

Does Economic Growth Cause Environmental Degradation? Evidence from Asia – Pacific Region

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Abstract— The baseline of this present research work tries to response the fundamental question of “does economic growth cause environmental degradation?”. The empirical research findings show that there exists a long term effect of environmental degradation, energy usage and economic development of Asia – Pacific regions. The study also suggested that, there is an immediate need of adopting the environmental safety measures like renewable sources of energy, greenery concepts to reduce their environmental degradation.

Keywords: Environmental degradation, Energy use, Economic development, Asia – Pacific, Panel econometric analysis

I. PREAMBLE

Research in the field of environment has given huge attention by the scholars and policy makers in recent years due to increase the natural disasters like climate change and increasing the global warming. These natural calamities lead to unseasonal rain, earth quakes, tsunami most specifically polar ice melt which will increase the sea level in near future. By considering these natural disasters took different kinds of meetings in and around the world to protect the countries and also aiming to improve the environmental quality of the earth. The initial meeting was held at Kyoto (1996), Japan has decided that all the countries in the globe must reduce their carbon dioxide emission level at least by 5% by 2008 – 2012. The recent meeting was held at Paris (2015), France come up with the recommendations that all the countries in the world must reduce their carbon dioxide emissions at least 2% in the present level. Apart from the two major meetings, there are various meetings was held in and around the world to reduce their emissions level on time to time.

It is apparent that these increasing emissions will be due to increase the economic position of the countries. Countries also try to empower their economic position and make their competitiveness, are bound to use their manufacturing units widely by using various energy sources such as crude oil, petroleum, natural gas and electricity and so on. However, when energy sources are used to the maximum, on one hand they can improve economically, on the other hand they produce more carbon dioxide emissions, which leads to global warming and climate change. The increase in the carbon emission especially leads to decline in the environmental quality which triggers the above said natural disasters such as flood, tsunami etc. The decomposition of environmental quality in the world has reached alarming stage and its far reaching consequences are not to be faced by the present generations but also by the future generations. This environmental substandard quality triggers natural disasters thus draws attention towards it. Thus consciences have to be built among people in

particular and countries at large to develop their economic position without affecting their environmental quality. The economic growth saws environmental degradation becomes important areas of research by the scholars and simultaneously they want to prove it.

In this background the present topic of the research made a small effort to estimate the relationship between environmental degradation, energy use in specify sectors and economic growth in Asia – Pacific region. It is well understood that carbon dioxide emissions (CO₂) is a foremost threat to environmental quality which may also result in natural disasters to deal with this complexity there is a need to study the type of relationship between carbon dioxide emissions (CO₂), energy utilization and economic growth and what type of measures can be taken by respective counties is a matter for relevance and to recommend the countries in the regions should adopt the possible steps to reduce the carbon emitted.

The entire research work compartmentalized into five sections as follows; section 1 gives brief introduction about the environmental degradation, energy use and economic growth. Section 2 gives a review of earlier works conducted so far all over the world. Section 3 discusses materials & methods used in the present work such as Environmental Kuntz Curve (EKC) hypothesis and econometric models. Section 4 provides the detailed results of environmental degradation, energy use and economic growth of selected countries and finally it provides concluding remarks in Section 5.

II. REVIEW OF EARLIER WORKS

Based on the earlier research works there are three approaches so far found the relationship between carbon dioxide emissions, energy utilization and economic development (Zang, X. P and Cheng, X. M, 2009) and Ghosh, S (2010). The first approach focuses on relating emissions and economy by using Environmental Kuznets Curve (EKC) which produces various curves. On this background the following studies able to find the evidence of EKC hypothesis. Sun, J. W (1999) examined EKC hypothesis and found U-shaped curve. Fodha, M and Zaghoud, O (2010) found the evidence of EKC by relating carbon dioxide emission and economic growth. Canas, A et al. (2003) identified the evidence of EKC hypothesis by emission and economy using cubic method by producing U-shaped curve. Galeotti, M et al. (2006) tested the evidence of EKC hypothesis by using cubic income formula for both OECD and non-OECD and found EKC hypothesis. Azomahou, T et. al (2006) examined the evidence of 100 countries and found EKC hypothesis curve. Apart from the above, few more studies also measured the evidence of EKC hypothesis by relating emission and economy [Bertinelli, L and Strobl, E (2005), Taskin, F and Zaim, O (2000)]. Some

studies also tried to measure the relationship between emission and economy and found no evidence of EKC hypothesis. Halicioglu, F. (2009) investigated the evidence of EKC hypothesis by using CO₂, energy, economic growth and international trade and did not show the evidence of EKC hypothesis. He, C and Sandberg, R (2012) used time series data in case of Canada and found no evidence of EKC hypothesis. Dinda, S et al. (2000) investigated the evidence of EKC by using SO₂ and economic growth by quadratic model and found that no evidence of EKC hypothesis. Perman, R and Stern, D. I (2003) examined the EKC hypothesis of 74 countries relating SO₂ and economic growth and found no evidence of EKC hypothesis.

The second view of approaches focused the relationship between energy use and economic development. The initial work proposed by Kraft, J and Kraft, A (1978) found cause and effect relationship between energy use and economy in case of USA. Lee, C. C (2006) found there exists a relationship between energy use and economy with industrialized countries by using various econometrics models. The studies like Yu, E. S. H and Choi, J. Y (1985), Ferguson, R et al. (2000), and Toman, M and Jemelkova, B (2003) found the absence of relationship between energy and economy.

Final approach proposed on the combination of first two approaches i.e. relationship between emissions, energy and economy. The initial work done by Shafik, N and Bandyopadhyay, S (1992) come out with the evidence of relationship exists between carbon dioxide emission and economy by using cubic function. Grossman, G and Krueger, A (1993) and Panayotou, T (1993) also found significant evidence while relating with SO₂ and NO₂ with economic growth. Selden, T. M and Song, D (1994) found long term relationship between emission and economic growth in case of Turkey by using quadratic formula. Ang, J. B (2007) found the long term relationship between emission, energy and economy by using quadratic formula found that long term relationship exists between emission and economy. Jalil, A and Mahmud, S. F (2009) found long run relationship between emission and economy. Hussain, M et al (2012) studied the relationship between emission, energy consumption and economic growth and found long run relationship in case of Pakistan. Ghosh, S (2010) found that no relationship exists between emission, energy and economy in case of India.

On the evidence of earlier research paper, the results are differing from authors i.e. some studies show significant relationship and some studies did not show the significant relationship. The earlier works also proved that most of the studies have concentrated to measuring the relationship between emissions, energy and economy in particular and no study have concentrated on specific sector wise. This leads a questions that, whether economic growth of the countries really stimulates the environmental degradation? Which sector produces more emission by using it energy sources? To answer these questions, the present research work focused to measure the relationship between emission, energy and economy in specific sector wise. This will helpful to the countries in the region as they can understand their level of carbon emissions in different sector

and also take necessary steps to reduce their emission level in respect to specific sectors.

III. MATERIALS & METHODS

The present study tries to find the answer “Does upsurge the economic growth causing environmental degradation? In this background the main objective of the study to measure the relationship between carbon dioxide emissions (CO₂), energy consumption, economic growth of Asia – Pacific region. The present study used the third approach to examine the relationship between emission, energy and economy in case of Asia – Pacific region. The secondary objectives of the study framed in the following manner. (i). to explore the EKC hypothesis for emission and economic growth of the region (ii). To measure the relationship between energy use and economic growth and (iii). To examine the relationship between carbon dioxide emissions, energy use in different sectors and economic growth of Asia – Pacific region. The study also hypothesized that there is no significant relationship between income level of the country and environmental degradation. Variables used in this study Carbon dioxide emissions (CO₂), Energy use in different sectors such as Petroleum, Coal and Lignite, Natural gas, Electricity and Gross Domestic Product (GDP) used in natural log form. The necessary data have been collected from world energy statistics 2019 for Asia – Pacific region over the period of 1990 to 2019.

The study follows the basic model which was used by Fodha M and Zaghdoud O (2010) to measure the relationship between emission, energy use and economic growth by employing Environmental Kuznets Curve (EKC) hypothesis through the following model.

$$CO_{2it} = a + b_0(PET + C\&L + NGAS + ELET)_{it} + b_1GDP_{it} + b_2GDP_{it}^2 + b_3GDP_{it}^3 + \epsilon_{it}$$

Where CO₂ – Carbon dioxide emissions per capita, Energy consumptions used in different sectors like (PET – Petroleum, C&L – Coal and Lignite, NGAS – Natural gas and ELET – Electricity) in kg of oil equivalent per capita, GDP – per capita gross domestic product used as proxy for economic growth.

Based on the EKC hypothesis, higher economic growth will product more emissions which will be explained through the following different shapes of curve.

If $b_1 > 0, b_2 < 0, b_3 > 0$, develops N – shape curve

If $b_1 < 0, b_2 > 0, b_3 < 0$, develops an inverted N – shape curve

If $b_1 < 0, b_2 > 0, b_3 = 0$, develops U – shape curve

If $b_1 > 0, b_2 < 0, b_3 = 0$, develops an inverted U – shape curve

The above equation clarifies that N – shape curve indicates when the income level of the country is increasing gradually, the environmental quality initially declines, improve later and goes weak subsequently. For inverted N-shape curve shows countries income level increasing gradually environmental quality improve beginning, later it declines and at last it improves. For U-shape curve explained when countries income level is low the environmental quality will be high similarly when income level is high and environmental quality declines. For inverted U-shape curve explains when countries income

level is maximum then the environmental quality improves and income level is low the environmental quality declines.

Further the study used various econometric models to examine the relationship between emission, energy use and economic growth. Since the nature of the data belongs panel data (i.e. over the period of time and across the individuals), hence the present study used sophisticated panel econometric models such as unit root test, co-integration test, cross-country analysis to measure the relationship between the variables.

IV. RESULTS & DISCUSSION

Variables	ASIA		PACIFIC	
	Co-eff	P-value	Co-eff	P-value
EU	0.6656	0.0000	0.7662	0.0000
PET	0.2317	0.0008	0.4687	0.0000
NGAS	0.0609	0.0836	0.2689	0.0000
C & L	0.3875	0.0000	0.2882	0.0000
ELECT	0.1932	0.0071	0.5251	0.0002
GDP	0.0106	0.0002	0.4298	0.0000
GDP2	0.0053	0.0002	0.2149	0.0000
GDP3	0.0035	0.0002	0.1432	0.0000

Table 1: Results of Environmental Kuntz Curve (EKC) hypothesis

The results of EKC hypothesis shows that the coefficient of energy use is more than 0 for both Asia and Pacific countries (0.6656 > 0 and 0.7662 > 0), indicating that higher usage of energy leads to countries economic growth and the same time it also emitting higher carbon dioxide in these regions. The above table also evident that Asia countries were supporting N-shape curve EKC hypothesis (b₁ > 0, b₂ < 0, b₃ > 0), it shows that these countries income level increasing slowly, the environmental quality initially declines, later improve and further it goes weak. For Pacific countries it supports inverted N-shape curve hypothesis (b₁ < 0, b₂ > 0, b₃ < 0), stating that increasing the level of income leads to improve the environmental quality in the initial years, later it declines and at last it improves the environmental quality. This proves that these countries environmental quality ups and downs during the study period and it also shows these countries emitting high level of carbon dioxide. Hence the caution should be taken to these countries to reduce their level of emission with an immediate effort.

Variab les	ASIA				PACIFIC			
	LLC (Lev el)	LLC (1 st Diff)	IPS (Lev el)	IPS (1 st Diff)	LLC (Lev el)	LLC (1 st Diff)	IPS (Lev el)	IPS (1 st Diff)
CO2	-0.48 83 (0.3 126)	-4.14 46 (0.0 000)	0.94 45 (0.8 275)	-4.37 93 (0.0 000)	2.36 77 (0.9 911)	-2.66 65 (0.0 038)	2.13 01 (0.9 834)	-1.39 68 (0.0 812)
PET	-2.25 47	-5.51 71	-1.31 25	-4.66 89	-1.08 78	3.06 02 (0.0	-1.39 23	-2.71 29

	(0.1 121)	(0.0 000)	(0.1 947)	(0.0 000)	(0.1 383)	011)	(0.1 819)	(0.0 033)
NG AS	-0.70 13 (0.2 416)	-5.19 13 (0.0 000)	1.06 67 (0.8 569)	-6.68 44 (0.0 000)	2.39 20 (0.9 916)	-3.42 83 (0.0 003)	0.42 69 (0.6 653)	-1.76 40 (0.0 389)
C & L	1.46 43 (0.9 284)	-4.18 38 (0.0 000)	1.92 72 (0.9 730)	-3.39 84 (0.0 003)	1.64 61 (0.9 501)	-3.34 91 (0.0 004)	2.21 30 (0.9 866)	-4.08 02 (0.0 000)
ELE T	-1.50 90 (0.0 656)	-3.60 35 (0.0 002)	1.80 79 (0.9 647)	-4.59 65 (0.0 000)	1.93 88 (0.9 737)	-1.93 88 (0.0 263)	3.15 83 (0.9 992)	-2.66 35 (0.0 039)
GDP	1.43 56 (0.9 245)	-3.25 88 (0.0 006)	0.25 87 (0.3 979)	-1.83 18 (0.0 335)	3.08 01 (0.9 990)	-1.36 80 (0.0 856)	3.02 18 (0.9 987)	-4.06 89 (0.0 000)

Table 2: Results of Panel unit root test

Table – 2, illustrates the panel unit root results of LLC and IPS to check the stationarity and integration properties of the selected variables. From the result it reported that both Asia and Pacific region showing non-stationarity in level and stationarity in first difference. Once the data become stationarity at first difference panel cointegration test is applicable to measure the relationship between environmental degradation, energy use and economic growth of Asia and Pacific region.

Variables	ASIA		PACIFIC	
	Co-eff	P- value	Co-eff	P-value
Panel v – stat	-1.0852	0.8611	-1.6649	0.9520
Panel rho – stat	1.9402	0.9738	1.8532	0.9681
Panel – PP stat	-0.9878	0.1616	-0.6148	0.2693
Panel – ADF stat	-3.0312	0.0012	-3.0927	0.0010
Group rho – stat	2.5882	0.9952	2.3176	0.9898
Group – PP stat	-0.9852	0.1623	-0.3083	0.3789
Group – ADF stat	-2.4827	0.0065	-2.5670	0.0051

Table 3: Results of Petroni co-integration test

The panel cointegration test attempts to identify the long run relationship between carbon dioxide emissions, energy use and economic growth of Asia-Pacific region. In this sector the famous petroni cointegration test is applied. Petroni (2000) panel cointegration allows to test the null hypothesis of no cointegration and the residuals, based on the panel analogue of Engle and Granger (1987) to test the distributions. In this model Petroni developed seven cointegration statistics, in which any four statistics shows significant results, then it will be confirmed that they have long run relationship between the variables. Table – 3, shows the results of panel cointegration tests for Asia and Pacific region. From the results it found that both Asia and Pacific region were rejected the null of co-integration in most of the statistics and it concludes that both Asia and Pacific did not support the long run relationship between the variables. Since the continents of Asia have many individual countries, so an in-depth study would be feasible to

understand the short run as well as long run by country specific information.

Countries	Long – run						Short – run
	CO2	PET	NGAS	C & L	ELE T	GDP	ECM
ASIA							
China	0.55 67	0.12 83	0.12 92	- 0.12 03	- 0.16 25	- 0.12 04	- 0.09 30
	- 0.03 41	0.00 00	0.00 00	0.00 00	0.01 40	- 0.01 14	- 0.00 00
India	0.34 07	- 0.03 89	0.01 61	0.09 34	- 0.17 47	- 0.16 80	- 0.28 87
	- 0.01 21	- 0.00 34	0.00 00	- 0.00 03	- 0.00 04	- 0.00 01	- 0.00 00
Indonesia	- 0.51 99	- 0.01 87	0.05 41	- 0.00 46	- 0.22 59	- 0.12 85	- 0.03 65
	- 0.18 99	- 0.06 85	0.00 00	- 0.00 97	- 0.00 02	- 0.00 01	- 0.78 93
Japan	0.82 32	- 0.06 76	0.09 16	0.18 40	- 0.02 68	- 0.18 01	- 0.13 79
	- 0.03 81	- 0.00 53	0.00 00	- 0.00 01	- 0.04 58	- 0.00 21	- 0.00 00
Malaysia	0.92 31	- 0.15 97	- 0.14 24	0.02 33	- 0.02 47	- 0.46 37	- 0.17 99
	- 0.23 25	- 0.00 05	0.00 26	0.00 00	0.06 61	0.00 47	0.12 43
South Korea	- 0.66 51	- 0.04 64	- 0.00 88	0.00 10	- 0.28 21	- 0.17 55	- 0.06 07
	- 0.14 47	- 0.00 92	- 0.18 20	- 0.07 90	- 0.02 97	- 0.31 40	- 0.18 22
Taiwan	- 0.37 52	- 0.00 27	0.04 71	- 0.00 25	- 0.04 22	0.05 47	- 0.02 75
	- 0.00 47	- 0.04 02	- 0.00 01	0.00 00	- 0.00 03	- 0.00 43	- 0.34 52
Thailand	- 0.16 36	- 0.02 38	0.01 03	0.20 91	- 0.04 48	0.04 54	- 0.29 06
	- 0.13 16	- 0.00 13	0.00 00	0.00 00	- 0.00 01	- 0.08 47	- 0.08 21
PACIFIC							
Australia	- 0.25 23	- 0.34 19	0.16 10	0.12 72	- 0.24 50	0.31 93	- 1.01 49
	0.00 00	0.00 01	0.00 00	0.00 00	0.00 02	0.00 42	- 0.12 45
New Zealand	- 0.45 35	- 0.60 48	0.23 15	0.05 93	- 0.37 08	- 0.31 18	- 0.14 31
	0.00	-	0.00	0.00	-	-	-

	00	0.00	00	00	0.00	0.00	0.16
		01			09	21	32

Table 4: Results of Cross – Country analysis

Table 4- reveals that cross country effect in relation between emissions, energy utilization and economic growth of Asia – Pacific region. This result can find both the short term as well as long term relationship between the variables. The information provided in short term column, if the error correction term shows negative indication with significant result then it will be treated as those countries have long term relationship. Whereas the variable shows negative indication but not significant value, it indicates those countries have only short run relationship. If the term shows no negative either significant or insignificant those countries did not support both short term and long term relationship. For Asian region the countries like China, India and Japan shows long term relationship effect with environmental degradation, energy use and economic growth, whereas the countries like Indonesia, Malaysia, South Korea, Taiwan and Thailand showed short term relationship only. For Pacific region both countries (i.e. Australia and New Zealand) shows only short term relationship rather than long term relationship. Those countries who shows long term relationship mainly using their manufacturing sectors for increasing their economic position. The countries who shows short term relationship using their manufacturing industries for improving their economic position with the caution of their emission level also they are generating income from other sources such as Tourism and allied sectors.

V. CONCLUDING REMARKS

The baseline of this research works starts with fundamental question with “Does economic growth cause environmental degradation? To find the answer the present study made an investigation on the relationship between carbon dioxide emissions, energy use and economic growth of Asia – Pacific countries. The result proved that higher level of energy consumption lead to increase the countries economic growth and high level of carbon dioxide emissions. The study also proved that it follows both N-shape curve as well as inverted N-shape curve in case of Asia and Pacific countries. EKC hypothesis result found that environmental quality of both regions will have ups and downs over the period of time. The empirical modelling proved that the countries like China, India and Japan have long term relationship between carbon dioxide emissions, energy use and economic growth while rest of the countries shows only having short term relationship between the variables. For those countries are supporting long term relationship it is because of they are trying to increase their economic growth so that they are bound to run more manufacturing industries. For those who have found short term relationship they are using their energy sources only in the need area and other use they may go with renewable energy sources and also they are adopting environmental safety measures to reduce their carbon dioxide level. Those countries showing short term as well as long term relationship they must adopt environmental safety measures such as renewable sources, greenery concepts like as per the direction of United Nations

Framework Convention on Climate Change and other Environmental agencies in the world. Those who did not show any relationship, they also use environmental safety measures so that they may not produce more carbon emissions in future years.

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