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Impact of Financial Development on the Environmental Quality in Iran

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In recent decades, undesirable environmental changes, such as global warming and greenhouse gases emission, have raised worldwide concerns. In order to achieve higher growth rate, environmental problems emerged from economic activities have turned into a controversial issue. The aim of this study is to investigate the effect of financial development on environmental quality in Iran. For this purpose, the statistical data over the period from 1970 to 2011 were used. Also by using the Auto Regression Model Distributed Lag (ARDL), short-term and long-term relationships among the variables of model were estimated and analyzed. The results show that financial development accelerates the degradation of the environment; however, the increase in trade openness reduces the damage to environment in Iran. Error correction coefficient shows that in each period, 53% of imbalances would be justified and will approach their long-run procedure. Structural stability tests show that the estimated coefficients were stable over the period.

Keywords: financial development, trade, Auto Regression Model Distributed Lag (ARDL)

Introduction

Environmental pollution and protecting the environment have been the global issues that have even now entered the political domain of countries. According to the Kyoto Protocol (Retrieved from http://www.unfccc.int), countries of the world have taken appropriate executive measures to preserve the environment as common public goods, they have also introduced some penalties for the world's major polluting countries. In Iran, due to the existence of large reserves of fossil fuels, to save energy is not taken seriously. Climate change caused by increasing concentrations of greenhouse gases is seen as an important factor in changing the world's climate, to the extent that in many cases, a small change in the weather condition may end in severe changes in the intensity and number of natural disasters and economic loss. Therefore, this is especially important because of some abnormal environmental effects at different stages of the production, conversion, and consumption of energy. Pattern of development in the energy sector would be acceptable only with minimum damage to the environment. Pollutants and greenhouse gases arising from the activities of energy sector have undeniable environmental effects at the regional and global level. Pollutant gases cause acid rain, health risks to humans and other creatures, climate change, and global warming. In this study, environmental quality index is a combination of various contaminants that is obtained by Principal Component Analysis (PCA).

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Many studies concentrated on the relationship between environmental pollution and economic growth in recent years, and the impact of financial development on the environment has received little attention. However, financial development through various channels could be effective on the quality of the environment: (1) Financial development through providing the necessary capitals for industrial and factory activities may lead to environmental pollutions (Sadorsky, 2010); (2) financial intermediaries may access to the environmental friendly new technology that can improve the environment (Tamazian, Chousa, & Vadlamannati, 2009); (3) financial development may provide more financial resources with less financial costs, for instance, for environmental projects (Tamazian et al., 2009; Tamazian & Rao, 2010).

This study investigates the effect of financial development on environmental quality in Iran over the period from 1970 to 2011. In this study, the environmental quality index is the combination of various pollutants which is obtained with the PCA. The paper is organized as follows: Part 2 of theoretical framework discusses the importance of economic and financial development for environmental quality, Part 3 presents a review of the literature, Part 4 presents data description and the econometric procedure, and the last two parts comprise the study results and conclusions.

Theoretical Framework

Environmental Kuznets Curve

Greenhouse gases emission from fossil fuels and other human activities are serious threat to global temperature. Changes in weather patterns may disrupt the environment and human activities.

A number of studies argue that the relationship between economic growth and environmental degradation follows an inverted U curve. This inverted U is known as environmental Kuznets curve (EKC). Accordingly, the use of natural resources and energy to achieve high economic growth increases the primary stages of industrialization process due to the high priority of production and employment over clean environment and low-technology, and consequently enhances the emission of pollution. At this stage, economic agents cannot supply the costs of reducing pollution due to the low per capita income, and thus the environmental impacts of economic growth are ignored. However, per capita income will improve the quality of the environment in the next stages of industrialization process after reaching certain level of per capita income, so that in such situation, the indicators of environmental pollution reduce with regard to the importance of clean environment, high technology, and appropriate environmental laws and regulations.

Also the relationship between financial development and environmental degradation can be expressed in the form of an inverted U relationship. So in the primary stages of financial development, because of the high priority of growth over clean environment, just financial development increases the volume of industrial activities. But in the next stages and after reaching to favorable growth, financial development will improve the quality of the environment, by investing in environmental projects and taking access to high technologies (Shahbaz, Hye, Tiwari, & Leitão, 2013a).

The first experimental study on the EKC was conducted by Grossman and Krueger (1991) in a report format as the environmental effects of the North American free trade agreement. They reviewed the relationship between air quality and economic growth in the 42 countries and concluded that the relationship between economic growth and the concentration of suspended particles in the air and sulfur dioxide is in the form of inverted U. This study was the basis for the next studies in this field.

Several studies, including Shafik (1994); Selden and Song (1994); Cole, Rayner, and Bates (1997); Lieb

(2004); Aldy (2005); Song, Zheng, and Tong (2008); and Iwata, Okada, and Samreth (2009), tested the hypothesis of EKC. Although the hypothesis of EKC has been confirmed in the most of studies, the results of some studies suggest the existence of a uniform or third degree forms relationship between pollution emissions and economic growth.

Impact of Financial Development and Trade on Environmental Quality

Despite many studies about the relationship between economic growth and environmental quality, a number of researchers, including Tamazian and Rao (2010), Zhang (2011), Pao and Tsai (2011), Jalil and Feridun (2011), Shahbaz et al. (2013a), and Shahbaz, Solarin, Mahmood, and Arouri (2013b), considered financial development as an important factor affecting the environmental quality in recent years. Well-developed capital markets and the strong banking system can promote the progress of technology and productivity. Capital of technologies that need large sums of investment can easily be provided in the developed financial systems (Tamazian et al., 2009). The financial markets provide the implementation of such technologies with risk sharing for investors.

Further development of financial sector can facilitate more investment with low cost, which also includes investment in environmental projects. Ability to increase such investments in environmental protection as the work of the public sector can be important for states in the local, state, and national levels (Tamazian & Rao, 2010). Corporate access to advanced and clean technologies, with the financial development that decreases CO_2 emissions and increases domestic production, financial and investment regulations are promoted for the benefit of environmental quality (Yuxiang & Chen, 2010). Financial systems with better performance release restrictions of the foreign financing provision which prevents industrial and corporative development and make way for economic growth (Levine, 2005). Thus, financing provision for industrial large activities can increase environmental pollutions.

The effects of trade liberalization on environment are separated into three effects: scale effect, composition effect, and technology effect. The effect of scale represents the change in the size of the economic activities, second effect represents the change in the composition or basket of the manufactured goods, and the effect of technology represents the change in the production technology, especially shift to clean technologies. The effect of the scale increases environmental degradation and the effect of technology reduces environmental degradation in trade liberalization. The effect of composition depends on the type of relative advantage. So according to the concept of comparative advantage, if a country has advantage in the polluting goods and has expertise in its production, then composition effect negatively influences the environment due to the changes in the composition of the country's manufactured goods to polluting goods; and if due to comparative advantage, the combination of a country's manufactured goods changes to clean ones, then the composition effect will have positive influence on the environment. Generally, following trade liberalization if the effect of technology dominates the scale and composition effects (in a country with a comparative advantage in polluting industries) or if the effect of technology and composition (in a country with a comparative advantage in clean industries) dominates the effect of scale, then trade liberalization will lead to positive environmental outcomes (Grossman & Krueger, 1991).

Literature Review

Many studies have been conducted on the relationship between economic growth and environmental

quality. A number of researchers have examined the role of factors such as energy consumption (Ang, 2007; Alam, Fatima, & Butt, 2007), foreign trade (Halicioglu, 2009), electricity consumption growth and population growth (Tol, Pacala, & Socolow, 2006), human resources and capital (Soytas, Sari, & Ewing, 2007) on the environment. Financial development has been considered as one of the effective factors on the environment.

Tamazian et al. (2009) examined the effect of financial development in the BRIC (Brazil, Russia, India, and China) countries using the modeling approach of the standard reduced form during 1992 to 2004. Results showed that higher levels of financial and economic development reduce environmental pollution, while financial liberalization and financial openness are crucial factors for reducing CO_2 emissions. In addition, adopting policies relevant to financial liberalization and openness to attract greater levels of research and development (R&D) and foreign direct investment (FDI) may reduce environmental pollution in these countries.

Tamazian and Rao (2010) in their study examined the effects of financial and institutional development on CO_2 emissions in 24 countries in transition period from 1993 to 2004. The results confirmed the existence of EKC. The importance of institutional quality and financial development on environmental performance was also confirmed. Based on the results, financial development had a positive effect on the environmental protection in the countries in transition. Results also indicated that financial liberalization might be harmful to the quality of the environment if it is not implemented in a strong organizational structure. Trade openness in these countries has led to an increase in pollution.

Using panel cointegration and Granger causality test for BRIC countries, Pao and Tsai (2010) examined the relationship between long-term and dynamic causality of carbon dioxide emissions, energy consumption, FDI, and GDP. The results indicate that in the long-run equilibrium, carbon dioxide emissions compared to energy consumption are elastic and compared to FDI are inelastic. The results also confirm the EKC hypothesis in the studied countries.

Zhang (2011) examined the effect of financial development on CO_2 emissions in China during the period from 1994 to 2009, and employed techniques such as Johansson cointegration vector, Granger causality test, and variance analysis. The results show that the financial development of China acts as an important stimulus in rising the greenhouse emissions. The size and scale of financial intermediaries were more important than other indicators of financial development. Nevertheless, the effect of financial intermediaries is far weaker. The size and scale of China's stock market have relatively greater effect on carbon emissions, while FDI, due to its small share from GDP, has the least effect on Carbon emissions. Using the ARDL model, Jalil and Feridun (2011) also examined the effects of growth, financial development, and energy consumption on CO_2 emissions in China in the two periods 1953-2006 and 1987-2006. In their study, the share of cash debt from GDP, the share of commercial bank assets from total assets of the banking system, and the share of foreign assets and liabilities from GDP were used as indicators of financial development. The results showed that financial development contributes to reducing environmental pollution in China. The results also confirmed the existence of EKC in China.

Shahbaz et al. (2013b) examined the effect of financial development on economic growth and energy consumption, CO_2 emissions in Malaysia from 1971 to 2011. The results showed financial development in Malaysia led to decrease in CO_2 emissions, while, economic growth and energy consumption increased CO_2 emissions. In another study, Shahbaz et al. (2013a) examined the effect of economic growth, energy

consumption, financial development, and trade openness on CO_2 emissions in the period from 1975 to 2011 in Indonesia. In their study, real per capita domestic credit to the private sector was considered as a measure of financial development. Results showed that economic growth and energy consumption in Indonesia increased CO_2 emissions, while, financial development and trade will diminish them. Furthermore, inverted U relationship between financial development and CO_2 dissemination was also confirmed.

Ozturk and Acaravci (2013) examined the effect of financial development, trade, economic growth, and energy consumption on CO_2 emissions over the period from 1960 to 2007 in Turkey, using the cointegration approach. Results showed that in the long term, trade increases CO_2 emissions, and financial development variable is not significant on the CO_2 emissions. EKC hypothesis was confirmed in Turkey as well.

In Iran, many researchers have studied the factors affecting the environmental quality. A number of studies have addressed the relationship between environmental quality and economic growth (Pazhouan & Moradhasel, 2007; Pourkazemi & Ebrahimi, 2008; Salimifar & Dehnavi, 2009; Ghazali & Zibaee, 2009; Mowlayi, Kavosi Kalashemi, & Rafiei, 2010), energy consumption (Behboodi & Barghi Golazani, 2008; Lotfalipour, Fallahi, & Ashena, 2010), trade openness (Barqi Askooei, 2008; Behboodi, Fallahi, & Barghi Golazani, 2010; Agheli, Velaei Yamchi, & Jangavar, 2010; Lotfalipour, Fallahi, & Bastam, 2012), factors of the labor force and capital (Sharzaei & Haghani, 2009), the value added share of the industrial sector from GDP (Nasrollahi & Ghaffari Goolak, 2009; Vaseghi & Esmaeili, 2009). Sadeghi and Feshari (2010) in an article using Johansson's cointegration approach over the period from 1971 to 2007 with regard to indices of carbon dioxide emissions and arable land for the environmental quality concluded that in addition to long-run equilibrium between the export and environmental quality indices, the variables of exports and FDI had a significant negative impact on environmental quality indices.

Fotros and Maboodi (2010) used econometric approach of Yamamato, investigating the existence and direction of causality among energy consumption, urbanization, economic growth, and carbon dioxide emissions over the period from 1971 to 2006. Results indicate a causal relationship among energy consumption, GDP, urbanization, and carbon dioxide emissions. Estimation of the relationship among carbon dioxide emissions, energy consumption, urban population and GDP showed that U hypothesis about environmental pollution and GDP in Iran is true. Sadeghi, Motafaker Azad, Pour Ebadelahan Kovich, and Shabaz Zade Kheyavi (2012) addressed the causal relationship between carbon dioxide emissions and FDI variables, per capita energy consumption and GDP in the environmental Kuznets hypothesis in Iran over the period from 1980 to 2008. Results verified the bilateral causal relationship between variables of CO_2 emissions and per capita energy consumption, and unidirectional causal relationship from GDP to per capita energy consumption.

Using panel data and generalized moments approach, Barqi Askooei, Fallahi, and Zhande Khatibi (2012) estimated the impact of variables such as energy consumption, factory products, economic openness, FDI, and economic growth on the carbon dioxide emissions for the period from 1990 to 2010 in D8 countries. The results showed that in the approach of fixed effects, all variables except FDI had a positive and significant relationship with carbon dioxide emissions.

Materials and Methods

Data

The ARDL can be used for short-term and long-term relations between the dependent and explanatory variables of the model. The model in this paper is as follows:

$$\mathrm{EN} = \alpha_0 + \alpha_1 \mathrm{FD}_t + \alpha_1 \mathrm{FD}_t^2 + \alpha_3 \mathrm{GDP}_t + \alpha_5 \mathrm{OP}_t + \epsilon_t \quad (1)$$

where EN is environmental quality index, FD is financial development, FD^2 is square of FD, GDP is gross domestic product and OP is trade openness.

Using PCA which is based on a linear combination of the original variables on the variance-covariance matrix and using the following indices, this study tries to extract the general index for financial development and address all aspects of financial development:

(1) index of financial development depth: the ratio of cash to GDP in current prices;

(2) basic index of financial development: the ratio of domestic bank assets to total assets of commercial banks and the Central Bank;

(3) index of financial development performance: the ratio of private sector's debt (to the banking system) to GDP;

(4) instrumental index of financial development: the ratio of money held by the public to total money supply;

(5) structural index of financial development: the ratio of banking system claim of private sector to total banking system credit.

Trade openness index is the ratio of total exports and imports to GDP and environmental quality index is combinations of Sulfur Oxide pollutants, SO_2 and SO_3, Nitrogen Oxides of NOX, Carbon Monoxide, SPM suspended particles, and Carbon Dioxide which are examined in PCA approach. Data on emissions of SO_2, SO_3, NOX, CO, and SPM were obtained from energy balance sheet of Ministry of Energy, Department of Power and Energy. Data on CO_2 were collected from Carbon Dioxide Information Analysis Center, data on GDP were obtained from UNCTAD (United Nations Conference on Trade and Development), and data on indices of financial development, the financial development squared and trade were obtained from economic reports and balance sheet of the Central Bank. In this study, the period between 1970 and 2011 was examined, and Microfit 4.0 and Matlab 8.01 were used for the estimation and forecasting.

Financial Development and Trade in Iran

Figure 1 shows the trend of financial development in Iran. As shown in the period between 1970 and 2011, financial development has declined and then increased due to imposed war. Overall financial development in Iran has been increasing. However, the amount of financing for the industrial activities has increased over the period. Figure 2 shows the amount of financing for the country's industrial sector compared to other sectors and activities with incremental growth, and shows that this sector has received more attention than other sectors in financial development process.

Figure 3 shows the amount of exports and imports in Iran. Exports and imports have increased over the years of the study.

Industries such as cement, glass, ceramics, iron and steel, pulp and paper, etc. apply a wide range of environmental effects and release in the air plenty of oxides of Carbon, Sulfur, and Nitrogen.

According to Figure 4 and 5, exports of polluting goods have declined in the period between 1970 and 2011 and have a downward trend. However, the growth in imports of polluting goods compared to total imported goods has risen. Therefore, the amount of pollutants produced during this period has a downward trend.

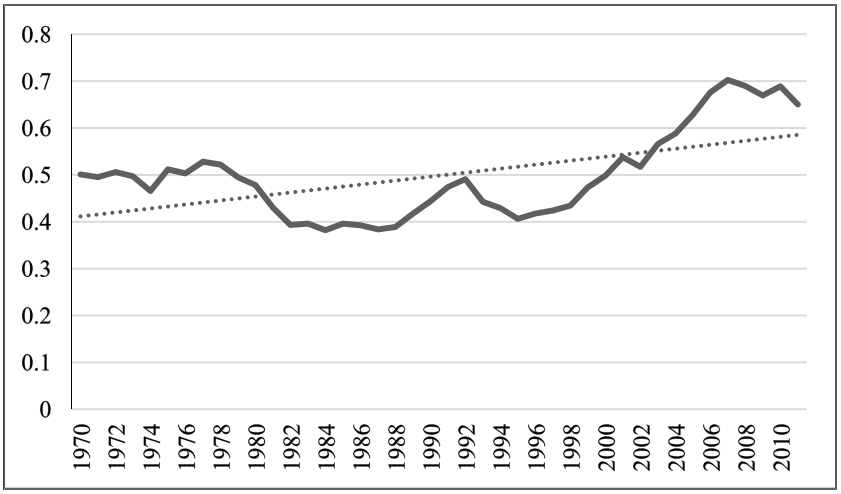

Figure 1. Financial development and its trend in the period between 1970 and 2011. Source: Economic reports and balance sheet of the central bank.

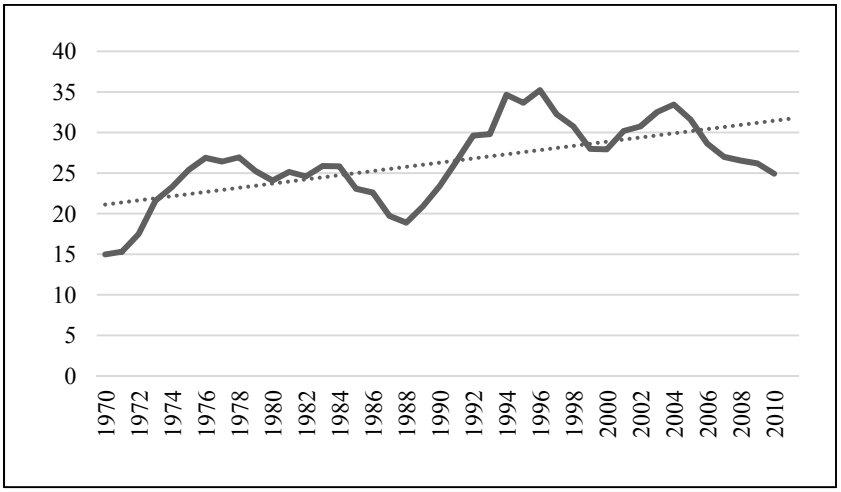

Figure 2. The financing of industrial activities compared to other activities. Source: Economic reports and balance sheet of the central bank.

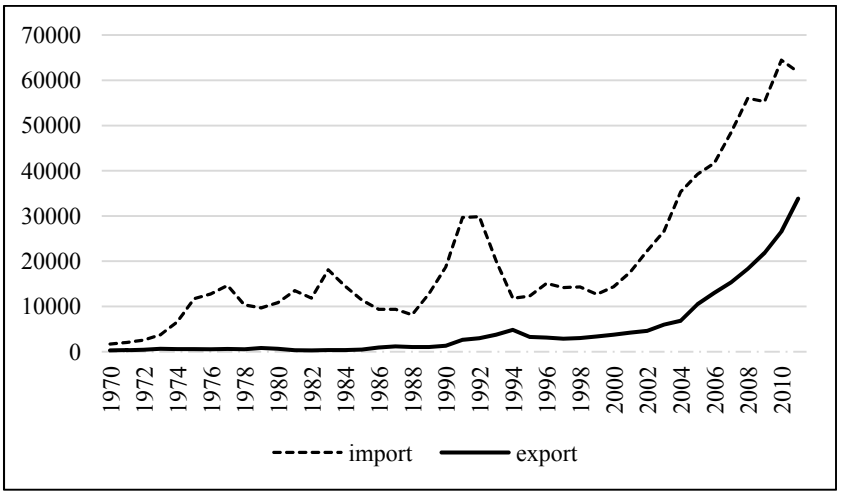

Figure 3. Exports and imports in the period from 1970 to 2011. Source: Economic reports and balance sheet of the central bank.

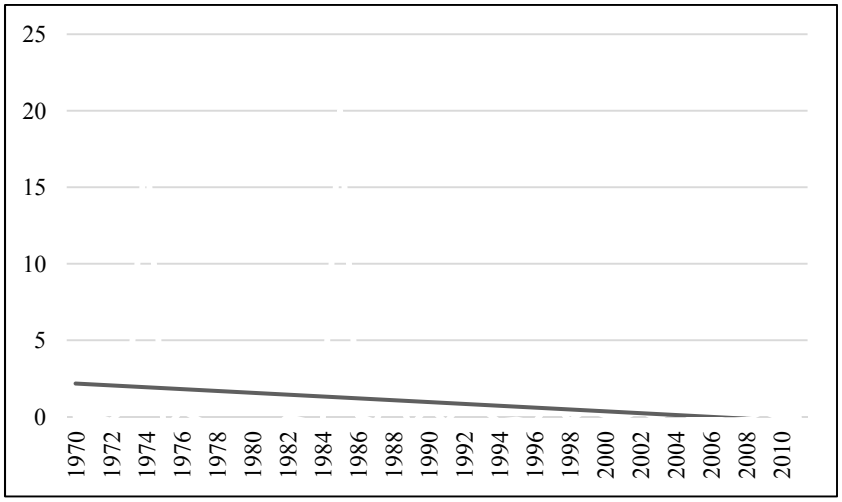

Figure 4. Trend of exporting polluting goods over the period from 1970 to 2011. Source: Economic reports and balance sheet of the central bank.

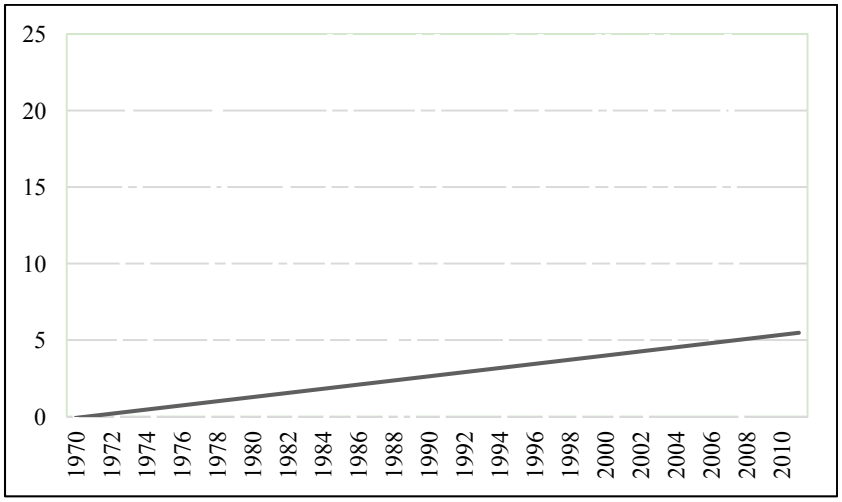

Figure 5. Trend of importing polluting goods over the period from 1970 to 2011. Source: Economic reports and balance sheet of the central bank.

Model

In this study, Autoregressive Distributed Lag Modeling Approach was employed which was proposed by Pesaran and Shin (1999). Most of recent studies suggest that ARDL approach is preferable to other approaches such as Engel-Granger, in examining the cointegration and long-run relationship among the variables. Whether the variables in the model are I(0) or I(1), this approach is applicable, and in small samples it is relatively more efficient than other approaches. ARDL Model is as follows:

$$\varphi(L,P)Y_t = \sum_{i=1}^{k} b_i(L,q_i)X_{it} + c'w_t + u_t \quad (2)$$

where

$$\varphi(L,P)Y_t = 1 - \varphi_1 L - \varphi_2 L^2 - \cdots - \varphi_p L^p \quad (3)$$

$$b_i(L,q_i) = b_{i0} + b_{i1}L + \cdots + b_{iq}L^q \; i = 1,2,\ldots,k \quad (4)$$

In the above relationships Y_t is the dependent variable and X_{it} is the independent variable. L is lag operator and w_t is a vector of categorical variables including predetermined variables in the model, such as intercept, dummy variables, time trend, and other exogenous variables. P is the number of lags used for the dependent

variable and q is the number of lags used for the independent variables. Numbers of optimal lags for each of the explanatory variables could be set by a measure of Akaike, Schwarz-Bayesian, Hanan-Queen, or adjusted coefficient of determination. In this study, given the small size of the data set, Schwartz-Bayesian measure was used. Long-run coefficients are calculated as follows:

$$\theta_i = \frac{\hat{b}_i(L,q_i)}{1-\hat{\varphi}(L,p)} = \frac{\hat{b}_{i0}+\hat{b}_{i1}+\cdots+\hat{b}_{iq}}{1-\hat{\varphi}_1-\hat{\varphi}_2-\cdots-\hat{\varphi}_p} \; i = 1, 2, \ldots, \tag{5}$$

ARDL approach consists of two steps to estimate the long-run relationships. First, the dynamic ARDL model is tested for long-run relationship, and in the next step, long-run and short-run coefficients are estimated. The second step is conducted only if the long-run relationship is verified in the first step. Having estimated ARDL dynamic model, this paper tested the following hypothesis:

$$\begin{aligned} \mathrm{H}_0 &= \textstyle\sum_{\mathrm{i}=1}^{p} \varphi_i - 1 \geq 0 \\ \mathrm{H}_1 &= \textstyle\sum_{\mathrm{i}=1}^{p} \varphi_i - 1 < 0 \end{aligned} \tag{6}$$

The null hypothesis implies the absence of a long-run relationship. Quantity t statistics requires to perform the test as follows:

$$t = \frac{\sum_{i=1}^{p} \hat{\varphi}_i - 1}{\sum_{i=1}^{p} S_{\hat{\varphi}_i}} \tag{7}$$

If t statistics obtained from the absolute critical values provided by Banerjee, Dolado, and Mester (2012) is larger, then the null hypothesis based on absence of cointegration is rejected, and long-run relationship is accepted (Nowferesti, 1999). In the second step, if the presence of cointegration is approved, the long-run relationship would be estimated.

Study Results

Before the test, reliability of all variables is checked to ensure that none of the variables is I(2). If there is any I(2) variable in the model, F statistics is not reliable. To ensure variables of time series used in the model stationary or none-stationary, Augmented Dickey Fuller (ADF) test has been used. Table 1 shows the ADF test's results in the level for the variables. Usually the Schwarz Bayesian Criterion (SBC) saves the number of lags. Therefore, in this study, the number of optimized lags is selected based on SBC criteria. OP variable in the level, while without trend, is stationary, but for the variables of FD, FD^2, GDP, and EN, Absolute Dickey Fuller statistic in both cases is smaller than the critical values. Therefore, the variables in level are none-stationary and the unit root hypothesis on the variables is not rejected.

Table 1

Results of Unit Root Tests in the Level

Variables	With intercept and without trend *			With intercept and trend **		
	Optimal lag	ADF statistics	Test results	Optimal lag	ADF statistics	Test results
EN	0	-0.95	Non-stationary	0	-2.11	Non-stationary
FD	1	-0.74	Non-stationary	0	-2.79	Non-stationary
FD^2	1	-0.72	Non-stationary	0	-2.44	Non-stationary
GDP	0	2.50	Non-stationary	5	0.25	Non-stationary
OP	9	-4.55	Stationary	9	-3.53	Non-stationary

Notes. * Critical value at the confidence level of 95% in cases without trend is -2.96; ** critical value at the confidence level of 95% in cases with trend is -3.56. Source: Research findings.

To find the stationary degree of the variables, ADF test was replicated for the first-order difference of the variables. Test results showed that variables get stationary by making one deduction.

Table 2

Results of Unit Root Tests on the First Difference of the Variables

Variables	With intercept and without trend *			With intercept and trend **		
	Optimal lag	ADF statistics	Test results	Optimal lag	ADF statistics	Test results
EN	0	-5.28	Stationary	0	-5.38	Stationary
FD	0	-3.94	Stationary	0	-3.71	Stationary
FD^2	0	-3.84	Stationary	0	-3.60	Stationary
GDP	0	-3.81	Stationary	0	-4.24	Stationary

Notes. * Critical value at the confidence level of 95% in cases without trend is -2.96; ** critical value at the confidence level of 95% in cases with trend is -3.56. Source: Research findings.

Result of estimation of ARDL model is based on the three parts: dynamic, short-run, and long-run relationships. The following equation as the dynamic relationships among variables can be specified and estimated:

$$\mathrm{EN} = \alpha + \sum_{j=1}^{p} \alpha_{1j} \mathrm{EN}_{t-j} + \sum_{j=0}^{q_1} \alpha_{2j} \mathrm{FD}_{t-j} + \sum_{j=0}^{q_2} \alpha_{3j} \mathrm{FD}_{t-j}^2 + \sum_{j=0}^{q_3} \alpha_{4j} \mathrm{GDP}_{t-j} + \sum_{j=0}^{q_4} \alpha_{5j} \mathrm{OP}_{t-j} + \mathrm{U}_t \quad (8)$$

To estimate the relationship, as the data are on annual basis, the maximum lags were taken two, and using Schwarz-Bayesian criterion, dynamic relationships among variables were selected. The optimal lags for each of the variables were set and the model was estimated as ARDL (1, 0, 0, 0, 0). To study the long-run relationship of the variables, the value of computational statistics of Banerjee et al. (2012) is calculated in the following way:

$$t = \frac{0.47-1}{0.14} = -3.78 \quad (9)$$

The value of table of Banerjee et al. (2012) at confidence level of 90% for a model with intercept is equal to -3.64; thus, the existence of long-run relationship among the variables is confirmed. Having ensured the long-term relationship, results of estimation would be provided in Table 3.

Table 3

Result of Estimation of Long-run Relationship

Variables	Coefficients	Standard deviation	t statistics	Critical value
FD	14.55	6.33	2.30	0.028*
FD^2	-0.11	0.06	-1.84	0.074**
GDP	20.84	3.14	6.63	0.000*
OP	-38.81	8.56	-4.53	0.000*

Notes. * Significant at 95% confidence level; ** significant at 90% confidence level. Source: Research findings.

As the results of the classic test show the lack of successive correlation among components of disturbances, properly specified equation and equal variance, the results of long-run relationship are reliable. Results obtained from Table 3 show that all variables are significant at the 90% confidence interval. The positive coefficient of GDP (20.84) shows that economic growth in Iran is primarily associated with emission increase. Coefficient of financial development and trade liberalization is positive and negative respectively, which

implies that increase in financial development causes rise in environmental degradation; however, trade increase promotes the quality of the environment. The coefficient of long term emissions relative to variable of squared financial development is significant and negative (-0.11), which shows that the inverted U relationship between financial development and environmental quality is true in Iran.

For a more detailed review of the results, changes in the environmental degradation index and financial development could be estimated in the model according to the coefficients, and assuming that all other conditions do not change, shown in Figure 6.

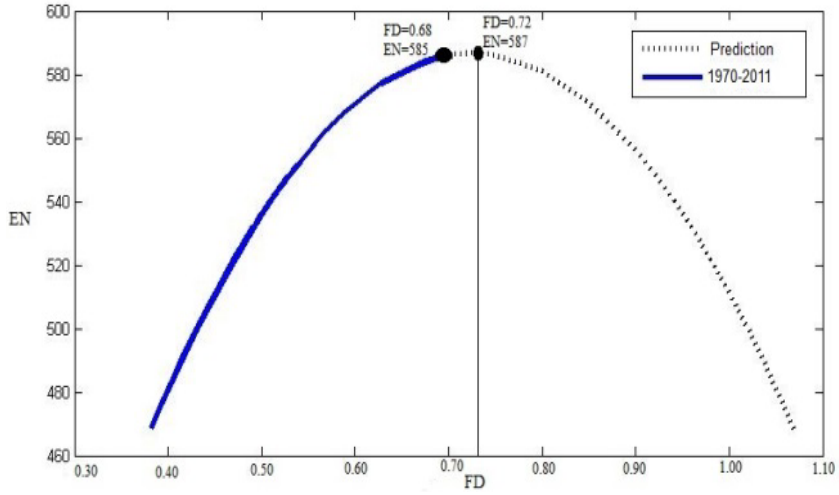

Figure 6. Inverted U relationship between financial development and environmental quality for Iran using Matlab. Sources: Research findings.

In this figure, the vertical axis and horizontal axis respectively represent the environmental emissions and financial development. As it is seen, the curve for Iran is similar to an inverted U and the estimated model fully meets the theoretical expectations. In the period between 1970 and 2011, Iran was in the first half of the curve, and financial development for levels higher than 0.72 leads to improved environmental quality. The estimated error correction model to study adjustment of short-run disequilibrium towards long-run equilibrium is presented in Table 4.

Table 4

Results of the Estimation of Error Correction Model

Variables	Coefficients	Standard deviation	*T*-statistics	Critical value
dFD	7.76	3.79	2.04	0.049*
dFD^2	-0.06	0.03	-1.71	0.096**
dGDP	11.12	3.25	3.42	0.002*
dOP	-20.70	6.23	-3.32	0.002*
ECM(-1)	-0.53	0.14	-3.80	0.001*

Notes. * Significant at 95% confidence level; ** significant at 90% confidence level. Source: Research findings.

The value of -0.53 was obtained for error correction coefficients in the model, which means a 53% adjustment in each period to establish a long-run equilibrium. The results of CUSUM and CUSUMSQ tests for evaluating the estimated coefficients and the results of stability test for short- and long-run coefficients over the time were shown in Figure 7 and 8.

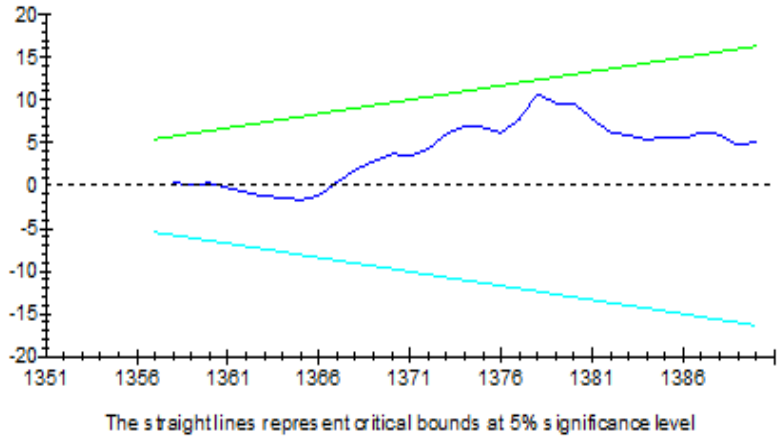

Figure 7. Plot of cumulative sum of recursive residuals. Sources: Research finding.

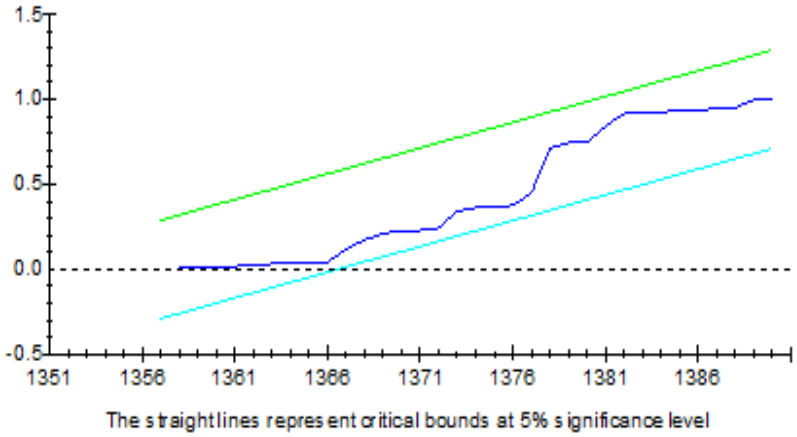

Figure 8. Plot of cumulative sum of squares of recursive residuals. Sources: Research finding.

As in both tests, the statistics were within the 95% confidence intervals, null hypothesis based on the stability of the coefficients was accepted and at the confidence level of 95%, the obtained results are valid.

Conclusions

Economic growth is one of the most important concerns of human communities. Development process in Iran, like other developing countries involves the use of the environment and at its degradation at the same times. Financial intermediaries through financial development may increase technological innovation and mobilize financial resources to identify the best production technology and make investments in projects involving clean environment. Nevertheless, financial development may increase financing for industrial activities which harm the environment.

Due to the different reliability degrees of the variables, long-run ARDL model was employed. The results show that the coefficient of financial development is positive and significant at the 0.05% probability level, and suggest that in addition to economic growth, financial development also affects environmental quality in Iran, and has led to increase environmental pollution. Negative squared coefficient of financial development implies that inverted U-shaped relationship between financial development and environmental quality is true for Iran. Results show that Iran is on the upside half of curve and according to predictions made on the basis of the

financial development of approximately 0.72 in Iran, financial development will lead to improved environmental quality. Given the high importance of development for developing countries, including Iran, to support environmental policies is of low priority. Based on the Figure 2, in the years considered, financing for industrial activity has increased compared to other activities and industries have been inefficient in protection of the environment. Financial development has made way for destruction of environment. In fact, the investments were only effective in increasing the size of the industrial activities and have not resulted in technological advancement in the industry.

Results show that economic growth had a significant and positive impact on emissions. The study's results also suggest that increased trade openness has led to improvement of environmental quality in the country. This could be due to that the goods which produce large quantities of pollutants in the manufacturing process are imported from other countries like China. As a result, the pollution increases in the exporting countries, and in Iran as an importing country, pollution reduces due to the reduction in production of polluting goods. Furthermore, it might be due to decline in export of polluting goods, which reflects low production and reduced pollution in Iran. The decline in the proportion of heavy polluting products' export such as cement, glass, ceramics, iron, and steel, which produce large amounts of pollutants in manufacturing process (Figure 5), and increased proportion of imports (Figure 4) confirm the results of the model. In addition, economic openness leads to an increase in imports of high tech intermediary and capital goods that create less pollution in production process.

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