

Examining the Relationship between Environmental Quality and Globalization in Iranian Economy

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ABSTRACT

One of the most controversial issues that has attracted the attention of researchers in various fields is the relationship between environmental quality and globalization. Despite extensive research in this area, there is no consensus in this regard. In this study, discrete wavelet transform (DWT) was applied to investigate the causal relationship between the two variables of environmental quality and globalization on different horizons using Iranian economic data during the period 1960: 01-2017: 04. Based on the results, there was no relationship between the two variables in the short and medium term. In the long term, there was a two-way causal relationship between the variables, so that improving the environmental quality (reducing CO₂ emissions) led to an increase in globalization (economic openness) and vice versa.

Keywords: greenhouse gases, international trade, discrete wavelet transform.

1. Introduction

Air pollution is considered as one of the fundamental problems in Iran's environmental affairs, the severity of the alarming dimensions of which has increased, especially in recent years. According to the World Health Organization, Iran is among the most polluted countries in the world in terms of air pollution index. The US Energy Information Administration (EIA) recently released a list of the top 10 producers of greenhouse gases based on carbon dioxide, with Iran at the bottom of the list. The organization has developed a list of the most polluting countries in the world by examining the amount of carbon dioxide produced by all types of industries and the amount of fossil fuels consumed in the world. In this list, China ranks first and Iran ranks ninth (EEA, 2014).

Environmental issues have been explored from various aspects in recent decades. In the 1960s, the public began to pay attention to environmental issues, and industrial pollution caused by growing industrial economies was mainly considered. In the late 1970s, the focus was on trade and environmental issues, and environmentalists held extensive meetings in different parts of the world to protest the poor state of the environment resulting from the growing development of trade. They argued that the volume of economic activity, including polluting activities, would expand and that the use of resources and energy would increase inappropriately as a result of trade liberalization.

Similarly, ecologists argued that the volume of economic activity, including polluting activities, would expand and that the use of resources and energy would increase inappropriately as a result of trade liberalization. They also stated that appropriate environmental policies would be softened, and even the adoption and implementation of national environmental laws in the face of the trade liberalization process would be delayed due to the expansion of free trade and thus increased competitive pressures between domestic firms and foreign competitors. In contrast, some proponents of free trade believe that the state of the environment can be improved by trade liberalization and the expansion of foreign exports. According to them, the use of resources becomes more efficient and thus

the loss of resources and energy and their pollution in the country is reduced due to the reaction of countries to competitive pressures resulting from the expansion of free trade and, as a result, access to free trade and performance based on relative advantage (Khalil and Inam, 2006).

Moreover, environmentalists and opponents of trade liberalization point out that appropriate environmental policies would be softened, and even the adoption and implementation of national environmental laws in the face of the trade liberalization process would be delayed due to the expansion of free trade and thus increased competitive pressures between domestic firms and foreign competitors. However, some proponents of free trade not only oppose the view that trade liberalization will destroy the environment, but also see trade liberalization as effective in improving the environmental situation. According to them, the use of resources becomes more efficient and thus the loss of resources and energy and their pollution in the country is reduced due to the reaction of countries to competitive pressures resulting from the expansion of free trade and, as a result, access to free trade and performance based on relative advantage.

Since the results of experimental studies are ambiguous, this study was conducted aimed at developing a new insight into the relationship between environmental quality and globalization in the Iranian economy during the years 1960: 01-2017: 04 by using the discrete wavelet transform approach.

The relationship between variables in different time horizons can be explored using wavelet analysis. So frequency analysis is the innovation of the study. For the purpose of the study, the rest of the paper is organized as follows:

In the literature review section, the theoretical framework and study background are examined. The third section is dedicated to methodology. The fourth section describes the results. Finally, the study concludes with the policy recommendations.

2. Literature Review

2.1 Theoretical Foundations

Environmental issues have been explored from various aspects in recent decades. In the 1960s, the public began to pay attention to environmental issues, and industrial pollution caused by growing industrial economies was mainly considered.

In the late 1970s, the focus was on trade and environmental issues, and environmentalists held extensive meetings in different parts of the world to protest critical state of the environment resulting from the growing development of trade. Environmental issues and crises created were gradually addressed in trade studies and related policies. According to environmentalists, the use of resources and energy has increased, which increases the emission of air pollutants as trade expands. They also stated that appropriate environmental policies would be softened, and even the adoption and implementation of national environmental laws in the face of the trade liberalization process would be delayed due to the expansion of free trade and thus increased competitive pressures between domestic firms and foreign competitors. In contrast, some proponents of free trade believe that the state of the environment can be improved by trade liberalization. According to them, the use of resources becomes more efficient and thus the loss of resources and energy and their pollution in the country is reduced due to the reaction of countries to competitive pressures resulting from the expansion of free trade and performance based on relative advantage.

Although the relationship between trade volume and the environment has been proven by many environmental economists such as Antle and Heidebrink (1995), Wheeler (2001), Frankel and Rose (2002), Vaughan (2003) and Cole et al. (2005), it seems very difficult to understand the nature of this relationship. Two views have been developed on how trade volume affects the environmental quality.

On the one hand, the expansion of trade will result in increased production, resource depletion and increased competition between domestic and foreign companies directly and increased environmental pollution indirectly. On the other hand, trade increases income, which indirectly increases the demand for improved environmental quality. Given the above, there are different approaches and theories on how trade affects the environment. In the following, the most important ones will be discussed:

2.1.1 The direct effect of trade on the environment

Negative effect: The most important theory on the direct impact of trade on the environment is competition for regression.

According to this theory, some countries emphasize the attraction of foreign investment to such an extent that they actively, contrary to environmental interests or the interests of indigenous labor, pass laws to encourage foreign investors to invest in their territory. For example, in some developing countries, including Zimbabwe, New Guinea, and Indonesia, mining laws are regulated in such a way that they overshadow environmental laws. Such decisions are very attractive to some companies that have low environmental standards. There are reports of various cases of environmental degradation by foreign companies, in which foreign investors have been accused of actions such as polluting the river, destroying natural forests and harming the health of the residents of the host country. International legal mechanisms are also ineffective in these cases. Requiring a foreign investor to comply with environmental health beyond the laws of the host country is inconsistent with the principle of national treatment of the investor (Vagts, 2003).

Positive effect: This view, which refers to the positive effect of expanding the volume of trade on environmental quality, was developed by Grossman and Krueger (1991). In their study, they divided the effects of trade liberalization on the state of the environment into three effects: scale, composition, and technology. The scale effect indicates a change in the size of economic activities, the composition effect indicates a change in the composition or basket of goods, and the technology effect indicates a change in production technology, especially a shift to clean technology.

Following the trade liberalization, the scale effect leads to an increase in environmental degradation and the technology effect leads to a decrease in environmental degradation. The effect of the combination effect depends on the type of relative advantage. According to the relative advantage in a country, if the country has an advantage in polluting goods and specializes in the production of those goods, then the combination effect will have negative effects on the environment due to the change in the composition of the country's manufactured goods to polluting goods. In addition, if the composition of a country's manufactured goods changes to clean goods due to the country's relative advantage in those goods, then the composition effect will have positive effects on the environment.

Generally, following the trade liberalization, if the technology effect dominates on the scale and composition effects (in the case of a country with relative advantage in polluting industries) or if the technology effect with the composition effect (in the case of a country with relative advantage in clean industries) dominates on the scale effect, then the trade liberalization will lead to positive environmental results.

At the most basic level, trade and the environment are interdependent because all economic activities are based on the environment. This is the basis for all basic inputs (metals and minerals, forestry and fishery) and for the energy required to complete the work. Economic waste is also imported into the environment. Trade, in turn, is affected by environmental concerns. So exporters must respond to market demands with greener goods. There is a multilateral, complex and important relationship between trade and the environment.

2.1.2 Pollution Haven Hypothesis

Pollution Haven Hypothesis is often used in the field of environment and trade. In this hypothesis, lower environmental standards are a source of relative advantage and change in the pattern of trade. This hypothesis was developed by Taylor and Copeland in 1944. According to them, strict environmental standards in industrialized countries lead to the transfer of polluting industries to countries with lower standards. In this hypothesis, countries with milder environmental policies have lower incomes (Copeland and Taylor, 1994).

An important hypothesis contracting the Pollution Haven Hypothesis is the Availability of Factors Hypothesis. This hypothesis assumes that environmental policies have no effect on the pattern of trade, but some factors determine trade, such as differences in availability of factors of production. According to this hypothesis, a country with abundant capital tend to export capital goods (regardless of

environmental policy). In other words, if a country has a relative abundance in the factor used in the production of polluting industries, it will specialize in the production of polluting industries by creating trade. However, if the country has a relative abundance in the factor used in the production of clean goods, it will trade clean goods. So if the Availability of Factors Hypothesis is correct and a country with a mild environmental policy has a relative abundance in the factor used in the production of clean goods, it will specialize in the production of clean goods and pollution in that country will be reduced by creating trade. This is inconsistent with the Pollution Haven Hypothesis (Copeland and Taylor, 2004).

The Pollution Haven Hypothesis has two basic principles: First, countries have different environmental preferences depending on their level of development. In this context, poorer and more backward countries consider the environment to be a luxury and unnecessary commodity, and vice versa. Due to growth problems and poor export potential, developing countries place less importance on the environment. As a result, affluent countries are more inclined to apply strict environmental regulations. Second, the difference between countries in environmental standards affects the allocation of investment flows between them, that is, strict regulations in one country repel investors without standards, and poor regulations in another country attract them. As a result of these two principles, in a world with countries with different levels of development, strict regulations lead the polluting industries of developed countries to transfer investment to backward countries (Neumayer, 2003; Levinson, 1996a, 1996b).

In general, according to the Pollution Haven Hypothesis, highly polluting industries are being transferred from developed to developing countries. Better to say, developing countries are more attractive to attracting these industries than developed countries due to their poor environmental laws regarding polluting industries-related products. In such a process, these countries become exporters of commodities produced by polluting industries through transferring these industries to developing countries. In other words, the environmental quality of developing countries decreases with the expansion of trade and the transfer of polluting industries to them.

2.2 Previous studies

In their study titled Trade and Environment in Latin America, Takeda and Matsuura (2005) examined the effect of polluting industry trade with the United States on environmental pollution in Latin America using panel data technique for 14 Latin American countries during 1986-1999. The results indicated that the polluting goods trade with the United States reduced carbon dioxide (CO₂) emissions in Latin American countries during the estimation period (Takeda and Matsuura, 2005).

In a study by Shioda et al. (2006), the effect of economic growth (as a result of trade) on the emission of various pollutants such as sulfur dioxide (SO₂), carbon dioxide and nitrogen dioxide (NO₂) and consumption in various economic sectors of Bangladesh was examined. According to the results, all goods and services produced in the economy were associated with energy consumption and emission of pollutants, so energy consumption could not be ignored among the various factors of economic activity affecting the environment and should be given special attention.

In a study by Verbek and De Clercq (2006), it was argued that, given Monte Carlo experiments, the environmental and economic characteristics of the time series may affect the experimental relationship of the Environmental Kuznets Curve (EKC). So the characteristics of the time series data affect the experimental results, but most studies have ignored it.

Temurshoev (2006) examined the effect of international trade on the environment in developed and developing countries and tested the Pollution Haven Hypothesis and the Availability of Factors Hypothesis in the United States and China using data-output analysis. Eventually, both hypotheses were rejected in these countries.

In one study, the effects of trade and economic growth on environmental degradation were studied by Kleemann and Abdulai (2011) with cross-country evidence approach using the data panel method. According to the findings, although the EKC hypothesis is valid in most pollutants, it is questionable in some of them.

In general, none of the theories related to trade and environmental degradation are definitively validated. In relation to sustainable development, the trade liberalization can be beneficial for rich countries and harmful for poor countries.

In a study by Managi (2011), endogenous trade and income and overall estimates of the effect of trade openness on the environment were examined using instrumental variable methods in OECD and non-OECD countries. The author argued that trade is in favor of OECD countries states and has very unfavorable effects on SO₂ and CO₂ emissions in non-OECD countries. The results indicated that the trade openness affected emissions through the effect of environmental regulations and the effect of working capital. In this regard, there was a significant conflict between OECD and non-OECD countries. The emissions of both gases in OECD countries decreased both in the short and long term. Trade also had positive effects on the emission of BOD around the world in both short and long term.

3. Wavelet Transform

Time series analysis can be justified from a continuous wavelet transform (CWT) with parameters of space and time to a transform with a more limited number of time scales with a different number of wavelet coefficients on each scale. In fact, this is the discrete wavelet transform. With a focus on the continuous process, it can be seen that the continuous wavelet transform moves on all points in the time series in two dimensions of time and frequency and extracts information. However, according to Equation (1), discrete waveform transform is applied only to limited points in the time series and extracts information:

$$\psi_{j,k}(t) = 2^{-j/2} \psi(2^{-j}t - k) \tag{1}$$

Similarly, the equation for the father wavelet will be as follows:

$$\phi_{j,k}(t) = 2^{-j/2} \phi(2^{-j}t - k) \tag{2}$$

Where k and j are integers that donate a set of shifts and discrete dilation (scales).

Discrete waveform transform has two limitations: first, the sample size must be divisible by 2j; second, the wavelet coefficients and scale are not constant relative to the shift. Maximum overlap eliminates the faults of discrete waveform transform and allows the analyzed data to be extracted at different scales, including the trend and details of the time series with each other and with the original time series itself in the form of par.

If the sampling method is such that a sequence of binary scales is used for the scales, but the right shifts are used instead of the binary shifts for the shifts so that $s = 2j$ and $u = k$, then a maximum overlap discrete wavelet transform (MODWT) is used.

The approximation of each discrete function or time series using wavelet functions is obtained as follows:

$$f(t) = \sum_{k=1}^{\infty} s_{j,k,j,k}(t) + \sum_{k=1}^{\infty} d_{j,k} \psi_{j,k}(t) + \sum_{k=1}^{\infty} d_{j-1,k} \psi_{j-1,k}(t) + \dots + \sum_{k=1}^{\infty} d_{1,k} \psi_{1,k}(t) \tag{3}$$

Where $s_{j,k}$ are the smooth surface j m and $d_{j,k}$ are details of the surface j m which are calculated by Equations (4) and (5):

$$s_{j,k} = \int \phi_{j,k} f(t) dt \tag{4}$$

$$d_{j,k} = \int \psi_{j,k} f(t) dt \tag{5}$$

Specifically, the minor wavelet coefficients, d_j, k , are the wavelet transform coefficients that can extract high frequency fluctuations and deviations from the time series smoothing process at any scale. Moreover, s_j, k are those wavelet transform coefficients that extract the time series process (Farzin Vash et al., 2013; Raei et al., 2015).

4. Results

Based on what was mentioned in the research methodology section, carbon dioxide gas emissions (environmental index) and the ratio of exports and imports to GDP (globalization index) during the period 1960: 01-2017: 04 using the MODWT method and the D4 filter, which is part of the Daubechies wavelets family, has been broken down into six levels.

The study data were obtained from the World Bank and transformed to seasonal frequency using the Denton method. R software and Wavlsim package were used to analyze the wavelet.

The first to fifth levels are related to the time horizons of 2 to 4 seasons, 4 to 8 seasons, 8 to 16 seasons, 16 to 32 seasons, 32 to 64 seasons and more than 64 seasons. Accordingly, the first and second levels are divided into short-term scales, the second, third and fourth levels into medium-term scales, and the fifth and sixth levels into very long-term scales. In the following, the relationship between the variables is analyzed using covariance, correlation and wavelet cross-correlation.

Covariance and the wavelet cross-correlation between carbon dioxide emissions and globalization can be seen in Figure 1. The first point that draws attention in the figure is the different results on different scales, which indicates that there is a multi-scale relationship between environmental quality and globalization.

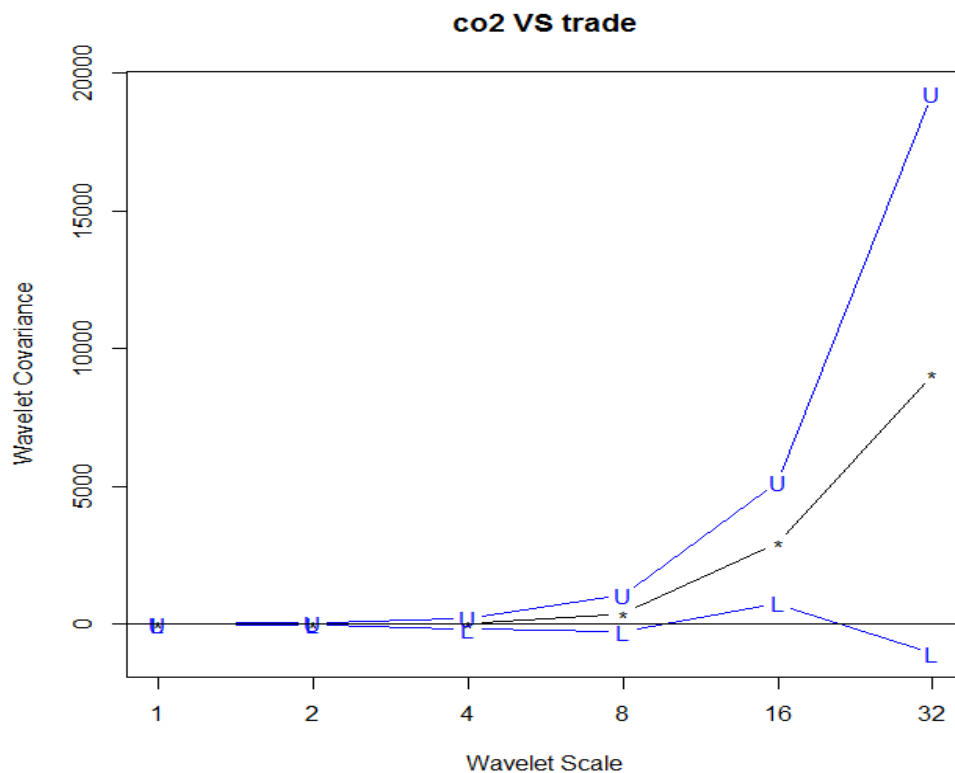


Figure 1. Wavelet covariance between the environmental quality and globalization (Source: Research findings).

Wavelet covariance shows the relationship between two time series. On a long-term scale, there is a positive relationship between globalization and environmental degradation.

In Figure 2, the wavelet correlation coefficient is presented because the covariance does not provide information about the intensity of the relationship between the variables. The correlation coefficient on different scales indicates the variability of the intensity of the relationship between the variables at different time horizons.

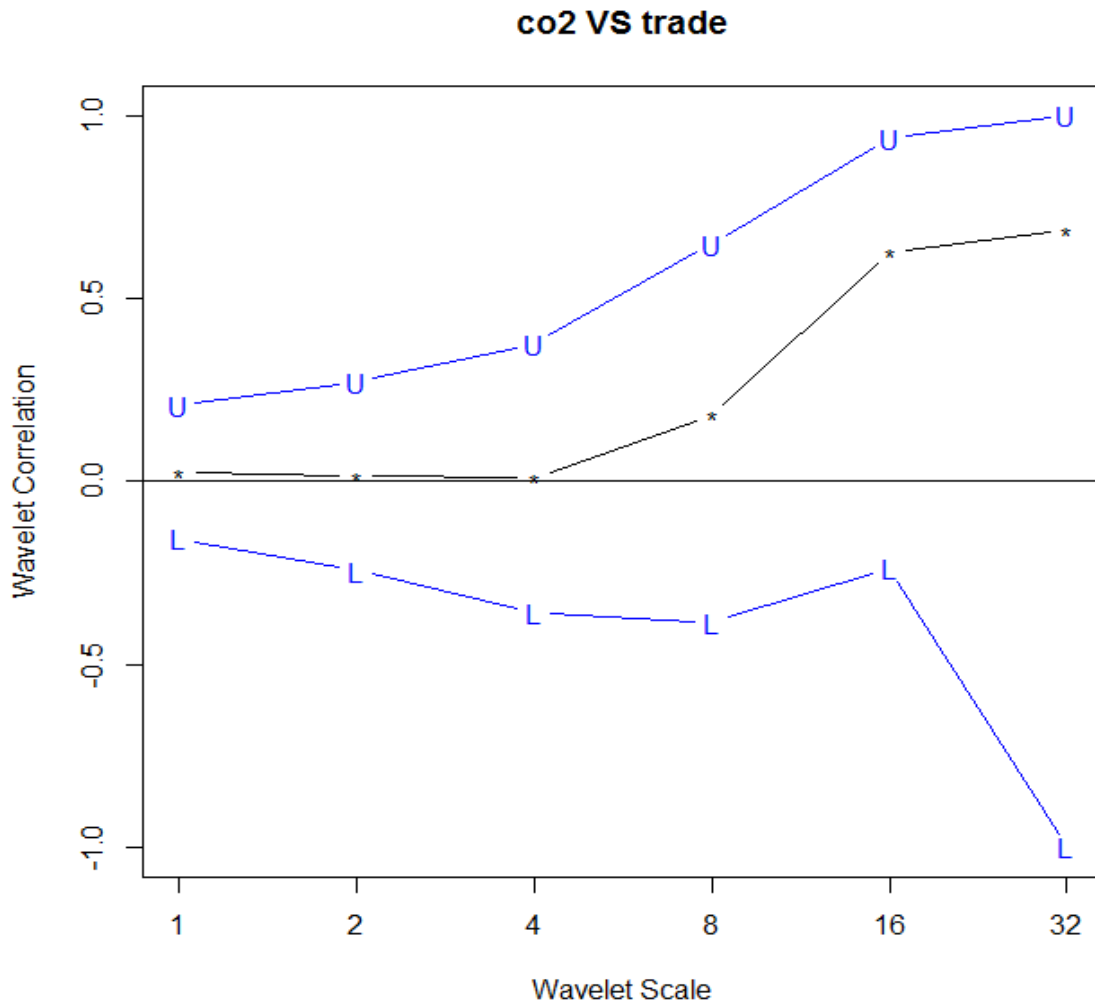


Figure 2. Wavelet correlation coefficient between the environmental quality and globalization (Source: Research findings).

The results suggest that there is a positive and procyclical relationship between the two variables in the long term.

The causal flow can be judged using the cross-correlation between the positive and negative lags with the knowledge of the primacy-recency relationship. With this explanation, the correlation between globalization and environmental quality (carbon dioxide emissions) with 36 positive lags (right half in each level) and 36 negative lags (left half in each level) for each time scale is provided in Figure 3.

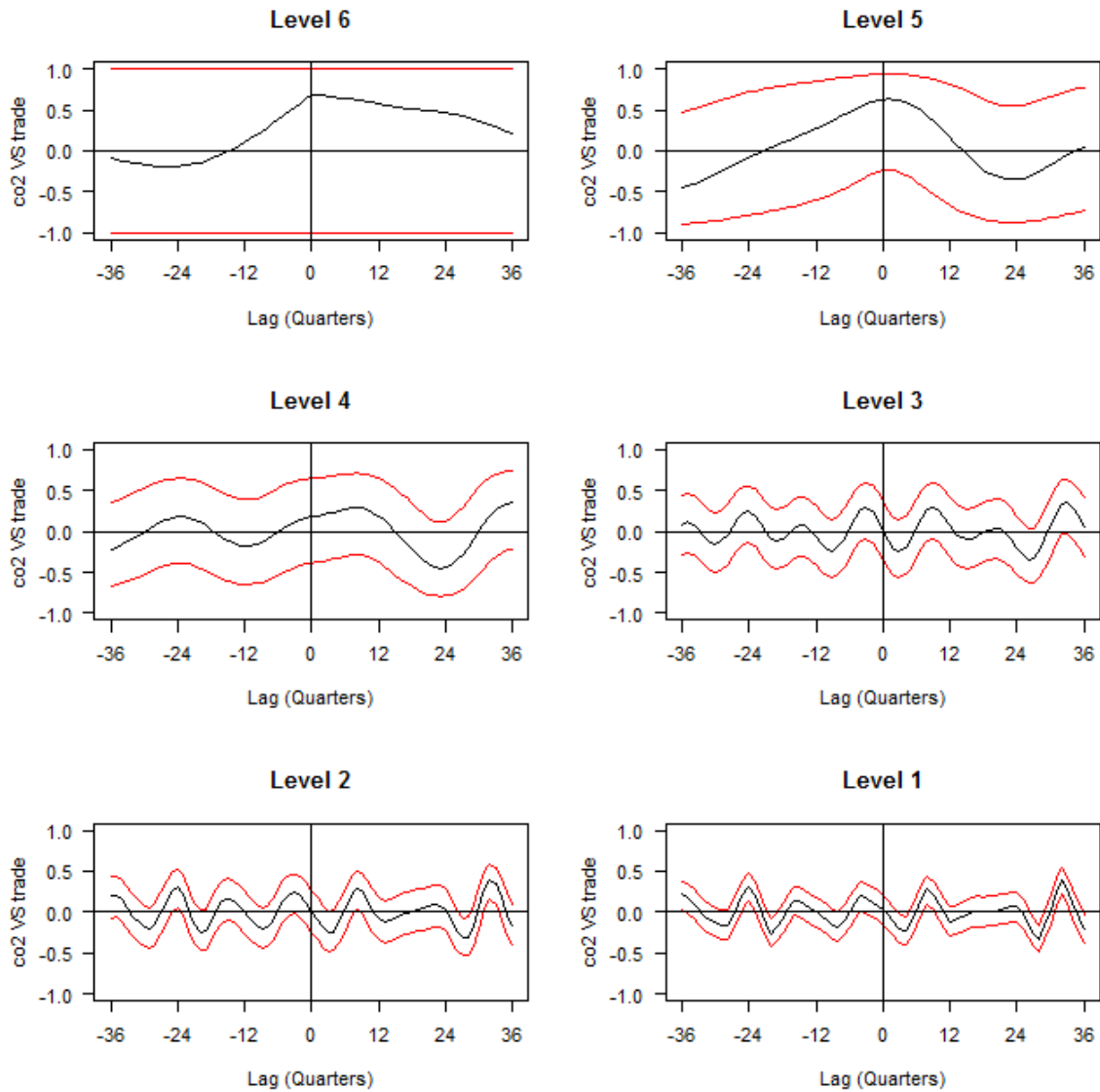


Figure 3. Wavelet cross-correlation between the environmental quality and globalization (Source: Research findings).

For each level, if the correlation of the positive (negative) lags of the environmental quality with the current values of globalization is significantly different from zero, the shape is skewed to the right (left). Then the environmental quality (financial) is the progressive variable and globalization (trade) is the regressive variable. In other words, there is a unilateral causality from the environmental quality (financial) to globalization (trade). If there is a significant difference between the wavelet cross-correlation coefficient and zero on both sides, it can be argued that there is a bi-directional causality between the variables. According to Figure (3), the value of the cross-correlation coefficient in all positive and negative lags is negligible in the first to fourth levels. So there is no causal flow between environmental quality and globalization in the short and medium term. In the long term, there is a bi-directional causality between environmental quality and globalization.

5. Conclusion and Policy Recommendations

Pollution is one of the main managerial challenges in countries today, as they manage pollution in the international arena in addition to policies and measures within their borders. To achieve growth and development, developing countries are facing the problem of environmental degradation, as most

economic activities depend on the use of natural resources, and fewer activities can be found that ultimately do not produce environmental waste. Accordingly, economists have long focused on economic growth and development, taking into account environmental considerations. So in this study, the relationship between environmental quality and globalization was examined using the continuous wavelet transform and data related to the period 1960: 01-2017: 04. Based on the results, there was no relationship between the two variables in the short and medium term. However, in the long term, there was a bi-directional causal relationship. So the following recommendations are provided:

1. Governments are recommended to play an effective and useful role in reducing environmental pollution by encouraging manufacturers in the industrial sector to use new and less polluting technologies, as well as providing the necessary facilities to benefit from these technologies.
2. Countries with similar conditions to Iran should prevent the import of polluting industries and produce knowledge-based goods and services to achieve sustainable and environmentally friendly economic growth in order to have a healthy environment in addition to achieving higher economic growth.

As one of the countries studied, Iran should avoid choosing polluting import industries such as steel mill and seek to increase environmentally friendly industries as well as increase knowledge-based products to achieve higher economic growth. In this way, it is possible to prevent the country from becoming a pollution haven one.

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