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The Effects of Energy Consumption and the Financial Sector on Environmental Pollution,Case Study: Iran

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Abstract

Environmental pollution and factors affecting it are important in any economy. The main goal of this study is the impact of economic growth, energy consumption, financial development and economic openness on environmental pollution in the Iranian economy during 1994 to 2023. Then the environmental Kuznets hypothesis is of particular importance to consider. The model estimate of environmental pollution is the new form of econometric method like dynamic model of Auto-regressive Distributed Lag (ARDL) and Johanson-Joselius. Results show positive relationship between per capita income and environmental pollution variables. The relationship between squared per capita income and environmental pollution are negative. So the environmental Kuznets hypothesis was true in Iran, and Iran is on the upward environmental Kuznets curve (EKC). Between energy consumption and pollution there is also a positive relationship. Though there was no clear relationship between the financial development and economic openness variables with the environmental pollution.

Keywords: Environmental Pollution, Energy Consumption, Economic Openness Index, the Financial Sector.

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Introduction

Economy is the knowledge of the optimal use of resources. Understanding of economics enables us to optimize use of scarce resources. We should note that personal benefit does not provide community benefits. Thus, the optimal use of natural resources in the collective benefit of future generations and to minimize environmental degradation and pollution must be done. In general, there is a bilateral reaction between economy and environment. Firms using the economic resources, including raw material and energy, produce goods and services. Inputs used in the production process, as residual waste return to environment. These forms of waste gases, mainly carbon monoxide, carbon dioxide, sulfur dioxide and solid waste and sewage cause pollution or impose external cost to society. Thus, any decision taken in consideration to economy is facing with opportunities.

With the goal of economic policies to achieve high level economic growth, the environmental hazards caused by economic activities has become a controversial topic. With regard to this aim in recent decades, some environmentalists from the view of "market failure" are opposed to free trade and economic growth and they are likely to consider the necessity of governments intervention. On the other hand, there are some bodies who believe that to achieve a healthier environmental and poverty eradication, economic growth is necessary. Thus the subject of conflict between economic growth and environmental quality become an issue in the economy. So that today the countries realized the importance of environmental issues, thus in terms of mutual risk and need in respect to this issue has set the status of national legislation and international agreements. Countries in this regard seem to be looking for reducing environmental pollution during the development process, and to continue with this, are following different views about the sustainable development. Economic growth is the main purpose of the economic policies of many governments. However, rapid economic growth often is causing serious losses to the environment. Hence, a potential conflict between economic policies and environmental condition exists. The answer to this question would be given that, whether environmental control and restricting the economic activities with regard to pollution as a by-product of these activities, that reduces human welfare in the long run, and some times in the short run, is necessary. This question has been analyzed in many studies of various aspects. But the centrality of environmental Kuznets curve hypothesis is in their studies.

1. The relationship between economic growth and air pollution

Studies of the environmental Kuznets curve in recent years, has established the relationship between economy and environment as well. Many believe that along with economic growth, pollution reduces. This attitude, however gathered many empirical studies and theoretical justification, including environmental Kuznets curve (EKC), but still has not achieved enough

comprehensiveness and acceptability. The reason would be a lack of strong theories basis, limited to the EKC studies and based on the air pollution and global issues.

Environmental Kuznets curve hypothesis, show that relationship between some of the indicators of environmental pollution and one of economic growth indicator (usually per capita income), is an inverted U-shaped relationship. In other words, increasing in the economic activities increased the environmental pollution but after reaching the maximum level of pollution, due to community awareness of environmental degradation and more toward a service economy, the downward curve starts. This means that after the curve peak, the economy is reducing the use of material and energy in the production process.

At the time to achieve high economic growth increased literacy and knowledge of citizens and people against the pollution of air, they react and protest and with the economic growth, technology advances used in the production process creates less pollution. On the other hand, in the societies that have a high level of growth, measurement and control of pollution is a serious issue and Pollution levels are consistently reflected in the media and public opinion. So in resisting the pollution and totally in resisting the pollution sources, organized groups of people make some protests. In these societies, comprehensive set of environmental legislation ordained and is strictly enforced. Some governments on pollution activities, imposed environmental fines, then producer can stop pollution activities or the manufacturer has to use filters. In other words firms are forced to internalize the pollution. The message of the hypothesis is clear in fact and is that the economic growth is both a cause and a remedy of pollution. Therefore when the economy reaches to the immaterial growth, economic growth becomes the treatment of environmental problems.

2. The relationship between energy consumption and environmental pollution

The economic literature suggests a strong relationship between the level of economic activities (economic growth) and energy consumption, because energy is a driving force of most production activities and services and has a special place in the growth and economic developments. Ecological economists like Nair and Aires (2006) stated that in the biophysical growth models, energy is the single most important factor for growth, in terms of labor and capital so that they are intermediate factors that need to use energy (Stern, 2004). The view of neoclassical economists such as Berndt and Denison (2007) is opposed to ecological economists. They believe that the energy by its affect on the labor and capital indirectly affects on the economic growth. Most neoclassical economists believe that it is a principle that energy has a small role in economic production and the basic factors of production are labor, capital and land (Eastern, 1933).

But indiscriminate use of energy, especially fossil fuels for economic growth objectives and further weakness in the efficiency of its use will increase environmental pollution. So that the consumption

of fossil fuels in Production, trade, service, household is one of the most important air pollution, greenhouse gases are causing.

Carbon dioxide is the main constituent's greenhouse gases. Emission of CO2 directly related to energy use and there is a strong correlation between the use of fossil energy, emission of CO2 and economic activities. On the other hand, there is a minimum level of emission associated with economic activities that can not be reduced, because in this case with the existing technology, decrease production levels and thus the welfare of the citizens. This is the main reason for the unwillingness of some countries to reduce of CO2 participation. Thus the problem of reducing carbon dioxide due to lack of incentives for reducing energy consumption and energy use of less polluting and renewable returns(Azomoha et al, 2006).

Now greenhouse gas emissions and atmospheric pollutants reduction make up the most important energy and environmental policies of the world. Many factors such as economical status, demographic, technological changes, institutional framework, international trade and lifestyle can affect emissions. Energy consumption cause over 80 percent of greenhouse gas emission that is caused through production process, transportation and consumption of different types of energy. Therefore energy and environmental policymakers should consider the changes to the co2 emission. The UN Human Development Report in 2007 mentioned that Iran had 1.5 percent of global emissions of carbon dioxide and it was thirteenth in the world.

3. The relationship between economic openness and environmental pollution

The environment of any country is not only affected by the domestic economy, but also by the changes in the foreign trade. This interaction of the environment with foreign trade, mainly takes place through trade liberalization. In fact, one of the major criticisms on environments Kuznets curve, is the lack of attention to the pattern of foreign trade. However, the pattern of trade resulting from the pollution haven hypothesis (PHH) is one of the main reasons for the reduction of pollution in countries with high income levels and increasing levels of pollution in countries with low income. So based on the pollution haven hypothesis (PHH), the difference in intensity between the environmental policies and practices in different countries will be leading to a comparative advantage in producing goods in countries with highest pollution intensity which has lighter environmental policies while the countries with intensive environmental policies become more skillful in producing clean products and import more polluting products from other counties.

Based on this hypothesis since developed countries have more intensive environmental policies than developing countries, active polluting industries in developed countries transfer operation and process of their products from developed countries to developing countries with lighter environmental policies, thus developing countries have become a base to absorb polluting industries. The conversion of developing countries with light environmental policies to a base of

polluting industries is explanatory according to the accessing these countries to relative advantage. According to the theory of relative advantage, the countries will be skillful in producing goods and services and export which will have less costs compared to other countries and instead they will import good and services which produce these goods and services with much more prices than other countries. Therefore, if low environmental standards in one country become a source of relative advantage and a factor to transfer polluting industries to these countries, in that case pollution haven hypothesis (PHH) will be confirmed and this will make some changes in the patterns of trades between the countries.

4. The relationship between financial development and environmental quality

The clearest reason using the financial development as an effective variable on the environmental pollution is that the existence of a suitable financial development will absorb foreign investment which in turn will affect the economic growth and therefore the characteristics of environment (Franklin and Romer). In addition, financial development will lead to the movement of financial resources for the environmental plans in reducing financial costs. (Tamaziyan). Because environmental plans have public sector activity, Tamazian and Rao showed that the suitable function of other governmental sectors are advantageous in achieving financial recourses for these plans. Anyway, financial development may lead to professional innovations (King and Levine). The technological developments can play an important role in reducing environmental pollution especially through energy sector.

The way of affecting foreign direct investment on the quality of environment is different especially in developing countries. Some scientists such as Stern (2004) believe that foreign direct investment can affect the quality environment due to influence economic growth. They conclude emphasizing Kuznets environment hypothesis indicating U converse relationship between economic growth and the quality of environment that developing countries are still in left part of the curve and make worse their environmental qualities by increasing the rate of foreign direct investment which help their economic growth.

Also, some scientists stating the pollution haven hypothesis conclude that entering foreign direct investment to developing countries will increase pollution and destruction of environment. Because the pollution haven hypothesis states that developed countries, especially those which are active in polluting industries, often tend to spread their polluting industries to countries which have weaker environmental standards. This is done through trade and foreign direct investment. The result of entering foreign direct investment to the host country with low level of environmental standards which often have little income is the growth in pollution.

Grossman (1995) believes that foreign direct investment with changes in the pattern of production and on the basis of Ribsinzk theory: stating that assembling human reassures lead to development

of clean industries and as a result can lead to decreasing pollution, conversely increase the development of physical capitals of polluting industries and can lead to increasing pollution, affecting environment. Countries in the first steps of development develop through gathering physical capitals and in the next development steps continue their development by acquiring effective human power. Therefore, by accumulating capitals in the first steps the rate of pollution will be increased and by the growth of annual per capita income and economic movement from industry to services and using labor force instead of capital, the pollution will be decreased. Thus, under this theory, the countries with much physical capital regardless of the available differences in environmental policies tend to export polluting goods and also, foreign direct investment with changing the production pattern to labor or capital intensive will affect the quality of environment.

From the other side some scientists accepting the Porter theory conclude that entering the foreign direct investment can help to decrease the pollution and improvement of the quality of environment in host countries. Because according to Porter theory, entering foreign direct investment as a production factor can accelerate the economical growth of the host country which accessing to clean technologies and compatible with environment can help to the improvement of environment (Dinda, 2004, List et all , 2000, Noll , 2001).

Experimental Studies

Abdoljalil and Met Feridon (2011) in their study entitled as the “effect of economical growth, energy consumption and financial development on the environment in China” have studied how these variables affect the pollution of the environment. The main purpose of this study was investigation of the long run equilibrium relationship between financial development and environmental pollutions. The results achieved by the analysis show a negative sign for financial development parameter.

Minah and Rafael (2010) in their research "Energy consumption, spreading out of pollutant emission and economical growth in South Africa" have investigated the relationship between energy consumption and economical growth with pollutant emission for the period of 1965-2006. Using the co-integration test, they found that the variable in short run have a significant and positive relationship with pollutants emission and economical growth. In addition, using the filled form of Granger test, they found a unilateral relationship from carbon dioxide emission to economical growth and from energy consumption to Co2 emission.

Fotros and Nasrindoost (2009) in their article "the relationship between air pollution, water pollution, energy consumption and economical growth in Iran during 1880-2004" have investigated the effects of some variables on the water and air pollution. The results indicate three unilateral causality relation: a) from carbon Dioxide emission to per capita income B) from carbon Dioxide emission to per capita energy consumption and c) from per capita energy consumption to water

pollution. The Kuznets theory for carbon Dioxide emission, per capita income, water pollution, per capita energy consumption is rejected and for the carbon Dioxide emission, per capita energy consumption relationship is accepted.

Halicioglu (2009) investigated in the study entitled as “economical study of carbon Dioxide emission and energy consumption, income and foreign trade in Turkey”. The results of test indicate that two cases are conceivable in the long run relationship of variables. For the first case long run relationship, carbon Dioxide emission can be determined by energy consumption, income and foreign trade. For the second case of long run relationship the income can be determined by carbon Dioxide emission, energy consumption and foreign trade.

Jalil and Mahmoud (2009) in the study "environmental Kuznets curve for Co2 emission in China using co-integration analysis" have investigated the long run relationship between carbon Dioxide emission and energy consumption, income, and foreign trade using time series date of 1975-2005. In particular, the study was performed with the aim of the environmental Kuznets curve (EKC) in China which shows the relationship between Co2 emission and per capita real gross domestic product. The autoregressive distributed lag Method (ARDL) was used for analysis and the second degree relationship between income and Co2 emission which shows the environmental Kuznets correctness for the period was confirmed. The results achieved from causative Grenger test show that there is a unilateral relationship from economic growth to Co2 emission.

Bargi Oskouee (2008) in his study " the effects of trade liberalization on the greenhouse gases emissions (Carbon Dioxid) in Koznt's environmental curve”; has studied the trade liberalization according to three factors of scale, combination and technology. The results of estimating model indicate that the increasing in trade liberalization and per capita income in countries with high per capita income and in countries with average per capita income lead to decreasing carbon Dioxide emission and in countries with average low per capita income and countries with low per capita income lead to increasing carbon Dioxide emission.

Behboudi and Golozani (2008) in their study entitled as the “effect of energy consumption and economical growth on environment in Iran” have attempted to study the relationship between energy consumption and economic growth on environmental pollution. The results gained by estimating long run relationship indicate that the intensity of using energy has a positive effect on environmental pollution and elasticity of excretion of carbon dioxide in respect to intensity of energy consumption is slightly less than one. From the other side, increasing per capita gross domestic product leads to increasing carbon Dioxide emission and polluting the environment, and elasticity of carbon Dioxide emission with respect to per capita gross domestic product is positive and more than 1.3.

Ang (2008) in the study entitled as the “relationship between long run economic development, pollution and energy consumption in Malaysia" has investigated this relationship in that country during 1971 to 1999. In this study using co-integration analysis method, he investigated the

relationship between variables, and this result is gained that in short run and long run the economic growth lead to energy consumption, and energy consumption leads to pollution.

Pajoyan and Moradhassel (2007) in their study “the investigation of the effect of economic development on air pollution" have tried to examine the effect of economic development on air pollution under the Kuznets' environment curve theory for 67 countries with different income groups (including Iran) using combined data methods (panel). For this purpose, the effect of economical growth, city population, environmental rules, the numbers of cars and the degree of economical openness' on the rate of air pollution were investigated. The results of this study indicate that the relationship between economical development and the level of environmental destruction is a kind of reverse U which indicated the good establishment of Kouzne's hypothesis. The results have confirmed the establishment of Kouzne'senviromental curve in investigated countries.

Ghorbani sepehr et al (2020) in their study “Investigating the effect of climate change on air pollution in metropolises" have reached these results that climate change itself is one of the results of the increase in the emission of pollutants in metropolitan areas, which has now overshadowed all aspects of human life. At the same time, climate change can be achieved through; Global warming, increasing emissions of some major pollutants such as ozone and particulate matter, forest fires, migration, metropolitan population growth, urban health threats, inversion and the creation of thermal islands are affecting metropolitan air quality.

Model Specification

In this study, using the Abdolmajid Model from Qaed university of Pakistan and Met Feridon from Middle East university of Turkey in 2011, we will investigate the effects of some Macro economy variable on the environmental pollution in Iran.

The Total from which is used and the name of variables in this study are as follow:

$$Co_2 = f(y_t, y_t^2, e_t, fdev_t, openj_t, \ldots) \quad (1)$$

here (Co2) environmental pollution, (y_t) national per capita income, (y^2) square of per capita income, (e_t) energy consumption, ($fdev_t$) financial development, ($openj_t$) openness of the economy.

Therefore, according to the above mentioned explanations, the general from of Model is introduced:

$$Co_2 = \alpha_0 + \alpha_1 y_t + \alpha_2 y_t^2 + \alpha_3 e_t + \alpha_4 openj_t + \alpha_5 fdev_t + \varepsilon_t \quad (2)$$

$$Co_2 = \alpha_0 + \alpha_1 y_t + \alpha_2 y_t^2 + \alpha_3 e_t + \alpha_4 openj_t + \varepsilon_t$$

$$Co_2 = \alpha_0 + \alpha_1 y_t + \alpha_2 y_t^2 + \alpha_3 e_t + \varepsilon_t$$

$$Co_2 = \alpha_1 y_t + \alpha_2 y_t^2 + \alpha_3 e_t + \varepsilon_t$$

Stationery Test of Variables

In the present study, the stationery test of Model variables was performed using the augmented Dicky-Foller test in the level of variables.

The results of this test in the level and first difference for non stationery variables in the provided models are in table (1).

Table 1. Unit Root Test

Variables	With constant term (C)				With constant and trend term (C+T)			
	ADF Statistic	Critical value in level of 5%	Number of Lag	Consequence	Test of statistic	Critical value in level of 5%	Number of Lag	Consequence
CO2	1.9492	-2.9850	1	-	-2.2206	-3.6027	0	-
ΔCO2	-6.9609	-2.9907	0	I(1)	-7.9780	-3.6119	0	I(1)
y	5.2503	-2.9850	2	I(0)	5.0677	-3.6027	2	I(0)
y^2	7.0742	-2.9850	2	I(0)	4.8800	-3.6027	4	I(0)
e_t	-0.8621	-2.9798	1	-	-3.0007	-3.5943	2	-
Δe_t	-3.5828	-2.9850	0	I(1)	-3.5616	-3.6027	0	I(1)
fdevt	3.4581	-2.9798	1	I(0)	1.5197	-3.5943	1	I(0)
$openj_t$	1.3867	-2.9850	4	-	0.9338	-3.6027	4	-
$\Delta openj_t$	6.0293	-2.9907	2	I(1)	3.3657	-3.6119	2	I(1)

As it is seen in table (1), the variables of per capita income and its square, and the index of financial development in its level was stationery, but variables of carbon Dioxide emission, energy consumption and the index of openness of economy become stationery with first difference.

As we know, in this case using the usual OLS method leads to producing unreal regressions, so for the effective evaluation of model it is better to use ARDL Method.

This Method is not sensitive to co-integration degree of explanatory variables and they are used regardless that the variables are I(0) or I(1), and choosing a appropriate lag in the model, an consistent estimate from coefficient of long run and short run can be achieved. For the investigation of long run relation between the model variables due to stationery some variables and stationery of some variables whit first difference, Johanson- Joselius Method can be used. In this study both methods are used for the investigation of this relationship and the results are compared with each other.

Estimation of Short Run Model

In short run Model, for determining the optimum lag Schwartz-Bayesian criteria will be used. Schwartz-Bayesian criteria use the least lag in choosing optimum lags. According to this criterion the dependant variable the carbon Dioxide emission with one lag and other variables without any lag will be chosen in the model. The results of short run model can be seen in table (2).

Table 2. The Results of Estimation of Short Run Environmental Pollution Model Using ARDL Method

Variables	Model (1)		Model (2)		Model (3)		Model (4)	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
CO2	0.364	2.04	0.424	2.6	0.53	3.67	0.525	3.90
y	17143.2	2.65	15402.6	2.53	7855.7	3.06	8041.5	3.54
y2	-110.13	-1.75	-120.31	-1.96	-157.71	-2.82	-160.54	-3.07
et	133.89	3.86	130.24	3.81	118.81	3.52	116.88	3.77
fdevt	30412	0.84	-	-	-	-	-	-
openjt	-0.41	-1.59	-0.31	-1.36	-	-	-	-
C	-47991.1	-0.73	4779.7	0.26	-2969.6	-0.17	-	-
R2	0.982		0.981		0.979		0.979	
t	198.13		240.65		290.02		402.32	

Because of positive coefficient of per capita income variable and negative coefficient of square of this variable which is significant, the positive relationship between economic growth and environmental pollution is confirmed. In addition, environmental Kuznets hypothesis is true for Iran,

and since the coefficient of per capita income is positive and square of per capita income is negative then Iran is still to upward part of this curve.

The positive coefficient and significance of energy consumption variable indicate that increasing of energy consumption, the environmental pollution increased. Although the coefficient of financial development variable is positive, because of insignificancy of this variable, a clear relationship between these two variables cannot be found. Because of the insignificancy of coefficient of economic openness variable, a clear relationship between the economic openness and environmental pollution in Iran cannot be found. Coefficient of determination is 98% which indicates the powerful explanatory of model and F statistic for Model is completely significant. That is, none of the coefficient of Mode is simultaneously zero. Based on the results except for the variables of financial development and openness of economy variables, the rest of variables (per capita income square of per capita income, energy consumption) are significant.

Now, to find out which of the insignificant variables is unnecessary, the variable omission test is done in the main model for which the results are given in the table below:

Table 3. The Results of the Test of Variable Omitting

Variable name	Financial development index omitting		Openness index omitting		Constant omitting	
Test name	Significance level	Statistic	Significance level	Statistic	Significance level	Statistic
LM Test	0.341	0.90669	0.141	2.1642	0.853	0.3422
LR Test	0.337	0.92116	0.134	2.2492	0.853	0.3442
F Test	0.409	0.71003	0.186	1.8549	0.868	0.2835

The three statistics of LR, F, and LM are illustrated in the table, for omitting the insignificant variables test. Based on the level of significance of financial development index and omission of economic openness index, we find out that the Null hypothesis (H_0) cannot be rejected for unnecessary of investigated variables. Thus, it can be said that both of the variables are unnecessary. Therefore, we delete each of these variables from the main model one by one, and evaluate the second and the third model on this basis. The results of estimation the three models are illustrated in table (3). Finally, because of the insignificancy of constant coefficient model estimated without it. Omitting the unnecessary variables the sign of remained variables is fixed in the fourth model and their value is not changed much.

Estimation of long run Model

Now, the existence and nonexistance of long run relationship are investigated in each of estimated models using Banerjee, Dolado and Mestre testes. In this case, the null hypotheses for the absence

of long run relationship against the one hypothesis for the presence of long run relation are examined as follow.

(3)

$$H_0 = \sum_{i=1}^{P} a_i - 1 \geq 0$$
$$H_1 = \sum_{i=1}^{P} a_i - 1 < 0$$

The result of statistic for the above test is illustrated as follow.

Table 4. The Results of Banerjee, Dolado and Mastre Test for Investigating the Long Run Relation in ARDL Model.

Model	Model 1	Model 2	Model 3	Model 4
Statistic	-3.56	-3.60	-3.36	-3.52
Critical value in level of 5%	-3.35	-3.35	-3.35	-3.35

Since the provided critical quantity by Banerjee, Dolado and Mestre is – 3.35 in %95 confidency, therefore, the calculated statistic for the each of three models from the point of absolute from critical value provided in table is higher. Thus, the null hypothesis for the absence of long run relationship is rejected. We conclude that there is a long run equilibrium relationship between the variables of the model. This long run relationship is illustrated in table 5.

Table 5. The Results of Long Run Pollution Model Using ARDL Model

Variables	Model (1)		Model (2)		Model (3)		Model (4)	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
y	26995.7	4.30	26774.1	3.89	16834.5	6.24	16950.9	6.73
y2	-173.42	-1.77	-209.14	-2.08	-337.96	-4.38	-338.41	-4.55
et	210.83	5.22	226.40	5.38	354.61	4.92	246.38	19.28
fdevt	47890.2	0.90	-	-	-	-	-	-
openjt	-0.64	-1.93	-0.53	-1.55	-	-	-	-
C	-75572.3	-0.76	8308.6	0.27	-6363.7	-0.16	-	-

Regarding the table (5), the presence of long run relationship between the variables is confirmed, and the results of long run relationship between the variables are provided in table 5. The results show a positive and significant relationship between per capita income and environmental pollution

in all the models. The squares of per capita income in all modeles are positive and significant. Therefore, pollution Kuznets hypothesis is confirmed in long run for Iran. In addition, the energy consumption has a positive and significant effect on environmental pollution in Iran. Therefore, the results in long run are exactly the same as results in short run.

Examination of Error Correction Model

Regarding the provided coefficient of error correction in table (6) and their significance, the rate of adjust is average.

Table 6. The Coefficient of Error Correction Model

	Model (1)	Model (2)	Model (3)	Model (4)
ECM	-0.635	-0.575	-0.466	-0.474
Statistics	-3.55	-3.52	-3.22	-3.52
Level of significance	0.002	0.002	0.004	0.002

The convergent relationship between the variables of the model provides the basis for using error correction Model. The most important reason for using this model is that it relates short run changes of variables to long run values. In ARDL Model it is possible to provide the related error correction model. According to the estimating table, all the coefficient of model is significant for all models. The coefficient of error correction sentence is -0.635 for model one, -0.575 for model two, -0.466 for model three and -0.474 for model four which indicates that error correction pattern in each of the four models is trying to adjust itself with average rate.

Johanson-Joselius Test for Environmental Pollution Model

First, we choose the optimum lag of environmental pollution Model using Schwartz-Bayesian and Akaike criteria. In the following table based on these criteria, and regarding Akaeik criterion, four optimum lags are chosen.

Table 7. Determining the Optimum Lag in Johanson- Joselius Test

Order	LL	AIC	SBC
4	-447.6491	-515.6491	-558.4244
3	-470.8341	-522.8341	-555.5446
2	-497.4668	-533.4664	-556.1125
1	-525.9867	-545.9867	-558.5677
0	-705.9741	-709.9741	-712.4903

Then, the number of co-integration vector is determined and estimated.

Table 8. Determine the number of co-integration vectors in environmental pollution model

Type of test	H_0	H_1	Statistics	Level of significance-90%	Level of significance-95%
λ_{max}	r=0	r=1	33.1868	23.9200	21.5800
	r<=1	r=2	20.9489	17.6800	15.5700
	r<=2	r=3	13.3259	11.0300	9.2800
	r<=3	r=4	7.4425	4.1600	3.0400
λ_{trace}	r=0	r=1	74.9040	39.8100	36.3900
	r<=1	r=2	41.7173	24.0500	21.4600
	r<=2	r=3	20.7683	12.3600	10.2500
	r<=3	r=4	7.4425	4.1600	3.0400

Regarding to λ max and λ trace test the number co-integration vector, after which with the estimation of co-integration vector the existence of long run relationships between variables is investigated.

Table 9. Co-Integration Vector Estimates for the Environmental Pollution Model

	Vector-1		Vector-2		Vector-3		Vector-4	
variables	Co-integration vector	Normalized co-integration vector	Co-integration vector	Normalized co-integration vector	Co-integration vector	Normalized co-integration vector	Co-integration vector	Normalized co-integration vector
CO2	0.000009	-1	0.000016	-1	-0.000017	-1	0.000012	-1
y	0.075670	-8325	0.97797	61484	-0.96109	-55295.1	-0.24623	20937.9
y2	-0.13791	15172.1	-0.29626	-18735.9	0.23328	13421.4	-0.084749	7206.6
et	-0.001657	182.3511	0.0029569	186.9947	0.0043396 7	252.9599	-0.0030697	-0.0030697

Observing the results, we find out that the second vector has economic interpretation according to theory and it is in agreement with the results of ARDL model. That is, the volume of environmental pollution has a positive relationship with per capita income and reverse relationship with the square of per capita income and a positive relationship with energy consumption.

Conclusion

In investigating short run model for estimated model we find out that regarding the positive coefficient of per capita income and negative coefficient of square of this variable which are also

significant, the positive relationship between economic growth and environmental pollution is confirmed. In addition environmental Kuznets hypothesis is true for Iran, and since the coefficient of per capita income variable is positive and the square of per capita income variable is negative, Iran is still in upward part of this curve.

The coefficient of variables of energy consumption, in short run positive and significant. That is, it shows that the increase in energy consumption, increased environmental pollution.

Although the coefficient of financial development variable is positive, regarding the insignificancy of this variable, a clear relationship between these two variables cannot be found out. Regarding the insignificancy of coefficient of economic openness variable, a clear relationship between economic openness and environmental pollution in Iran cannot be found.

The coefficient of determination is 0/98 which indicates a high explanatory power of model, and the F statistic for evaluated model shows that none of the coefficient of models is zero simultaneously.

Investigating long run model, regarding the Banerjee, Dolado and Mestre tests for estimated models, the long run relationship between the variable is confirmed. In addition, the results show a positive relationship between per capita income and environmental pollution in all models. The square of the coefficient of per capita income in all the models is negative, too. Therefore, environmental Kuznets hypothesis is confirmed in long run for Iran. In addition, energy consumption coefficient has a positive and significant effect on environmental pollution in Iran.

Regarding the coefficient of provided error correction which was significant for each of three investigated model the rate of modification is average.

For investigating the long run relationship between variables Johanson-Joselius Model was used. Regarding the second vector, a positive relationship between per capita income and environmental pollution negative relationship between square of per capita income and environmental pollution, and a positive relationship between energy consumption and environmental pollution are confirmed. The results from Johanson-Joselius Model are in corroboration with ARDL Model results.

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