International Journal of Academic Research in Business and Social Sciences
January 2013, Vol. 3, No. 1
ISSN: 2222-6990

Has CO_2 Emission Increased the Iranian Economic Growth?

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Abstract

In recent decades, damages of environmental effects have increased. These damages are due to different factors like population growth, economic growth, energy consumption and industrial activities. This paper is trying to investigate the Environmental effects of energy consumption and economic growth by using annual time series date (1971-2008) as well applying the Johansen-Juselius co-integration approach in Iran. The Findings show that if the consumption energy intensify increases one percent leaded to incline carbon dioxide gas emission near to 0.877 percent on average. Meanwhile, increasing one percent per-capita gross domestic product caused to raise per-capita carbon dioxide gas emission about 1.29 percent on average. Moreover, the results gained from Engel Granger Causality test demonstrated a mutual causality between the Iranian economic growth and volume of CO2 emission at 5 percent confidence level.

Keywords: Energy, The Environment, Economic Growth, Johansen - Juselius Co-integration Method.

Introduction

In recent decades, damages of environmental effects due to different factors like population growth, economic growth, energy consumption and industrial activities have been increased. The relationship between economic growth and environment is one of the important and complicated discussions. If in the path of sustainable development, economic activities and the environment be focused simultaneously, they as two compliment factors take economy toward equilibrium level (Emadzade et al, 2007). Executing any economic activity needs energy. So on one side, it considered as a stimulus engine of economic and social development and life quality improvement, and on other hand it causes the environment pollution. Especially if energy consumption accompanies with inefficiency, it intensifies pollutants production.

International Journal of Academic Research in Business and Social Sciences
January 2013, Vol. 3, No. 1
ISSN: 2222-6990

Iran known as a country which has wealthy and widespread underground reserves. Thus, it is so important to be investigated the environmental effects of energy consumption and economic growth given attaining high economic growth rate policy.

The main goal of this paper dominates on investigating economic growth and energy consumption effects on the environment pollution. Analyzing the sensitivity of per-capita carbon dioxide emission relative to economic growth and energy consumption are two basic questions which we are looking for. Paper framework divided into the following subsections: at first we review theoretical and empirical studies. Secondly it introduces estimation approach and research model. Then it continues with analyzing acquired results. Fourth stage is going to give us recommendations and final conclusions. Meanwhile our study by using the Johansen-Juselius co-integration approach is trying to find any co-integrated vector among the model variables. Then Error Correction Model (ECM) measured to determine short run relationship adjustment toward long run. The statistics related to per capita gross domestic products, share of industry sector, total population, urban population were gathered from time series database of central bank of Iran and date concerning energy ace intensify collected from Iranian energy balance sheet published by ministry of power. As well, the data related to per capita carbon dioxide emission were gathered from the World Development Indicators (WDI) website.

1. Research literature

Since the environmental pollutions posed as a social and economic matter, the study of determining effective determinants on the environment pollution has been started. Under this scope, almost respective elites and experts believe that some elements including energy consumption, economic growth, share of industry sector to GDP and population growth have key role in generating and extending pollution. Thus, at the following sections, it is mentioned according to the empirical and theoretical structures. Then the trend of gas emission and its related issues given the final released report of facts and figures of ministry of Iranian power is examined.

1.2 Theoretical framework

To specify the theoretical framework, paper presents its topics in three separate sections: 1. Economics and environment. 2. Economic growth and environmental effects. 3. The effect of the environment and population.

1.2.1 Economics and the environment

Economics is the knowledge of optimal use from sources. Applying this vital platform (economics) could enable individuals to use natural rare resources appropriately. But it should be indicated that individuals' benefits are not always along with the society benefits. So, due to this reason, using optimally these natural resources should be with collective benefits, considering future generations and minimizing environmental pollution and demolition (Behboudi et al 2008). In general, there is mutual reaction between economics and the

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January 2013, Vol. 3, No. 1
ISSN: 2222-6990

environment. Firms by utilizing economic resources like raw materials; capital, lobar and energy produce goods and services So that, during the processes, part of used inputs as wastages come back to environment. These wastages which generated often in the form of carbon dioxide gas, monoxide carbon gas, sewerage and rigid materials cause to pollute and generate negative externalities. Thus, as a result concluded that adopting any decision in an economy comprises unhanded opportunities (Abbaspour, 2007).

1.2.2 Energy Consumption, Economic Growth and the Environment

Because energy known as a stimulus force for productive and service activities therefore its outstanding position in economic growth and development is obvious. Economic literature indicates strong correlation between economic activities and energy consumption. The Ecologic economists state that energy is only the most important factor of growth so as under their view, labor force and capital used in production process as intermediate elements again need to energy (Stern, 2004: 4). Neoclassic economists' point of view like Berndt and Denison is unlike the ecologic economists. They believe that because Firstly, energy affects labor force and capital, so it is effective on economic growth indirectly not directly. Most of neoclassic economists' thought are based on this issue that energy input has a small role on economic production and it applied as an intermediate factor so that the basic factors are including: labor force, capital and land (Stern, 1993). Irregular energy consumption (especially fossil fuels) increases the environment pollutants. For instance, carbon dioxide emission is the most important green gas which pollute whether. Thus designing proper and practical plan at the aim of attaining high rate of economic growth is necessary (Alam et al 2007). Myer and Kent state that the relationship between energy consumption and the environment destruction is as follows: though, after industrial revolution, energy input increased average productivity but recently its pollution impacts on the environment are increasing (Shim, 2006).

1.2.3 Economic Growth and Environmental Effects

Because promoting economic growth rate caused to be used more natural resources and it generates grater undesirable pollutants Therefore, it is one of the pivotal factors which recognized as the origin of environmental changes. A lot of studies about this issue have been done. Environment Kuznets' Curve is a sample of that discussion. Concept of Environment Kuznets' Curve for the first time posed through Grossman, Krueger, Shafik and Bandyopadhyays' studies in 1990 decade. These studies along with the released global development report in 1992 represented that if technology, preferences and investment supposed be fixed, inclining economic activities result to more environmental destruction. As well, per capita income improvement increases demand to invest in environmental sectors. So it not should be definitely said that economic growth causes environmental destruction (IRBD, 1992). Bekerman extended the Kuznets' model. He believed that at the initial stages, economic growth has negative impact on the environment. But finally countries through gained profits and wealth can improve environment situations (Bekerman, 1992). The proponents of Environment Kuznets' hypothesis believe that at the high levels of development, economic structure is moving toward industries and services which are information intensive. Meanwhile

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at those levels, the environment awareness increases, useful environmental regulations implements and consumed expenditures rise to maintain and promote environmental settings. Generally, to specify the effects of economic growth on environment, it divided into three parts: scale effect, combination effect of inputs (or structural effect) and technology effect.

Scale Effect: extending production level provided been fixed technology level and inputs ratio increases environmental destruction.

Combination Effect of Inputs: where harmful inputs ratio rises, the destructive effect of economic growth on environment increases.

Technology Effect: improving production efficiency declines the used environmental inputs. It also downs production sewerages so as eventually bad and negative effects on the environment than before decline (Stern, 1998).

Environmental and Population Effects

In environment economics literature, population is one of the other effective elements on the environment pollution. Where population growth ups leaded to increase demand for agriculture lands, energy resources, water resources and etc. So it destroys forests and pastures, declining agriculture lands fertility and polluting more the environment. The researchers have investigated this issue by using time series and cross section date of developed and global countries. The results show that their population growth and individual factors are the main elements to pollute the environment (Sadeghi et al 2004).

There are two different views about the relationship between urban population and the environment pollution. The first view indicates that the impact of population increase on the environment pollution is positive. Because where urbanization increases, using infrastructure, transportation system and energy rise. As well, where economy transfers from the agriculture to the industry framework causes to increase the environment pollution. But the second outlook emphasize on urbanization culture which leads to reduce energy consumption in cities than urbane centers. So the relationship between population growth and the environment pollution could be negative or positive (Alam et al 2007).

2. Literature review

Dietz and Rosa (1997) investigated the impact of population and energy consumption on the environment. Their findings showed that the carbon dioxide gas and energy elasticity is closed to one. Population increase also inclines carbon dioxide gas emission. Study of tol and his associates (2006) about the long term relationship between energy consumption and carbon dioxide in United States over the 1850-2002 period demonstrated that the acceleration rate of carbon dioxide emission increases where the fossil fuels rise. Meanwhile they concluded that Population growth, economic growth and electricity of consumption growth are effective factors on carbon dioxide gas emission. Alam and his cooperators (2007) for the period of

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1971-2005 in Pakistan in a study (investigating impact of determinative factors on the environment pollution) pointed out that increasing gross domestic products and usage energy intensify pollute more the environment. Ang's study (2007) which was conducted during 1960-2000 period in Franc indicated that economic growth in long term is causality of energy consumption and the environment pollution. By the way, there is a unidirectional causality from energy consumption to short term production growth. Grossman and his teammate (1991) were the first researchers which proved invers u shape of environment Kuznets' curves between two economic growth and the environment pollution variables. Shafik, and Bandyopadhyay (1992) by using time series date confirmed the environment Kuznets' curve. Rosa and York (2000) employed the Kuznets' theorem for the several important weather pollutants in Spain. They concluded that SO_2 gas emission is only under Kuznets' theorem and other pollutants don't have consistency on that. Iranian researchers also have studied this part of economy. For instance, Sadeghi and Saadat (2004) through employing annual time series date investigated the causality between population growth and economic growth on the environment. The results showed that there is unidirectional causality running from population growth to environment destruction. Meanwhile, there is mutual causality between economic growth and the environment destruction. Barghi oskoeei (2008) studied the environment Kuznets' curve for the high, average and low per capita income countries over 1992-2002. He concluded that increasing trade and per capita income liberalization in high per capita income countries leaded to decrease carbon dioxide gas emission but in low per capita income countries, it inclines the gas. Pourkazemi and Ebrahimi (2008) attempted to study the environment Kuznets' curve by using annual time series data during 1980-2003 in the Middle East countries. That study employed two double logarithmic and simple models to investigate the environment Kuznets' curve. The results revealed that the simple model only confirms Kuznets' theorem.

Grunewald et all (2011) examined existing the Environment Kosnets Curve (EKC) for 163 countries over a period of 28 years. Tier results demonstrate that the EKC is verified for Germany or Belgium countries while the U inverse shape of environment Kuznets curve doesn't confirm for middle- and low-income countries.

The position of Iran under the facts and figures

Energy Indicators in Iran

Year	Population (Million)	GDP (10^{12} Rials)	Energy production (Mtoe)	Net export (Mtoe)
1974	32.0	196.6	312.8	288.3
1978	36.4	219.2	259.6	228.5
1989	53.2	191.5	164.2	97.6
1995	59.2	267.5	242.6	137.7
2000	64.2	320.1	247.6	129.6
2005	69.4	438.9	309.5	145.5
2006	70.5	467.9	316.1	134.9
2007	71.5	499.1	332.0	136.7
2008	72.6	501.0	332.0	127.2

Source: final report of Ministry of Power of Iran

GHG Emissions from Fuel Consumption in Iran, 2008

(10^3Ton)

Fuel / Gas	CH_4	CO_2	SPM	CO	SO_3	SO_2	NO_x
LPG	0.8	7184.5	-	12.7	-	0.03	1.8
Gasoline	27.6	58277.6	31.8	8573.8	-	36.7	330.7
Kerosene	0.8	18051.8	-	5.4	-	16.6	3.5
Gas Oil	4.6	96260.1	294.6	156.0	6.5	531.8	695.6
Fuel Oil	2.3	67785.4	18.6	60.4	9.1	992.0	192.3
JP4	0.002	252.2	0.1	36.9	-	0.2	1.4
ATK	0.02	3063.1	15.6	8.5	0.2	19.9	31.9
Natural Gas	8.9	260204.6	25.9	119.8	-	0.5	551.1
Animal wastes	0.04	144.6	•	•	•	•	•
shrubs and scrubs	0.3	836.8	•	•	•	•	•
Firewood	0.7	2725.8	•	•	•	•	•
Charcoal	0.001	3.5	•	•	•	•	•
Coal	0.0004	40.8	•	•	•	•	•
Coke oven gas	0.0001	327.3	•	•	•	•	•
Blast furnace gas	0.001	2050.9	•	•	•	•	•
Coke	0.1	642.8	•	•	•	•	•
Refinery gas	0.1	5060.1	•	•	•	•	•
Total	**46.2**	**522912.0**(1)	**386.8**	**8973.6**	**15.9**	**1597.8** (1)	**1808.3** (1)

In compliance with the above figure, the CO2, CO, SO2 and NOx gases have the biggest consumption in Iranian economy.

pollutant GHG Emission in Iran by sectors, 2008

(10^3Ton)

Sector/Gas	CH_4	CO_2	SPM	CO	SO_3	SO_2	NO_x
Total Final Energy Consumption:							
Residential, comm. Public	4.1	135098.4	13.0	67.8	1.6	131.6	125.7
Industry	2.3	85929.9	19.1	25.6	5.9	393.2	171.3
Transportation	35.4	122233.4	300.0	8685.9	4.7	419.1	885.2
Agriculture	0.8	13171.2	31.0	27.4	0.5	73.5	71.3
Energy Sector Uses:							
Refinery	0.4	19447.2	•	•	•	•	•
Power plants	3.3	147413.5	23.7	166.9	3.2	581.2	555.0
Total	**46.2**	**523293.6**	**386.8**	**8973.6**	**15.9**	**1598.6**	**1808.6**

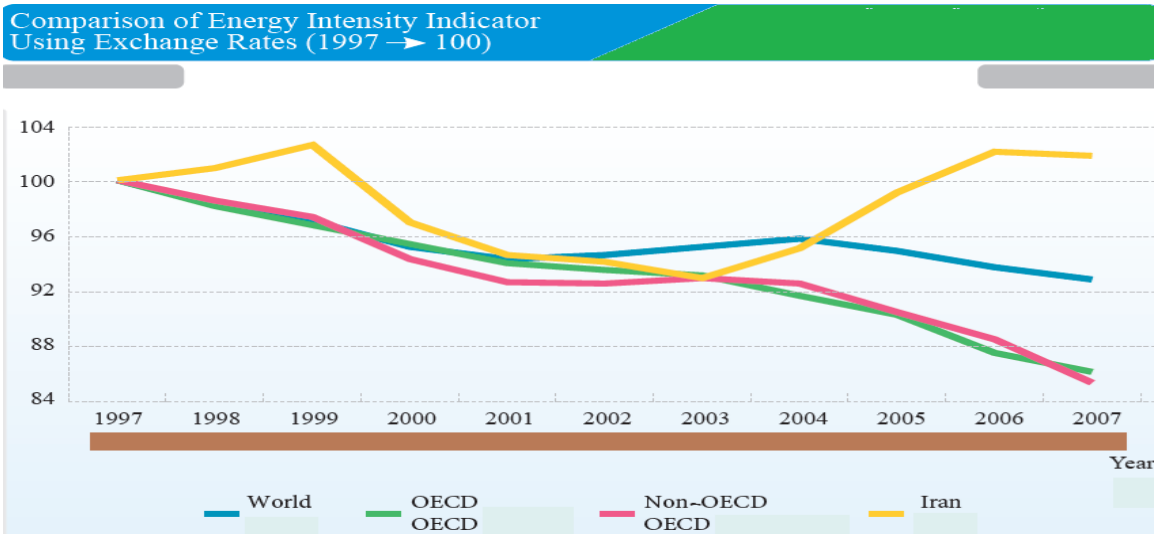
Source: final report of Iranian Ministry of Power

Key Indicator: CO_2 Emissions /GDP [1]

(Kg Co_2/ 2000 US $)

Country	2000	2001	2002	2003	2004	2005	2006	2007
Germany	0.39	0.39	0.39	0.39	0.39	0.37	0.36	0.34
Indonesia	0.44	0.45	0.45	0.44	0.44	0.44	0.43	0.45
UK	0.34	0.34	0.33	0.32	0.32	0.31	0.3	0.29
USA	0.58	0.58	0.56	0.56	0.54	0.53	0.51	0.5
Iran	0.82	0.83	0.81	0.8	0.82	0.82	0.86	0.84
Turkey	0.34	0.33	0.33	0.33	0.31	0.29	0.3	0.32
China	0.61	0.57	0.56	0.59	0.64	0.64	0.64	0.61
Japan	0.36	0.36	0.37	0.37	0.36	0.35	0.34	0.34
Saudi Arabia	0.89	0.91	0.97	0.94	0.95	0.95	0.97	0.99
Russia	1.48	1.41	1.33	1.27	1.17	1.11	1.07	0.99
France	0.25	0.25	0.24	0.24	0.24	0.23	0.22	0.21
Korea	0.56	0.56	0.53	0.52	0.52	0.49	0.47	0.46
India	0.41	0.39	0.39	0.37	0.36	0.34	0.34	0.33
World	**0.52**	**0.51**	**0.5**	**0.5**	**0.5**	**0.49**	**0.48**	**0.47**

According to the two above figures be seen that Iran doesn't have appropriate status than other industrialized and developing countries that having extensive volume of industrial products.



Source: final report of Iranian Ministry of Power

Given the figure, the energy intensify index as a proxy of energy efficiency of Iran economy in compare with the other regions is high so that its value after 2003 has been accelerated considerably.

3. Model specification

As before mentioned, the aim of this study is to investigate energy consumption and economic growth effects on the environment. The literature review indicate that the environmental effects levels depend on per capita income, energy consumption and population growth. Our model which used is based on Atiripat model and adopted from empirical study applied by Alam et al (2007) specified as follows:

$$CO2 = f(GGDP, IS, POPG, URBN, ENERGY) \qquad (1)$$

$$CO2_t = C_1 + C_2 GGP_t + C_3 IS_t + C_4 POPG_t + C_5 URBN_t + C_6 ENERGY_t + \varepsilon \qquad (2)$$

$CO2$ Indicates per capita carbon dioxide gas emission, GGDP is symbol of per capita gross domestic products, IS term is share of industry sector to GDP, the POPG is total growth rate of population, URBN shows urbanization population (per 1000 persons), ENERGY states use energy intensify and finally ε term is related to residual value.

International Journal of Academic Research in Business and Social Sciences
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ISSN: 2222-6990

3.1 Model estimation

3.1.1 Investigating variables stationary and determining optimal order of VAR model

The first supposition in time series date is the stationary. Each time series is product of a stochastic or random process. Meanwhile a continues collection of data are a real realization from the main stochastic process (means that it is a sample of stochastic process). Generally, where a stochastic process is stationary that its mean and variance be fixed over the time passing and it`s co-variance value among the two periods of time only be depended on the interval of two periods of time (Gujarati, 2005: 909). So to escape from spurious regression is binding to be tested the stationary. The following table represents this vital stationary test according to top to bottom philosophy.

Table (1): Stationery test (Adjusted Dickey Fuller test)

variable	Verified in	Include in test equation	Critical value
LCO_2	I(1)	none	%5
LGGDP	I(1)	Intercept	%5
IS	I(1)	none	%1
LGPOP	I(1)	none	%5
LURBN	I(1)	none	%5
LENERGY	I(1)	none	%5

Source: Authors' finding

In compliance to above table, all variables are stationary in first difference. At the second stage tried to be specified the optimal order of model and existence or not existence of co-integration vectors among the variables under Johansen - Juselius method. To determine the order of model, Schwartz criterion selected, so that it had the optimal order of one.

3.1.2 Investigating co-integration vectors

The results of co-integration vectors existence by using maximum approach of eigenvalues and trace matrix have shown at tables 3 and 4 as follows:

Table (2): Trace matrix test (***λtrace***)

Null hypothesis	Alternative hypotheses	The statisic	Critical value at 95% level	Probe value
r=0	r≥4	71.12	68.96	0.0478
r=1	r≥2	42.54	46.65	0.198
r=2	r≥3	22.101	27.77	0.332

Source: Authors' finding

Table (3): Eigenvalues maximum test (λmax)

Null hypothesis	Alternative hypotheses	The statisic	Critical value at 95% level	Probe value
r=0	r=1	27.44	32.67	0.201
r≤1	r=2	20.54	26.34	0.265
r≤2	r=3	8.78	19.98	0.711

Source: Authors' finding

So the following regression model shows the co-integrated vector:

$$LDCO2 = 1.29LDGGDP + 0.21LDIS + 0.011LDGPOP - 1.01LDURBN + 0.87LDENERGY \quad (3)$$

3.1.3 Estimating Error Correction Model (ECM)

At this stage, the restrictions imposed on $LDCO_2$ variable to estimate the ECM value. Therefore the results of this process gained as follows:

$$DLCO2 = 0.486 - 0.601ecm(-1) \quad (4)$$

4. Empirical results

According to gained co-integrated vector concluded that elasticity of per capita carbon dioxide emission relative to gross domestic products is positive. This coefficient value (1.29) states that where GDP quantity increases one percent leads to incline CO_2 gas emission near to 1.29 percent on average. The elasticity of carbon dioxide gas emission relative to energy intensify is positive and significant So as, where it increases one percent caused to incline per capita CO2 emission about 0.877 percent on average directly. The major reasons to justify this high value of coefficient explained through lack of efficiency in energy usage, using some energy carriers which release more pollutants, technology deficiency and etc. Meanwhile, the coefficient of urbanization variable shows whatever this process increases; greenhouse gases emission intensifies more the warming. The results of ECM model confirm the long run relation among logarithmic forms of CO_2 gas emission and per capita gross products, share of industy sector, energy intensify urban population and population growth rate. The ECM coefficient is significant. It demonstrates that the adjustment velocity of short term error toward long run period is high. In a sense, the equilibrium error of short run adjusted in lesser time.

Moreover, the results gained from Engel Granger Causality test demonstrated a mutual causality between the Iranian economic growth and volume of CO2 emission at 5 percent confidence level.

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ISSN: 2222-6990

5. Conclusion

The study tried to show whether there is a positive and significant relationship between the Iranian economic growth and CO2 emission under the Johansen-Juselius co-integration and Engel Granger causality techniques. The results showed that there is a significant and positive relationship between the Iranian economic growth and CO2 emission variables as far as the causality test also confirmed a mutual relationship between the variables. Facts and figures showed that Iran in terms of having advanced and efficient technology rather other industrialized and even developing countries doesn't have proper statues so that regardless utilizing suitable technologies can't generate competitive position in the global village as far as even it has bad consequences by the international associations in terms of imposing tremendous taxes and penalties.

6. Recommendations

Promoting technological application of industrial and transformational systems which have tremendous effects in decreasing the environment pollution could have key and essential role.

Reforming the subsidy distribution system in order to optimize energy consumption can be useful to control the pollutant emission (So that Iranian government is implementing that policy now).

Allocating efficient and sufficient financial resources to investors who are importing advanced technologies.

Trying to reduce the energy intensify through cooperation of all sectors including: people, economic firms, industries, government and etc.

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January 2013, Vol. 3, No. 1
ISSN: 2222-6990

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