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DOES ECONOMIC GROWTH CAUSE MORE CARBON EMISSION? FROM THE INDIAN PERSPECTIVE

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***Key points:* *Environmental degradation, CO_2 emission, GDP, Kuznets curve, Cointegration*.**

ABSTRACT:

With the growth and development of the world economy in general and India in particular the livelihood of the people is getting better but economic growth is often alleged with fact that it is related to environmental degradation directly or indirectly. In this paper we will try to answer the question whether increasing GDP is causing more CO_2 emission or GDP is increasing because of the more CO_2 emitting activities. The data for the study have been collected mainly from the secondary sources such as WB databank, research papers, government reports etc.

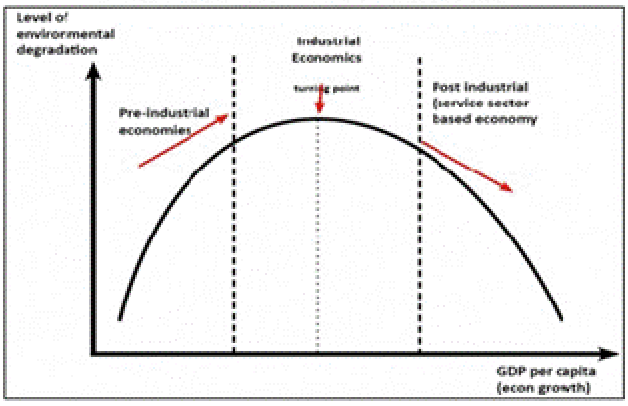
1. INTRODUCTION:

It is evident that with the growth and development of the world economy the livelihood of the people is getting improved. But as we know for everything, we are doing has a cost and similarly for economic growth also we have to bear some costs in the form of environmental damage. Since 1850, different human activities have been releasing excess greenhouse gases which are damaging or hampering our environment. Stephen Montzka, a research chemist with NOAA in Boulder, Colo said there are four main greenhouse gases we are to worry about. Namely these Carbon Dioxide (CO_2), Methane, Nitrous Oxide (N_2O) and a group that contains Chlorofluorocarbons (CFCs) and their replacements. However, Montzkafurther stated that these four greenhouse gases are the ones "that we [humans] have direct control over."

We have empirical evidences that shows that with the initial stages of development of the states the level of environmental degradation or the environmental pollution increases but when the development reaches a threshold level the level of pollution or degradation gradually declines. This relation is shown by the *Environment Kuznets Curve (EKC)* which is of 'Inverted-U' shape.

The following diagram shows the Environment Kuznets Curve –

FIGURE 1: Environment Kuznets Curve



In this paper, an attempt has been made to explore the relationship between the growth of GDP Per Capita and the magnitude of *emission*.

We have taken the data on GDP Per Capita and Per Capita CO_2 emission of India for the data period of 1960-2014. We will test the causality between these two variables. Then we will try give an overview and show the trend of the CO_2 emission by these three Asian countries for the year of 1960 to 2014. Lastly, we will look at the data of the percentage of fossil energy consumption to total energy use by three countries (India, China and Japan) of Asia.

2. LITERATURE REVIEW:

A paper byJalil and Mahmud(2009) have tested the Environment Kuznets Curve for China over the period of 1971-2005, where they found that there is a unidirectional causality moves through economic growth to CO_2 emission. They also found that the energy consumption is another determinant that give rise to the CO_2 emission.
AgainChoi, Heshmati and Cho (2010) havestudied the existence of the environmental Kuznets curve (EKC) for carbon dioxide (CO_2) emissions and its causal relationships with economic growth and openness by using time series data (1971-2006) from China, Korea and Japan. They found that the **Environment Kuznets Curve** does not exist for **Korea**. Whereas **China** had an N-shaped Kuznets curve because the cubic model specification was statistically significant. This curve was initially an inverted U-shaped curve, but after the turning point, it rises again. And

lastly for **Japan**, the inverted N-shaped curve, which is unexpected, was statistically significant in terms of the relationship between GDP and CO_2 emissions. In terms of CO_2 emissions, there was no U-shaped EKC. Their results suggest that economic growth is not the only determinant that reduces environmental degradation.
Galeotti et al. (2006) stated that empirical studies for the EKC hypothesis for CO_2 emissions are “at best mixed”.
Munasinghe (2008) suggested that the hypothesis of ***sustainomics*** can be the key to green growth and insisted that developing countries can achieve their target economic growth while maintaining a lower pollution level.

3. OBJECTIVES:

a. The objective of the paper is to analyze the causal relationship between CO_2 emission and economic growth.
b. We will try to see the trend of CO_2 emission by India, China and Japan during the year of 1960-2014.
c. We shall look at the trend of fossil energy use by 3 major Asian countries (India, China and Japan) for the period of 1971 to 2013.

4. RESEARCH QUESTIONS:

a. Does the economic growth cause the growth of CO_2 emission to go up?
b. Is there any significant difference in the trend of total CO_2 emission by three Asian countries India, China and Japan during 1960 – 2014?
c. Is there any significant difference in the trend of fossil energy use as percentage of total energy use by India, China and Japan during 1971 – 2013?

5. DATA &METHODOLOGY:

5.1. Sources of data:

The study is mainly based on the secondary sources of data. Data is collected from different secondary sources like World Bank databank, research papers, government reports etc.

5.2. Methodology:

In the paper we are mainly analyzing the causality between economic growth (GDP per capita) (Appendix – 1)and CO_2 emission (Mt. per capita) (Appendix – 2) for India. The timeseries dataof these two variables for the period of 1960-2014 have been collected from the World Bank databank and is also transformed in *Natural Logarithm* form. Thus, the two variables will be-

a. **LGDP**,indicating the **Natural Logarithm of GDP Per Capita**, and
b. **LC**, indicating the**NaturalLogarithm ofCO_2 Emission Per Capita.**

We check the stationarity of these two data series by *Augmented Dickey Fuller (ADF)* test at 10% level of significance. If they are not stationary then we will difference them and again run ADF test.

Once they become stationary at same level, we will proceed towards *the test of cointegration* by which we will be able to check whether there exists any long run relationship between these two variables or not.

If we find cointegration between them then we will proceed towards another test called the *Granger Causality test*, which will tell us about which variable is moving 1^{st} or which is caused by which. There may exist *unidirectional* or *bi-directional* causality, which we will find later on.

In the successive sections we will be discussing and give an overview on the trend of the total CO_2 emission by India, China and Japan for the year 1960-2014 (data inAppendix – 3) and also the trend of the percentage of fossil energy use in the total energy use by India, Japan and China (data inAppendix – 4) for the year 1971-2013.

Test of stationarity (ADF test), cointegration and granger causality test are done by EViews 10 software.

6. TEST OF STATIONARITY:

To test the stationary of the variables, we have used the Augmented Dickey-Fuller test where the null hypothesis is that the variable is stationary. And on the other hand, the alternative hypothesis is that the variable is not stationary.

TABLE 1

Variables	**Level (p-Values)**	**First Difference (p-Values)**
LGDP	3.63 (LGDP)	-6.41*** (DLGDP)
LC	1.10 (LC)	-7.59*** (DLC)
NOTE: *** denotes that the variable is stationary at 1% level of significance.		

In the Table 1 we can see that both the variables are non-stationary at level and stationery at their first difference denoted by DLGDP and DLC.

7. TEST OF COINTEGRATION:

In this part we will show the result of the *Johanson Cointegration test*, which will tell us about the long run association between the two variables DLGDP and DLC. The cointegration test result of the variables (DLGDP and DLC) are shown below–

TABLE 2				
Date: 11/13/19 Time: 14:13 Sample (adjusted): 1963 2014 Included observations: 52 after adjustments Trend assumption: Linear deterministic trend Series: DLC DLGDP Lags interval (in first differences): 1 to 1 Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.1 Critical Value	Prob.**
None *	0.524664	49.87665	13.42878	**0.0000**
At most 1 *	0.193808	11.20257	2.705545	0.0008
Trace test indicates 2 cointegrating eqn(s) at the 0.1 level				
* denotes rejection of the hypothesis at the 0.1 level **MacKinnon-Haug-Michelis (1999) p-values				

TABLE 3				
Normalized cointegrating coefficients (standard error in parentheses)				
DLC	DLGDP			
1.000000	**-0.774522**			
	(0.15089)			

The above Table 2shows that the two variables DLC and DGDP are cointegrated as the probability value of **None*** is **0.0000**(<0.1)which indicates that there exist at least one cointegrating equation, i.e., there exist a long run association between DLC and DGDP at 10% level of significance.

The following (Table 3)Normalized cointegrating coefficients shows that DLC and DLGDP are **77.45%**(1: -0.774522; here we will neglect the '–' sign) cointegrated.

Therefore, we can now check the **Granger Causality** between these two variables (DLC and DLGDP) which will tell us which variable is moving first.

7. TEST OF GRANGER CAUSALITY:

So far, we come across the unit root test and cointegration test. Now, we ran *the Granger Causality test* (for the variables LGDP and DLC) introduced by Engle –Ganger.

TABLE 4

Pairwise Granger Causality Tests

Date: 11/13/19 Time: 14:05

Sample: 1960 2014

Lags: 2

Null Hypothesis:	Obs.	F-Statistic	Prob.
DLGDP does not Granger Cause DLC	52	2.84244	**0.0683**
DLC does not Granger Cause DLGDP		1.98115	0.1493

The above table shows that the**Null Hypothesis** of **DLGDP does not Granger Cause DLC** has not been accepted as the probability value **0.0683 is less than 0.1** and thus, we will accept the **Alternative hypothesis that DLGDP Granger Causes the DLC** at 10% level of significance.

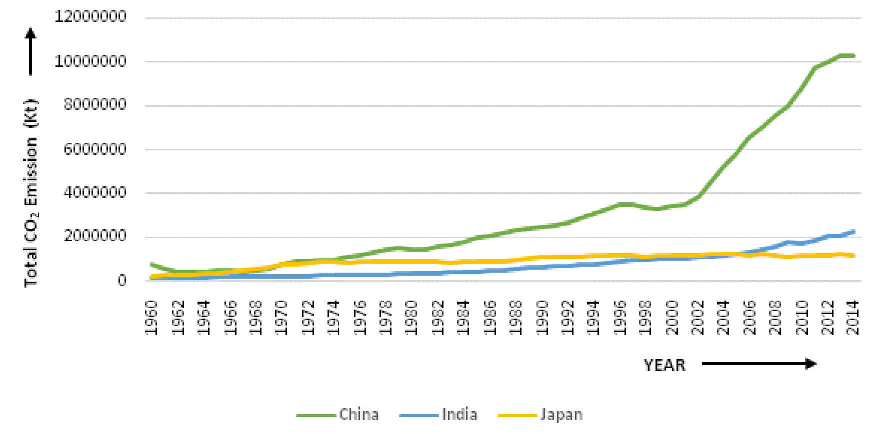
Again, the table shows that the 2nd**Null Hypothesis** of **DLC does not Granger Cause DLGDP** has been accepted at 10% level of significance as the probability value **0.1493 is greater than 0.1**.

So, here we can now concludeit by saying that there is a unidirectional long runcausality between GDP Per Capita and CO_2emission, where the GDP per capita is causing CO_2 emission to grow.In layman's language, the GDP moves 1st and it causes more CO_2 emission. In other words, there is a positive long run relationship between economic growth and increasing CO_2 emission for India (1960-2014).

8.TREND OF CARBON EMISSION BY ASIAN COUNTRIES:

In this section we will look at the total CO_2 emission (Kt) by three Asian countries, viz., Japan, India and China. We will look at their trend and also at the annual growth rate in these countries.

FIGURE 2: Total CO_2 Emission (Kt)



Source: World Bank Databank (https://data.worldbank.org/)

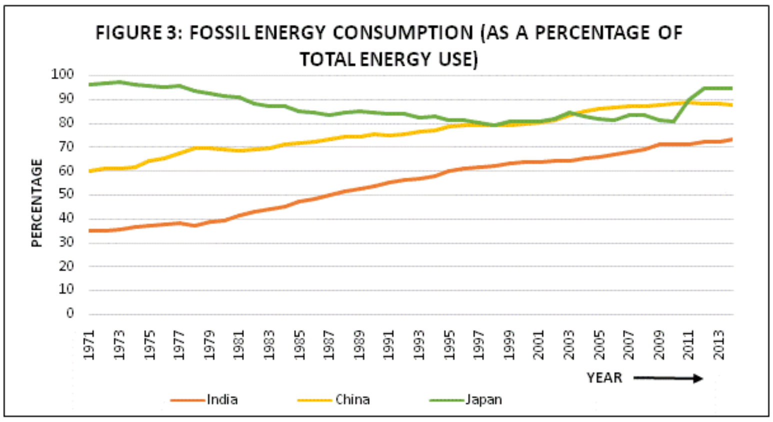
In theFigure 2,we can see that total CO_2 emission is increasing for all these countries, but however, it is visible from the graph that the rise is much higher for China but from the year 2001 the graph is rising steeply, may be some economic transformation has been taken place from that period and that's why is increasing at a faster rate relative to the earlier years. In the year 2006, India's CO_2 emission exceedsJapan but there is not much difference between their Emission level. The Compound growth rate of CO_2 Emission for India is 5.56%. For Japan and China, it is 3.11% and 4.9% respectively.

9. TREND OF FOSSIL ENERY USE AS A PROPORTION OF TOTAL ENERGY USE:

In this section we will try to look at the fossil energy used by three major Asian countries (India, China and Japan).

In the following graph we have plotted the line showing percentage of fossil energy consumption as percentage of total energy use for the period of 1971 to 2013.

In the graph (Figure 3) we can see that during 1971-2013, the fossil energy consumption as percentage of total energy consumption is showing an increasing trend for all the sample countries except Japan.For Japan the percentage hasdeclined from about 96.51% in 1971 to 80.91% in 2010. But, however, it has increased again to 94.4% in 2013. So, here we can say that the rate of use of fossil energy is very high as a percentage of total energy use for Japan. The great East Japan Earthquake in 2011 reduces the energy self-sufficiency ratio of Japan.



Source: World Bank Databank (https://data.worldbank.org/)

Interestingly for other two countries, viz- India, and China, it is showing an increasing trend during 1971-2013. This may be because of faster economic growth and increase in PCI which results in more use of transportation and vehicles, more movements of people from one area to another. Though the PCI is increasing the income and wealth inequality is at a higher side. The GINI coefficient for India is 0.479 (2018) and for China it is 0.476 (2017) which shows that the inequality is really not that low. So, in this case most of the population are unaware about the renewable sources of energy and thus the percentage of fossil energy use to total energy use is high for these two countries.

By observingthe two curves of India (Red) and China (Yellow) we can see that the gap between them is getting shrink which reflects that the rate of increase in the percentage use of fossil energy to total energy has been increasing faster in India. And surprisingly the GINI Coefficient for India is little higher than that of China.

10. CONCLUSION:

Many studies have agreed with the existence of trade-off between Environmental quality and Economic growth. However, some studies again show that this trade-off exist until a certain level of growth, after reaching a certain threshold level of growth the economic growth takes care of the environmental quality. EKC shows this relationship.

In the **SECTION 7,** we have got about the 77% of cointegration between GDP Per capita and CO_2 emission per capita of India for the year of 1960-2014. Testing the Granger Causality let us know that there exists a unidirectional causality that goes through GDP per capita to per capita CO_2 emission. It means that the rise in GDP Per Capita is causing the Per Capita CO_2 Emission is increasing.

While looking at the trend of the total CO2 emission by three Asian counties (1960-2014)it shows us that the Chinas total emission has been rising steeply or at a faster rate than that of India and Japan.

Lastly, we come across the trend of percentage of total fossil energy use in total energy use by three Asian countries for the year of 1971-2013. We found that it is very high for Japan, the average percentage is 86.7% for this time period. Whereas it is comparatively very low for India, 54.22%. For China also, though less than Japan, it is at a higher, about 75.92%.

We can conclude that with the growth we always cannot expect the environmental quality to get better if the growth is not inclusive for all section of the people, because if the major proportion of the population is not able to adopt the green technologies for their day to day life, as it costs more, the environment quality will not improve.

11. REFERENCES:

Stern, D.I. (1998). Progress On The Environmental Kuznets Curve?.*Environment and Development Economics*, *3*, 173–196.

Ang, J. (2007). CO_2 Emissions, Energy Consumption, And Output In France. *Energy Policy*, *35*, 4772–4778.

Jalil, A., & Mahmud, S. (2009). Environment Kuznets Curve for CO_2 emissions: A cointegration analysis for China. *Energy Policy*, *37*, 5167–5172. Retrieved from www.elsevier.com/locate/enpol

Rahman, M., Alam, S., & Arefin, S. (2007). The Relationship Between Carbon Emission (CO_2) and Economic Growth In

Bangladesh. *The Chittagong University Journal of Business Administration*, *22*, 373–384.

Choi, E., Heshmati, A., & Cho, Y. (2010, November). An Empirical Study of the Relationships between CO_2 Emissions, Economic Growth and Openness. *Discussion Paper Series*, 1–27.

Borhan, H., Ahmed, E., & Hitamc, M. (2012). The Impact of CO_2 on Economic Growth in Asean 8. *Procedia - Social and Behavioral Sciences*. Elsevier B.V.