policy Brief. Without a doubt, that is one of the most pressing contemporary environmental issues facing the area. It is crucial to recognize the relationship between long-standing environmental problems and those that have just lately come to light. The production of methane from waste disposal leads to global warming, which in turn causes desertification, water shortages, and a multitude of other ecological catastrophes. For example, desertification reduces the number of plant and animal species. More livestock and too much grazing also contribute to desertification, as does the release of methane from waste disposal.

If we really want to gauge the severity of these issues, we may discover that the ecological footprint is a useful instrument to apply. According to the WWF/Ecological Footprint study, *Our Living Planet*, which assesses the environmental effects of 150 nations, the United Arab Emirates has the biggest footprint in the world, indicating that its residents place the most strain on the planet per capita. The research examines the environmental effects of the population of each nation. At 11.9 global ha/person, the Total Ecological Footprint (TEF) per capita in the United Arab Emirates is much larger than the world average of 1.8 global ha/person. Also, the ecological footprints of Kuwait and the Kingdom of Saudi Arabia, which are 7.6 and 4.6 global hectares per person, are much bigger than they should be.

Since the 1970s economic reforms, Gulf has become the economy with high growth rate. However, the high economic growth has been attained at the sake of poor environmental standards. The economy is working on achieving better growth irrespective of the quality of environment. The basic purpose of Gulf is become highly industrialized country along with urbanization. However, this will add more to the emissions of carbon dioxide. In Gulf, the key determinants of CO₂ emissions include the consumption of energy, urbanization, national income level and financial development, leading to the structural changes in the economy of Gulf. The country is working on promoting its financial sector, according to National Bureau of Statistics, for achieving higher economic growth from 1990-2014. The broad money (M2) balance has increased twice to 122.8 trillion from 2.5 trillion. The commercial banks have increased the provision of loan, which has resulted in the liquidity expansion by 27 times. The liquidity expansion has reached to 71.8 trillion from 2.7 trillion from period 1992–2013 (Abula & Adebayo, 2016). The

environment can be positively/negatively affected when the financial sector is expanding at such a rapid rate. Different variables can be related to the emissions of CO₂ in a different way. For this, the use of nonlinear autoregressive distributive lag model (NARDL) has been the key focus. In order to deal with the emissions of carbon dioxide, financial development cannot be avoided. The national income level of the country increases with financial development along with causing the increase in emissions as well (Shahbaz et al. 2016). For consumer lending practices, efficient financial institutions are effective and make it easier to purchase products such as machines, household equipment, refrigerators and automobiles etc. causing even more emissions of CO₂ (Popper et al., 2016).

If permitted to expand, a country's financial sector can help bring about greater economic security. Even yet, this may cause new and dangerous environmental problems to surface. It's undeniable that technological progress has boosted production efficiency, which is good news for the economy as a whole. With better manufacturing approaches, the degradation of environment is reduced achieving economic of scale and low production waste (Ghisellini et al., 2016). Through establishment of heavy industries and use of poor practices in production, environmental issues can arise because of financial development. This creates a negative influence on the environment. Similarly, there are mixed results in literature concerning the relation between the carbon emissions and growth of financial sector (Shen, et al., 2019). It has been found by several studies that environment damage can be caused through financial development, which results in increased level of CO₂ emissions (Bekhet et al., 2017). Alternatively, few researchers have argued on the positive influence of financial development on Carbon Dioxide. A negative association between the two factors has been supported by some research findings (Omri et al., 2015).

The carbon dioxide emissions are affected by use of energy, financial development and real economic growth. The affect can be positive or negative. One of the key factors in carbon dioxide emission is the use of energy. The use of energy is an important part of daily lives (Omri et al., 2015). In the high-energy consumption, transportation, industrial, residential and commercial sectors are the four main industries. Almost 51% of the total energy consumption is done by the industrial sector (Wang & Feng, 2017). Moreover, an upsurge is caused by these sectors in energy consumption. The use of fossil fuels has created a key concern because of its negative impact on the environment. It has been realized that increase in the consumption of energy is becoming alarming for the world economies. In order to reduce emissions of carbon dioxide and protect the natural environment, several scientific projects have been initiated (Calel & Dechezlepretre, 2016). According to some studies, there is an inverse U-shaped relation existing between CO₂ emissions and national income. Initially, the degradation of environment increases and after reaching the turning point, it starts decreasing (Riti et al., 2017). The casual relation between energy consumption and carbon emissions was examined by another study (Kais & Sami, 2016). This research study incorporates financial development as the measurement of environmental quality. In this way, it will add to the existing literature. The use of NARDL has been made in this research, which is an advanced econometric approach. An efficient way of dealing with the component of asymmetry in financial development on emissions of CO₂ has been provided by NARDL with reference to the economy of Gulf for time 1980–2014. The testing of asymmetric effect helps in understanding the dominating effect of CO₂ emissions to be positive or negative for Gulf. The use of asymmetrical ARDL supports in determining the type of effect to be negative–negative or positive–positive effect. Moreover, it can be resulting in a symmetrical effect when the two effects cancel each other. In the previous research studies, it has been considered that the effect of financial development is symmetric. The relation of CO₂ emissions has been tested with financial development. This research will test the asymmetry effect first and in case of its existence, the use of NARDL will be done. ARDL approach will be used for testing short and long run relationships, if the financial development effect is symmetric. There are five parts in this research. In first part, the study background is presented. In the second part of this study, literature review has been conducted. The third part is based on research methodology. In the fourth part of the

study, empirical research findings have been signified. The conclusion is presented in the last part of research study.

Literature Review

Using different types of variables and aspects, there has been great amount of research conducted on the emissions of CO₂ by researchers and environmental protection institutions. The results of the literature studies have been classified into three different categories.

Environmental Kuznets Curve

The existence of Environmental Kuznets Curve has been examined in this part. The presence of EKC was examined by researchers (Al-Mulali et al., 2016) for different regions and countries. It was suggested by the results of research that every empirical study has different outcome from another. For some findings, the results are positive and for others, the results are negative. Some of the results are based on conditions of different circumstances. The findings get varied with the variation of approaches and countries along with time. Moreover, use of different approaches of econometric with different variables result in different outcomes. There has been support for EKC in research, among different cross-country analysis over different time periods. For the OECD countries, the existence of EKC has been found by some studies (Saboori et al., 2016). In the sampled non-OECD countries, the results were contradictory. An N-shaped Environmental Kuznets Curve was found by another study on OECD countries (Allard et al. 2018). The single country analysis of India supports EKC hypothesis [38]. Alternatively, a cubic relationship has been confirmed between CO₂ emissions and GDP for Austria. Further, the N-shape and U-Shaped EKCs have been rejected by research findings for 16 transition economies.

Innovative Achievements across Globe in Economic Growth and CO₂ Emissions

In this global era, global warming has become a crucial aspect of industrial development. Implementing low carbon practices is the best way to control the emission of carbon dioxide as suggested by literature. CO₂ is one of the Greenhouse gases, which is equally important for sustaining livelihood, but a high level of its emission is resulting in destructing situation for the natural environment. Activities such as combustion of fossil fuels are adding to the alarming situation of global warming. It is the topmost concern for every economy to control the emissions of CO₂. The emission of CO₂ does not influence the social, political and economic issues. However, in recent years, several conferences for agreements to reduce CO₂ emissions have been conducted by the United Nations Framework Convention on Climate Change (UNFCCC). It was agreed by the worldwide community that the main issue is climate change, which can influence the living circumstances of the people across the world (Nordhaus 2015). It was agreed by the Conference of Parties conducted in Durban in 2011 that practices to lower carbon emissions will be implemented. In 2012, Doha has adopted the Kyoto Protocol for limiting the GHG emissions (Rosen, 2015). The maximum limit was agreed to be 2°C for global warming by the nations in the last fifth achievement of the IPCC report and efforts will be made to make GHG to zero level by the year 2020 (Quéré et al., 2015). The approval of roadmap for Paris agreement development was done in 2016 conference in Marrakech. The traditional research studies have focused on the low carbon emissions and its role in the education industry, industrial and production firms. Different approaches and techniques have been used for examining the relation between efficiency of environment and socio-economic development (Quéré et al., 2015) economic growth as well as emissions of CO₂.

To investigate the connection between trade liberalization, energy consumption, CO₂ emissions, GDP growth, and the development of Nigeria's monetary system (Rafindadi, 2016), the author used the innovation accounting test. The tapio decoupling method was employed to investigate the connection between rising CO₂ emissions and developing economies in Gulf provinces. By separating environmental stress from economic expansion, the Global Integrated Assessment Model was introduced. This model considers a wide variety of factors that may affect carbon emissions, resource consumption, and energy consumption. To meet long-term energy goals and reduce climate change's negative impact on Lithuania, (Balentis et al., 2016) conducted a DEA

analysis of the country's economy. In this analysis, we use the Environmental Performance Index as our benchmark. And also adopted DEA as a method of optimization to implement the trading of carbon emissions. Using ridge regression to achieve economic growth in the Gulf region by 2020 while simultaneously reducing carbon emissions. Parallel Data Envelopment Analysis was used to measure the energy and environmental performance of the Chinese transportation system in order to achieve sustainable development. Chen et al. (2018) employed the Shephard distance function, also known as Index Decomposition Analysis, alongside production-theoretical decomposition analysis (PDA) to reduce carbon emissions. The drop in carbon emissions can be ascribed to two distinct variables: a rise in the technical efficiency of GDP and a rise in the rate of technological change at GDO.

(Bian, et al., 2016; Wang et al., 2016) based their study on a non-radial efficiency measure and employed the DEA approach to determine the relationship between the economic development of APEC members and their carbon dioxide emissions. Using a metric based on Super slack, the researchers determined the efficacy of a low-carbon economy across 30 Chinese regions (Super-SBM). This allowed them to compare the economic improvement of each province. (Mardani, Streimikiene, et al., 2018) employed ANFIS to identify the key variables associated with GDP growth forecasts. Historical data analysis was the key to achieving this objective. According to the conclusions of the study, the share of total electricity consumption derived from renewable energy sources is the most important element in influencing the accuracy of growth estimates. In addition, the non-linear Grey Bernoulli model, also referred to as the NGBM, was implemented. The Autoregressive Integrated Moving Average (ARIMA) linear model was also employed to evaluate the relationship between Gulf area energy consumption, economic growth, and carbon dioxide emissions. For the period 2011–2020, the annual growth rate of energy consumption was 0.06 percent, while the annual growth rate of the gross domestic product was 6.67 percent, and the annual growth rate of carbon dioxide emissions was 4.47 percent. (Luukkanen, Akgün, et al., 2015) applied the LINDA (Long-Range Integrated Development Analysis) model to investigate and forecast energy and emission for the years 2013–2030. This was done so that projections regarding the Gulf region's economy might be made. According to the research's findings, the amount of CO₂ emissions is expected to decrease by one-third by 2030. Support Vector Machine, as well as Support Vector Machine (SVM), Artificial Neural Network (ANN), and Genetic Programming, were used to predict the economic growth and CO₂ emissions associated with population growth in rural and urban areas (GP). According to the study's results, there is a substantial relationship between the two variables. (Sun & Zhang, 2018) used PSO (Particle Swarm Optimization) and ELM (Extreme learning machine) to forecast CO₂ emissions for the development of low-carbon activities in the Gulf. According to the study's findings, the proposed method is suitable for improving the forecast of low-carbon development and CO₂ emissions for approximately 22 different parameters. Globally, the shift to a low-carbon economy is fraught with difficulty and has the potential to damage the climate of industrialized and rising economies alike. So, thorough planning is required in order to achieve the goals.

Use of Energy and Economic Growth

This section discusses studies that connect rising energy use with a flourishing economy. Contradictory findings emerged from studies conducted across numerous regions, historical eras, national borders, econometric analyses, and variables. In this study, we use India and Pakistan as case studies to show that energy consumption and CO₂ emissions are interconnected and, moreover, that this relationship goes in both directions. India's economic growth and trade liberalization have coincided with a corresponding increase in the country's carbon dioxide output. There is a connection between CO₂ emissions and energy usage, according to the findings of one study. Yet, there is a negative correlation between CO₂ emissions and financial success. There is a bidirectional relationship between Tunisia's GDP and its CO₂ levels. Rising CO₂ emissions are a result of the Gulf region's expanding economy and rising energy demand (Wang and Feng 2017). Mixed results were obtained from the cross-country analysis. Research conducted on Indonesia, Gulf, Brazil, India revealed that consumption of energy, and income increases the

emissions of CO₂. Population is considered a strong contributive factor in emissions of CO₂ for Brazil and India. In case of Taiwan and Gulf, there is a causality that works in both directions between rising economic activity and increased energy consumption. It has been revealed by few research studies conducted on South Asian countries that in unidirectional relation, which exists from consumption to income [48, 50]. However, it was found by another study that environmental quality is improved through financial system stability (Schädel et al., 2016). The increase in population, use of energy and economic growth create a negative impact on the environment. Carbon dioxide emissions have a unidirectional relationship with consumption of energy, production of electricity, GDP, production of electricity from oil, coal and natural gas, in the case of Pakistan. It has been suggested by a research that use of energy, foreign direct investment and economic growth results in CO₂ emissions. Alternatively, the results of another research support that the environment is improved by Foreign Direct Investment. Environmental Kuznets Curve has been found for Turkey. An increase is caused by consumption of energy in CO₂ emissions for the Commonwealth of Independent States. The hypothesis of EKC is supported by the findings (Nordhaus, 2015). There is co-integration among capital formation, consumption of energy and real GDP for G-7 countries. For countries such as Portugal, Greece and Spain, there is unidirectional relation among emissions of CO₂, economy and energy consumption. An insignificant impact is created by income on the emissions of CO₂ for United States in the long-run. Use of energy is positively influenced by CO₂ emissions for about 58 economies across the globe. However, this effect was positive for four panels including Middle Eastern, Latin America, Sub-Sahara, Europe, Asia and Caribbean region. GDP and energy consumption have unidirectional association for Cambodia and this relation was bidirectional for CO₂ emissions and real GDP.

Financial development and CO₂ emissions

Recent empirical research has investigated whether or not CO₂ emissions and economic growth are associated for a variety of economies. A study was conducted using the Indian economy as a point of comparison to assess the impact of income, trade, and financial expansion. According to empirical studies, there is a positive association between carbon emissions and finance industry expansion. According to the Granger causality test, the relationship between economic growth and inexorable expansion is unidirectional (Liu et al., 2018). Another study looked at Turkey to see how economic development, financial openness, energy usage, and trade openness changed over time. Emissions are reduced when a certain level of carbon emissions per unit of population is reached.

There is no link between long-term increases in CO₂ emissions and global financial progress. The relationship between CO₂ emissions and financial development was determined to be discordant using the co-integration approach, the Granger causality test, the ARDL method, and the panel data method (Saboori et al., 2016). Which of the following best describes the most current research findings on CO₂ emissions and their relationship to economic growth? Many empirical studies evaluated the impact of finance industry expansion on CO₂ emissions and energy consumption from the perspective of a developing country, notably the Gulf. The Gulf region was the focus of these investigations.

These two factors contribute to an increase in worldwide CO₂ emissions (Wang and Feng 2017). To evaluate the relationship between economic development and energy use, a study was done on about 22 emerging economies. The rise of the financial sector in developing nations increases the amount of available energy in those nations. In a second study, it was demonstrated that CO₂ emissions and financial development in the Gulf, Russia, Brazil, and South Africa are interwoven, suggesting that the significant component of financial development influences environmental quality. Both domestic loans to the private sector and FDI were used as proxies for the variable reflecting financial development in a previous study. The conventional view of the development of the financial industry does not center on the concept of foreign direct investment. Many studies have been done to determine how the expansion of the financial sector affects the state of the natural environment. The results are inconsistent. Foreign Direct Investment (FDI) leads to a

decrease in carbon emissions by enhancing both energy efficiency and production (Omri et al., 2015). The relation between CO₂ emissions, economic growth and health expenditures were examined for years 1995-2013. The results of the study reveal that a bidirectional association exists between economic growth, health expenditures and emissions of CO₂. The relation existed for all the countries other than the group of low-income countries. It was concluded by the research article there exists EKC but the income level threshold is not attained. The relation of consumption of electricity is positive with CO₂ emissions, while imports and exports are negatively associated with the CO₂ emissions. The relation between the use of energy and CO₂ emissions was examined by (Wang & Feng, 2017) along with the impact factors related to the emissions of CO₂ because of energy for years 1995–2011. It was indicated by the outcomes of this research study that economic level, urbanization and industry proportion were the key drivers behind the emissions of CO₂. The interregional differences in Gulf were evaluated by (Abula and Adebayo 2016), for the emissions of CO₂ from coal, which influence economic growth. It has been demonstrated by the findings of this research that interregional economic and emissions vary because of government policy. The influence of population growth, energy consumption and income were analyzed on emissions of CO₂. The results reflected that the use of energy and income are linked with increase in CO₂ emissions for four selected countries. A significant relation exists between the growth of population and carbon emissions for Brazil and India. The relation is insignificant for Indonesia and Gulf. The changing interrelationship based on the use of energy, output-energy-environment nexus, carbon emissions and economic growth was analyzed for the years 1971-2011. The results of the study found that there is different impact of different types of CO₂ emissions related to energy usage and economic growth. A two-way relation exists between use of energy and economic growth. The relation between financial development, use of energy, financial development and economic growth was analyzed by Schädel et al. (2016), for years 1980-2011. In countries such as Saudi Arabia, Oman, Bahrain and Qatar carbon emissions are increased by economic growth. Moreover, the main driver leading reduction in energy emissions is financial development. The relation between technology, population, CO₂ emissions and affluence were also studied. It was found that a U-shaped relation exists between urbanization and CO₂ emissions for three regions. Income is increased by carbon emissions. The relation between carbon emissions, energy, real income and investment was analyzed for years 1971–2010. The results of the study revealed that the influences of real income on emissions of carbon could be affluence by improving use of clean energy as well as efficiency of energy. The decoupling influence of economic growth on emissions of carbon was examined by (Sun & Zhang, 2018).

Data

This study focused on the asymmetric relationship between economic growth, energy consumption, financial sector expansion, and carbon dioxide emissions. All of the information on the variables was obtained from the World Bank. Carbon dioxide emissions have been measured in kilotons (kt), domestic credit to the private sector as a percentage of GDP per year, annual economic growth as a percentage of GDP in constant 2010 US dollars, and per capita energy consumption in kilos of oil equivalent. Malaysia, Singapore, Thailand, and Indonesia are just a few of the Gulf region countries for which data was collected between 1980 and 2014 during this time period. Proxy factors such as the ratio of domestic lending to the private sector as a proportion of GDP have been suggested as indicators of financial development. Another example is the domestic lending to the public sector ratio. A format suitable for algorithms has been created using the variables.

Methodology

For investigating the relationship between economic growth and carbon dioxide emissions, conventional research has applied standard time series methods like ARDL co-integration analysis (auto-distributive lag model). ARDL is followed by the Granger causality test and error correction modeling (EC modeling). Using econometric techniques that account for the symmetric link that

exists between financial development and CO2 emissions facilitates the investigation of both the long run and short run relationships. This study is performed alongside the short run relationship. As a result, these are insufficient to provide the acceptable level of asymmetry between the variables. A new research study sector (Shen, Liao et al. 2019) expanded the ARDL model to another work as an extension of asymmetric of a nonlinear ARDL co-integration process (NARDL) for dealing with short run and long run asymmetries in the required variables. As an extension of a nonlinear ARDL co-integration approach, this was performed. In this study, the same research methodology utilised in the prior study was utilized. The NARDL methodology was used to study the relationship between the price of oil and the cost of food in Malaysia. The association between economic growth and the utilization of woody biomass has been investigated by a separate study employing the same methods and referencing numerous African states. The association between rising energy use and expanding economies in the United States of America was explored (Dogan & Turkekul 2016).

Before presenting the NARDL model, the following long-run regression will illustrate the relationship between energy consumption, financial development, CO2 emissions, and economic growth.

Model Estimation

Even though the ARDL method has been in use for quite some time, it was not until fairly recently that it was shown to be a valuable instrument for analyzing the long-run correlations that exist between different economic time series. When compared to other Cointegration techniques, this one provides a variety of benefits from an econometric point of view that make it stand out from the competition. One of the most significant advantages of ARDL is that it may be used in circumstances in which the degree of integration of the series is unclear. Second, while dealing with a very small number of samples, the ARDL methodology nevertheless produces accurate estimates of the long-run coefficients. The fundamental model of an ARDL regression is represented by an equation.

$$\Delta y_t = \omega_0 + \omega_1 \Delta y_{t-1} + \omega_2 \Delta y_{t-2} + \dots + \omega_n \Delta y_{t-k} + \gamma_1 y_{t-1} + \gamma_2 y_{t-2} + \dots + \gamma_n y_{t-k} + \varepsilon_t \dots (1)$$

The ARDL method, which illustrates what would be done to carry out the bound cointegration test of variables as outlined by Pesaran et al., (2001) is represented by the equation [2.]

$$\Delta \ln(y)_t = \alpha_0 + \sum_{i=1}^k \alpha_i \Delta \ln(y)_{t-1} + \sum_{i=1}^k \alpha_i \ln(y)_{t-1} + \varepsilon_i \dots \dots \dots (2)$$

The sign Δ for the difference operator is the dot, which is written as. We are able to determine the level, t-1, and long run connections by using F-statistics, which allow us to investigate the significance of the level and t-1 variables. In order to evaluate the importance of the model as a whole, we will apply the formula $H_0: 1 = 2 = \dots = 7 = 0$. The values $i = 1, 2, \dots, 7$ and $j = 1, 2, \dots, 7$ are all constants in the natural logarithm version of the equation (3).

The crucial values may be determined from previous research if the variables in question are simply level variables $I(0)$, merely differentiable variables $I(1)$, or mutually cointegrated variables. In order to assess whether or not the alternative hypothesis of cointegration is statistically significant, the F-statistic values that were gathered are compared to the two sets of crucial values that were obtained from earlier research. We have previously gone through $I(0)$ and $I(1)$, which refer to the lower and higher critical values, respectively. When the estimated F-statistics are greater than the critical value, cointegration is found to be existent, and the null hypothesis is shown to be incorrect as a result. Cointegration is ruled out in this scenario as a result of the fact that the null hypothesis cannot be accepted if the estimated F-statistic is lower than the lower limit. The results are inconclusive if the F-statistic falls anywhere on the continuum between the two values being compared. Without knowing the orders of integration for the variables, it is impossible to come to any conclusions about the situation.

$$\Delta \ln(CO_2)_t = \alpha_0 + \sum_{i=1}^k \alpha_i \Delta \ln(CO_2)_{t-1} + \sum_{i=1}^k \alpha_i \Delta \ln(FD^+)_{t-1} + \sum_{i=1}^k \alpha_i \Delta \ln(FD^-)_{t-1} + \sum_{i=1}^k \alpha_i \Delta \ln(EC)_{t-1} + \sum_{i=1}^k \alpha_i \Delta \ln(GDPG)_{t-1} + \int_1 \ln(CO_2)_{t-1} + \int_2 \ln(FD^+)_{t-1} + \int_3 \ln(FD^-)_{t-1} + \int_4 \ln(EC)_{t-1} + \int_5 \ln(GDPG)_{t-1} \dots \dots \dots (3)$$

Results and Discussion The results of the correlation test between the dependent variable and the independent variables were very helpful to the pre-estimation analysis. This was especially true when taking into consideration the probable correlations that were offered by the theories. Before beginning the econometric analysis, it is necessary to examine the degree to which the variables are correlated with one another. This will allow for the identification of the statistical relationships that exist between and among the variables.

Table 1 .
Correlation Analysis

	CO2	FD+	FD-	GDPG	EC
CO2	1.00				
FD+	0.15 (0.41)	1.00			
FD-	0.20 (0.27)	0.13 (0.48)	1.00		
GDPG	0.26 (0.15)	-0.13 (0.46)	0.41 (0.02)	1.00	
EC	0.03 (0.87)	-0.12 (0.52)	0.43 (0.01)	0.03 (0.88)	1.00

The optimal models for Gulf's selection were chosen using the criteria shown in Table 2. The models ARDL (2,1,0,0,1), ARDL (2,1,0,2,1), and ARDL (1,2,0,0,0) were chosen to represent Model 4, Model 5, and Model 6, respectively.

Table 2.
Optimal ARDL Model Selection

Variables	Coefficients	Standard Error	t-statistics	p-Value
Model 1: ARDL (2,1,0,0,1)				
CO2(-1)	0.416	0.132	2.925	0.007*
CO2(-2)	0.456	0.143	3.081	0.005*
FD+	0.000	0.000	2.432	0.032*
FD+(-1)	0.000	0.000	5.937	0.000*
FD-	-0.321	0.126	-3.442	0.001*
GDPG	0.001	0.001	1.221	0.232
EC	0.024	0.044	0.532	0.612
EC(-1)	0.065	0.037	1.763	0.092**
C	7.406	2.882	2.570	0.018*
T	0.045	0.009	4.731	0.000*
Model 2: ARDL (2,1,0,2,1)				
CO2(-1)	0.425	0.183	2.327	0.031*
CO2(-2)	0.340	0.173	1.959	0.065
FD+	0.000	0.000	1.401	0.177
FD+(-1)	0.000	0.000	4.338	0.000*
FD-	-0.428	0.195	-2.201	0.040*

GDPG	0.045	0.056	0.795	0.437
GDPG (-1)	0.033	0.057	0.570	0.575
GDPG (-2)	0.103	0.062	1.675	0.110
EC	0.033	0.048	0.689	0.499
EC (-1)	0.097	0.053	1.831	0.083**
C	12.379	6.254	2.378	0.042*
T	0.080	0.033	2.892	0.007*
Model 3: ARDL (1,2,0,0,0,)				
CO2(-1)	0.436	0.128	3.824	0.001*
FD+	0.001	0.000	4.158	0.000*
FD+ (-1)	0.001	0.001	1.802	0.072**
FD+ (-2)	0.000	0.000	-3.552	0.003*
FD-	-1.224	0.310	-3.394	0.005*
GDPG	-0.281	0.066	3.254	0.003*
EC	0.435	0.123	3.309	0.001*
C	25.974	7.213	4.188	0.000*

The ARDL model is used as an extension of asymmetric of a nonlinear ARDL co-integration procedure (NARDL) for dealing with short run and long run asymmetries in the variables desired. In this research, the similar method of research has been used. The findings of the study are providing support to the argument broached in the study that financial development, energy consumption and economic growth are linked with CO2 emission.

Conclusion

According to the findings of the research conducted, various kinds of CO2 emissions have varying degrees of effect on the amount of energy used and the expansion of the economy. The consumption of energy and the expansion of the economy are intertwined in a relationship that works both ways. Many authors, spanning the years 1980–2011, conducted research to investigate the relationship that existed between financial development, the use of energy, financial development, and economic growth. The expansion of the economies in Middle Eastern nations like Saudi Arabia, Oman, Bahrain, and Qatar leads to higher levels of carbon emissions. In addition, the most important factor leading to a reduction in energy emissions is the growth of the financial sector. In addition, the relationship between technology, population, levels of CO2 emissions, and levels of prosperity was investigated. It was discovered that the relationship between urbanisation and CO2 emissions for three different regions looks like the letter U. Emissions of carbon dioxide have a positive effect on income. The use of econometric methods that take into account the symmetric relationship that exists between financial development and CO2 emissions provides support for both the analysis of the long run relationship and the short run relationship. This analysis is done in conjunction with the short run relationship. As a result of this, these are not adequate to accomplish the desired level of asymmetry among the variables. The ARDL model is used as an extension of an asymmetric nonlinear ARDL co-integration procedure (NARDL) to deal with desired short- and long-run asymmetries in variables. In this research, the same method of research that was used in the previous study was used. The findings of the study lend credence to the contention put forth in the study itself, namely that CO2 emissions are linked with economic growth, energy consumption, and financial development.

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