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Research Article

INVESTIGATE THE RELATIONSHIP BETWEEN ECONOMIC VARIABLE AND CO2 EMISSION: PANEL CO-INTEGRATION APPROACH (CASE STUDY: A SELECTION OF DEVELOPING COUNTRIES)

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ABSTRACT
The present paper deals with the relationship between population growth, energy consumption and economic growth in a selection of developing countries during the period 1999-2010 through the panel data approach. Findings indicated that there was a significant positive link between population growth, energy consumption and foreign trade with CO2emission. Findings also support the Environmental Kuznets Curves (EKC) theory in the studied countries.

Keywords*: C23, O57, Q51*

INTRODUCTION
Environmental issues have recently had an influence on the political decisions, particularly those concerning growth and development. In this regard, natural resources as the input needed for production and environmental quality as a welfare measure have been taken into account. The link between environmental issues and economic variables and development theories and experiences is being broadly studied (Valeria, 2006). One of the most important objections to the classical and neoclassical development theories is that they do not pay attention to sustainable development and achieving economic growth even at the expense of destroying the environment. While neoclassical economists believe that market performance should be as free as possible in such a way that the international division of laboris achieved desirably, environment advocates put forward the view that the capital flow should be done while considering all social and environmental costs of welfare and development (Daly 1991). Therefore, global economy is inseparably linked to the environment because for the sake of production it is necessary that natural resources be extracted, processed and then exploited.
Public attention to environmental issues started during 1960s and the main focus of this attention was the industrial pollution raised by increasing growth of industrialized economies. During the late 1970s, the issues relating to commerce and environment soared and environmental advocates arranged many protests and meetings throughout the world in reaction to the tragic situation of the environment caused by the increase in trade development (Holinger, 2008). Carbon Dioxide (CO2) is the main gas component of greenhouse gasses and is closely related to the use of energy as an input in economic activities (Azomahou, 2006). During recent decades, the commerce sector, together with other institutions, has had a determining and increasing role in the nations' economic growth and led to an increase in energy demand and its consumption. Since this trend in fossil energy consumption is followed by greenhouse gas emission and air pollution, it is expected that economic growth will increase environmental pollution. According to statesmen, a reduction in fossil energy-related economic activities is somewhat possible in short- and midterm and it cannot be reduced excessively, because this will lower the production levels and hence, the citizens' welfare levels. Kuznets (1955) proposed the environmental curve for the first

time in a study titled 'economic growth and income inequality'. He believed that in the course of economic growth, the association between per capita income and income inequality was in the form of an "inverted U". Based on his theory, the inequality of income distribution increases in primary stages of economic growth concurrent with an increase in the per capita income, but then, after reaching a certain level or turning point, this inequality will reduce gradually. In the1990s as some evidence of a link between various indexes of environment degradation and per capita income in form of an inverted U, similar to the one existing between per capita income and income inequality in original Kuznets' curve, this curve was introduced to environment-related studies as well and the aforesaid association between economic growth (or per capita income) and pollution indexes (environment degradation) as an inverted U, came to be known as the Environmental Kuznets Curve (EKC)

The first series of empirical studies on EKC was performed in three independent papers by Grossman and Krueger (1991) to assess the environmental impacts of North American Free Trade Agreement (NAFTA). Grossman and Krueger (1991, 1995) examined the EKC for SO2, cigarette smoke and suspended particles in air using the data measured by the Global Environmental Monitoring System (GEMS) and GDP per capita at the Purchasing Power Parity (PPP) scale for 52 cities in 32 countries during1977-1988.Their results indicated that the EKC hypothesis is confirmed in the group of studied countries. Shafik and Bandyopadhyay (1992) estimated the EKC for10 environmental degradation indexes including inaccessibility to safe and potable water and appropriate healthcare, deforestation, urban waste, sulfur oxides and carbon emission. The study sample included 149 countries during 1960 and 1990, and they used logarithmic-linear, logarithmic-quadratic functions and the logarithmic cubic polynomials function. Their results showed that while inaccessibility to safe and potable water and appropriate healthcare reduced consistently as income increased, urban waste, sulfur oxides and carbon emission increased over time. However, deforestation was independent of income level. Generally, air pollutants with the turning point at the income level between $300 and $4000 conformed to the EKC hypothesis. Panayoto (1992, 1993, and 1995) obtained similar results with the income turning point at a range of$3000-5000 for the mentioned pollutants using cross sectional data. He also found that deforestation with the income turning point around $800 supported the EKC hypothesis. On the other hand, Cropper and Griffith (1994) achieved a turning point of $4700-5400 in Africa and Latin America at the PPP scale for deforestation by using panel data method for 64 countries over a 30–year period. Grossman and Krueger (1991) studied the link between foreign trade and environment. In their study, the three effects of scale, composition and technology were separated and the direct and indirect effects of trade on air pollution were examined. The composition effect, in addition to income-related implications, includes any changes in economic structure in the combination of inputs and outputs, even specialization resulted from trade expansion. However, researchers suggest that the way trade affects pollution through the composition effect depends on whether a nation is at advantage in manufacturing polluting products or not. Myer and Kent (1993) considering the link between energy consumption and environment degradation pointed out that although the mean productivity of production factors increased with higher energy consumption after the industrial revolution and especially during recent decades, this consumption led to the degradation of the environment through its polluting impacts. This isbecause Carbon dioxide (CO_2) is the primary greenhouse gas emitted through the combustion of fossil fuels. Thus, the energy sector has the greatest contribution to the changes in environmental conditions, and therefore the energy policy and the environmental policy are very closely related. In the meantime,Alam et al. (2007) addressed the link between energy consumption and environment pointing out that energy overuse, especially fuels used to realize economic growth objectives and,the poor efficiency in their consumption would lead to increased pollution is one of the factors resulting in emission of greenhouse gases -including CO2-. Dietz and Rosa (1997) studied the effects of population and energy consumption on the environment and found that the elasticity of CO_2 emissions and energy consumption are close to unity. Also, an increase in population brings about an increase in CO_2 emissions. Rosa and York (2000) examined Kuznets hypothesis for several important air pollutants in Spain and concluded that the SO_2emission confirmed that theory but

this was not the case with regard to other pollutants. Ang (2007) investigated the dynamic causal relationship between CO_2 emission, energy consumption and GDP in France 1960- 2000. Results showed that economic growth accounts for the energy consumption and environmental pollution, and there was a *one-way causal* relationship from *energy consumption to* GDP *growth* in *short term*. Also, it was shown that *CO2 emissions increase with energy consumption*.

The purpose of this study is to examine the link between per capita income, foreign trade and energy consumption with CO_2 emission in 72 selected developing countries (including Iran)using the GMM. Also, the EKC hypothesis will be tested in this study.

METHODOLOGY

This model takes advantage of synthetic data as well as Chow Test and Hausman Test to evaluate model. The findings endorsed Fix Effects (FE) method and discarded Random Effects(RE) one .

Chow Test reject evaluating the pattern using pooling data. Put another way, it is impossible to use the least squares method to evaluate the pattern. Then we used Hausman Test and statistic to confirm Fix Effects (FE). Eviews8 software was used to do the tests

$$Co_2 = f(\ Gdp, Gdp^2, energy, trade, growth, urban)$$

CO_2: CO_2 emission *per capita* per *country i per year t*

GDP Per Capita is the GDP at purchaser's prices in constant 2000 U.S. dollars per country *i* per year *t*

(GDP Per Capita)^2: is the squareroot of the GDP per capita in constant 2000 U.S. dollars per country *i* per year *t*

Population Growth: is the population growth per country *i* per year *t*

Energy: is the energy consumption per capita per country *i* per year *t*

Growth is growth population country *i* per year *t*

Trade is ipoort + export country i per year t

All data required for this study was gathered from World Bank's official website for the study period.

Model estimation

Given the foregoing, the intended model is estimated using the GMM approach. The estimation results and the statistical tests are illustrated in Table 1.

Table 1: Model Estimation Results (CO_2 dependent variable)

(Prob)	T stasitic	Cofficent	Variable
0.000	8.87	0.152	Gdp
0.000	- 5.83	- 0.0024	Gdp^2
0.000	3.93	0.0152	Trade
0.000	11.87	0.371	Energy
0.000	9.88	0. 24	Growth
0.002	3.16	0.0155	Urban
R^2 = 0.99		Prob (F_Statistic) = 0.0000	

According to research results, the link between energy consumption and CO2emission is positive and statistically significant. That is, the CO2emission increases with energy consumption in the studied countries. Moreover, the relationship between foreign trade and CO2emission is positive and statistically significant. In other words, increased commercial transactions have a positive and increasing effect on CO2emission. Also, the increased population growth is associated with an increase in carbon dioxide emission. On the other hand, according to Table 1, CO2 increases in the studied countries at lower per capita income levels, in alignment with an increase of per capita income. But, at higher income levels, the intensity of resource extraction and environment destruction is reduced at higher per capita incomes. In

other words, at primary levels of development, increased per capita income results in environment degradation, whereas at higher income levels, more growth leads to better environmental performance, which supports the EKC hypothesis too. That is to say, the studied countries are in the descending section of EKC and with increased per capita income, the environmental situation will improve in these countries.

CONCLUSION

The present paper aimed at examining the relationship between per capita GDP, energy consumption and CO2emission in a selection of 72 developing countries using the GMM during 1999-2010. The results indicated a positive and significant association between energy consumption, foreign trade and CO2emission. Also, the results showed that increased population growth had a positive and significant effect on CO2emission among these nations; that is, population growth is followed by CO2emission growth. Also, the signs on the per capita income and square root of the per capita income terms were positive and negative, respectively which meant that during the primary stages of economic growth, concurrent with an increase in per capita income, the income distribution inequality elevates and after reaching a certain level or a turning point, this inequality decreases gradually. That is, a relationship in the form of an inverted U shape exists between per capita income and CO2, which supports Kuznets' environmental hypothesis in the studied countries.

According to the results, as energy consumption has a positive and significant effect on CO2 emission, policy making should be towards improvements in energy consumption and increasing the efficiency of energy consumption. Also, since population growth has a positive and significant effect on CO2 emission, any action towards reducing and moderating population growth within the studied nations can affect CO2 reduction.

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