18. Pragmatic study of Fiscal Growth and Environmental Issues

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Abstract

The purpose of this study is to investigate the acquaintance of macroeconomic and environmental indicators particularly the CO_2 emissions in Pakistan based on (Environmental Kuznets Curve) EKC hypothesis. Data from 1991-2010 were used to verify the results of the hypothesized associations of studied factors. Short& long run relations between the variables are calculated by using Johansen Co-integration method, VAR model, Wald test and Unit root test was used to check the stationary of the time series data. Results showed that the energy consumption is a major reason of CO_2 emissions and population density, agriculture value addition per worker, GDP growth rate are also significant predictors of CO_2 emissions but the intensity of them is not as much as the energy consumption.

Key words: Environmental Kuznets Curve (EKC), CO_2 Emissions, Energy consumption, Agriculture value addition.

1. Introduction

Today's world is being changed due to its alarming weather patterns and universally environmental issues are considered the most sizzling issues. People chant slogans about save the world for upcoming generations but in reality environmental stewardship must be taught to everyone in our society (Vince Cruz, Espedido & Abeledo, 2014). Sustainability, a broader term in itself is being used for it. Human development has fuelled this constant up gradation and now in effect to these we are facing global environmental change. Economics, society and environment work as pillar towards each other as if they are interconnected. For sustainability purposes it needs to be in state of equilibrium (Sinha Babu & Datta, 2014). Numerous factors have changed the atmospheric environment; factors like population growth with time, economic development, technological change, resource depletion, current life style of human being. Anthropogenic activities have increased the air pollution in recent years, greenhouse gases is one of the major contributors is among it. Recent years have changed the perspective and new technologies like renewable energy, energy efficiency, forest conservation, population growth are active ways to tackle the issues concerning environment. Emissions from the source and GDP show a linear path but in most cases it is not often true. The environmental Kuznets curve (EKC) was defined properly in the 1990s. That the EKC is an inverted U-shaped relationship between the economic development and the degree of income in-equality. This behaviour shows that as GDP increases, the environmental damage on surroundings increases and as it reaches maximum peak value, it then declines. When we look at any developing economy like Pakistan, where the average growth rate is about 5%, carbon dioxide emissions mount up with the size of economy because the industrial processes are immature, inefficient and polluting in output. The second stage deals with the structural and composition effect because the economic growth induces structural changes within the system. In last stage, societies invest heavily in research and development to replace the obsolete pieces of technology and change it with cutting edge technology which is cleaner and efficient as well as brings sustainability to the system. The three phases of EKC are shown in the Fig. 1.

Pakistan is facing huge energy deficits during the last decade or so, no new developmental work has been done to address this issue. Higher energy inputs put immense burden on the carbon dioxide emissions prevailing in the environment. This rise in demand of energy production and consumption has created energy crisis as well put more burden on the environmental degradation. This energy nexus has put enormous burden on governments to closely observe and control the energy markets (Robalino-López, Mena-Nieto, García-Ramos & Golpe, 2015; Zeshan & Ahmed, 2013).

When we see the case of Pakistan, we see growth during the last decade but on the other hand energy consumption has added pollution towards the environment. The CO_2 emissions generated by the country's most used fuel resource, which is also on verge of depletion due to unsustainable use i.e. natural gas. The main undermining feature during this phase is inefficient and less developed technology which led towards environmental degradation. Higher demand and lack of inability to meet up with the desired amount caused pollution, more emissions in form of greenhouse gases. Pakistan being a developing country has taken some steps towards environmental development by incorporating sustainable development goals in its policy which is "national environmental policy, NEP 2005". Its sole purpose was to protect environment and provide healthy environment to its citizens. This study is purposed to test the environmental Kuznets curve hypothesis in the company of energy consumption, GDP, carbon dioxide emissions and population density (Ahmed & Long, 2012).

This study is unique in its approach and it is a first attempt to check the momentary and sustainable relationship between the considered economic and environmental variables to explain the EKC hypothesis in Pakistan. Data used in this study were indicating latest period from 1991-2010. Objectives of the study are:

- To know the momentary relationship between the GDP growth, population density, energy consumption, agricultural value addition per worker and CO2 emissions.
- To know the sustainable relationship between the GDP growth, population density, energy consumption, agricultural value addition per worker and CO2 emissions.

Remaining portion of the paper consists of Literature review with history and all the significant studies all over the world on EKC; research methodology includes the data period and statistical techniques and results and interpretations, at the end conclusion with policy implications is given. Tables of all the statistical techniques are given at the end in the appendix after references.

2. Literature Review

The environmental Kuznets curve concept was popularized by the World Bank development report (IBRD, 1992). The environmental Kuznets curve is a supposed related connection between various indicators of environmental degradation and income per capita.

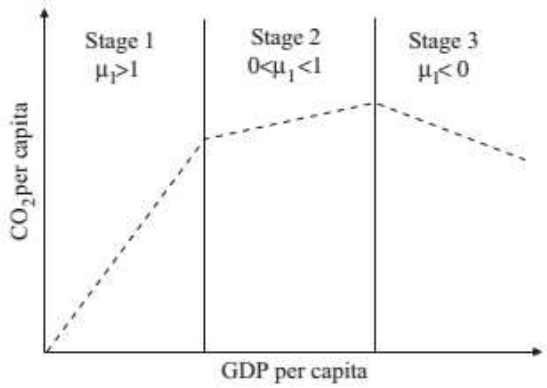

Fig. 1. Schematic plot of the U inverted relationship between GDP per capita and CO2 emission per capita: stage 1 corresponds to a rapid growth of the emission, stage 2 to the stabilization phase, and stage 3 to the reduction of the CO2 emission as the income increases (Stern, 2003).

In early stages when environment faces economic growth degradation and polluting factors but after some time the income per capita scenario changes. This means that at higher income levels economic growth leads towards environmental improvement. It is implied from the above that environmental

impact indicator is an inverted U-shaped function of income per capita. Estimated EKC is shown in fig. 2. (Stern, 2003). To grab the concept of sustainable world and economy without compromising business is priority for many and this concept approved it (Stern, 2004). Today the businesses around the globe are facing issues like carbon emissions and pollution, waste water and toxic waste. Governments around the world are trying to enforce certain rules, regulations as well as restrictions and awareness among companies to incorporate corporate social responsibility for a sustainable future. In 1997, Kyoto protocol treaty was signed by governments to overcome the issue of greenhouse gases (GHG's). According to the protocol industrialized countries had to reduce emissions up to 5% during period of 2008-2012. The issue of climate change is also very concerning to the developing world especially Asia, due to rapid industrialization and growth. In case of Pakistan, energy consumption is huge to run its economic cycle. More than 50% of energy consumption depends upon oil and gas, which later contribute towards carbon dioxide emissions.

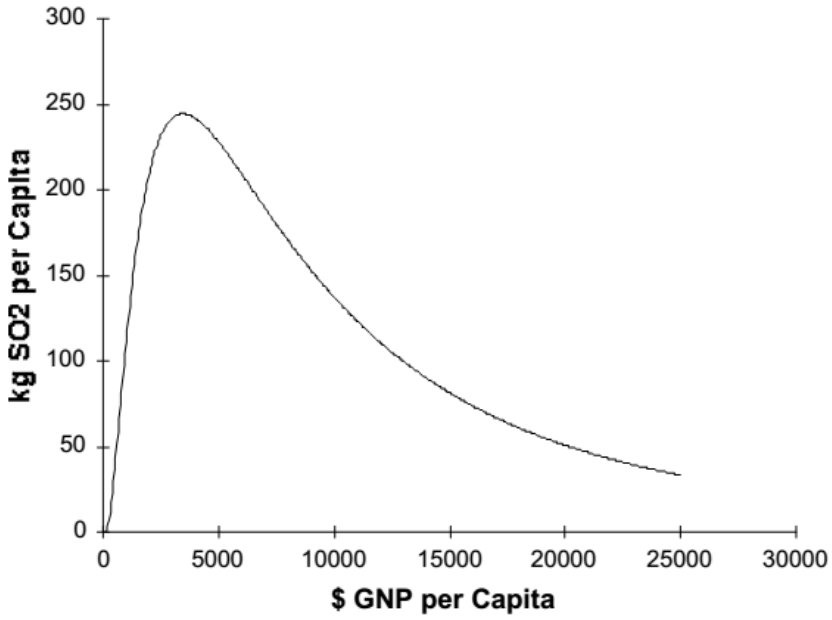

Fig. 2. Environmental Kuznets Curve for Sulfur Emissions

According to (Halkos & Tzeremes, 2011) China is cruising along its economic growth and on the way to diminish the natural balance of the resources. It is the largest emitter of carbon emissions. It has been verified that factors like socioeconomic in which economic growth, agriculture and industry play major role, legislation and technological advancements can cope with the uprising. The EKC curve shows promise when data input was explained also by using the time series data. It is well known that you cannot limit your carbon emissions as growth and prosperity are linked to it but due to the modern technological and structural effects it can be tamed.

In a study by (Binti Borhan & Musa Ahmed, 2010) pollution is a result of growth and production process and it affects only in terms of health effects to workers, resulting in reduction as well as inconsistent production process. EKC curve shows positive relationship between GDP, pollutant and endogenous variables like population growth, pollution factors; water pollution, air pollution, solid waste etc. Hausm54an test and least square test have been used in methodology to test dependent variables.

In another finding of (Ahmed, 2014) in which the EKC hypothesis has been proved by variables like growth rate, energy usage and trade volume. The methodology used to determine the authenticity is Johansen co-integration method. Mongolia is a resource rich country and it can tackle the pollution problem in the long run by using the sustainable growth and developing latest technology to its use. (Farhani et al., 2014) also estimates the EKC curve in relationship with environmental management tool of sustainability. The data is collected from Middle Eastern and MENA countries over a span of 20 years. It was further elaborated with help of panel data methodology. Panel models supported the data input and it was further checked and supported by causality test. Thus, the EKC data achieves the level of sustainable practices with respect to human growth. Moreover, it can further be explored to create adequate policies for a better scenario.

3. Research Methodology

The CO_2 emissions are really realistic occurrence, but the majority of the CO_2 studies are statistically frail. Almost s weak notice has been taken to the arithmetical properties of the numbers utilized. So, the above said shortcoming is tried to be resolved up to the utmost level in this study. Time series data from 1991 to 2010 was collected from the website of World Bank and following statistical techniques were applied in order to verify the results on hypothesized relationships between the studied variables of the study. The flow of statistical techniques was as under by using E-Views 8.

- ✓ Descriptive statistics
- ✓ Unit root test
- ✓ Johansen co-integration test (For long term relationship)
- ✓ VAR Model
- ✓ Variance Decomposition for Co2_Emi(to know the impact every variable)
- ✓ Wald Test (For short term relationship)

In table.1 the descriptive statistics are given which indicates the shape of the data and their central tendency. Major indicators of the descriptive statistics are mean, median, standard deviation and skewness of the data. Starting from the CO_2 emissions (CO_2_EMI) which have mean value of 0.77 with standard deviation of 0.11 and skewness of 0.31. First exogenous variable Agriculture Value Addition per Worker (AGR_VA_PW) showed mean value of 1007.23 with standard deviation of 62.03 and skewness 0f -1.16.

Second predictor of EKC is Energy Consumption (ENER_CONSM) which has mean value of 58.69 with standard deviation of 3.13 and skewness of -0.41. Another independent factor is GDP growth (LN_GDP) with mean value of 1.23 and standard deviation of 0.57 and skewness of -0.36. Population density (POP_DNST) is also one of the predictor of EKC CO_2 emissions and average value of it is 187.08 with standard deviation of 23.83 and skewness of -0.07.

Unit root test in table. 2 is used to check the stationarity of the time series data by Augmented Dickey Fuller (ADF) instigated by Dickey and Fuller (1979), also used by the contemporary researchers like jayanthakumaran et al. (2011); Lean et al (2011). Result of ADF test showed in table.1 identified that the all variables are stationary at first difference except the population density which is stationary at level. The results are shown in the group not individual calculations.

Long term relationship between the variables is verified by the maximum likelihood method (Johansen co-integration) introduced by Johansen and Juselius (1990), in which two equations are developed which showed the long term relationship between the studied variables as also used by (Wang et al, 2011; Chang, 2010; Halicioglu, 2009). VAR model is applied which the most suitable was declared by the Johansen co-integration maximum likelihood approach as also used by (Ahmad and Long, 2012; Hussain et al.2012).
Results of VAR model are shown in table 4 in which all the hypothesized variables showed probability value of less than 0.1, 0.05 and 0.01. Major predictor of CO2 emissions is energy consumption and population density. Value of R-square is 0.61 and adjusted R-square is 0.40, which means that 61% variation in CO2 emissions is due to these hypothesized variables and remaining 39% variation is due to other undefined factors. With the help of variance decomposition, performance of the all the variables in defining CO2 emissions is clear in which energy consumption has 52%, GDP growth has 12%, 32% CO2 emissions itself and population density has 3% participation. Results of the study also match with the previous studies in different countries of the world (Borhan and Ahmad, 2015; Ahmad and Qazi, 2013; Ahmad and Long, 2012; Hussain et al.2012; Halkos and Tzeremes 2011).

In Table. 6 Wald test is used to check the short term relationship between the variables, Wald test is applied after the results of the VAR model and the results clearly showed that all the variables are not connected in the short term except GDP growth. So it can be deduced from the results that GDP growth is associated with CO2 emissions in the short run as well as in the long run.

4. Conclusion

This research considered the EKC assumption and concluded the connection sandwiched between CO_2 emissions and energy consumption, agriculture value addition per worker GDP growth and population density by adopting statistical techniques such as unit root ADF, Johansen co-integration, and VAR model and Wald test for Pakistan from 1991 to 2010. All the variables are significantly affecting CO_2

emissions in Pakistan. These results are according to the theory of EKC. Results also clarified the long run relationship between the CO_2 emissions and energy consumption, GDP growth, population density and agriculture value addition per worker. So, it can be concluded that EKC is momentary as well as sustainable phenomenon in Pakistani environment and a new finding is the involvement of agriculture value addition per worker in developing EKC is also explored.

Policy makers should consider these issues to reduce CO_2 emissions in order to solve health and other threatening issues in future. Population control may also help to solve environmental issues in Pakistan. Energy consumption will be a threatening issue in future as in Pakistan energy consumption is ever increasing phenomenon. So at national level serious steps are needed to be taken into account in order to eradicate this alarming issue otherwise in future, Pakistan will face intense environmental chaos.

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Appendix

Table.1 (Descriptive statistics)

	AGR_VA_PW	ENER_CONSM	CO_2_EMI	LN_GDP	POP_DNST
Mean	1007.235	58.69381	0.774496	1.236163	187.0855
Median	1022.975	58.93101	0.738715	1.307947	188.5437
Maximum	1068.870	63.39008	0.969294	2.041986	224.6125
Minimum	863.7200	52.30527	0.597421	0.014293	148.1802
Std. Dev.	62.03184	3.131567	0.115101	0.574009	23.83634
Skewness	-1.169102	-0.417682	0.310259	-0.364983	-0.074858
Kurtosis	3.169335	2.275044	1.828205	2.279953	1.797276
Jarque-Bera	4.579891	1.019495	1.465122	0.876099	1.224134
Probability	0.101272	0.600647	0.480676	0.645294	0.542229
Sum	20144.69	1173.876	15.48993	24.72326	3741.710
Sum Sq. Dev.	73111.04	186.3275	0.251717	6.260229	10795.25
Observations	20	20	20	20	20

Table.2 Unit Root Test

Group unit root test: Summary

Series: CO2_EMI, AGR_VA_PW, ENER_CONSM, LN_GDP, POP_DNST

Date: 08/18/15 Time: 21:21

Sample: 1991 2010

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 3

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	0.51900	0.6981	5	85
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.75656	0.0001	5	85
ADF - Fisher Chi-square	35.9038	0.0001	5	85
PP - Fisher Chi-square	58.8897	0.0000	5	90

Table. 3 Johansen Co integration Test (For long term relationship)

Series: CO2_EMI AGR_VA_PW ENER_CONSM LN_GDP POP_DNST

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.997081	164.8758	69.81889	0.0000
At most 1 *	0.827430	59.82006	47.85613	0.0026
At most 2	0.647642	28.19489	29.79707	0.0756
At most 3	0.365984	9.418966	15.49471	0.3280
At most 4	0.065362	1.216720	3.841466	0.2700

Trace test indicates 2 co-integrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.997081	105.0558	33.87687	0.0000
At most 1 *	0.827430	31.62518	27.58434	0.0143
At most 2	0.647642	18.77592	21.13162	0.1035
At most 3	0.365984	8.202246	14.26460	0.3585
At most 4	0.065362	1.216720	3.841466	0.2700

Max-eigen value test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

CO2_EMI	AGR_VA_PW	ENER_CONSM	LN_GDP	POP_DNST
-76.97551	-0.045639	2.111109	-3.731621	0.191485
44.71895	0.048233	-2.882690	3.666514	0.021329
1.412170	-0.028744	-0.112865	4.256863	0.074028
48.60439	0.075572	-2.178152	4.584869	-0.094675
42.07181	0.052164	0.779078	3.817588	-0.489821

Unrestricted Adjustment Coefficients (alpha):

D(CO2_EMI)	0.006656	0.006270	0.002816	0.005716
D(AGR_VA_PW)	-7.234535	-8.683248	8.082740	-8.386460
D(ENER_CONSM)	-0.007461	0.345552	0.079978	0.172045
D(LN_GDP)	0.019411	0.286943	-0.186655	-0.051943
D(POP_DNST)	-0.093351	-0.008823	-0.031069	-0.021418

TABLE. 5Variance decomposition of CO2_EMI

Period	S.E.	CO2_EMI	AGR_VA_PW	ENER_CONSM	LN_GDP	POP_DNST
1	0.022405	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.031489	71.84419	2.898506	25.08169	0.130854	0.044759
3	0.040204	65.37803	1.780185	30.86266	1.911671	0.067453
4	0.049310	55.72500	4.203600	38.42673	1.546976	0.097689
5	0.056746	49.74264	3.609570	42.01445	4.511054	0.122280
6	0.064615	42.14173	3.659305	46.28136	7.781904	0.135707
7	0.071276	37.71829	3.249673	48.55326	10.34027	0.138508

Dependent Variable: D(CO2_EMI)

D(CO2_EMI) = C(1)*(CO2_EMI(-1) + 0.000592906336871*AGR_VA_PW(-1) - 0.0274257162193*ENER_CONSM(-1) + 0.0484780256372 *LN_GDP(-1) - 0.00248761152878*POP_DNST(-1) + 0.646255196284) + C(2)*D(CO2_EMI(-1)) + C(3)*D(AGR_VA_PW(-1)) + C(4) *D(ENER_CONSM(-1)) + C(5)*D(LN_GDP(-1)) + C(6)*D(POP_DNST(-1)) + C(7)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.512363	0.406501	-1.260422	0.2336
C(2)	-0.462147	0.335878	-1.375937	0.1962
C(3)	0.000718	0.000420	1.711053	0.1151
C(4)	0.020659	0.008317	2.483888	0.0304
C(5)	0.039122	0.021592	1.811921	0.0974
C(6)	-0.072928	0.021575	-3.380158	0.0061
C(7)	0.303334	0.085641	3.541919	0.0046
R-squared	0.615647	Mean dependent var		0.017307
Adjusted R-squared	0.406001	S.D. dependent var		0.029071
S.E. of regression	0.022405	Akaike info criterion		-4.473761
Sum squared resid	0.005522	Schwarz criterion		-4.127505
Log likelihood	47.26385	Hannan-Quinn criter.		-4.426017
F-statistic	2.936593	Durbin-Watson stat		2.076820

8	0.077370	34.25425	3.124758	50.64690	11.83886	0.135238
9	0.082174	32.54656	2.883506	52.19210	12.24806	0.129783
10	0.086273	31.65474	2.762884	53.62613	11.83276	0.123491

Wald Test (For Short term Relationship)

Coefficients	Probability value
C(2)	0.20
C(3)	0.10
C(4)	0.76
C(5)	0.08
C(6)	0.21