

## Economic Growth, Foreign Direct Investment and the Environment: An Empirical Investigation for SAARC Countries

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### Abstract

*The study tests the validity of the environmental Kuznets curve (EKC) for SAARC countries by using closed and open economy Models. The Peroni Panel Cointegration technique along with FMOLS estimation techniques have been used for empirical analysis by using the data from 1972-2015. The long run and short run estimates of the closed economy model reveals positive and significant relationship between Per capita GDP, per capita GDP<sup>2</sup> and the carbon emissions that deny the existence of EKC. The findings of open economy model signify that FDI not only helps to transfer cleaner technologies, but it enables the producers to use less pollutant technologies for the production purposes. Moreover, an increase in the forest area is helpful for reducing the carbon emissions. Finally, population density and energy consumption are proved significant contributors of carbon emissions. The study suggests that effective policies should be followed for reducing emissions, regulating FDI-environment and per capita GDP environment relationship.*

**Key Words:** Environment, Pollution, Carbon Emissions

**JEL Classification:** O13, Q53, Q32

### Introduction

In the recent decades, there is an ongoing debate on the sustainability of economic growth in changing environment which includes the effects of global warming, dwindling energy resources, and technological changes. The experience of developed nations shows that the economic growth cannot be achieved without sacrificing environment quality. The use of advance technologies, environment friendly policies renewable energy transitions and energy efficiency improvements make it possible for such countries to establish a balance between economic growth and environmental conservation and it also allows them to carry out economic activities without compromising the environment. However, the use of modern technology, institutions, law and regulations, environment friendly policies and raised environmental awareness of the citizens etc to increase the possibility of co-existence of environmental concerns and economic growth is limited to the developed countries and it is not applicable to the developing countries as developed countries are capable to invest into technologies, capable to improve institutional environment, introduce new laws and regulations to protect environment and raise environmental awareness in citizens, etc that can be helpful in achieving economic growth without damaging the environment. While in developing countries, the governments are least inclined to put money aside for investing in environment conservation as economic growth is seemed as their top priority and it is believed that quality of life can only be achieved with sufficient economic ability. As a result, in developing counties economic growth is weighed over environmental concerns.

The growth-environment relationship can be explained firstly with the help of the Environmental Kuznets Curve (EKC) hypothesis, which argues that growing income levels

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initially can lead to environmental degradation, for instance deforestation, water/air pollution, land degradation, exploitation of natural resources but beyond a threshold level, it will generate demand for better environment from the citizens and consequently lead to the adoption of superior environmental governance mechanisms (Cole et. al. 1997; Chakraborty and Mukherjee 2013b). Secondly, foreign direct investment may be fuelled up from rising trade-investment-degradation nexus according to which Foreign Direct Investment has been invested into sectors / regions that are polluted intensively and degrades environmental sustainability of the recipient country a phenomenon known as the pollution Haven Hypothesis (PHH) (Cole et. al. 2011, Chakraborty and Mukherjee, 2015). Thirdly, if the countries are endowed with natural resources (e.g. fossil fuels, minerals, forests) will focus too much on the exports from these sectors then the resulting obsession may compromise its overall growth of the scenario (Dietz et. al. 2007). This is known as the Natural Resource Curse Hypothesis (NRCH). On the other hand, overexploitation of these resources is likely to degrade the environment further. Lastly, analysing the growth and environmental quality trade-off from a micro perspective, Porter Hypothesis (PH) proposes that rise in the income and enforcement of stricter environmental regulations are likely to motivate the firms in order to innovate and enhance their efficiency level to stay locally and globally competitive (Jaffe and Palmer 1997; Chakraborty and Mukherjee, 2015). Clearly if PH and the later stage of EKC effect dominate the PHH and NRCH effects in a country, environmental sustainability may accompany with the growth wave (Mukherjee and Chakraborty, 2015). It can be inferred from above discussion that the growth of a country will be brown or green depends upon these four effects.

South Asia is the most thickly populated region of the world where one fifth of world's population live (Visser, 2016). India is the largest among individual countries which located in the center of the region. The rest of the countries include Afghanistan, Bangladesh, Nepal, Bhutan, Maldives, Pakistan and Sri Lanka. This region is enriched with natural mineral resources except resources of oil. Different organizations are working for the development of this region and to solve its social, political and economic problem as well. Major organizations that have are significant impact on the development process are South Asian Association or Regional Cooperation (SAARC), South Asian Preferential Trading Agreement (SAPTA) and South Asian free Trade Area (SAFTA).

The objective of the study is to examine the impact of FDI, population density, forest area, and Growth on the environment for SAARC countries. The validity of EKC has been tested for both close economy and open economy. The study has been organized as follows: Part two consists of review of literature both theoretically and empirically. Part three consists of methodology. Part four is about results and discussions. Part five concludes the study.

## **Literature Review**

Hypothesized association between income per capita and various indicators of environmental degradation is known as the environmental Kuznets curve (EKC). The initial stages of economic growth may result in increased pollution emissions and decline in environment quality but this trend can be reversed after achieving certain level of per capita income meaning high levels of income per capita and growth also leads to improvement in environment quality. This depicts that emissions per capita or environmental impacts are an inverted U – shaped function of per capita income. The EKC approach has been developed by Grossman and Kruger (1991) and it models the aggregate emissions and ambient pollution concentrations. The Kuznet (1995) developed a model which describes the relationship between per capita GDP and income inequality. Later on, this Kuznet model has been used for studying the environment and economic development nexus. Holtz-Eakin and Selden (1992) and Grossman and Krueger (1993) examined how air and water pollution increases with growth of GDP and income level declines by increase in pollution emissions. A number of researchers (Drabo, 2010; Aubourg et. al., 2008; Bousquet and Favard 2005; Yoruk and Zaim 2006; Dasgupta et. al., 2002; Jorgenson, 2006; Maih et. al., 2010; Dinda et. al., 2010), have analyzed the relationship between environmental pollution and

per capita income and their result indicates the existence of EKC. Studies suggest that the EKC result is not same for all the countries; it can be of inverted U shape, S shape as investigated by Mukherjee, (2006) in the study of India. Whereas Shen et. al., (2004) found N-shape of EKC after studying the China. This specifies that, the shape of EKC depends upon the structure and environmental policies of a country. In some of the studies conducted such as Bertinelli and Strobl (2004), Eriksson et. al. (2003) and Tiezzi, (1999) the relation between environmental quality and economic growth was positive. There is difference between the environmental quality of developed and developing countries because developed countries give more importance to their environment and their people are also conscious about their living style. But developing countries are lagging behind in environmental quality and are less concerned about it. That's why the environmental quality of developed countries is better than developing countries. Nahman and Antrobus (2005) and Jorgenson (2006) have worked on the theory of unequal ecological exchange which proves that the developed countries keep their environment clean by importing polluting goods from developing countries. When developing countries export more to developed countries, then after some time they face higher rate of deforestation in their environment. There are several factors which can impact on environment like greenhouse gases, pollutants like CO<sub>2</sub>, SO<sub>2</sub>, political factors and the role of not-for-profit organizations etc. Lee et. al. (2008) found a near-fitting inverted "U" curve trend by examining the relation between GDP per capita and global greenhouse gases (GHG) emissions per capita. Furthermore, Aubourg et. al. (2008) explains that, policies for reducing debt burdens, introducing political reforms, can be used as approaches to reduce pollutant emissions in developing countries. Not only political factors but also not-for-profit organizations play role in betterment of society, which create a positive impact on environment as studied by John et. al. (2004). Authors have used different techniques to establish EKC like Yoruk and Zaim (2006) and Taskin (2000), established environmental Kuznets curve relationship between income and environmental efficiency for OECD (Organization for Economic Co-operation and Development) countries by constructing an environmental efficiency index. Lee, Chung & Koo (2005) have worked on the relation between economic growth and environment sustainability by using the Environmental Sustainability Index (ESI) and the result of their study showed that income appears to have a beneficial effect on pollution measures and it has a detrimental effect on most ecological efficiency measures of environmental sustainability.

The present study focuses on the growth and environment nexus for the SAARC countries because of the increase in urbanization and growth, SAARC countries are more vulnerable towards pollution and environmental degradation (Salman 2012). Several studies have been conducted to examine the growth and environment relationship among the South Asian countries and found interesting results. Miah et al. (2011) studied waste emissions and economic development for Bangladesh by following EKC framework and found that EKC for waste, emissions from waste, and suspended particular matter follows the usual EKC course with a turning point related to higher income per capita in most cases. Barua and Hubacek, (2008) studied per capita income and water pollution within 16 states of India. The studied showed mixed results as water quality is different in different states and many of the Indian states go through similar transitions of initial high per capita pollution followed by improvements of per capita pollution levels and finally further increase of pollution levels with additional economic growth. Akhmat et. al. (2013) examined the causal relationship between energy consumption and environmental pollutants in the selected SAARC countries and findings demonstrated that energy consumption acts as an important driver to increase environmental pollutants in SAARC countries. Nowadays, the EKC has become an important matter for policymakers; the turning point in EKC has a major place in issues and debates. Egli and Steger, (2005) are of the opinion that turning point is affected by the use of abatement technologies. There should be subsidies provided for abatement technologies rather than tax on polluting consumption. If the countries will wait for turning point then it may take longer time to reach at that point. So, the countries should become aware, and as the increasing trend is observed they must take proper steps to

save the environment from pollution and try to achieve the turning point by focusing more on environmental quality and GDP. Therefore, the present study will be an important addition in this area of research.

### Analytical Framework

To test the validity of the EKC we follow the standard literature presented by Grossman and Krueger (1995), Chakraborty (2010), Pao and Tsai (2010), Muhammad et. al. (2011), Chandran and Tang (2012), Ren et. al. (2013), Bukhari et. al. (2014). This study employs following two economic models to explain the effect of number of variables on carbon emissions for SAARC countries.

$$CO_2 = f(GDP, GDP^2, FA, PD, EC) \quad (1)$$

$$CO_2 = f(GDP, GDP^2, FDI, FA, PD, EC) \quad (2)$$

where equation (1) captures the growth-environment relationship within the closed economy framework and equation (2) has been used to estimate the open economy model for SAARC countries. Moreover, CO<sub>2</sub> represents Carbon dioxide emissions and it is used as a proxy of environmental degradation, FDI is foreign direct investment, net inflows, GDP represents Real GDP per capita, FA is the forest area, PD is population density and EC represents fossil fuel energy consumption. In order to test the EKC the empirical models can be written as follow

$$LCO_{2,it} = \alpha_0 + \alpha_1 LGDP_{it} + \alpha_2 LGDP_{it}^2 + \alpha_3 LFA_{it} + \alpha_4 LPD_{it} + \alpha_5 LEC_{it} + \varepsilon_{it} \quad (3)$$

$$LCO_{2,it} = \beta_0 + \beta_1 LGDP_{it} + \beta_2 LGDP_{it}^2 + \beta_3 LFDI_{it} + \beta_4 LFA_{it} + \beta_5 LPD_{it} + \beta_6 LEC_{it} + \mu_{it} \quad (4)$$

We have selected all these variables on the basis of relevant theoretical and empirical literature available on the EKC. All the required data have been sourced from World Development Indicators (WDIs), the World. The study covers the time from 1972 to 2015 and eight countries. The importance of all variables is explained in detail as follow

### Carbon Dioxide Emission (CO<sub>2</sub>)

CO<sub>2</sub> is used as a measure of environment quality which emitted from the consumption of fossil fuels, development of cement industry, burning of fuel and gas, or consumption of three matters of state namely solid, liquid and gas that produce carbon emissions. The per capita carbon emissions are calculated by dividing the quantity of carbon dioxide produced by human activities by the population of the country. CO<sub>2</sub> has chosen as a dependent variable of the study and the unit of this measure is as a metric kg per capita 2005 as a base year.

### Energy Use (EU)

The use of power and energy as raw material input to manufacturing process is known as energy consumption and energy use. The total quantity of oil use divided by population of a country is the formula to calculate the energy consumption kg of oil equivalent per capita.

### Per Capita Real Gross Domestic Product (GDP)

The Per capita GDP is obtained by dividing the real GDP by the total population of the country. The Nominal GDP divided by consumer price index is formula to calculate real gross GDP which is combination of consumption, investment, government spending, exports and imports. The other method to measure real GDP includes all the variations in market prices that happened during the current year either because of inflation or deflation. Real GDP is used to capture the market size of SAARC countries.

### GDP Square

The GDP<sup>2</sup> is used to test the validity of environment Kuznets curve for SAARC countries. The EKC shows that after reaching at a certain level of income people starts considering environmental good as a luxury good which further increases their demand for superior environmental quality

at higher level of income. This can also be considered as a valid justification for high income countries to focus on pollution control technologies and strategies (Ruttan, 1971).

### **Foreign Direct Investment (FDI)**

The most useful tool for the long run growth and economic development of a country is FDI that stimulates the economy by bringing advanced management and technological skills along it (Johnson, 2006; Lipsey, 2002). According to Walsh and Yu (2010), FDI contributes in enhancing economic growth of rapidly growing economies. Moreover, FDI is positively associated with social uplift of people as it improves living standard of people (Gonzalez, 1998; Srinivasan, 1983). For host economies, it can also create virtuous circle of confidence building. The FDI inflows reinforce local investment environment that in return, affects investment both at local and foreign level (Khan and Yun-Hwan, 1999). Hence, FDI is considered as one of the important factors of economic growth as it can play significant role in achieving socio-economic objectives of country for example technological advancement, skill enhancement, poverty eradication and jobs creation.

### **Population Density**

South Asia is densely populated region that covers around twenty two percent of the world's population. This rapid increase in population of SAARC region is a serious environmental threat and causes water pollution, atmospheric pollution, depletion of non-renewable natural resources, deforestation and loss of oxygenation, and biodiversity that is indispensable for life on earth. Among these dangerous air pollution or atmospheric pollution is one of the factors of environmental degradation being caused by the usage of outdated vehicles, industrialization, and the use of available fuels for instance, coal or unleaded gasoline.

### **Forest Area**

The rapid reduction in the forest area is among one of the most serious problems of developing countries. It can be the result of urban development, the deliberate removal of forest cover for agriculture or it can be a consequence of grazing animals either wild or domesticated. According to [Gervet \(2007\)](#), deforestation comprises not only the conversion of forest to non-forest, but also causes degradation that reduces the density, forest quality, and structure of the trees, the species diversity, the biomass of plants and animals, the ecological services supplied, and the genetic diversity. The increasing deforestation is the result of removal of trees without sufficient reforestation and also a significant loss of biodiversity. The amount of water in the soil, groundwater and the moisture in the atmosphere, all are affected by the forest area of a country.

## **Results and Discussions**

### **Panel Unit Root Test**

It is always preferable to test the stationarity property of the series before applying any cointegration technique because in case of mixed order of integration, all cointegration techniques yield spurious results. A panel unit root test consists of two processes: common unit root process and individual root process. We will apply the individual as well as the common unit root tests. The basic difference between these two approaches lies in the fact that the individual unit root test allows the parameters to behave freely across all the cross sections and the common unit root test assumes common parameters across all the cross sections. The general approach is to apply both tests simultaneously but the decision is largely reported on the basis of overall test results. This study employs the Im, Pesaran and Shin (IPS) unit root test to check the stationarity of each cross section individually (Levin and Lin, 1992; Pesaran and Shin, 1995,1999; Harris and Tzavalis, 1999 and Levin, Lin and Chu, 2002). The individual panel unit root test is more powerful to test the stationarity of each cross section as compared to the standard panel unit root process (Levin, Lin and Chu,2002). The IPS unit root test results are reported in

table 4.1. Results show that all series are non-stationary at level but they become stationary at first difference which means that at first difference we reject the null hypothesis that cross section series is individually non-stationary at first difference. Thus, CO<sub>2</sub>, LGDP, LFA, LPD, LEC and LFDI are integrated of order one i.e. I(1).

**Table 1.** Panel Unit Root Test (Individual Root-Im, Pesaran and Shin)

Variable	Level		First order difference	
	Constant	Constant & Trend	Constant	Constant & Trend
LGDP	2.07635 (0.9811)	0.08825 (0.5352)	-9.51576 <sup>***</sup> (0.000)	-8.19460 <sup>***</sup> (0.000)
LCO <sub>2</sub>	0.06392 (0.5255)	2.947 (0.998)	-8.16064 <sup>***</sup> (0.000)	-8.83730 <sup>***</sup> (0.000)
LFDI	3.31958 (0.999)	-0.35677 (0.3606)	-8.82884 <sup>***</sup> (0.000)	-7.25704 <sup>***</sup> (0.000)
LFA	6.12952 (1.000)	-0.82183 (0.2056)	-1.44862 <sup>*</sup> (0.0737)	-5.16099 <sup>***</sup> (0.000)
LEC	6.60323 (1.000)	4.17979 (1.000)	-5.29345 <sup>***</sup> (0.000)	-6.02367 <sup>***</sup> (0.000)
LPD	1.75673 (0.9605)	2.16025 (0.9846)	-5.01900 <sup>***</sup> (0.000)	-5.33908 <sup>***</sup> (0.000)

Note: <sup>1</sup>\*\*\*, \* Indicate level of Significance at 1% and 10% Respectively. <sup>2</sup> Probabilities are given in Parenthesis.

### Panel Cointegration Analysis

The cointegration relationship among variables is empirically tested by employing the Pedroni residuals cointegration test. Pedroni presented the panel cointegration tests based on residuals for models consisting on more than one independent variables. It is best test to deal with heterogeneous data. The Peroni Panel Cointegration test has measured for two models. One is the closed economy model which is without the effect of FDI for the SAARC countries and the second model is the open economy model with the inclusion of FDI.

The Pedroni residual test results for the close economy model (1) are reported in table 4.3. Results based on the within dimension pedroni test indicate that the null hypothesis of no cointegration is rejected on the basis of the Panel rho-Statistic, Panel Augmented Dickey Fuller (ADF) statistics, and the Phillips and Perron (non-parametric) statistics which support the existence of the long run relation among the variables of the study for SAAR countries. While, the between dimension Group PP-Statistic and the Group ADF-Statistic results also support the existence of the cointegration among the selected variables of the study.

**Table 2.** The Pedroni Panel Cointegration Test for the Close Economy Model (1)

Test	Constant trend	Constant & Trend
<b>Within-Dimension</b>		
Panel v-Statistic	1.198(0.116)	0.244(0.404)
Panel rho-Statistic	-3.037 <sup>***</sup> (0.001)	-2.505 <sup>***</sup> (0.006)
Panel PP-Statistic	-4.486 <sup>***</sup> (0.000)	-4.577 <sup>***</sup> (0.000)
Panel ADF-Statistic	-1.540 <sup>*</sup> (0.062)	-1.817 <sup>**</sup> (0.036)
<b>Between-Dimension</b>		
Group rho-Statistic	-0.719(0.236)	0.586(0.720)
Group PP-Statistic	-3.590 <sup>***</sup> (0.000)	-3.359 <sup>***</sup> (0.000)
Group ADF-Statistic	-1.731 <sup>**</sup> (0.042)	-3.253 <sup>***</sup> (0.001)

Note: <sup>1</sup>\*\*\*, \* Indicate level of Significance at 1% and 10% Respectively. <sup>2</sup> Probabilities are given in Parenthesis.

Similarly, Pedroni Panel Cointegration test for the open Economy Model (2) also support the existence of cointegration relationship among variables of the study (see table 4.3). In other words, we can say that there exists long run relationship among all the independent variables of the study and the dependent variable (carbon emissions).

**Table 3.** The Pedroni Panel Cointegration Test for the Open Economy Model (2)

Test	Constant Trend	Constant & Trend
<b>Within-Dimension</b>		
Panel $\nu$ -Statistic	1.364 <sup>**</sup> (0.015)	5.588 <sup>***</sup> (0.000)
Panel rho-Statistic	-0.149(0.371)	-0.920(0.188)
Panel PP-Statistic	-1.749 <sup>***</sup> (0.010)	-4.002 <sup>***</sup> (0.000)
Panel ADF-Statistic	-2.231 <sup>***</sup> (0.004)	-3.970 <sup>***</sup> (0.000)
<b>Between-Dimension</b>		
Group rho-Statistic	0.444(0.672)	0.586(0.720)
Group PP-Statistic	-2.678 <sup>***</sup> (0.004)	-3.359 <sup>***</sup> (0.000)
Group ADF-Statistic	-2.797 <sup>***</sup> (0.003)	-3.253 <sup>***</sup> (0.001)

Note: <sup>1\*\*\*</sup>, <sup>\*</sup> Indicate level of Significance at 1% and 10% Respectively. <sup>2</sup>Probabilities are given in Parenthesis.

### Fully Modified OLS (FMOLS) Analysis

According to Pedroni (2001, 2004) fully modified ordinary least square (FMOLS) is much stronger estimation technique as compared to the single equation methods as it directly tests the presence of the cointegration vector. Furthermore, these methods allow us to pose the null hypothesis in a more natural form. The FMOLS panel cointegration test results for the SAARC countries are reported in table 4.4. The long run estimates for the close economy model depict that the per capita GDP has positive relationship with the carbon emissions. The coefficient of the per capita GDP is statistically significant and its value is 0.122 showing that one percent increase (decrease) in per capita GDP will result in 0.122 percent increase (decrease) in carbon emissions. This positive nexus between GDP per capita and carbon emissions indicate that environmental pressure increases more rapidly than income at early stages of growth and SAARC countries are focusing on the economic growth at the cost of environmental quality. Similarly, there is also positive and significant relationship between per capita GDP<sup>2</sup> and carbon emissions which indicates that EKC does not hold in case of SAARC countries. The coefficient of the per capita GDP<sup>2</sup> is statistically significant although its value is quantitatively small (0.012). The EKC shows that after reaching at a certain level of income people will start considering environmental good as luxury goods which will increase their demand for superior environmental quality at higher level of income. This can also be considered as a valid justification for high income countries to focus on pollution control technologies and strategies (Ruttan, 1971). Whereas, our results may suggest that SAARC countries have not yet achieved that threshold level of income where further income increases yield improvement in the environment quality. This result may also indicate that these countries are still transitioning through the early stages of the inverted U-shape Kuznets curve.

**Table 4.** Panel FMOLS Test Results

Variables	Coefficient (Prob.)	Coefficient (Prob.)
	Close Economy Model	Open Economy Model
LGDP	0.122 <sup>***</sup> (0.004)	0.150 <sup>***</sup> (0.000)
LGDP <sup>2</sup>	0.012 <sup>**</sup> (0.003)	0.009 <sup>***</sup> (0.000)
LFA	-1.777 <sup>***</sup> (0.000)	-1.906 <sup>***</sup> (0.000)
LPD	0.002 <sup>***</sup> (0.000)	0.002 <sup>***</sup> (0.000)
LEC	1.333 <sup>***</sup> (0.000)	1.372 <sup>***</sup> (0.000)
LFDI	-	-0.050 <sup>***</sup> (0.001)
<b>Diagnostic Test</b>		
R-Squared	0.993	0.994
Adjusted R-Squared	0.993	0.994

Note: <sup>1\*\*\*</sup>, <sup>\*</sup> Indicate level of Significance at 1% and 10% Respectively. <sup>2</sup>Probabilities are given in Parenthesis.

Forest area (FA) has also been proved a significant factor for reducing carbon emissions in case of SAARC countries. Result shows that reducing deforestation offers a major opportunity to reduce emissions at a relatively low cost which is in accordance with the Stern Review on the climate change report (2006). The coefficient of FA is negative and statistically significant which shows that with one percent increase (decrease) in forest area carbon emissions will decrease (increase) by 1.77. One possible explanation behind this relationship is that when forests grow, they store carbons and release it back to the environment when they are harvested, die or burned. Thus, these forests become net contributors of carbon to the atmosphere. Moreover, the positive and significant relationship between Population Density (PD) and carbon emissions suggests that more population will lead to more pollution in case of SAARC countries. *Finally*, empirical evidence indicates that energy consumption leads to increase carbon emissions. With one percent increase (decrease) in energy consumption the carbon emissions will increase (decrease) by 1.333 percent.

Table 5.4 also reports the long run estimates for the Open economy Model. The coefficients of all the variables are statistically significant and the signs of the estimated coefficients of all the variables are in line with the predictions of the closed economy estimates of the model. Results reveal that EKC does not hold, population density and energy consumption are important contributors of environment degradation in case of SAARC countries. Whereas, forest area is negatively and statistically significantly related with the carbon emissions. Furthermore, negative and statistically significant relationship between FDI and CO<sub>2</sub> shows that with one percent increases (decrease) in the FDI the carbon emissions increase (decrease) by 0.050 percent. This Result also signify that FDI not only helps to transfer cleaner technologies to the SAARC countries but it also enables the producers to use less pollutant technologies for the production purposes.

## Conclusion

There is hot debate regarding the sustainability of the environment and growth in case of both developed and developing countries. This study focuses on testing the validity of the environmental Kuznets curve for SAARC countries including Afghanistan, Bangladesh, Nepal, Bhutan, Maldives, Pakistan and Sri Lanka. This region is enriched with natural mineral resources expect resources of oil. The study tested the long run and the short run impacts of energy use, real GDP, FDI, population density, forest area on the carbon emissions in SAARC countries. Panel data of SAARC countries has used from 1972 to 2015. Im, Pesaran and Shin (IPS) unit root test has been applied to check the stationarity of each cross section individually. The Peroni Panel Cointegration test has measured for two models. The first model is a closed economy model in which we have omitted the FDI variable for the SAARC countries and in the open economy model FDI is used as a variable which captures the effect of external sector. The results of each model suggest that there exists long run relationship among the variables of the study. After that, the FMOLS panel cointegration technique has been used to estimate both models. The long run estimates for the close economy model depict that the per capita GDP has positive relationship with the carbon emissions. Positive and significant relationship between per capita GDP<sup>2</sup> and carbon emissions indicates that EKC does not hold in case of SAARC countries. The results suggest that SAARC countries have not yet achieved that threshold level of income where further income increases yield improvement in the environment quality. The positive and significant relationship between Population Density (PD) and carbon emissions suggests that more population will lead to more pollution in case of SAARC countries. The results also indicate that increase in forest area can play a crucial role in reducing carbon emissions. The findings also state that energy consumption leads to increase carbon emissions.

The results of open economy model are in line with the predictions of closed economy model. EKC does not hold, population density and energy consumption are important contributors of environment degradation in case of SAARC countries. Whereas, forest area is negatively and statistically significantly related with the carbon emissions. Furthermore, negative



and statistically significant relationship between FDI and CO<sub>2</sub> suggests that FDI not only helps to transfer cleaner technologies to the SAARC countries but it also enables the producers to use less pollutant technologies for the production purposes. Policy implications of the study are straight forward. The coexistence of positive relationship between per capita GDP and carbon emissions poses important challenges to the policy makers and governments of SAARC countries. The policy makers in SAARC countries should take the responsibility to promote and develop technical innovations in green energy in order to reduce CO<sub>2</sub> emissions. Furthermore, the policy makers should also consider exogenous effects while forming any growth policy. It is also recommended that SAARC countries should adopt environment friendly policies. The positive association between fossil fuels energy consumption and carbon emissions implies that energy efficiency should be increased in order to increase the energy output. The policy makers and governments of SAARC group should also announce policy reforms for the reforestation process and to attract foreign investment in their countries on the immediate basis.

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