ADVANCE SOCIAL SCIENCE ARCHIVE JOURNAL
Available Online: https://assajournal.com
Vol. 05 No. 01. Jan-March 2026.Page#.146-158
Print ISSN: 3006-2497 Online ISSN: 3006-2500
Platform & Workflow by: Open Journal Systems

Environmental Kuznets Curve (EKC) Hypothesis and Co2 Emissions: An Empirical Study of MENA Developing Countries

Fazal Karim
Ph.D in Economics, Institute of Development Studies, The University of Agriculture, Peshawar
karim.economist@yahoo.com
Shah Saud
Ph.D in Agriculture Extension, Agriculture Extension Education and Communication, The University of Agriculture, Peshawar
shah.saud1991@gmail.com
Rafiullah
MS in Economics, Abdul Wali Khan University, Mardan
rafi.iiui@gmail.com

ABSTRACT
This study examines the impact of per capita income, its square, forest area, FDI inflows, population density, urbanization, and trade openness on CO2 emissions in MENA developing countries. Using 35 years of data (1981–2015) from the WDI, stationary was tested with the ADF test, and the ARDL bounds testing approach was applied. Results show that all variables significantly reduce CO2 emissions in both the short and long run. Unit root tests indicate that CO2 emissions and per capita GDP are occasionally co-integrated, supporting the Environmental Kuznets Curve (EKC) hypothesis. The findings highlight that higher income and FDI contribute to emission reduction, while coordinated environmental and economic policies are essential for sustainable development in developing MENA countries. Similarly, the findings show that developing countries need to bring into line a well-coordinated environmental and economic policy mix that would ensure greater output. Similarly, at the same time look after their environment from deprivation and pollution.

Keywords: Environmental Kuznets Curve (EKC) Hypothesis**,** CO2 Emissions, Population Density, Urbanization, Trade Openness

1. INTRODUCTION

BACKGROUND AND STATEMENT OF THE PROBLEM

The link between economic growth and environmental quality has been widely studied, with the Environmental Kuznets Curve (EKC) hypothesis, proposed by Krueger (1991), suggesting an inverted U-shaped relationship between pollution and per capita income. According to EKC, environmental degradation initially rises with economic growth, but after reaching a certain income threshold, further growth leads to environmental improvement. This pattern occurs as higher-income populations demand better environmental quality and adopt cleaner, less resource-intensive production practices (Ajide & Oyinlola, 2010).

Figures from developing countries show that CO2 emissions have generally increased over time, while per capita income exhibits a rising trend. Variables such as trade openness, urbanization, population density, and forest area show smoother trends, while FDI inflows fluctuate, occasionally spiking in specific years. In Sub-Saharan countries, per capita income shows significant growth, while population density, trade openness, and urbanization exhibit steady upward trends. FDI inflows remain volatile, reflecting the uneven impact of external investment on environmental outcomes.

According to EKC theory, environmental pressures may decelerate once economic growth advances, although this varies across pollutants and countries. Population growth intensifies waste generation, increasing environmental pollution, even as income rises. Unit root tests show CO_2 emissions and per capita GDP are sometimes co-integrated, supporting the EKC hypothesis. However, sustainable economic growth requires political commitment and coordinated policy interventions to balance economic development with environmental protection (Beckerman, 1992).

In developing countries, environmental degradation occurs slowly due to resource limitations. Key factors influencing CO_2 emissions include forest area, per capita income, its square (PY2), FDI, population density, urbanization, and trade openness. The EKC framework hypothesizes that emissions increase with income up to a threshold, after which environmental quality improves. Panel data analysis is crucial, as income-pollution relationships vary across countries. High income and effective policies are needed to reduce emissions in early stages of development. The Heckscher-Ohlin trade theory further explains that developing countries, specializing in labor- and resource-intensive production, may face higher environmental degradation compared to developed countries.

Studies consistently find that as income rises from low levels, CO_2 emissions and other pollutants initially increase, then decline once economies reach a higher income stage. Population growth exacerbates consumption and waste generation, increasing pollution. Proper econometric techniques are essential to accurately assess these relationships and avoid spurious correlations (Perman & Stern, 2003). In high-income economies, the scale effect reverses, enabling pollution reduction efforts to offset environmental pressures. EKC studies also indicate that tropical regions with high population densities experience more deforestation and environmental stress (Panayotou, 1993). Overall, developing countries face limited capacity to curb CO_2 emissions, while developed economies show greater resilience, reflecting significant progress over recent decades.

The study aims to identify the key factors influencing CO_2 emissions in developing countries. It examines both the environmental degradation of CO_2 and contributing factors, including FDI, forest area, per capita income, PY2, population density, urbanization, and trade openness. The research focuses on understanding how these variables affect CO_2 emissions and differentiates this work from prior studies by addressing the specific context of developing economies.

The main objectives are to assess the relevance of the EKC hypothesis in estimating CO_2 emissions in developing countries.To examine the influence of forest area, per capita income, PY2, FDI, trade openness, urbanization, and population density on CO_2 emission levels.

Significance of the study is that most EKC research has focused on developed countries, leaving developing economies under explored for the 1981–2015 period. This study provides guidance for developing countries to adopt EKC informed policies and identify the income thresholds necessary for pollution reduction. It also emphasizes the importance of country-specific strategies for sustainable development, as international EKC experiences may not directly apply to low-income nations. By analyzing these relationships, the study aims to help developing economies pursue economic growth while mitigating environmental degradation.

2. LITERATURE REVIEW

The EKC hypothesis is inspired by Kuznets' (1955) income inequality model. Applied to environmental economics, it suggests an inverted U-shaped relationship between income and environmental degradation. In early stages of development, countries prioritize growth over environmental protection. However, at higher income levels, environmental awareness, stricter regulations, and cleaner technologies reduce pollution.

Farzin and Bond (2006) find out empirical evidence for a dampening effect of population density on pollution. In their study focusing that a lot of population densities are becoming the cause of damping or wastages which create environmental pollution problems for developing economies.

Azmomahon (2006) carry out an extensive analysis on a panel of 100 countries for the period 1960-1996.Their results show that linearly positive relationship between CO2 emissions and per capita but interestingly they find an inverted U-shaped relationship between CO2 emissions and population.

According to saying of Van Alstine and Neumayer (2008) that developing economies have lack of resources to control on the environmental pollution as compare to the developed countries. So these economies mostly in progress of development to boom their economy till now (2008).

Bernauer and Koubi (2009) show similar result that democracies have higher commitments to stringent environmental policies and more international environmental agreements. Therefore it was suggested that democratic policies of any economy play positive role for the environmental degradation that why democratic developing economies make contract to international countries. Therefore most of the democratic countries have lot of environmental pollution problems.

Grossman and Krueger (1995) provided early empirical support for the EKC. Several studies have tested EKC across countries using CO_2 emissions, energy consumption, and industrial pollution as proxies for environmental degradation. Results vary by region and methodology. Some studies confirm the inverted U-shape, while others find N-shaped or monotonic relationships.

Recent panel studies emphasize the role of FDI, capital formation, and institutional quality in shaping environmental outcomes. Developing countries may attract pollution-intensive industries due to weak regulations (Pollution Haven Hypothesis), while developed economies shift towards cleaner production.

3. RESEARCH METHODOLOGY

3.1. METHODOLOGY AND RESEARCH DESIGN

The selection and identification of an appropriate research methodology is an important and crucial feature of the research. It is like a guide line for collecting data from different sources. The most important aspect is that it defines the type of data to be selected and identifying the model for further empirical analysis for a suitable research methodology.

Main objective of thesis to measure the impact of per capita income for the Environmental pollution (CO2) emissions. To check the basic relationship among PY,PY^2, FDI, forest area, population density, urbanization and trade openness position on CO2 emissions of developing regions (Source: WDI).The numerical measurement of the thesis on a data sampling for developing countries for 35 years (1981-2015).

3.2. COUNTRIES SELECTION CRITERIA FOR MENA COUNTRIES

Our selection criteria of developing countries contains as follow :

Middle East and North Africa countries as Iran, Israel, Libya, Morocco, Oman, Bahrain, Qatar (Middle Income level).

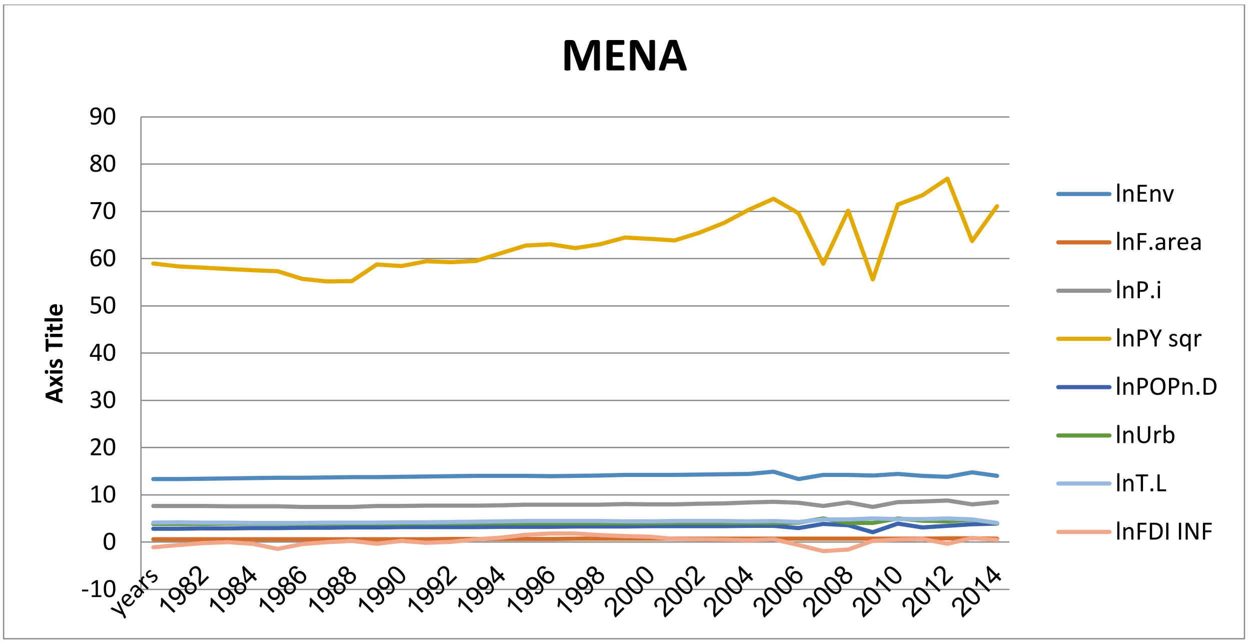

Figure 1 Diagram of the Middle East and North Africa countries**.**

In the above figure1, per capita incomes in MENA countries starts with a smooth trend and then rises to an upward trend, while population density, Urbanization and trade liberalization show the same upward trend with time passage. Forest area graph is a bit straight with little upward trend whereas FDI Inflation is quite fluctuating and has a high value in year 2005.

3.3. ECONOMETRIC MODEL

As our research objective is to enumerate and analyze the importance of other precipitating factors like forest area, per capita GDP, PY^2, FDI inflows, trade openness, and urbanization and population density for CO2 emissions in developing countries. Our sample consists of 17 countries during the period from 1981 to 2015. Model is used to investigate the basic interaction of CO2 emissions with independent variables based on the following equation: source are given below as:

$$E_{it} = \varphi_t + \beta_1 FA_{it} + \beta_2 PY_{it} + \beta_3 PY^2_{it} + \beta_4 FDI_{it} + \beta_5 Uit + \beta_6 PD_{it} + \beta_7 TO_{it} + \mu_{it}$$

Where i=1,..., N t=1,.....,T

Hence E_{it}= Ln(E_{it}) show Environmental pollution in term of (CO2) emissions in log form. LnFA (Forest Areas) PY_{it}=Ln(PY_{it}) log of p/c income in country ith in year (periods(t)),PY_{it}^2=Ln(PY^2_{it}) log of per capita income square and TL_{it}= Ln(TL_{it}) show the log of trade liberalization. LnPD (Population density), Urbanization and FDI Inflows are the explanatory variables which may affect the pollution. The parameter vectors as β= ($\beta_1=\beta_2=\beta_3=\beta_4=\beta_5=\beta_6=\beta_7$) and an error term is μ_{it}. If the relationship between environmental pollution and income is not monotonic but it show U-shape inversely, so coefficient FA of β_1, is positive and coefficient on per capita income β_2 is negative. At country level term μ_i it shows a country specific effect due to the controls for unobserved factors that affect pollution.

3.4.1. Dependent Variables

This study uses CO2 emissions as the dependent variable to measure environmental degradation at both global and local levels. Carbon dioxide emissions are widely recognized by the World Development Indicators (WDI) and other organizations as a key indicator of air quality. CO2 emissions mainly result from fossil fuel combustion, cement production, and gas flaring, making them a major contributor to greenhouse gas emissions. The data, measured in metric tons per capita and transformed into logarithmic form, are sourced from the World

Bank. Since CO2 emissions are controllable through effective regulation and cleaner production technologies, they serve as an appropriate indicator of environmental quality.

3.4.2. Independent Variables

The independent variables include per capita income (PY), its square (PY^2), foreign direct investment (FDI), population density, urbanization, trade openness, and forest area. These factors are considered key determinants of environmental quality and economic development. As economic activity increases, energy consumption also rises, which may worsen environmental pollution. However, developed countries tend to have better mechanisms and policies to control pollution compared to developing economies.

Forest area plays a vital role in environmental protection, with evidence supporting an inverted U-shaped relationship between income and deforestation. Per capita income and its square capture the EKC hypothesis, indicating that pollution initially increases with income and later declines. FDI significantly affects environmental quality, while high population density intensifies pressure on natural resources. Trade openness can reduce pollution through access to cleaner technologies but may also increase pollution if dirty industries relocate to developing countries. Urbanization contributes to higher fossil fuel consumption through increased transportation, leading to greater CO2 emissions.

3.5. DATA AND VARIABLES

3.5.1. SAMPLE SELECTION

The study uses panel data from selected Asian countries over the period 1981-2015 Countries were chosen based on data availability and economic relevance.

Variable	Description
CO_2	Carbon emissions (proxy for environmental degradation)
Yg	Economic growth
GDPPC	GDP per capita
$GDPPC^2$	Square of GDP per capita
FCF	Fixed capital formation
FDI	Foreign direct investment
POP	Population growth
PD	Public debt
INF	Inflation
FC	Financial crisis dummy

4. DATA SOURCES AND EMPERICAL ESTIMATION

4.1 DATA SOURCE

Our data contain for the period of 35 years (1981 to 2015).Almost data for all regions are available for sample periods. The data on carbon dioxide emission, PY, PY^2, forest area, population density, trade liberalization, and FDI obtained from the WDI.

4.2 ESTIMATION PROCEDURES

4.1.1 AUGMENTED DICKEY FULLER (ADF) TEST

ADF test has been applied for all indicators for the level of stationary. ARDL Bound approach will be used while when we check the unit root property. Hence, here must be testified the co integration order firstly because all the indicators must be integrated at I (0) and I (1), otherwise the results will be false if none of the variable should be stationary beyond these two limits.

4.3 DESCRIPTIVE STATISTICS

In descriptive statistics we run the Evievs software on the original data to find out the results of each indicator. We write the value of each variable to compare with others regions of developing countries.

4.4 CORRELATION OF THE MODEL

In correlation method we check the correlation between the dependant and independent variables whether the variables are positively or negatively correlated**.**

4.5 UNIT ROOT TEST

A free requisite before panel test of co integration is that all indicators in the model must be integrated in order one. For the application of univariate and panel unit root tests. We first empirical measure of ADF for stationary in the model so for all the 17 countries the given variables are to be integrated of order one. When we considered a panel form then it is necessary that for each of these variables the same internationals property should be exists. For further analysis use ARDL and Bound test to find out long run properties of covariance, co-integration and correlation matrix for all over the model. We divide 17 countries in to five regional panels accordingly to the application of unit root test. Our first panel contains on 7 Middle Eastern developing countries, second panel contains of 2 South Asia developing countries, third panel of 3 Latin American developing countries, fourth panel of 3 East Asia developing countries and fifth panel of 2 Sub Saharan developing countries. The results of all the five panels are estimated from the unit root tests and other tests accordingly to the table given in coming chapters.

4.6. ARDL AND BOUND TESTING APPROACH USED FOR CO-INTEGRATION

In this thesis find out the long run relationship between CO2 emission, forest area, per capita income (PY),PY^2, Population density, urbanization and trade openness for developing countries by using ARDL bound testing approach. ARDL have commonly used and have their own individual status as compare to the ordinary traditional models. ARDL features are given as:

a) Its results should be correct as well as refined.
b) It should be properly systematic because all the indicators at same level are not integrated.
c) This approach compare to other traditional models is isolated from the complexity of problems.

ARDL AND CO-INTEGRATING OF LONG RUN

The ARDL and co integrating Long Run Form is use to check the covariance and correlation and also used for the all over the models results in our research work.

5. EMPIRICAL ESTIMATION OF MENA PANEL

5.1. DESCRIPTIVE STATISTICS

Table 1. DESCRIPTIVE STATISTICS FOR MENA COUNTRIES.

	ENV	FA	FDI	POPD	PY	PY^2	T.OPEN	URB
Mean	1156971	1.918	1.988	24.35	2582.9	6671372.4	73.42	52.84
Median	1161126	1.907	1.40	24.40	2236.2	528143.2	73.06	52.98
Maximum	1936521	2.064	6.178	31.49	5038.6	253874.9	89.64	57.55
Minimum	627954.1	1.773	0.235	17.02	1683.7	27545.32	58.37	47.50
Std. Dev	377183.8	0.116	1.687	4.38	818.8	969.4	11.18	2.98
Skewness	0.4141	0.084	1.302	-0.062	1.451	2.105009	-0.011	-0.137
Kurtosis	2.227	1.266	3.625	1.826	4.791	22.94424	1.327	1.903
Jarque-	1.399	3.286	7.777	1.503	12.425	154.38	3.030	1.379

Bera								
Probability	0.496	0.193	0.020	0.47	0.002	0.000004	0.21	0.50

The results of descriptive statistics is listed in the given table 1 as that mean values of (EnvCO2) and (FA) are 115697 and 1.918 respectively, while standard deviation values 377183.8 and 0.116,while the maximum values are 1936521 and 2.064 respectively. Similarly their minimum values are 627954.1 and 1.773. (FDI) and (population density) mean value 1.988, 24.35 as mention, hence values of standard deviation 1.687, 4.38 correspondingly as well as minimum and maximum values of, 0.3235, 0.6.178 and17.02, 31.49 correspondingly. (Per capita income) and PY^2 have a mean value 2582.9, 2075.23, and maximum values are 5038.6 and 253874 and their minimum values are 1683.7, 27545.3 and standards deviation values are 818.8, 969.4 respectively. While (trade openness) & (urbanization) have 73.42 and 52.84 respectively and these two variables have standard deviation values of 11.18, 2.98 respectively. Their maximums are 89.64 and 57.55 respectively and minimums are 57.37, and 47.50 respectively.

5.2. CORRELATION MATRIX

Table 2. CORRELATION MATRIX

Variables	LnENV	LnF.Area	LnFDI	Ln PY	$LnPY^2$	lnPOPD	LnTL	LnUrbon
LnENV	1.000							
Ln F.A	0.9411	1.000						
LnFDI	0.6535	0.7768	1.000					
LnPY	0.8572	0.8740	0.5170	1.000				
$LnPY^2$	1.88829	0.9945	0.1983	0.8234	1.000			
LnPOP.D	0.9998	0.9533	0.7238	0.8301	0.812	1.000		
LnTL	0.8559	0.9546	0.8292	0.8378	0.824	0.878	1.000	
LnURBN	0.994	0.9564	0.7085	0.8416	0.834	0.999	0.8755	1.000

Correlation matrix results in Table 2 are quite clear indicating that Forest area (FA), per capita income (PY), PY^2, (FDI), population density (POPD), urbanization and openness of Trade are positively correlated to FDI, while FDI, per capita income, population density, trade openness, and urbanization are positively correlated with Forest Area. Similarly per capita income, population density, urbanization and trade liberalization are positively correlated with FDI, whereas population density, trade liberalization and urbanization have positively correlated with per capita income. Similarly trade openness and urbanization are positively correlated with population density. Whereas urbanization also positively correlated with trade liberalization.

5.3. UNIT ROOT FINDINGS

Table 3. AUGMENTED DICKEY FULLER TEST FOR MENA

Variables	Intercept		Intercept and Trend		Outcome
	Level	1stDifference	Level	1stDifference	
LnENV	-0.171**	-3.147	-4.479**	-4.330	1(0)
LnF.A	-1.298*	-2.531	-1.574*	-1.458	1(0)
LnFDI	-1.959**	-1.784	-4.835**	-4.805	1(0)
LnP/C	1.860	-1.284**	-3.401	-4.246**	1(1)
$LnPY^2$	2.640	-2.243**	-4.421	-5.642**	1(1)
LnPOP.	-8.636**	-2.424	-1.846**	-3.188	1(0)

LnTL	-0.424**	-1.803	-4.471***	-4.421	1(0)
LnURB	-7.388	-5.73**	-2.215	-2.718**	1(1)
***, (**) and * indicates the rejection of Null hypothesis at 1%, 5% and 10% level of significance respectively. Critical values are MacKinnon (1996) one sided p-values					
***, (**) and * indicates the rejection of Null hypothesis at 1%, 5% and 10% level of significance respectively. Critical values are MacKinnon (1996) one sided p-values					

Before applying ARDL to get long run and short run results stationary of the data must be checked either all the variables are stationary at level are not otherwise the results will be spurious and for such purpose Augmented Dickey Fuller test has been used in this research. Time series properties of ln(CO2), ln(FA) and ln(FDI(ln(PY),ln(PY^2), ln(POPD), ln(URB), ln(TL), are given below in Table 3. Results show that variables ln(CO2), ln(FA) and ln(FDI) are stationary at level while stationary at first difference, whereas ln(PY) are not stationary at level. While ln(TL) and ln(POPD), at level are stationary but URBN at first difference are not stationary. So, ADF test gives mixed results for the empirical estimation that's why we use ARDL test.

5.4. LAGS CRITERIA

Table 4 VAR LAG ORDER SELECTION CRITERIA

Lag	LogL	LR	FPE	AIC	SC	HQ
0	312.3350	NA	5.8e-20	-24.426	-24.085	-24.332
1	551.061	324.66*	1.7e26*	-39.609*	-36.846*	-38.8474*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error **SC: Schwarz information criterion**
HQ: Hannan-Quinn information criterion, **AIC: Akaike information criterion**

In table 4 ARDL approach should be run firstly decided that our in model how many lags includes. In this study the criteria of log length must be based on AIC if the observation less than 60. We can select lag in our model accordingly to the criteria of log length.

5.5. CRITICAL VALUES BOUNDS

Table 5 ARDL BOUND TEST RESULTS

ARDL Bound Test
Sample: 1981-2015
Included observations: 35
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	K
F-Statistic	5.83	6
Critical Value Bounds		
Significance	Lower Bound (L0)	Upper Bound (L1)
10%	1.99	2.94
5%	2.27	3.28
2.5%	2.55	3.61
1%	2.88	3.99

The listed table 5 show about lower bound (L0) or upper bound (L1) greater show the long relationship if the F-test value falls in it. If it lies between lower and upper bound then the results are inconclusive. In the following listed table the F value as 5.83 >1.99The above table conclude that there no existence of long relationship among indicators.

5.6. LONG RUN ESTIMATIONS

Table 6. ESTIMATED LONG RUN COEFFICENTS USING ARDL APPROACH

Dependent Variable: lnEnv(CO2)

REGRESSOR	**COEFFICENTS**	**STANDARD ERROR**	**T-Statistics**
LnFA	-4.832	2.686	-1.79**
LnPY	-0.0194	0.027	-0.700
LnPY^2	-0.0004	0.0021	-0.060
LnPOPD	-0.006	0.105	-0.059
LnURB	-5.436	2.88	-1.89**
LnTO	0.892	0.655	1.357
LnFDI	26.705	10.82	2.46**

DIAGNOSTIC TEST

TEST	**STATISTICS**	**P-Values**
R^2	0.98	
X^2*Serial*	8.39	0.000
X^2*ARCH*	1.23	0.26
X^2*WHITE*	0.83	0.53
X^2*Normal*	0.16	0.92

Note:

- χ^2 *Normal Test*
- χ^2 *WHITE Test*
- χ^2 *(Serial is the Breusch–Godfrey LM test statistic for no first-order serial correlation)*
- χ^2*ARCH Test)*

****** Test statistics are significant at 1% level of significance.*

***** Test statistics are significant at 5 % level of significance.*

*** Test statistics are significant at 10% level of significance.*

In the above listed table 6 it is quite clear that in long runs relationship forest areas have a significant negative impact on Environmental CO2 emission. Similarly, per capita income (PY), PY^2, shows an insignificant negative impact on CO2 emission. Population density (Pop D) shows an insignificant negative impact on CO2 emission. Urbanization (URB) shows a significant negative impact on CO2 emission. Trade liberalization and FDI have in long and in short run significantly affects on CO2 positively.

5.7. SHORT RUN ESTIMATIONS

Table 7.ERROR CORRECTION REPRESENTATION FOR THE SELECTED ARDL MODEL

Dependent Variable: ***ΔEnv(CO2)***

REGRESSOR	**COEFFICENTS**	**ST. ERROR**	**T-Statistics**
ΔFA	-0.28	0.83	-0.34
ΔPY	-0.014	0.01	-1.2
ΔPY^2	-0.0021	0.002	-2.32
ΔPOPD	-0.14	0.06	-0.23
ΔURB	-3.5	1.51	-2.31**
ΔFDI	0.18	0.12	1.51*
ΔTL	17.27	4.97	3.47***

*ECM= LNENV – 1.832*LNFA -0.0195* LNFDI - 0.0063*LNPY -5.436*LNPY^2 -9.342* LNPOPD 0.890* LNTL 26.705 LNURBN -75.3511*

R-Squared= 0.996	Adjusted R-Squared=0.453	F-statistics =434.93

S.E. of Regression = 0.024	Residual Sum of Squares=0.009	SD-dependantvar = 0.317
Akaike Info. Crit = -4.26	Schwarz Bayesian Criterion =-3.77	
Note: **** (**) and * represents significance at 1%, (5%) and 10% levels respectively.*		

In the above listed table 7 in error correction term followed long run relationship among variables. The ECM the Forest Area value must be negative and insignificant showing with CO2 emission. For long and short run equilibrium the ECM change are convergence. The ECM estimated values are highly significant at 48% approximately. So, the long relationship in the current years is disequilibria than the previous shocks. The results of the short run show that forest area, per capita income (PY) and, PY^2, population density and FDI have an insignificant negative impact on CO2 emission, while urbanization and trade openness have a significant positive impact on CO2 emission in short run. While population density have a significant negative impact on CO2 emissions.

5.8. FINDINGS

The empirical results indicate that the determinants of CO_2 emissions exhibit varying impacts across regions. Forest area shows mixed effects, with a generally positive correlation but insignificant long-run and short-run impacts in MENA countries. Per capita income is positively correlated with emissions across all panels, though its effect in MENA remains insignificant in both time horizons. The squared income term presents mixed outcomes, supporting the EKC pattern in some regions, particularly where significant effects are observed. Foreign direct investment is positively associated with emissions, exerting a significant long-run impact in MENA but an insignificant short-run effect. Population density demonstrates a positive correlation across regions, with a significant short-run effect but an insignificant long-run impact in MENA. Urbanization significantly increases CO_2 emissions in both the long and short run in MENA and reflecting intensified energy use. Similarly, trade liberalization consistently shows a positive and significant relationship with emissions in these regions, suggesting that expanded economic activity contributes to higher environmental pressure.

6. CONLUSION, POLICY RECOMMENDATION AND LIMITATIONS

6.1. CONCLUSION

The empirical results of the thesis attempts to investigate the relationship between CO2 emissions along with explanatory variables like forest areas, per capita income, per capita income square, FDI, population density, urbanization and trade openness in MENA developing countries. This thesis using a panel analysis over the period of 1981 to 2015.The study considers that independent variables play important role in the deduction of carbon dioxide emissions. While makes the study exclusive from previous studies in terms of low and middle level economies as classified by World Bank for MENA developing countries. This study reveals that it may be correct to generalize the reaction of these explanatory variables on the CO2 emissions as an environmental variable to EKC hypothesis. Also it is found that these variables like: forest area, per capita income, per capita income square, FDI, population density, urbanization and trade openness may degrade environmental pollution in the EKC positions. We are able to observe that the responses to EKC hypothesis depend largely on the nature of dependant and independent variables. The results reveal that Environmental Kuznets Curve is valid for the selected developing countries for some CO2 emissions but invalid for others. The findings show that developing countries need to bring into line a well coordinated environmental and economic policy mix that would ensure greater output. Therefore at the same time look after their environment from deprivation and pollution.

With regard to the EKC relationship, we reviewed studies adopting the recently developed unit root and co –integration tests for dataset. The results which we found up from empirical analysis are showing mixed results of integration, the co integration amongst variables finds through application of ARDL test. In long run co integration results show that forest area, per capita income, per capita income square, FDI, population density, urbanization and trade openness show significant positive impact to reduce CO2 emissions in the MENA developing regions.

6.2. POLICY RECOMMENDATIONS

The increase in trend of CO2 emissions has promoted a number of policy responses. Several studies have suggested ways of reducing carbon dioxide emissions through different sources. The main objective of the thesis to be acquainted the importance of the Environmental Kuznets curve hypothesis in order to estimate of CO2 emissions. It also to enumerate and analyze the importance of other precipitating factors like forest area, per capita GDP, per capita income square, FDI inflows, trade openness, urbanization and population density for degradation of CO2 emissions in MENA developing countries.

The main implication of our finding is that even though 17% of these countries considered in this study reveal that in the long run per capita income, per capita income square, FDI, forest area, and trade openness have contributed less to carbon dioxide emissions. Its impact is still positive in the long run and only slightly lower in the short run.

(i) One feature of carbon dioxide emissions policies suggests a possible tax on polluters.
(ii) A second feature of policy related to restriction carbon dioxide emissions is through a carbon emissions trading scheme. Whether a pollution tax or emissions trading scheme is more relevant is not an issue considered in this study. Policy reforms that are growth oriented and environmental preserving are necessary in the developing regions.
(iii) Policies that restrict importation of carbon-intensive products and highly polluting Trans-National Corporations must be embarked upon in the sub-region of developing countries.
(iv) Governments in the various developing countries should make greater efforts to reducing the discharge of carbon dioxide CO2 emission.
(v) Environmental-related institutions are to be strengthened to ensure suitable sanctions on significant companies and approval of cleaner technologies. It was found that the EKC hypothesis may be clear in developing countries.
(vi) The EKC relationship for CO2 emissions necessary to be recognized and differentiated because environmental policies are adopted to ensure better environmental quality in the developing countries.
(vii) Leaders in developing countries should make greater efforts to reducing the discharge of carbon dioxide emissions in the developing regions.

6.3. LIMITATION OF THE STUDY

This research thesis is limited to a few variables as forest area, per capita income, per capita income square, FDI inflow, population density, urbanization and trade openness having a significant and insignificant impact on environmental CO2 in all the five regions of developing countries due to following limitations as:

- The implementations of the environmental policies of the developing countries are equal to zero almost.
- The developing countries may not be able to follow the same path of development as sit by the developed countries.
- There is no concept of pollution tax on the polluters in the developing countries

References

Antweiler .W.M, 2001. Is free trade good for the environment? *American Economic Review*, *91: 877-908.*

Arrow K, Bolin, B, 1995. Economic growth, carrying capacity, and the environment. *Science, 268: 520-521.*

Beckerman's.A, 1992. Economic growth and the environment: whose growth? whose environment? *World Development, 20, 481-496.*

Cole.M.A,1997. The environmental Kuznets curve: an empirical analysis. *Environment and Development Economics, 2: 401-416.*

Coondoo.D, 2002. Causality between income and emission: a country group-specific econometric analysis. *Ecological Economics, 40: 351-367.*

Dasgupta.S, 2002. Confronting the environmental Kuznets curve*. Journal of Economic Perspectives, 16: 147168.*

Bruyn.S.M, 1997. Explaining the environmental Kuznets curve: structural change and international agreements in reducing sulphur emissions. *Environment and Development Economics, 2: 485-503.*

Ekins.P, 1997. The Kuznets curve for the environment and economic growth: examining the evidence. *Environment and Planning A, 29: 805-830.*

Hausman.M.A, 1978, Environmental Impacts of a North American Free Trade Agreement. National Bureau of Economic Cambridge*. Research Working Paper 3914.*

Lucas.R. E. B, 1992. The toxic intensity of industrial production: global patterns, trends, and trade policy. *American Economic Review, 82: 478-481.*

Hilton, F. G. H,1998. Factoring the environmental Kuznets curve: evidence from automotive lead emissions, *Journal of Environmental Economics and Management, 35: 126-41.*

Holtz-Eakin.D.T,1995. Stoking the fires? CO2 emissions and economic growth*. Journal of Public Economics, 57: 85-101.*

John.A, 1994. An overlapping generations model of growth and the environment. *Economic Journal, 104: 1393-1410.*

John.A.P.R, 1995. Shortlived agents and the long-lived environment. *Journal of Public Economics, 58: 127-141.*

Kaufmann.R.K,1997. The determinants of atmospheric SO2 concentrations: reconsidering the environmental Kuznets curve, *Ecological Economics, 25: 209-220.*

Kuznets.S, 1955. Economic growth and income inequality. *American Economic Review, 49:1-28.*

Lefohn.A.S, 1999. Estimating historical anthropogenic global sulfur emission patterns for the period 1850-1990. *Atmospheric Environment, 33: 3435-3444.*

List. J. A,1999. The environmental Kuznets curve: does one size fit all? *Ecological Economics, 31: 409-424.*

Lopez. R, 1994. The environment as a factor of production: the effects of economic growth and trade liberalization, *Journal of Environmental Economics and Management, 27: 163-184.*

Connell.MC.K.E, 1997. Income and the demand for environmental quality. *Environment and Development Economics, 2: 383-399*.

Mundlak.Y, 1978. On the pooling of time series and cross section data. *Econometrica, 46: 69-85.*

Panayotou.T, 1997. Demystifying the environmental Kuznets curve: turning a black box into a policy tool. *Environment and Development Economics, 2: 465-484.*

Pearson. P. J.G, 1994. Energy, externalities, and environmental quality: will development cure the ills it creates. *Energy Studies Review, 6: 199-216.*

Perman.R.D.I, 2003. Evidence from panel unit root and cointegration tests that the environmental Kuznets curve does not exist. *Australian Journal of Agricultural and Resource Economics, Vol. 47.*
Schmalensee.R.A, 1998. World Carbon Dioxide Emissions: 1950-2050. *Review of Economics and Statistics, 80: 15-27.*
Selden.T. M and Song.D, 1994. Environmental quality and development: Is there a Kuznets curve for air pollution? *Journal of Environmental Economics and Environmental Management, 27: 147-162.*
Selden.T. M. and Song.D, 1995. Neoclassical growth, the J curve for abatement and the inverted U curve for pollution. *Journal of Environmental Economics and Environmental Management, 29: 162-168.*
Selden.T. M. and Forrest.A. S,1999. Analyzing reductions in U.S. air pollution emissions: 1970 to 1990. *Land Economics, 75:1-21.*
Shafik.N, 1994. Economic development and environmental quality: an econometric analysis. *Oxford Economic Papers, 46: 757-73.*
Stern.D. I, 1998. Progress on the environmental Kuznets curve? *Environment and Development Economics, 3: 173-196.*
Stern.D.I and Common.M. S, 2001. Is there an environmental Kuznets curve for sulfur? *Journal of Environmental Economics and Environmental Management, 41: 162-178.*
Stern.D. I, 2002. Explaining changes in global sulfur emissions: an econometric decomposition approach. *Ecological Economics, 42: 201-220.*
Stern.D. I and Barbier.E.B, 1996. Economic growth and environmental degradation: the environmental Kuznets curve and sustainable development. *World Development, 24, 1151-1160.*
Stokey.N. L, 1998. Are there limits to growth? *International Economic Review, 39(1): 1-31.*
Suri.V and Chapman.D, 1998. Economic growth, trade and the energy: implications for the environmental Kuznets curve. *Ecological Economics, 25: 195-208.*
Torras.M and Boyce.J.K, 1998. Income, inequality, and pollution: A reassessment of the environmental Kuznets curve, *Ecological Economics, 25: 147-160.*
Viguier.L, 1999. Emissions of SO2, NOX, and CO2 in transition economies: emission inventories and Divisia index analysis. *Energy Journal, 20(2): 5987.*