

*Archive OF SID****Investigation of the Determinant of CO<sub>2</sub> Emission in Iran: Using Environmental Kuznets curve*****Vaseghi, E., Esmaeili, A.K.**

1-Ms.C., Department of Agricultural Economics, College of Agriculture, Shiraz University, Shiraz-Iran

2-Assoc. Prof., Department of Agricultural Economics, College of Agriculture,

Shiraz University, Shiraz-Iran

esmaeili@shirazu.ac.ir

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**Extended Abstract**

The gaseous composition of the Earth's atmosphere is changing at an accelerated rate because of the influence of human activities. Different factors increase the air contamination by CO<sub>2</sub>. Understanding factors affecting atmosphere gaseous is important for managing and reducing air contaminants. The natural presence of the so-called 'greenhouse gases' (water vapor, carbon dioxide, nitrous oxides and methane) in the atmosphere is essential for life. Greenhouse gases trap heat in the lower atmosphere and keep the Earth far warmer than it would be without such gases. Over the Earth's long history, the concentration of these gases has markedly decreased. This decline has occurred due to complex transformation processes that operate at different time scales and involve transfer of materials between the three carbon reservoirs: atmosphere, land biosphere and oceans. However, over the past century human activities have been releasing greenhouse gases (GHGs) at a rate unprecedented in geologic time. As a consequence of this acceleration in the rate of emissions, the concentration of GHGs in the atmosphere has increased by 30%, since pre-industrial times.

Among the greenhouse gases, CO<sub>2</sub> is the most important and about 60 percent of greenhouse gases derived by human activities are related to CO<sub>2</sub> emission. The main resource of CO<sub>2</sub> emission is fossil fuels that unfortunately now a day are the basic tools to generate energy in industrial-economic systems. Furthermore, energy is a main factor to achieve economic development which is highly needed for developing countries. It is worth noting that the report of greenhouse gases emission in 1994 (the base year for preparing the inventory of greenhouse gases in developing countries) in different sectors of the countries shows that the energy sector has had the biggest part (84%) in CO<sub>2</sub> expanse.

Recent empirical researches on relationship between certain environmental indicators of environmental degradation and per capita income concluded that, in some cases an inverted U relationship or Environmental Kuznets Curve (EKC), exists between the mentioned variables. But unfortunately in spite of the importance of this issue, a few studies have been developed on this subject in Iran. Therefore, the aim of this paper is to investigate factors affecting CO<sub>2</sub> emission in Iran by using Environmental Kuznets curve. According to the environmental Kuznets curve (EKC) hypothesis, at the first stage of economic development environmental pressures would increase as per capita income increases, but after a critical turning point these pressures diminish along higher income levels. The name is due to the similarity with the relationship between the level of inequality and per capita income considered by Kuznets (1955). The explanatory factors that most frequently appear in the literature are, first, environmental quality is considered as a luxury good whose demand increases at higher income levels; second, production composition changes with economic development and the increasing importance of the service and industry sectors, which is a 'more environmental friendly' sector, reduces the environmental impact of economic activity; and third, technological progress linked to economic growth causes a decrease of environmental pressures.

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Empirical model to test the EKC hypothesis in Iran for the period from 1974 to 2003:

$$CO_{2t} = f(E_t, T_t, P_t, S_t)$$

Where:

$CO_{2t}$ :  $CO_2$  emission in year t.

$E_t$ : per capita income (constant 1997 prices) in year t

$T_t$ : Deviation from mean temperature ( $C^0$ ) in year t

$P_t$ : price of fuel in year t

$S_t$ : share of value added in the industry sector of GDP (As an index of structural change) in year t.

The main purpose kuznets curve is to study the relation between  $CO_2$  and  $E_t$  in Iran. But as it was mentioned other factors must be involved. As the high rate of structural change is an inseparable part of the growth process and important components of this structural change are: gradual displacement of economic activities from agriculture to industry and lately from the industry to the services, and as the most amount of emission is from the energy and fuel sector, then two variables P and S can prevail the relation between  $CO_2$  emission and economic structure of Iran. In this study, fuel price was measured by the amount of consumes, thermal expenses and value of the different net fuels and was considered as a criteria for the total price of consumed fuels. The last variables that was considered in this model, was the deviation from mean temperature.

The purpose of importing this variable is to check the indirect energy consume. Hence due to the high amount of energy consume in winters for heating, deviation from the average of winter temperature was used in this study to show this factor. It is predicted that in winters because of the temperature reduction, the  $CO_2$  emission will be increased by the extra amount of fuel usage. Also it is worth noting that the most important purpose of this study is to test the Kuznets Curve hypothesizes for greenhouse gases in Iran.

Due to stationary test results, the auto regressive distribution lag (ARDL) is used to estimate the model. Considering the limited time period of this study, to determine the number of optimal lags of pattern variables, Schwarts Bayesian Criterion we used. The Result of estimation shows that considering the Schwarts Bayesian Criterion are chosen as ARDL (1.1.0.0.2.2.).

Also econometric tests confirmed the classic hypothesizes and there is no problem of auto correlation, specification error and non-normality of disturbance terms. The obtained determined coefficient is 99%, in other word this indicates that almost 99 percent of the dependant variable changes are explained by independent variables. In addition, the hypothesis of existence long term relation between model's variables was tested.

Since the critical content presented by Benerjee, Dolado & Master, is equal to -3.82, so the zero hypothesis is repelled and the result shows that there is a balanced long term relation between variables of Kuznets model in Iran. The estimated model is shows in Table 1.

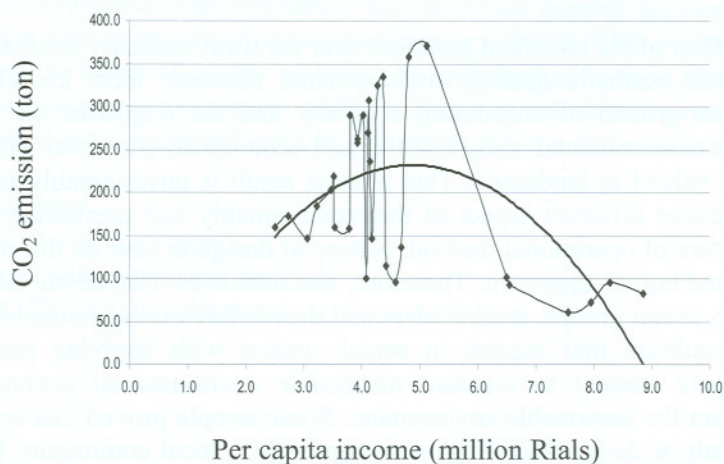
**Table1: Estimation of an Environmental Kuznets Curve for Iran  $CO_2$  emissions, (ARDL (1.1.0.0.2.2.))**

Variable	Description	Standard error	coefficient
C	constant	94.95	393.975 <sup>***a</sup>
E	per capita income at constant 1997 prices	44.31	154.598 <sup>***</sup>
$E^2$	Square of constant per capita income	3.72	-10.871 <sup>**</sup>
S	share of value added in the industry sector of GDP	3.6	124.994 <sup>***</sup>
T	Deviation from mean temperature in winter( $C^0$ )	13.46	-25.597 <sup>**</sup>
P	price of fuel	89.3	-125.040 <sup>[*]</sup>



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The sign of variable coefficient of per capita income is positive and sign of variable coefficient of square per capita income is negative, which illustrates there is second degree and inverted U shape between growth and CO<sub>2</sub> emission. In other words, this relation confirms the existence assumptions of Kuznets in Iran and shows that when per capita income increases, CO<sub>2</sub> emission increases first, and then from a point called turning point when per capita income increases, emission decreases. In this study turning point of curve is obtained 7.11 million Rials. This result of per capita income and CO<sub>2</sub> emission for Iranian economy according to used data in this study was showed in Figure 1.



**Fig. 1: Relation between per capita income and CO<sub>2</sub> emission in Iran**

Moreover, one can see that the share of value added of industrial sector from gross domestic product has positive and significant effect on emissions and in fact expresses the fact that changing economic structure, namely, the growth of industrial sector, increases emissions.

The sign of variable coefficient of deviation from the average of mean winter temperature as predicted is negative and significant and this result shows that whatever the temperature in winter is more than average of temperature in winter, it's required less energy to warming of places and in fact with less energy consumption, carbon dioxide emissions also decreased. In addition, fuel price variable also shows negative effect on emission. It is worth noting that the effect of this variable is significant at the level of 11 percent, and this shows low sensitivity of CO<sub>2</sub> emission into change of fuel price. Here can deduce that increasing of fuel price, decreases demand of it which reduces the carbon dioxide emissions indirectly.

In order to study relation between short-term emission of carbon dioxide and other variables that studied the error correction model (ECM) was used. The results of short-term pattern are the same as long-term relation. In addition, first order difference of fuel price variable isn't achieved significant in the short-term. Error correction sentence in ECM is significant and its sign is predictable (negative). The value of this coefficient is estimated -0.15 and can elicit such that in each year 0.15 of imbalance of a period will adjustment in the model of after period. In the other words, environmental policies in the form of carbon dioxide control takes time for about 6 years to reveal its full effect on the Iran's economy. Therefore adjustment towards balance can be done even though the process takes long time.

### Key words

CO<sub>2</sub> Emission, per capita income, Environmental Kuznets curve, Autoregressive distributed lag (ARDL)