ENVIRONMENTAL KUZNETS CURVE FOR CARBON EMISSIONS IN BOSNIA & HERZEGOVINA

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Abstract

The relationship between environmental quality and economic growth has been empirically modeled through emissions–income relationship so far, and the outcome of most of these studies has been formulated by the so called environmental Kuznets curve (EKC) hypothesis. According to the environmental Kuznets curve hypothesis, the relationship between per-capita GDP and per capita pollutant emissions has a U shape, an inverted-U shape, a N shape and an inverted-N shape. This implies that, economic growth may be profitable for environmental quality. The purpose of this study is to test whether the EKC hypothesis is valid for Bosnia and Herzegovina. Firstly, EKC relationship for CO_2 emissions for Bosnia & Herzegovina, over a time period of 1992–2009, has been tested and tried to determine relationship between CO_2 emissions–income. As a result of the analysis EKC hypothesis is rejected and inverted N shaped relationship was found between CO_2 emissions–income.

Keywords: EKC Hypothesis, CO2 Emissions.
JEL Classification: Q53, Q56

1. Introduction

The effect of global warming on the world have been focus on by academics and researcher. The aim of empirical studies on the EKC is to search for evidence of a connection between income and environmental quality. In order to determine answer the relevant question of whether economic growth can be a part of the solution for environmental problems.

The aim of this study is to test whether the EKC hypothesis is valid for Bosnia and Herzegovina that was not investigated before. Firstly, over a time period of 1992–2009, EKC relationship for CO_2 emissions for Bosnia & Herzegovina testing and try to define link and shape between CO_2 emissions–income.

1.1 Kuznets Curve

In 1955 Simon Kuznets suggested that, as per capita income increases, income inequality also increases at first but then, after some turning point, starts declining (Kuznets, 1955). This changing relationship between per capita income and income inequality can be represented by an inverted-U-shaped curve, known as the Kuznets curve. The Kuznets curve hypothesis points that at beginning, at lower levels of per capita income, income distribution is skewed toward higher income levels so that income inequality is high. As income rises, skewness is reduced and income inequality becomes lower. This relationship can be seen above in Figure 1.
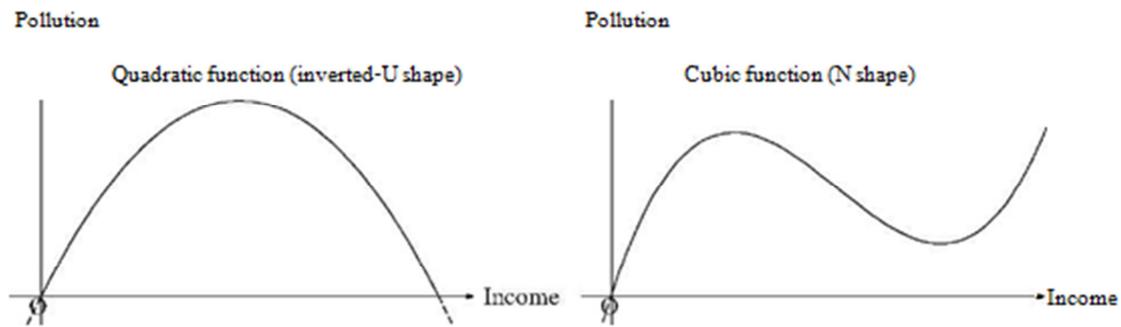

Figure1: Inverted-U-shaped and inverted N shaped

Figure 1 shows the inverted-U-shaped and inverted N shaped relations. The term of " environmental Kuznets curve" was defined by Panayotou in 1993 (Kijima et al, 2010). Selden and Song hypothesised environment - income relationship might be similar to Kuznets income inequality, namely of an inverted-U shape (Tisdell, 2001).

Main idea of EKC relationship explain different ways in the literature. The explanation for the EKC hypothesis can be describe as follows:

- Countries achieves a sufficiently high standard of living thus people assign an increasing value to environmental amenities (Selden and Song, 1995).

- Income reaches a high level thus paying for clean environment rises (Roca,2003).

- Environmental degradation tends to increase from rural to urban or from agricultural to industrial, but it starts falling with another change from energy intensive industry to services and knowledge-based technology intensive (Grossman and Krueger, 1993).

- Develop countries can afford to spend more on R&D, technological progress occurs with economic growth thus the dirty and obsolete technologies are replaced by new and cleaner technology (Komen et al, 1997).

- The political system play an important role in the implementation of environmental-friendly policies (Ng & Wang, 1993).

As a result of explanations above, the environmental Kuznets curve (EKC) can be define relationship between environmental contamination and per capita income that takes form an inverted-U shape.

After the UNFCCC Kyoto meeting (1997), carbon dioxide emissions have become a important study topic for the researchers all of the word. Almost each country's CO2 and income data test for EKC. These studies about EKC hypothesis, some researchers concluded that there is EKC relationship with carbon dioxide and income, while others not. The reader is refered to Huang,W.,M., et al (2008).

2. Data and Methodology

In this study we use annual Gross Domestic Product (per-capita GDP) and per capita pollutant emissions (CO2 emission) for the Bosnia and Herzegovina for the period of 1992–2009.

The data set are obtained from the World Development Index of the World Bank (constant 2000 US$). All variables used in the study are in natural logarithm form.

The availability of CO2 emissions and GDP for Bosnia & Herzegovina's data set only for 1992-2009 period is the limitation for this research. But by using such limited data, we can provide a conclusion as to the study on the EKC hypothesis for Bosnia & Herzegovina. Before the econometric analysis LN(CO2), LN(GDP) and LN(CO2) - LN(GDP) graphs are analysed. Observation scatter plot for as follows.
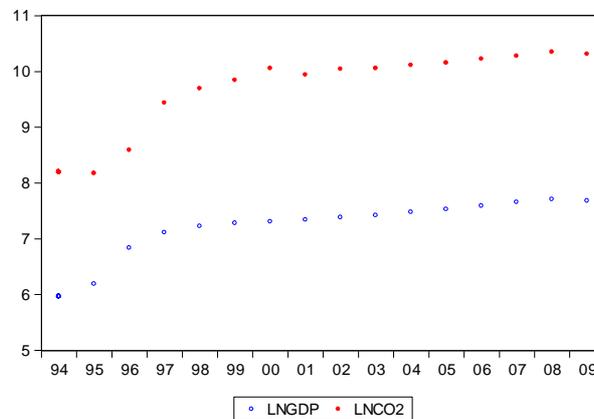

Figure2: Ln(CO2) emission and Ln(GDP)

Figure 2 and Figure 3 reports for Bosnia and Herzegovina for the period of 1992–2009 Ln(CO2) emission and Ln(GDP) data.
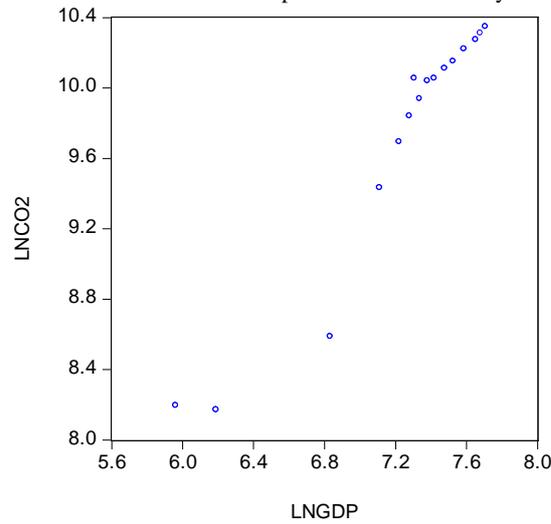
Figure3: Ln(CO2) emission - Ln(GDP)

From Figure 2 and Figure 3, there seems a relationship between income and CO2 emission.

3. Methodology And Results

Beceuse of data set limitation, we use simple regression analysis to test EKC hypothesis for Bosnia and Herzegovina. First we created our regression model by using Ln(CO2) emission dependent variable and Ln(GDP), $Ln(GDP)^2$ and $Ln(GDP)^3$ as independent variables. And we checked regression residuals for regression assumptions by diognastik test. Our regression model and variable explanations as follows.

3.1 Cubic Parametric Models

We use parametric models that standard EKC literature as follwing form:

$$y_{it} = \alpha_i + \beta_1 x_{it} + \beta_2 x_{it}^2 + \beta_3 x_{it}^3 + \beta_4 z_{it} + \varepsilon_{it}$$

where t is time period, y_{it} is per-capita CO2 emissions, x_{it} is per-capita GDP and z_{it} is a vektor of variables that may affect y_{it}.

By using the model with an estimate of income and environmental pollution degradation of the following possible results were achieved:

1. $\beta_1 = \beta_2 = \beta_3 = 0 \implies$ there is no relation between GDP and CO2,
2. $\beta_1 > 0 \ and \ \beta_2 = \beta_3 = 0 \implies$ there is a linear relation between GDP and CO2,
3. $\beta_1 < 0 \ and \ \beta_2 = \beta_3 = 0 \implies$ there is a monotonically increasing relation between GDP and CO2,

4. $\beta_1 > 0$, $\beta_2 < 0$ and $\beta_3 = 0$ => there is a inverted U shape relation between GDP and CO2,

5. $\beta_1 < 0$, $\beta_2 > 0$ and $\beta_3 = 0$ => there is a U shape relation between GDP and CO2,

6. $\beta_1 > 0$, $\beta_2 < 0$ and $\beta_3 > 0$ => there is a N shape relation between GDP and CO2,

7. $\beta_1 < 0$, $\beta_2 > 0$ and $\beta_3 < 0$ => there is a inverted N shape relation between GDP and CO2.

3.2 Results

Regression Output   of Cubic Model For Bosnia and Herzegovina

Variables	Coefficient	Std. Error	t-Statistic
LNGDP	-211.4799	38.97846	-5.425559*
SQR(LNGDP)	30.61309	5.652778	5.415584*
CUBE(LNGDP)	-1.460725	0.272172	-5.366927*
C (Constant)	490.5333	89.19458	5.499586*
Note:*;. **. and *** represent respectively 1%. 5% and 10% significance levels			

Table 1: The results of the regression estimator

R-squared: 0.98   Adjusted R-squared: 0.98 and Prob(F-statistic): 0

Estimation equation is as follows

$$LNCO2 = -211.479932538 * LNGDP + 30.6130896715 * SQPLNGDP - 1.46072532469 * CUPLNGDP + 490.533286904.$$

Regression residuals diognastik tests are as follows:

Residuals is normal (J.B. Porb. = 0,67), residuals have no correlation (Breusch-Godfrey Serial Correlation LM Test: Prob. Chi-Sqr.(8)= 0.5388), residuals have no heteroskedasticity (Heteroskedasticity Test: White Prob. Chi-Sqr.(8)= 0.0700) .So regression model satify the regression assumptions.

4. Conclusion And Remarks

In this study, we investigate the relationship between economic growth and pollutant emissons degradation based on the EKC hypothesis for for Bosnia and Herzegovina during the period 1992-2009 using time series data and regrestion analysis. According to the regression model Environmental Kuznets Curve hypothesis, over the time period of 1992–2009 for CO2 emissions and GDP for Bosnia & Herzegovina, was rejected. The parameters of regression $\beta_1 < 0$, $\beta_2 >$

$0 \; and \; \beta_3 < 0$ is found. So there is a inverted N shape relation between GDP and CO2 for Bosnia & Herzegovina. The empirical results provide support for a relationship between the per capita emissions CO2 pollutant and per capita GDP, indicating that there is a monotonically increasing linear relationship between per capita CO2 emissions and per capita GDP that was not investigated before for Bosnia and Herzegovina.

The finding of this increasing linear relationship between per capita CO2 emissions and per capita GDP implies that emission reduction policies must be taken immediately. Bosnia and Herzegovina is a young and green country. The environmental content enacted laws and the enforcement of this law will prevent in the future to struggle with environmental pollution and related problems. This laws and it's applications will be a feasible policy tool for Bosnia and Herzegovina to achieve its sustainable growth.

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