CO2 emissions and financial development: evidence from the United Arab Emirates based on an ARDL approach

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CO_2 emissions and financial development: evidence from the United Arab Emirates based on an ARDL approach

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This paper explores the influence of economic and financial development on carbon emissions in the United Arab Emirates. The study uses the ARDL approach in order to investigate the long run relationship between carbon emissions and a set of economic and financial variables. The long-run and short-run Granger-causal directions are captured through the Error Correction Model (ECM). In order to determine the relative contributions of economic and financial variables to the evolution of per capita carbon emissions, variance decomposition is used. The period considered for the purpose of this study is the full sample (1975–2013). To the best of our knowledge there is no study in this kind focusing only on the United Arab Emirates. Hence we are attempting an humble contribution with this regards. The findings tend to suggest that there is a decline of CO_2 emissions in the long run. Also, considering the error correction model output, we can argue that the financial variables, especially the domestic credit to private sector, have an impact in CO_2 emissions. This finding is in line with that of Shahbaz et al. (2013) who found out through two different studies (South Africa and Malaysia) that private sector credit had a reducing impact on CO_2 emissions.

Keywords: CO_2 emissions, United Arab Emirates, Financial development, FDI, GDP, VECM ARDL

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1. Introduction

The recent increasing threat of climate change and major global warming has ignited the curiosity of many researchers and policy makers on identifying the relationship between financial development, economic growth and environmental pollution. The level of CO_2 emissions and the global warming consequences differ among countries. This could be due to social and natural characteristics specific to each country. Along the journey some theories and hypothesis developed such as the Environmental Kuznets Curve (EKC) hypothesis, which studies the relationship between economic development and environmental degradation. It suggests that there is a positive relationship between economic development and environmental degradation. As nations evolve and attempt to raise living standards, they degrade the environment and create bad impacts in the society. Hence countries development go in parallel with side environmental impacts such as pollution, deforestation and many more.

Major energy exporters are the oil-exporting countries and they top the list in terms of CO_2 emissions. Al-Hinti et al. (2013) did a comparative analysis of energy indicators and CO_2 emissions in 15 Arab countries and found out the oil-exporting countries, all emit CO_2 at rates well above the world average of 4.18 ton/person. As per their findings depicted in the table 1 below, UAE comes at the second place for CO_2 emissions.

Table 1: Basic information on the population, economic, energy and emissions status of Arab countries

Country	*Population*[1]	*Area*[2]	*GDP*[3]	*Net energy exports*[4]	*TPES*[5]	*CO_2 emissions*[6]
Saudi Arabia	23.95	2000.00	214.94	413.64	140.41	324.88
UAE	5.32	83.60	95.79	109.44	43.81	103.09
Kuwait	2.46	17.82	43.47	107.1	25.12	64.85
Qatar	0.78	11.43	22.47	57.38	18.06	38.57
Bahrain	0.72	0.71	9.92	8.7	7.49	16.95
Oman	2.53	309.50	22.71	47.24	11.83	25.26
Iraq	25.38	435.05	21.28	73.2	29.75	81.22
Syria	18.58	185.18	20.73	11.09	18.44	47.78
Jordan	5.44	89.34	10.55	−6.37	6.52	16.70
Lebanon	3.54	10.45	19.85	−5.18	5.4	15.29

Globally, UAE has been ranked thirty when it comes to CO_2 emissions and one of the highest consumers of energy per capita worldwide, based on Radhi (2009) findings. The illustration is provided in the figure below, as per the author findings when evaluating the potential impact of global warming on the UAE residential buildings, a contribution to reduce the CO_2 emissions.

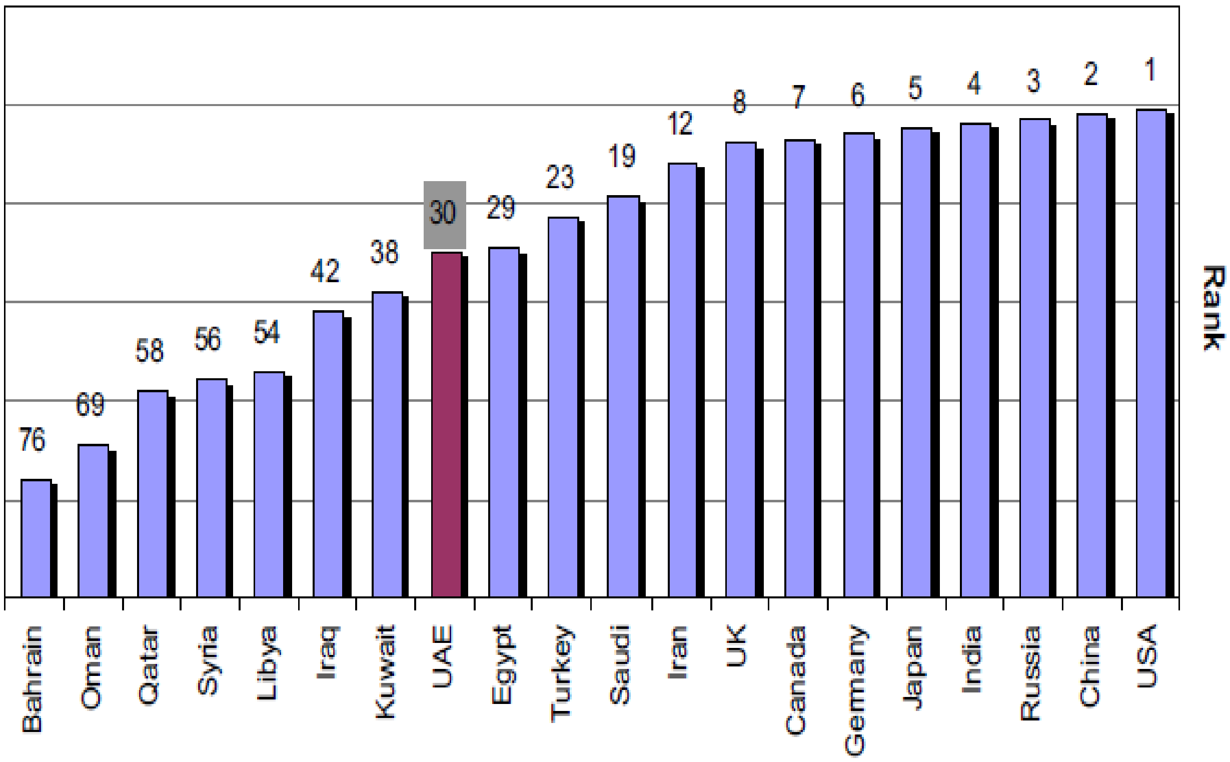


Figure 1: Rank of UAE in terms of CO2 emissions, Radhi (2009).

The United Arab Emirates is a federation composed of seven Emirates that spans approximately 83,600 km2. The climate is similar to those arid and semi-arid zones. In this part of the world, the summer season is very dry. The temperature can raise to about 48C in coastal cities – with accompanying humidity levels reaching as high as 90%. In the southern regions, temperatures can reach 50C, Radhi (2009). According to the World Resources Institutes (2006), around 4% of the CO2 emissions in the United Arab Emirates is a result of the direct emissions of buildings, 43% by electricity generation and 45% by manufacturing and construction industries.

In another hand, in the “UNITED ARAB EMIRATES: 40 Years of Progress Retrospective Analysis of Key Indicators” published by the Price Court, a thorough analysis of the CO2 emissions for the past 40 years (1970-2007) suggest that as the country strives to improve its environmental performance, carbon dioxide emissions per capita is declining. The report relied on data extracted from the World Bank's World Development Indicators Database. The illustration is provided below:

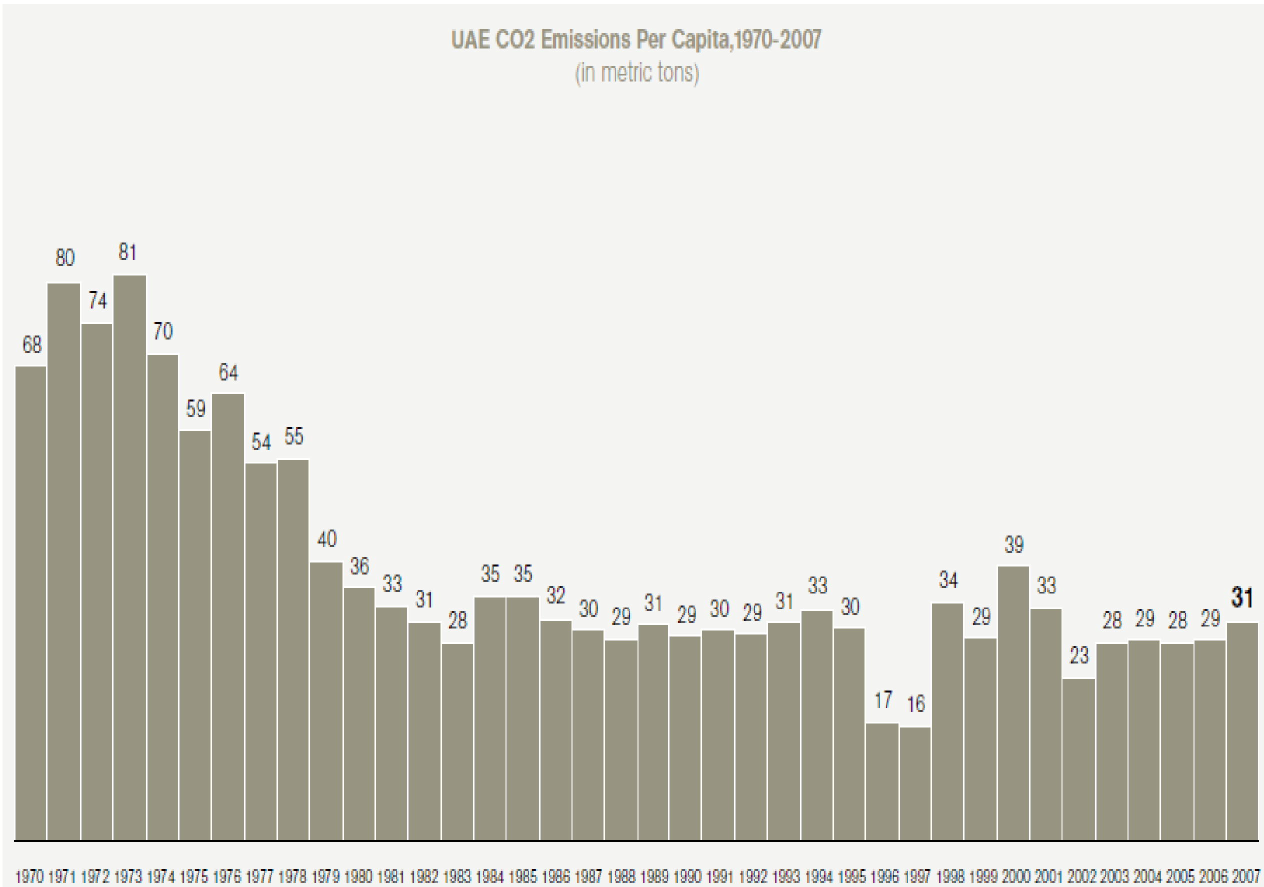


Figure 2: UAE CO2 Emissions Per Capita

Narayan and Narayan (2010) tested the Environment Kuznet's Curve (EKC) hypothesis for 43 developing countries including United Arab Emirates and found out that carbon dioxide emissions have fallen over the long run. In another hand, this means that as these economies have grown CO_2 emissions have fallen. This is indeed in line with our results and strengthens our findings of this study.

2. Literature Review

The existing research in this area is rather large with different theories, assumptions and policy implications, as well. The most common literature is the discussion on Environmental Kuznets

Curve (EKC) hypothesis which is based on the theoretical proposition that during the early stage of economic development pressure on the environment is high. This pressure in return leads to the environment deterioration. As time goes, the pressure relaxes and the environmental conditions improve, Narayan and Narayan. (2010). The major findings are of three folds: existence of long relationship, lack of long relationship, and neutral.

A number of studies have pointed out the existence of a long-run positive relationship between economic growth, energy use and CO2 emissions. Jammazi and Aloui (2015), used a wavelet window cross-correlation to examine the cross linkages CO2 emission, economic growth, and energy consumption for GCC countries. The findings suggest the existence of bilateral causal effects between energy consumption and economic growth, while only a unidirectional relationship was found from energy to emissions. Also, Ozturk and Acaravci (2010), and Ang (2007) studies confirms the presence on the long-run relationship.

Abbasi and Riaz (2016) used an augmented VAR model to study the long run relationship between CO2 emissions and financial development in Pakistan. The findings of the study suggest that per capita CO2 emissions were cointegrated with financial development indicators and per capita GDP. Adding to that, the estimated long run model for the full analysed sample showed that only GDP per capita had statistically significant impact on CO2 emissions. In returns this caused emissions to increase with the standards of living.

In another hand, Sordosky (2010), studied the impact of financial development on energy consumption in emerging economies. The research was based on a panel data set on 22 emerging countries covering the period 1990–2006. The results show a positive and statistically significant relationship between financial development and energy consumption. Hence, effective financial intermediation encourages the customers to take bigger loans and pollute more through automobiles that increase CO2 emissions.

Some other researchers viewed that the issue differently and argue that the development of the financial sector enhances research and development together in building energy efficient technologies and in consequence reduces CO2 emission. This is the stand of Frankel and Romer

(1999). This is in line with the view of Bello and Abimbola (2010), and Wang and Jin (2007) who found that a boost in FDI led to lower CO2 emissions. Also, this engaged companies to adopt more energy efficiency strategies and attracted more investors. Interestingly some other findings suggest the exactly opposite of the earlier stream. In fact, Ren et al. (2014), and Lau et al. (2014) arrived at the same conclusion. The former analysed the CO2 emissions in various industrial sectors of China. They concluded that FDI led to an increase of CO2 emissions in the industrial zones. This is due to a lack of knowledge and awareness of efficient resource utilization. The latter focused on Malaysia and investigated the presence of EKC for Malaysia in presence of FDI. The results suggested that in the long run, FDI was the cause of an increase of CO2 emissions. As for private sector credit, it was found by Shahbaz et al. (2013), in their analysis of financial development impact on CO2 emissions for Malaysia, that it decreases the impact on CO2 emissions.

3. Data and Methodology

3.1 Data

We have presented the definitions of all the variables used in this study in Table 1 below. We extracted the annual data on GDP, FDI, Domestic credit provided by financial sector (DCF), domestic total credit to private sector (DCP), CO2 emissions, and oil rents (OIL) from World Development Indicators (WDI, 2017). We hypothesized the per capita CO2 emissions to be related to the level of economic development (proxied by per capita GDP), financial development and FDI. Contrary to authors like Abbasi et al. (2016) and Zhang (2011), who took into consideration both the scale and the efficiency of financial intermediation development and stock market development, we considered only the first one. This is mainly due to data limitation in terms of market capitalization in the United Arab Emirates. We represented the scale of financial intermediation development by the percentage of total credit in GDP. As for the percentage of private sector credit in GDP, it was taken as proxy for financial intermediation efficiency. The full sample data set is from 1975 to 2013. This include the crisis period.

3. 2 Methodology: Autoregressive Distributed Lag Approach

In this study we aim to investigate the impact of economic and financial development on CO2 emissions in the United Arab Emirates during the period 1975–2013. At first we explore the long run relationship between economic, financial and environmental variables using ARDL approach.

The ARDL model was introduced by Presaran et al. (2001) for the sake of incorporating I(0) and I(1) variables in the same estimation. When dealing with Stationary variables I(0), OLS is most appropriate. As for dealing with non-stationary I(1) variable we adopt the VECM (Johanson).

In another hand, Marashdeh (2006) suggests that one of the main reasons for preferring the ARDL model against others (Engle and Granger, Johansen, Johansen and Juselius and Gregory and Hansen) is that it is applicable irrespective of whether the underlying regressors are purely I(0) , purely I(1) or mutually Cointegrated. During our analysis we hit into I(0) and I(1) hence we decided to go for ARDL being the most appropriate. Hence, in this study, An Autoregressive Distributed Lag (ARDL) approach is adopted to examine the impact of economic and financial development on CO2 emissions.

The equations for the ARDL are as below:

$$\Delta FDI_t = \alpha + \Delta FDI_{t-i} + \Delta GDP_{t-i} + \Delta DCF_{t-i} + \Delta DCP_{t-i} + \Delta OIL_{t-i} + \Delta CO2_{t-i} + (FDI_{t-1} - GDP_{t-1} - DCF_{t-1} - DCP_{t-1} - OIL_{t-1} - CO2_{t-1})$$

$$\Delta GDP_t = \alpha + \Delta GDP_{t-i} + \Delta FDI_{t-i} + \Delta DCF_{t-i} + \Delta DCP_{t-i} + \Delta OIL_{t-i} + \Delta CO2_{t-i} + (GDP_{t-1} - FDI_{t-1} - DCF_{t-1} - DCP_{t-1} - OIL_{t-1} - CO2_{t-1})$$

$$\Delta DCF_t = \alpha + \Delta DCF_{t-i} + \Delta GDP_{t-i} + \Delta FDI_{t-i} + \Delta DCP_{t-i} + \Delta OIL_{t-i} + \Delta CO2_{t-i} + (DCF_{t-1} - GDP_{t-1} - FDI_{t-1} - DCP_{t-1} - OIL_{t-1} - CO2_{t-1})$$

$$\Delta DCP_t = \alpha + \Delta DCP_{t-i} + \Delta GDP_{t-i} + \Delta FDI_{t-i} + \Delta DCF_{t-i} + \Delta OIL_{t-i} + \Delta CO2_{t-i} + (DCP_{t-1} - GDP_{t-1} - FDI_{t-1} - DCF_{t-1} - OIL_{t-1} - CO2_{t-1})$$

$$\Delta OIL_t = \alpha + \Delta OIL_{t-i} + \Delta DCP_{t-i} + \Delta GDP_{t-i} + \Delta FDI_{t-i} + \Delta DCF_{t-i} + \Delta CO2_{t-i} + (OIL_{t-1} - GDP_{t-1} - FDI_{t-1} - DCF_{t-1} - DCP_{t-1} - CO2_{t-1})$$

$$\Delta CO2_t = \alpha + + \Delta CO2_{t-i} + \Delta OIL_{t-i} + \Delta DCP_{t-i} + \Delta GDP_{t-i} + \Delta FDI_{t-i} + \Delta DCF_{t-I} + (CO2_{t-1} - OIL_{t-1} - GDP_{t-1} - FDI_{t-1} - DCF_{t-1} - DCP_{t-1})$$

The variables used in this study and their definitions are provided below:

Table 1: Variables and data definitions

Variables	Description	Definition	Period	Source
Carbon emissions (CO2)	Measured in Metric tons per capita	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacturing of cement. They include CO2 produced during consumption of solid, liquid, and gas fuels and gas flaring.	1975–2013	WDI
Economic development (GDP)	Proxied by GDP per capita at constant 2000 US dollars	GDP per capita is the Gross domestic product divided by midyear population	1975–2013	WDI

Foreign direct Investment (FDI)	FDI (% of GDP)	FDI are the net inflows of investment to acquire a lasting management interest in an enterprise operating in an economy other than that of the investor.	1975–2013	WDI
Domestic credit (DCF)	Domestic credit provided by financial sector (% of GDP)	Credit loaned by financial sectors	1975–2013	WDI
Domestic credit to private sector (DCP)	Domestic credit to private sector (% of GDP)	Credit given to the private sector	1975–2013	WDI
OIL rents	Oil rents (% of GDP)	Oil rents are the difference between the value of crude oil production at world prices and total costs of production.	1975–2013	WDI

4. Empirical results and discussions

4.1 Descriptive statistics

Before analysing the results, below is the descriptive statistics of the entire data set. We also provided the graphical representation of CO2 emissions with all the economic and financial development indicators.

First off all we notice a downward trend of CO2 emissions during the period, and a decrease in population results in decreased CO2 emissions. Also GDP per capita and CO2 emissions displayed a downward trend too. On another hand, an increase of FDI, Domestic credit provided by financial sector (% of GDP) and Domestic credit to private sector (% of GDP) lead to a decrease of CO2 emissions during the period of 175-2013.

Table 2: Descriptive statistics

Variables	LCO2	LFDI	LGDP	LOIL	LDCF	LDCP
Maximum	4.154856	2.071555	11.6527	4.135322	4.641656	4.436404
Minimum	2.775537	-5.755851	10.44412	2.374274	-5.563500	2.278582
Mean	3.385984	0.469606	11.08177	3.149663	3.218866	3.4271
Std. Deviation	0.322371	1.199064	0.335862	0.363591	1.568522	0.489005
Skewness	0.331456	-3.490437	-0.137965	0.469068	-4.636007	0.061704
Observation	39	39	39	39	39	39

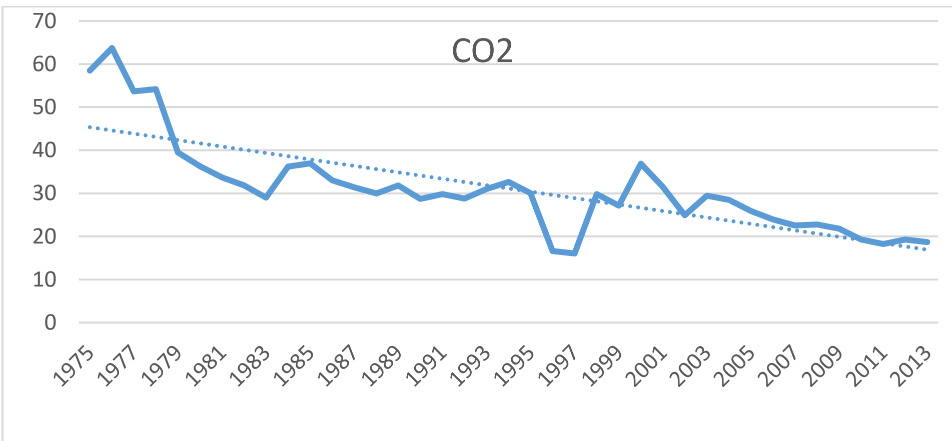


Fig. Trends of CO2 emissions across years

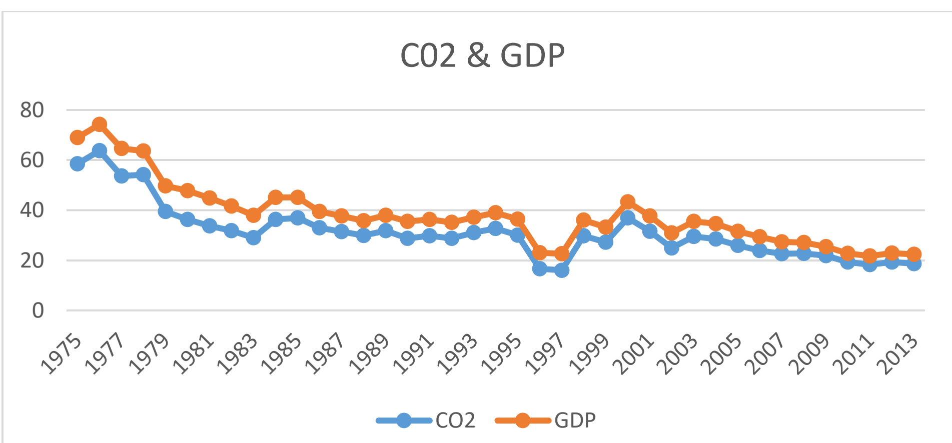


Fig. 1 Trends of CO2_GDP per capita

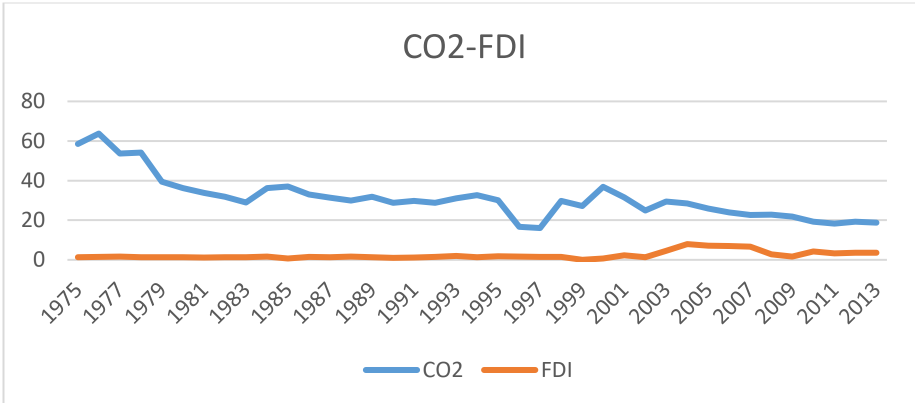


Fig. 2 Trends of CO2_FDI (% of GDP).

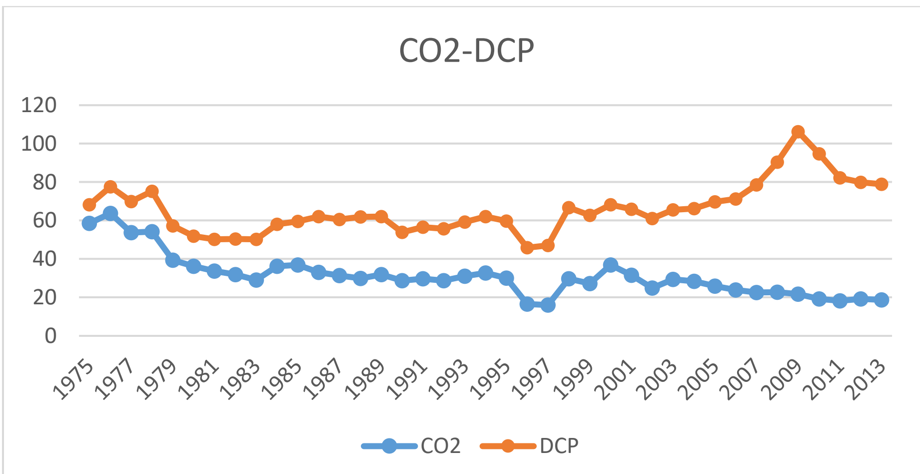


Fig. 3 Trends of CO2_DCP (% of GDP).

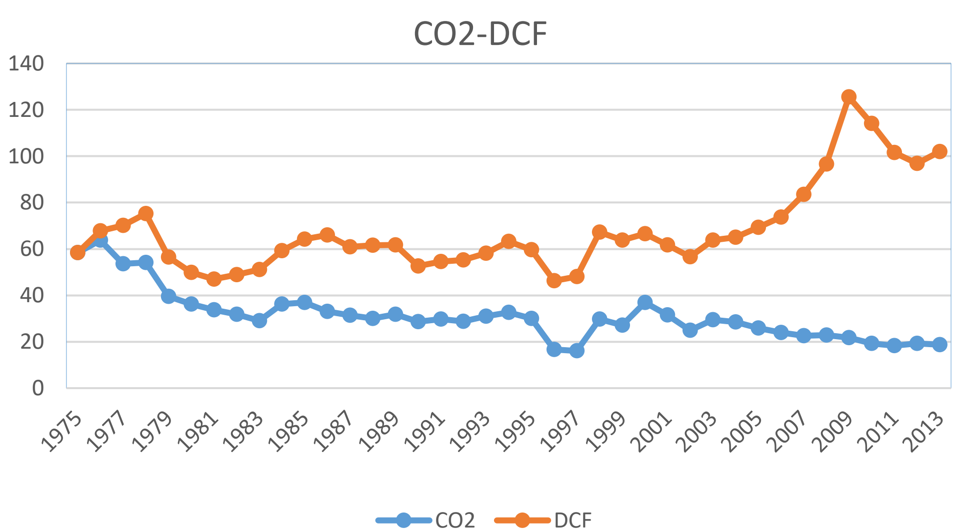


Fig. 4 Trends of CO2_DCF (% of GDP)

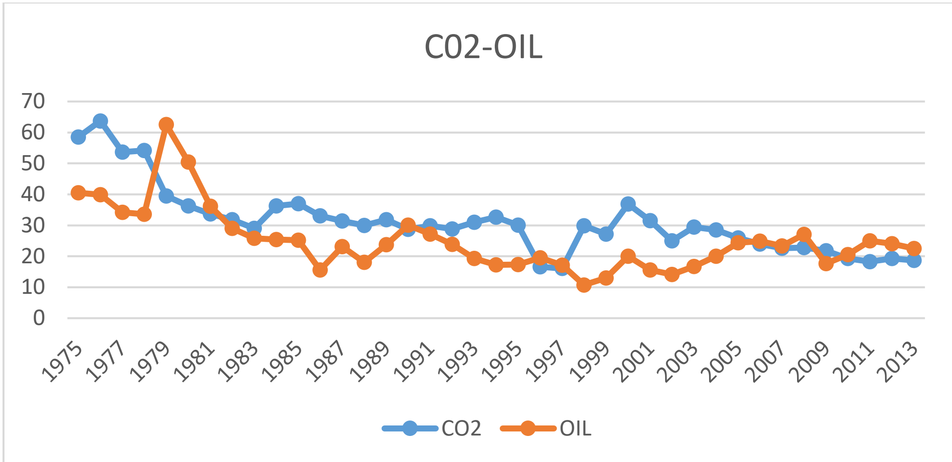


Fig. 5 Trends of CO2_DCF (% of GDP).

4.2 Unit Root Test

4.2.1 ADF test

Quite often, financial time series do not have a constant mean, variance and covariance as well. Hence they are non-stationary variables. We can't apply OLS on non-stationary variables as this will lead to an erroneous output. Hence we need to render our variables stationary by using the differenced form. However, there is a limitation in that in the sense that the differenced form does not hold the long run relationship or the theoretical form in the estimation. To overcome this problem, we perform the unit root test through the Augmented Dickey Fuller test, Phillips-Perron (PP) test, and KPSS test. The results of those tests are provided below:

Table 3: ADF test at level form

	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT
LOG FORM	LFDI	ADF(5)=SBC	- 65.4340	- 2.586	- 3.551	Non-Stationary
		ADF(5)=AIC	- 59.4480	- 2.586	- 3.551	Non-Stationary
	LGDP	ADF(1)=AIC	44.2415	- 2.672	- 3.551	Non-Stationary
		ADF(1)=SBC	41.2485	- 2.672	- 3.551	Non-Stationary
	LOIL	ADF(1)=SBC	0.6823	- 3.087	- 3.551	Non-Stationary
		ADF(1)=AIC	3.6753	- 3.087	- 3.551	Non-Stationary
	LDCF	ADF(1)=SBC	18.3910	- 3.551	- 3.430	Stationary
		ADF(1)=AIC	21.3841	- 3.551	- 3.430	Stationary
	LDCP	ADF(1)=SBC	26.3295	- 2.768	- 3.551	Non-Stationary
		ADF(1)=AIC	29.3225	- 2.768	- 3.551	Non-Stationary

	LCO2	ADF(1)=SBC	9.4715	- 2.768	- 3.551	Non-Stationary
		ADF(1)=AIC	12.4645	- 2.768	- 3.551	Non-Stationary

	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT
1ST DIFF. FORM	DFDI	ADF(5)=SBC	- 65.8319	- 3.218	- 2.956	Stationary
		ADF(5)=AIC	- 60.7019	- 3.218	- 2.956	Stationary
	DGDP	ADF(1)=SBC	37.7272	- 3.408	- 2.956	Stationary
		ADF(1)=AIC	39.9258	- 3.408	- 2.956	Stationary
	DOIL	ADF(5)=SBC	- 8.8602	- 2.248	- 2.956	Non-Stationary
		ADF(5)=AIC	- 3.7302	- 2.248	- 2.956	Non-Stationary
	DDCF	ADF(1)=SBC	16.5654	- 4.184	- 2.956	Stationary
		ADF(1)=AIC	18.7640	- 4.184	- 2.956	Stationary
	DDCP	ADF(1)=SBC	23.4153	- 4.000	- 2.956	Stationary
		ADF(1)=AIC	25.6139	- 4.000	- 2.956	Stationary
	DCO2	ADF(1)=SBC	5.2146	- 5.470	- 2.956	Stationary
		ADF(3)=AIC	7.9199	- 4.000	- 2.956	Stationary

The results show that not all the variables used are non-stationary at their level form and stationary at their first difference form. Hence the variables are a combination of type I(0) and I(1). This is the reason why we went for ARDL.

4.2.2 Phillips-Perron(PP) test and KPSS Test

We went further with the unit root test and used the Phillips-Peron test and KPSS Test. Phillips-Peron corrects both autocorrelation and heteroscedasticity. As for ADF it corrects only autocorrelation. The results of Phillip-Peron test and KPSS are provided below:

Table 4: PP test

PP	VALUE	T-STAT.	Implication
DFDI	- 3.5348	- 16.595	Stationary
DGDP	- 3.5348	- 4.207	Stationary
DOIL	- 3.5348	- 10.498	Stationary
DDCF	- 3.5348	- 66.765	Stationary
DDCP	- 3.5348	- 5.555	Stationary
DCO2	- 3.5348	- 8.062	Stationary

Table 5: KPSS test

KPSS	T-STAT.	CV	Implication
LFDI	0.1408	0.186	Stationary
DFDI	0.1655	0.186	Stationary
LGDP	0.1048	0.186	Stationary
DGDP	0.1237	0.186	Stationary
LOIL	0.1455	0.186	Stationary
DOIL	0.1717	0.186	Stationary
LDCF	0.1364	0.186	Stationary
DDCF	0.1524	0.186	Stationary
LDCP	0.1060	0.186	Stationary
DDCP	0.1323	0.186	Stationary
LCO2	0.1347	0.186	Stationary
DCO2	0.1653	0.186	Stationary

As we can see from the results variables have been stationary.

4.3 F-Test for long-run relation

As part of the stages I the ARDL approach, we tested the existence of the long run relation between the variables being investigated. This was done by computing the F-statistic in order to check the significance of the lagged levels of the variables in the error correction.

The appropriate critical values for a wide range of number of regressors (k) have been suggested by Pesaran, Shin, and Smith (1996). This allowed to find out whether the ARDL model has an intercept. They provided two sets of critical values to benchmark with: one set assumes that all the variables in the ARDL model are I(1), while the second set assumes all the variables are I(0).

If the computed F-statistic falls outside this suggested band a conclusive decision can be made without needing to know whether the underlying variables are I(0) or I(1), or fractionally integrated. If the computed statistic falls within the critical value band the result of the inference is inconclusive and depends on whether the underlying variables are I(0) or I(1). The results of the Akaike long run relationship among variables is presented below:

Table 6: F-Statistics for Testing the Long-Run Relationship (ARDL)

Variable	Fstat	Lower Bound	Upper Bound	Cointegration
FDI	5.455	2.9993	4.4166	Yes
GDP	3.814	2.9993	4.4166	Inconclusive
OIL	5.2399	2.9993	4.4166	Yes
DCF	6.7979	2.9993	4.4166	Yes
DCP	0.73868	2.9993	4.4166	No
CO2	4.1555	2.9993	4.4166	Inconclusive

The above table shows the calculated F-statistics are higher than the upper bound 4.4166 for FDI, OIL and DCF, considering 5% significance level. Hence we have a cointegration in the long run. In the other hand, we were unable to prove an existence of cointegration for DCP. As for GDP and CO2, the results are inconclusive.

4.4 Results of error correction models

Cointegration is about log run relationship between the variables and it does not depicts unfold the process of short-run adjustment to bring about the long-run equilibrium. Hence, it mainly allows us to state whether there is a long run relationship between the variables or no. However, it worth to highlight that However, there may exist a short-run deviation from the long-run equilibrium. All the results, as shown in Table 7, suggest that at 5 % significant level all the variables are endogenous except DCP. Therefore the domestic credit to private sector (DCP) is the leader while the others are the followers.

Table 7: Error correction models

ecm1(-1)	Coefficient	Standard Error	T-Ratio [Prob.]	C.V.	Result
dLFDI	-1.3420	.23560	-5.6963[.000]	5%	Endogenous
dLGDP	-.22560	.090300	-2.4983[.020]	5%	Endogenous
dLOIL	-.41268	.12375	-3.3347[.003]	5%	Endogenous
dLDCF	-.40308	.14146	-2.8494[.009]	5%	Endogenous
dLDCP	-.11017	.11899	-.92584[.363]	5%	Exogenous
dLCO2	-.94981	.23117	-4.1088[.000]	5%	Endogenous

5. Variance Decompositions (VDC)

After identifying the exogenous from the endogenous among the variables, we proceeded with the VDC (Variance Decomposition). VDC tells us which variable is the strongest leader and which variable is the weakest follower. It shows the relative endogeneity or exogeneity. This identification is done by ranking the variables based on the degree of dependence on their own past. We have orthogonal and generalized VDCs. The orthogonal depends on the particular ordering of the variables in the VAR and assumes that when a specific variable is shocked all other variables in the system are switched off. As for generalised it neither depends on a particular order nor it makes the orthogonal assumption. Due to some inconsistency of the orthogonal and generalized VDC results we are reporting the generalised as it is not bias on the order of the variables. By using generalized VDC, the below results shows that CO2 is the strongest leader with > 50% in all the horizons examined. Interestingly this is in contrast with the error correction results. GDP appears to be the weakest follower among all the variables. The results are provided below for horizon 3, 6, and 9. Generally the order of our variables are as follow:

1. Rank 1: CO2
2. Rank 2: FDI
3. Rank 3: DCF
4. Rank 4: OIL
5. Rank 5: DCP
6. Rank 6: GDP

The policy implication from these results is that for the United Arab Emirates to boost its Gross Domestic Product and attract more Foreign Direct Investment (FDI), it has to work on its CO_2 emissions. A sound and healthy environment with less pollution has a direct influence on the development of the country. This is in line with earlier depicted figures such as the ones below which show respectively CO2 & GDP and CO2 & FDI trend from 1975 to 2013.

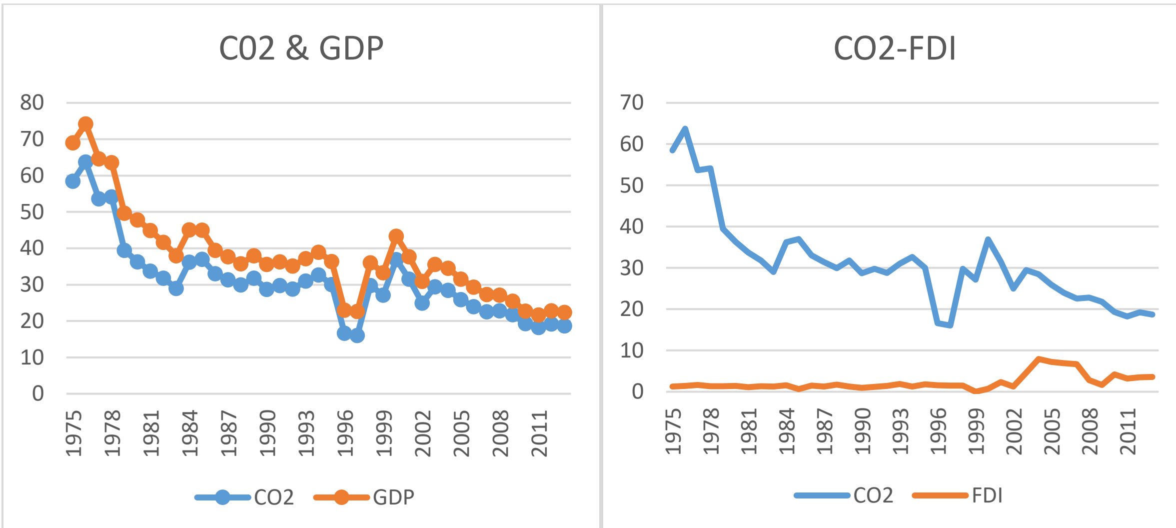


Fig. 6 Trends of CO2_GDP_FDI

Table 8: Ranking based on VDC (Generalized)

Var	Horizon	DFDI	DGDP	DOIL	DDCF	DDCP	DCO2
FDI	3	0.471668	0.097552	0.051946	0.026322	0.069106	0.283406
GDP	3	0.050246	0.246465	0.117367	0.275952	0.250291	0.059679
OIL	3	0.027448	0.186015	0.365605	0.17271	0.161664	0.08656
DCF	3	0.018682	0.131587	0.102276	0.461874	0.234598	0.050983
DCP	3	0.012445	0.223985	0.121518	0.298472	0.307722	0.035858
CO2	3	0.19174	0.096421	0.04674	0.029408	0.045634	0.590057
Exogenuity		0.471668	0.246465	0.365605	0.461874	0.307722	0.590057
Rank		2	6	4	3	5	1

Var	Horizon	DFDI	DGDP	DOIL	DDCF	DDCP	DCO2
FDI	6	0.443892	0.084412	0.053502	0.081488	0.104807	0.231899
GDP	6	0.029889	0.209282	0.063325	0.351694	0.296648	0.049162
OIL	6	0.038897	0.169574	0.308036	0.210244	0.188295	0.084955
DCF	6	0.01615	0.133277	0.094498	0.470425	0.249655	0.035995
DCP	6	0.013803	0.214599	0.092047	0.320379	0.327347	0.031825

CO2	6	0.157926	0.073501	0.040371	0.107553	0.076566	0.544083
Exogenuity		0.443892	0.214599	0.308036	0.470425	0.327347	0.544083
Rank		**3**	**6**	**5**	**2**	**4**	**1**

Var	Horizon	DFDI	DGDP	DOIL	DDCF	DDCP	DCO2
FDI	9	0.460588	0.075019	0.064985	0.080767	0.102612	0.21603
GDP	9	0.026856	0.215466	0.07161	0.347077	0.292562	0.046429
OIL	9	0.038272	0.165479	0.305781	0.221389	0.193862	0.075217
DCF	9	0.01849	0.130135	0.091238	0.481421	0.247694	0.031022
DCP	9	0.014862	0.216162	0.091752	0.321247	0.328722	0.027253
CO2	9	0.150348	0.074066	0.046659	0.10052	0.071557	0.55685
Exogenuity		0.460588	0.216162	0.305781	0.481421	0.328722	0.55685
Rank		**3**	**6**	**5**	**2**	**4**	**1**

6. Impulse Response and Persistence Profile

In this study we also used impulse response to find the impact of shock of one variable on others. Impulse response function uses a variable specific shock to see the impact on others, their degree of response. In our case, we want to find the reaction of other variables when CO_2 being the leader is shocked. The IRF gave us close output to the VDC result. It worth to highlight that FDI has been very volatile along the period.

Fig 1: IRF (generalized) with shock to CO2

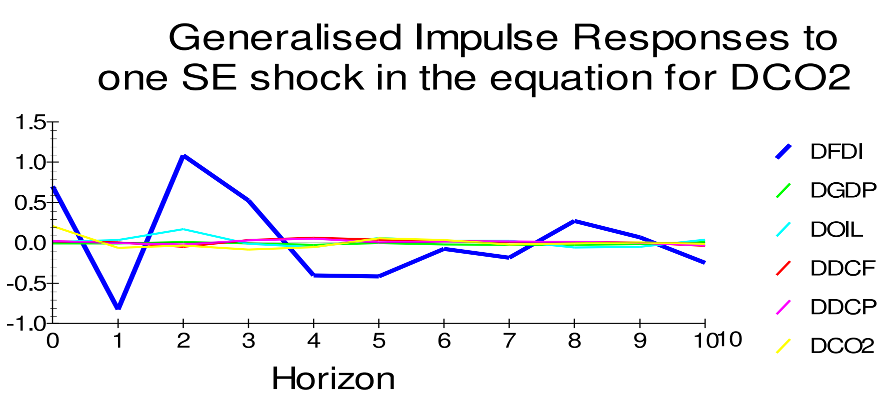


Fig 2: IRF (orthogonal) with shock to CO2

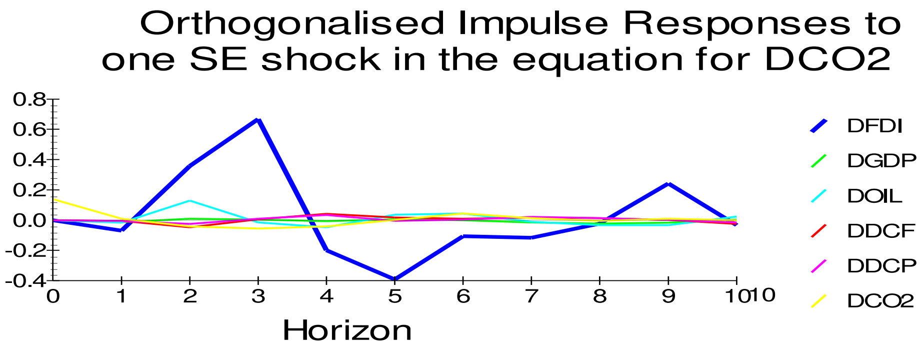
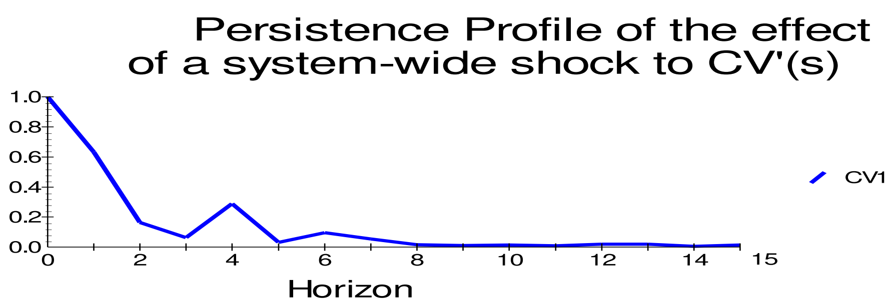


Fig 3: PP with shock to CO2



6. Conclusions and Policy Implications

The study aimed at exploring the influence of economic and financial development on carbon emissions in the United Arab Emirates. ARDL approach was used in order to investigate the long run relationship between carbon emissions and a set of economic and financial variables. The findings suggest that there is a cointegration in most of the used variables. The error correction model suggests that domestic credit to private sector is exonegeous while CO_2, foreign direct investment, gross domestic product, oil rents and domestic credit to financial sector are endogenious.

Also we found that reports of CO_2 trends and studies of Narayan and Narayan (2010), and some other researchers suggest that carbon dioxide emissions in the UAE have fallen over the long run. This is in line with our findings examining a sample data between 1975 and 2013. As per the results also, the financial intermediation Granger caused CO_2 emissions reduction. This finding is in line with that of Shahbaz et al. (2013) who found out through two different studies (South Africa and Malaysia) that private sector credit had reducing impact on CO_2 emissions.

A message to the policy makers in that regards is that financial development has a meaningful contribution in reducing environmental degradation. A more developed financial sector can lead to more research and development of environmental friendly technologies or more financing at a lower cost. Therefore more financing is needed to build a more sustainable environment. Financing is to be prioritized on environmental projects (cleaner energy, green technologies, solar, renewable energy). The banking industry should favour loans and give incentives to businesses that promote sustainability or generate less carbon emissions. Regulators need to better promote awareness of the dangers of CO_2 emissions. It is, also, of the benefit of the society that the regulator should shorten funding to entities that contribute in CO_2 emissions.

Last but not least, along the analysis of this study, we found some challenging results that are against the main stream, we reported them as is and attempted to find the reason behind. The variance decomposition results between orthogonal and generalized were different too. As the orthogonal VDC is biased to the ranking order we relied on the generalized output. It suggested that CO_2 is the strongest leader with > 50% of variation explained by itself in all the horizons examined. Going against the wind (main stream) and relying on the VDC results we would argue that mitigating CO_2 gives the UAE a good image and attract more foreign direct investments (FDI).

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