**GRAPH:**

GRAPH 1: *CO2 Emissions By Countries in 2015 (million tone)*

Source: The Statistics Portal, 2016

GRAPH 2: *Per Capita CO2 Emissions of Highest Emitting Countries (tCO2)*

Source: Global Carbon Atlas, 2016

GRAPH 3: *Development of Foreign Direct Investment (Billion $, 1970-2013)*

Source: UNCTAD, 2015.

 

 GRAPH 4: *CUSUM and CUSUMQ Stability Tests (1970-2014)*

**TABLE**

## TABLE 1: *Summary of Literature Review*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Author** | **Country** | **Period** | **Method** | **Findings** |
| Linh and Lin (2015) | Most Populated 12 Asia Countries | 1980-2010 | Panel Data | CO2↔ Energy Consumption (short term)Incomer ↔FDI ( short term )CO2→ Energy Consumption, FDI, Income (long term)FDI→ Energy Consumption (long term) |
| Tang and Tan (2015) | Vietnam | 1976-2009 | Cointegration and Causality Analysis | CO2 ↔ IncomeCO2↔FDIEnergy Consumption ↔ CO2 |
| Koçak (2014) | Turkey | 1960-2010 | ARDL | EKC hypothesis is supported. |
| Kivyiro and Arminen (2014) | 6 Africa Countries | 1971-2009 | ARDL | In the long term, all variables move together. (CO2, FDI, GDP, Energy Consumption) |
| Şahinöz and Fotourehchi (2014) | Turkey | 1974-2011 | OLS | Pollution Haven Hypthesis is supported. |
| Akın (2014) | 12 High-income Countries | 1970-2012 | Dynamic Panel Data | Negative relationship between FDI and CO2.Positive relationship between energy consumption and CO2.Per capita income increases CO2. |
| Sbia (2014) | United Arab Emirates | 1975Q1-2011Q4 | ARDL | FDı and openness increases CO2.Economic growth increases clean energy consumption. |
| Azlina et al.. (2014) | Malaysia | 1975-2011 | Cointegration and Causality Analysis | CO2 emisyonları gelir, enerji tüketimi ve yenilenebilir enerji kullanımının Granger nedenidir.CO2 is granger cause of income, energy consumption and use of renewable energy. |
| Omri et al. (2014) | 54 Countries | 1990-2011 | Dinamik Panel Veri | FDI↔GDP (all countries)CO2↔FDI (Countries except for North Asia and Europe) |
| Al-Mulali and Tang (2013) | Gulf Cooperation Council Countries | 1980-2009 | Non-Linear Panel Data | Pollution Haven Hypthesis is not supported. |
| Chandran and Tang (2013) | ASEAN-5 | 1971-2008 | Cointegration  | While income and road sector energy consumption are the determinants of CO2 emissions, FDI is not. |
| Öztürk and Acaravcı (2013)  | Turkey | 1960-2007 | Cointegration | EKC hypothesis is supported. |
| Mahmood and Chaudary (2012) | Pakistan | 1972-2005 | ARDL | FDI, value-added manufacturing industry and population intensity increase CO2. |
| Al-mulali (2012) | 12 Middle East Countries  | 1990-2009 | Panel Data | GDP ↔ CO2FDI ↔ CO2Enerjy Consumption ↔ CO2Total Trade ↔ CO2 |
| Farhani and Rejeb (2012) | 15 Middle East and North Africa Countries | 1973-2008 | Panel Data | No relation between GDP, energy consumption and CO2 in the short term.GDP→Energy ConsumptionCO2→ Energy Consumption |
| Arouri et al. (2012) | 12 Middle East and North Africa Countries  | 1981-2005 | Panel Data | Energy Consumption increases CO2. |
| Sanglimsuwan (2011) | 63 Countries | 1990, 1995 and 2000 | Panel Data | Only in the short term there is a inverted-U shaped relation between CO2 and GDP. |
| Wang et al. (2011) | 28 China States | 1995-2007 | Panel Data | CO2, GDP and energy consumption are cointegrated.CO2↔ Energy ConsumptionEnergy Consumption ↔ GDP |
| Lieter (2011) | EU Countries | 1998-2007 | Panel Data | Environmental regulations increase investment on industry. |
| Pao and Tsai (2011) | BRIC Countries | 1980-2007 | Panel Data | Strong relationship between CO2 and FDI.GDP→FDI |
| Choi et al. (2010) | China, Japan and Korea | 1971-2006 | VAR, VEC | “N” shaped EKC for Japan.Inverted-U shaped EKC for Korea.“N” shaped EKC for China. |
| Öztürk and Acaravcı (2010) | Turkey | 1968-2005 | ARDL | EKC hypothesis is supported. |
| Halıcıoğlu (2009) | Turkey | 1960-2005 | ARDL | Most important factor that determines CO2 emissions is income which is followed by energy consumption and foreign trade. |
| Jalil and Mahmud (2009) | China | 1975-2005 | ARDL | Income and energy consumption are important determinant to increase CO2 emissions.GDP →CO2 |
| Annicchiaricoet al. (2009) | İtaly | 1861-2003 | Cointegration VEC | CO2↔ GDP  |
| Azomahou (2006) | 100 Countries  | 1960-1996 | Non-Parametric Panel | Positive relationship between economic development ad CO2 emissions. |
| Merican et al. (2007) | ASEAN 5 | 1970-2001 | ARDL | FDI increases CO2 emissions in Malaysia, Philippines and Thailand, however it has no impact on CO2 emissions in Indonesia and Singapore. |
| Gökalp and Yıldırım (2004) | Turkey | 1989-2001 | Time Series | Pollution Haven Hypthesis is not supported. |
| Egli (2004) | Germany | 1966-1999 | Causality | There is a relationship which similiar with EKC hypothesis between NOx and NH4. |
| Koop (1998) | 44 Developed and Less Developed Countries | 1970-1990 | Panel Data | Rich countries make a good progress to decrease CO2 emissions technically unlike the poor countries. |
| Grossman and Krueger (1991) | 42 NAFTA Countries | 1991 | Cross-Section | Inverted-U shaped EKC Hypothesis is supported. |

## TABLE 2: *Variables Used in Analysis*

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Abbreviation** | **Explanation** | **Data Source** |
| Per capita CO2 emissions | CO2  | Per cdapita metric ton | BP Statistical Yearbook 2015 |
| Per capita GDP | GDP | US Dollar | World Bank |
| Per capita FDI | FDI | US Dollar | UNCTAD |
| Per capita energy consumption | EC | Kg (oil equivalent) | World Bank |

## TABLE 3: *ADF and PP Unit Root Test Results*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables**  | **ADF** **(Level)** |  **ADF****(First Difference)** | **PP** **(Level)** | **PP****(First Difference)** | **Result** |
| CO2 | -1.40 | -6.46 | -1.21 | -6.46 | I(1) |
| GDP |  3.23 |  3.32 | -2.22 | -6.69 | I(1) |
| FDI | -1.59 | -6.36 | -1.62 | -6.35 | I(1) |
| EC | -3.04 | -6.52 | -3.26 | -6.60 | I(1) |
| **Critical Value (%1)** | -4.18  | -3.59 |  |  |  |
| Note: The value in parentheses for the ADF test indicates the number of lag length according to the SIC criterion. The maximum lag length is 9. At level value, intercept and trend test format and at first difference value, intercept regression equations are used. |

## TABLE 4: *Determination of the Optimal Lag Length*

|  |  |  |  |
| --- | --- | --- | --- |
| **P** | **AIC** | **SBC** | **B-G Testi** |
| 1 | 6.22 | 6.54 | 0.05 |
| 2 | 6.20 | 6.70 | 0.02 |
| 3 | 5.86 | 6.52 | 0.01 |
| \*, P represents lag length, AIC represents Akaike Information Criterion and SBC represents Schwarz-Bayesian information criterion. \*\*, B- G test expresses probability values of Breusch-Godfrey Autocorrelation test. |

## TABLE 5: *Bound Testing Results*

|  |  |  |  |
| --- | --- | --- | --- |
| **k\*** | **F Statistics** | **Lower Bound (%1)** | **Upper Bound (%1)** |
| 3 |  8.72 |  4.98 |  6.42 |
| \*k, represents independent variables in the equation. Critical values obtained from Tablo CI(iii) in the study of Narayan (2005).  |

## TABLE 6: *ARDL Model Estimation Results*

|  |
| --- |
|  **Short Term** |
| **Variables** | **Coefficient** | **Standart Error** | **T-rasyo (prob.)**  |
| CO2(-1) | 0.57 | 0.07 | 8.36 ( 0.00)  |
| GDP | 0.02 | 0.004 | 5.69 (0.00) |
| FDI | 0.01 | 0.02 | 0.50 (0.62) |
| EC | 2.97 | 0.67 | 4.44 (0.00) |
| E(-1) | -1.94 | 0.70 | -2.81 (0.01) |
|  **Long Term** |
| GDP | 0.05 | 0.004 | 11.13 (0.00) |
| FDI | 0.02 | 0.04 | 0.50 (0.62) |
| EC | 2.41 | 0.84 | 2.86 ( 0.00) |
|  |  **Diagnostic Test Results** |
| R2 | 0.99 | Normality | 2.72y |
| Heteroscedasticity | 0.66x | Autocorrelation | 0.70x |

x, and y, represent Breusch-Godfrey LM test and Jarque- Bera Normality Test, respectively. \*, shows significancy at 5% significance level.

## TABLE 7: *ARDL Error Correction Model Estimation Results*

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Coefficient** | **Standart Error** | **T-rasyo (prob.)**  |
| ∆ GDP |  0.03 | 0.004 |  6.90 (0.00) |
| ∆ FDI | -0.03 | 0.02 | -1.40 (0.17) |
| ∆ EC |  3.09 | 0.60 |  5.12 (0.00) |
| EC(-1) | -0.43 | 0.08 | -5.55 (0.00) |

**DATA**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | fdi | co2 | gdp | ec2 |
| 1970 | 1,668007 | 42,1 | 3137,051 | 65,65403 |
| 1971 | 1,263758 | 46,3 | 3233,926 | 68,99165 |
| 1972 | 1,178878 | 51,1 | 3391,467 | 70,28143 |
| 1973 | 2,114169 | 58,9 | 3418,549 | 72,39129 |
| 1974 | 1,67221 | 61,3 | 3524,367 | 72,57193 |
| 1975 | 2,909229 | 64,6 | 3689,209 | 72,37633 |
| 1976 | 0,249372 | 71,7 | 3982,153 | 73,1049 |
| 1977 | 0,658212 | 76,4 | 4025,506 | 74,85099 |
| 1978 | 0,810429 | 72,7 | 3995,148 | 73,6975 |
| 1979 | 1,747749 | 71,4 | 3881,465 | 70,98887 |
| 1980 | 0,409969 | 73,4 | 3700,797 | 71,91817 |
| 1981 | 2,114079 | 75,8 | 3791,496 | 71,59577 |
| 1982 | 1,195706 | 82,5 | 3836,015 | 72,17233 |
| 1983 | 0,977214 | 84,9 | 3934,777 | 73,87616 |
| 1984 | 2,347409 | 92,0 | 4105,933 | 74,38064 |
| 1985 | 2,013092 | 99,1 | 4189,576 | 76,59234 |
| 1986 | 2,490689 | 109,0 | 4393,212 | 77,98248 |
| 1987 | 2,247487 | 121,0 | 4717,646 | 78,86663 |
| 1988 | 6,791289 | 124,0 | 4738,447 | 77,03619 |
| 1989 | 12,49392 | 130,2 | 4668,016 | 79,78316 |
| 1990 | 12,66793 | 138,6 | 5012,894 | 81,80089 |
| 1991 | 14,75108 | 144,5 | 4964,875 | 81,41887 |
| 1992 | 15,12134 | 149,0 | 5130,641 | 81,3742 |
| 1993 | 11,21435 | 155,7 | 5435,901 | 81,38847 |
| 1994 | 10,55309 | 153,2 | 5101,068 | 81,61679 |
| 1995 | 15,12244 | 167,0 | 5417,041 | 82,59588 |
| 1996 | 12,14619 | 183,1 | 5725,889 | 83,23558 |
| 1997 | 13,3339 | 196,7 | 6063,638 | 83,78303 |
| 1998 | 15,33237 | 199,9 | 6107,451 | 83,64275 |
| 1999 | 12,57957 | 196,7 | 5811,841 | 84,56266 |
| 2000 | 15,54425 | 216,6 | 6112,877 | 86,30128 |
| 2001 | 52,29305 | 200,4 | 5679,942 | 86,12402 |
| 2002 | 16,64044 | 208,9 | 5942,725 | 86,08868 |
| 2003 | 25,81202 | 222,8 | 6167,146 | 87,0572 |
| 2004 | 41,66315 | 230,3 | 6652,576 | 86,70592 |
| 2005 | 148,0742 | 241,1 | 7117,233 | 88,05964 |
| 2006 | 294,1291 | 270,5 | 7514,389 | 89,00397 |
| 2007 | 317,2389 | 295,9 | 7773,471 | 90,49675 |
| 2008 | 282,1207 | 294,9 | 7732,488 | 90,57388 |
| 2009 | 120,5063 | 297,6 | 7264,632 | 89,89939 |
| 2010 | 125,9538 | 304,5 | 7814,801 | 88,98548 |
| 2011 | 220,8637 | 324,1 | 8397,143 | 89,89722 |
| 2012 | 179,507 | 337,2 | 8471,642 | 89,35932 |
| 2013 | 164,9081 | 324,7 | 8719,621 | 87,35264 |
| 2014 | 160,1592 | **348,5** | 8864,743 | 90,16574 |