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RESEARCH PAPER

# Globalization and its Effect on the Environment: A Case Study of Iran in the Presence of Structural Breaks

**Seyed Mohammadreza Mahdavian[a,*], Najmeh Tafarojnooroz[b], Ahmad Akbari[c]**

a. Department of Agricultural Economics, Faculty of Agriculture, University of Zabol, Zabol, Iran.
b. Department of Economics, University of Shiraz, Shiraz, Iran.
c. Department of Economics, University of Sistan and Baluchestan, Zahedan, Iran.

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## Abstract

The world economy is moving more and more towards globalization, and there has been significant growth in international trade, especially in the last two decades. Increasing economic integration in the world has led to the importance of environmental issues. The present study seeks to investigate the effects of globalization on the quality of the environment along with the variables of GDP, energy consumption, and industrialization index, considering the structural break in Iran between 1971 and 2017. The Lee-Strazicich test investigated the stationarity of the variables, and co-integration between variables with multiple intervals was measured using the Maki test. Using the FMOLS approach, it was found that globalization, energy consumption, and industrialization have positive and significant effects on environmental pollution (CO2 emission). The relationship between GDP and the squared GDP with CO2 emissions is negative and positive, respectively; the environmental Kuznets curve (EKC) hypothesis is not confirmed in Iran and is U-shaped. Also, according to the results of the Toda-Yamamoto causality test, there is a one-way causality from energy consumption to CO2 emissions, globalization, and GDP. In addition, a one-way cause was observed from GDP and industrialization to globalization and from CO2 emissions to GDP.

**Keywords:** $CO_2$ Emission, Energy Consumption, Toda-Yamamoto, Variance Decomposition, Maki Cointegration.
**JEL Classification**: F64, Q50, C22, O44.

## Introduction

One of the most significant challenges facing the world today is environmental degradation. Environmental degradation has devastating effects on human health, biodiversity, ozone layer, air quality, natural resources (water, soil, and forest), and the economy as a whole. One of the most important factors affecting environmental degradation is the global growing trend of $CO_2$ emissions, which is mainly caused by the increase in demand for energy consumption (Rahman, 2020). Environmental problems caused by human activities and their effects, as well as the social and economic activities that cause these problems, have become a global problem in recent decades. The term globalization is multidimensional and has different meanings in different contexts. As a complex process, several factors determine the globalization speed and direction; while its economic, social, and environmental aspects have a significant and long-term impact. The environmental crises that occurred over the past decades have proven the need for a review of human activities and a fundamental change in

* Corresponding author email: sm.mahdavian@uoz.ac.ir; sm.mahdavian@yahoo.com

human lifestyles on Earth more than ever before. The sustainable development concept emerged after the serious consequences of the environmental crisis, refers to the harmonious relationship of natural resources, economic development, and the environment to protect the health of current generations and the preservation of the planet's economic wealth for future generations. Simply put, the development is sustainable when it prevents the complete erosion or disappearance of natural resources or jeopardizes global human rights (Ilic and Hafner, 2015). The relationship between $CO_2$ emissions and globalization has been one of the most important issues in global economic and environmental studies since 1970. According to the proponents of globalization, this phenomenon is not harmful to countries, because it helps the quality of the environment by reducing carbon dioxide emissions. Opponents of globalization, on the other hand, claim that with increasing emissions, $CO_2$ reduces the quality of the environment. According to the opponents, while globalization will increase production, if any production technology and consumption remain unchanged, it will lead to environmental degradation. In addition, although globalization strengthens economic development, especially in developing economies, it has accelerated the decline in natural resources and caused environmental degradation in those countries (Shahbaz et al., 2019). Although globalization has caused growth in international trade, the acceleration of financial flows, innovation in science and technology, as well as greater cooperation between countries, it has also contributed to environmental degradation. Industrial production, growth of energy production and energy consumption, traffic development, uncontrolled exploitation of natural resources, and development of technology and agricultural chemical pollution are among the main causes of environmental problems in terms of environmental protection and sustainable development (Ilic and Hafner, 2015). The rest of the paper is structured as follows. First, let's review the problem statement. The next section provides the theoretical background of globalization, the relationship between environment-globalization and economic growth, energy consumption- environment. Then, by reviewing previous studies, the data, model, and research methodology will be examined. Finally, the empirical findings and conclusion, and recommendations will be provided.

**Problem Statement**

Today's economy, especially in the last two decades, has become more global than ever before due to significant growth in international trade, and nations seem to be increasingly merging with other countries in the world. This becomes even more apparent when an economic shock in one region, immediately affects the economies of other regions of the world (Salahuddin et al., 2019). Not only is trade vital to the global economy, but also affects the global environment. It is estimated that more than 20% of the world's pollution is caused by international trade (Mi et al., 2018). In recent years, due to the rapid development of the global economy and the consumption of large amounts of fossil fuels, severe cases of environmental pollution have occurred. Therefore, a set of policies and initiatives have been considered in all countries to improve the quality of the regional environment. In addition, improving the environment quality has increasingly become an important mission for green development and high-quality economic growth for the international community. Most importantly, the pace of economic growth in different countries or regions has gradually entered a new pattern of transition from rapid growth to moderate and slow growth with the intense pressure of pollution control measures around the world. (Jiang et al., 2019).

Understanding the importance of globalization and its impact on carbon dioxide emissions through various channels in developing and developed countries is very crucial in the globalized world. Currently, it is believed that this phenomenon is an economic tool to improve economic growth and prosperity by reducing trade and investment restrictions among

countries. However, at the same time, some researchers see globalization as a vehicle that affects $CO_2$ emissions and economic activity through various channels. A country engaged in trade and investment requires higher amounts of energy to produce the goods and services it needs, which in turn will lead to more carbon emissions into the environment. Channels such as trade, investment, and technology have many implications for the environment and economic activity (Shahbaz et al., 2019). Total global greenhouse gas emissions have increased by almost 4% per year since 1995 with the rise of international trade. The production of pollutant products in a country or the consumption of highly contaminated goods that have entered another country through a global supply chain may reduce environmental responsibilities in a globalized world. Therefore, the quality of the environment is deteriorating in developing countries such as China and India through exported goods produced in developing countries and through international trade (Wang et al., 2017). According to the International Energy Agency report (2018), the global increase in energy demand had a 2.1 % growth in 2017, while this amount was 0.9 percent in 2016 and the average increase in the last five years was 0.9 percent. $CO_2$ emissions related to energy in the world have has also reached a significant level of 32.5 gigatons and shows a 4.1 % growth in 2017. Global carbon emissions have reached from 20,521 million tons in 1990 to 32840 million tons in 2017, which shows a 60% growth in $CO_2$ emissions (International Energy Agency, 2018). This is a matter of concern because carbon dioxide is a major Green House Gas (GHG) that mainly causes warming and climate change, and ultimately increases the vulnerability of communities and the critical scarcity of resources on Earth.

*Information about Iran*

The importance of the issue of globalization and its effects, the position of geopolitical Iran, and environmental conditions in the country led to this study, in addition to globalization, the effects of variables that affect the quality of the environment, such as GDP, energy consumption, industrialization also be examined. The statistics presented in the next section will further clarify the importance and reasons for choosing Iran as the country to be studied. $CO_2$ emissions levels in Iran increased by 231.5 percent from 171 million tons in 1990 to 567 million tons in 2017. Also, carbon emissions per capita GDP have reached from 0.7 kg per unit of GDP in 1990 to 1 kg in 2017 (International Energy Agency, 2018). According to the report by British Petroleum Company (2017), Iran's share of the global carbon emission was a significant amount of 1.9 percent in 2016, and the total $CO_2$ emissions in Iran increased by 3.5 percent between 2005 and 2015; while the global growth average was 1.6 percent. This is shown in Figure (1) for a better image.

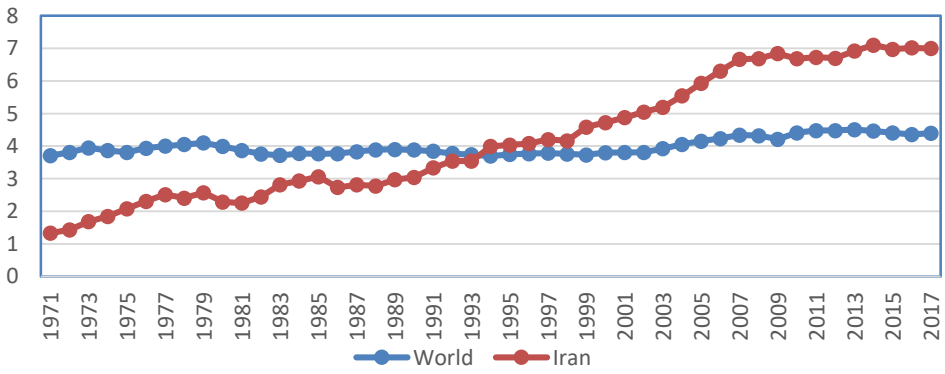


**Figure 1.** Carbon Emission Per Capita (tons)
**Source:** International Energy Agency.

On the other hand, Iran is one of the leading countries in this field because of its vast energy and other natural resources so that 3.9 percent of its oil resources (fourth rank in the world) and 18 percent of the world's gas resources (second rank in the world) are in Iran. In a growing economy in which, the need for energy consumption will naturally increase as production and population increase. According to statistics, Iran has a significant share in terms of energy consumption so Iran accounts for 1.9% of oil consumption and 5.64% of gas consumption in the world (World Energy Council report, 2017). According to the US Energy Information Administration report (2018), Iran's share of energy production in terms of oil and gas production in the world was 4.94% and 5.67%, respectively. Also, primary energy consumption in Iran increased by 40% between the years 2006 and 2016. According to the statistics and Iran is the eighth rank among carbon emissions countries per year (International Energy Agency, 2017), the need to identify the factors affecting environmental pollution in Iran is becoming increasingly clear. Iran’s process of importing and exporting and comparing it with the global trend is also presented in Figure (2). In the field of trade, the ratio of total exports and imports (%GDP) is considered an important indicator. This index has not had a stable trend and has gone through a fluctuating trend in different years and different periods.

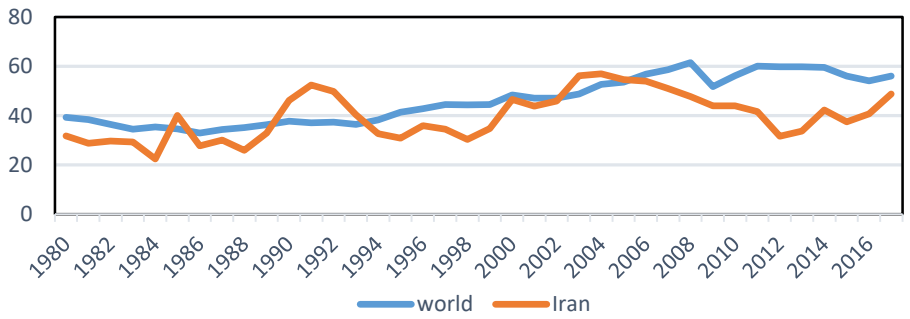


**Figure 2.** The Rate of Total Exports and Imports to GDP (%)
**Source:** World Bank.

Iran's export trend also shows that the country's non-oil exports rose from $ 27.21 billion to $ 44.67 billion between 1971 and 2017. Also, during this period, the amount of imports has increased from 28.71 to $ 43.16 billion (Iranian Customs Report, 2018). According to this introduction and statistics presented in the problem statement section, the importance of examining the relationship between globalization and other factors affecting environmental quality (carbon emissions) in Iran, including energy consumption, and economic and industrial growth is becoming more and more obvious.

## Literature Review

### *Globalization*

The English term globalization refers to the emergence of international networks in the economic and social system. The term "globalization" was first used in 1930 in a journal called "Towards a New Education," which was a general overview of human experience in education. Since the creation of the concept of globalization, many interpretations of it have been provided. Martin Albrow and Elizabeth King are the sociologists who have defined globalization as follows: All the processes that place the nations of the world in a single global society (Cuterela, 2012). Globalization refers to the process of comprehensive economic integration that increases the international mobility of national resources and the interdependence of countries’ economies. It is a process of change that increases the link

between countries and makes social relations possible. It has brought countries closer together and strengthened economic bonds. Today, as economies and societies merge, individuals and institutions have access to what they want faster and more economically than ever before. In this regard, globalization ensures the acceleration of trade and more developed global labor, and thus market forces. The significance of globalization can also be attributed to its effects on income inequality, social problems, and further environmental degradation (Dogan and Can, 2019). Globalization is the integration of the national economy with the global economy in terms of trade, capital mobility, and other socio-economic and political aspects that have different effects on the environment (Rahman, 2020). Many environmentalists believe that globalization is helping to increase global demand for goods and services, leading to increased economic activity and production. This ultimately leads to environmental degradation through the reduction of limited natural resources (in terms of quantity) (Shahbaz, 2017). In contrast, it is also argued that globalization can improve the quality of the environment by transferring technologies that are environmentally friendly through multinational corporations to countries with poor environmental standards (Dogan and Deger, 2016). Globalization has increased the level of interdependence among national economies. This has even made political relations dynamic in the world (Xu and Lv, 2018).

*Globalization and Environment*

Although the relationship between globalization and environmental quality is ambiguous, it seems that advanced economies blame developing countries for the growth of polluting industries. This is because contaminant and pollutant industries in developing economies seek higher production and higher employment at the expense of damaging the quality of the environment. This problem has been statistically demonstrated in a recent report by the World Resource Institute (WRI) on climate change. The degradation of environmental quality in developing countries has been largely due to astonishing changes in open economy policies (Shahbaz et al., 2019). Higher levels of environmental quality degradation in developing countries are mainly due to poor implementation of environmental laws and regulations and lack of control and pressure on production centers with pollution in the production process. This means that globalization allows developing countries to expand their industrial sector at the expense of environmental quality. In other words, industrial production is more associated with environmental quality reduction. On the other hand, it is argued that developed countries are more strictly protecting their environmental quality by enforcing environmental regulations. Consequently, higher economic growth increased energy consumption, and weakness of environmental standards are the most important causes of environmental damage in developing countries (Baek et al., 2009). Globalization can have both positive and negative effects on the environment, and can both exacerbate environmental problems and pave the way for new ways to fix these problems. Although the globalization process has a somewhat positive effect on the environment, its negative effects are far greater. Significant positive effects of globalization on the environment include advances in resource use, increased environmental awareness, and the development of environmentally friendly technologies (Ilic and Hafner, 2015). However, it appears that the negative effects of globalization go beyond its positive effects. Through deforestation, globalization has a negative impact on the environment and is often seen as a major cause of deforestation. Excessive use of natural resources due to increased demand as well as the impact on the ecosystem due to population growth has had a significant negative impact on the environment (Adesina, 2012). On the adverse effects of globalization on the quality of the environment in developing economies, globalization reduces the quality of the environment in the industrialization stage. For instance, if businesses in developing countries do not import and use advanced technologies

in energy consumption and do not follow strict and restrictive environmental protection laws and regulations, while only working for greater profitability, they also put the environmental health at risk by the higher level of carbon dioxide emissions. Also, in the globalized world, if people's attitudes toward environmental quality and environmental ethics do not change in developing countries, globalization will have a negative impact on environmental quality (Shahbaz et al., 2019). According to this introduction and the basics and statistics related to Iran, it is very important to examine the globalization situation and the quality of the environment in Iran, and the impact of these variables on each other. In the following, in addition to examining the various dimensions of globalization and its effects on the environment, the channels that affect the globalization of the environment will also be examined.

*The Globalization Dimensions and its Effects on the Environment*

Global production is steadily increasing as globalization increases and industrialization grows rapidly. So that the growth rate of real global GDP in 2016 and 2017 was 2.51% and 3.14%, respectively (World Bank, 2018). The economic dimension of globalization can increase or decrease environmental degradation. One of the effects of this dimension, which increases environmental degradation, is caused by the conditions for the relocation and growth of highly polluting industries from countries with strict environmental laws to countries with lower environmental regulations. In addition, more globalized countries may economically protect their economic goals, while deciding to ignore their growing carbon footprint. In other words, in order to increase their production and economic activities, they are indifferent to its environmental aspect and consider only the acquisition of economic benefit as the main goal. The effects of economic globalization that reduce environmental degradation can also be attributed to foreign direct investment, which enables the development of efficient production processes in these countries through the transfer and dissemination of clean technologies to developing countries (Lil and Marks, 2019). However, it has been proven that with the development of economic globalization and the challenges and opportunities that change the global scenario, developing countries are finding it more difficult to adapt to the current situation. According to classical theory, the expansion of the global economy creates welfare through the division of labor and expertise according to the comparative advantage in each country. This principle leads to international transactions in which less developed countries can use the global market to access cheaper capital goods and technology. On the other hand, the challenges posed by globalization reduce governments' ability to regulate and set redistributive policies that limit social welfare. This situation occurs in most developing countries that do not have strong and efficient institutions for globalization management (Lascurain, 2017).

From a political dimension, globalization can also have a positive or negative effect on the environment. An example of the negative effects of political globalization on the environment is the decline in the number of governing bodies working on global issues such as climate change (Stiglitz, 2007). From a social dimension, globalization can also have a positive or negative effect on the environment. Further knowledge of environmental problems does not necessarily change the behavior of citizens or their greater awareness of the environment. This can be explained by the concept of mental distance; a term which means that citizens do not associate their behavior with environmental problems. In addition, global media encourages people to consume more, which itself can be a problem for the environment (Steffen et al., 2006). On the other hand, social globalization allows for greater access to knowledge. As access to education is increasing, large numbers of citizens are now becoming more aware of the negative impact of their behavior on the environment and becoming more

aware of the environment. In addition, the population's awareness of the environmental problem increases the consumption of environmentally friendly goods. Thus, social globalization can implicitly and implicitly create more pressure to protect the environment (Motoshita et al., 2015).

*The Channels of Globalization's Impact on the Environment*

Business and investment activities in various global sectors are expanding and multiplying with the expansion of the globalization wave in various dimensions. The dynamic relationship between increasing or decreasing globalization and the environment can be analyzed using three main channels: the scale effect, composition effects, and technique effect (Rafindadi and Usman, 2019). Under the influence of the scale effect, globalization leads to economic growth and increased energy consumption, which in turn increases environmental pollution (Dedeoglu and Kaya, 2013). In some studies, this effect has been referred to as the income effect. In other words, as globalization increases, foreign trade, production, and investment increase, and as carbon emissions increase, the quality of the environment decreases (Rahman, 2020). Globalization potentially affects economies of scale by integrating production agents and interaction between different markets. It affects national borders. For instance, compositions and their opportunities increase interaction between market forces around the world intensify competition, and create product diversity and the availability of better-quality products through a new level of the economic scale, which ultimately leads to productivity and efficiency (Salahuddin et al., 2019). On the contrary, under the influence of composition, while energy consumption decreases, economic activity increases because the share of high carbon products in production processes has decreased (Stern, 2007). In other words, by changing the ratio of capital to labor, the structure of the economy changes, and the economy can be transferred from agriculture to the industrial and services sectors. If the economy shifts from agriculture to the industrial sector, Co2 emissions will start to rise, and if this progress is made more from the industrial sector to the service sector (technology sector), carbon emissions will begin to decline (Shahbaz et al., 2018). The technique effect arises when globalization reduces energy consumption and emissions due to the transfer of advanced technologies and facilitates knowledge and access to international markets, which can also contribute to economic growth (Rafindadi and Usman, 2019).

*Previous Studies about Globalization – Environment*

Salahuddin et al. (2019) examined the relationship between urbanization, globalization, and carbon emissions in sub-Saharan African countries during the years 1980-2017. Using the ARDL approach, it was found that in the short term there is no specific relationship between pollution and globalization, while in the long run there is a significant and negative relationship between globalization and carbon Dioxide emissions. According to the results of the Toda-Yamamoto causality test, no causal relationship between $CO_2$ and globalization was observed. In a study entitled whether globalization weakens the environment, Leal and Marques (2019) studied the effect of globalization (using the KOF index) on the environment in selected EU countries during the years 1990-2016. By using the econometric approach of ARDL, it was found that in general, economic and political globalization has a positive effect on the environment and reduces the quality of the living environment. Shahbaz et al. (2019) studied the relationship between globalization and carbon dioxide emissions in 87 countries by low-income, middle-income, and high-income countries during the years 1970-2012. The results of the unconditional correlation analysis approach showed that in 53.3% of high-income countries, the relationship between globalization and carbon emissions is significant

and positive. However, in 43.3% of these countries, this relationship is negative and increasing globalization has reduced carbon emissions. In middle-income countries, the relationship between globalization and carbon emissions has been positive in 75% of countries. In low-income countries, globalization has had a positive effect on carbon emissions in 55.5% of countries, also globalization has been a negative effect on $CO_2$ in 33.3% of these countries. One study used a fixed and random effect approach. Acheampong et al. (2019) examined the effects of globalization and energy consumption on reducing carbon emissions in 46 sub-Saharan African countries. Using data from 1980-2015, globalization has been shown to have a negative and positive effect on carbon emissions by proxy foreign direct investment and by trade openness proxy, respectively. The study also confirmed the existence of the environmental Kuznets curve hypothesis. Rafindadi and Usman (2019) examined the relationship between globalization, energy consumption, and environmental degradation in South Africa during the years 1971-2014. Using the ARDL approach and Fully Modified Least Square (FMOLS), it was found that in the short and long term, the relationship between globalization and carbon dioxide emissions is positive and negative, respectively. Overall, the share of economic growth, energy consumption, and globalization in pollution emissions are 12.98, 2.27, and 3.49 percent, respectively. The Toda-Yamamoto test results indicate that there is unidirectional causality from energy use to environmental degradation and bidirectional causality between economic growth and globalization. In a study, Rahman (2020) examined the effects of Egypt's electricity, economic growth, and globalization on the quality of the environment in ten countries with high electricity consumption during the years 1971-2013. Using a Fully modified Ordinary Least squares approach and dynamic Ordinary Least squares, it was found that globalization has a significant negative impact on $CO_2$ emissions. Causal relationship results also showed that there is bidirectional causality between carbon Dioxide emissions and globalization. Sethi et al. (2020) by ARDL method examine the effects of globalization, financial development, economic growth, and energy consumption on environmental sustainability in India over the period 1980–2015. Findings reveal that an increased level of globalization and financial development while improving economic performance are inimical to the sustainability of the environment. In the short run, globalization, economic growth, and increased energy consumption are contributing directly to environmental degradation.

**Economic Growth-energy Consumption- Environment**

It is well known that a higher level of pollution emission (carbon dioxide emission) might lead to reducing the productive capacity of a country and climatic change. On the other hand, it is also a fact economic growth necessitates a higher amount of energy consumption and thus carbon dioxide and other pollution emissions (Boopen and Vinesh, 2011). There are three literature research strands about the relationship between economic growth (GDP), energy consumption (EC), and environmental degradation. The first strand is focusing on the relationship between GDP and environmental degradation which could be tested by the Environmental Kuznets curve (EKC) hypothesis. The second strand is focusing on the relationship between Energy Consumption and GDP. Finally, the third strand is exploring the relationship between GDP, Energy Consumption, and environmental pollution (Kasman and Duman, 2015; Tiba and Omri, 2017; Zaidi et al., 2017). In examining the relationship between economic growth and environmental quality, the existence of the Environmental Kuznets Curve (EKC) hypothesis is examined. Kuznets's name is derived from the hypothesis of the inverse relationship between income inequality and economic development this theory states that in the path of economic development of any country, income inequality first increases and gradually decreases after remaining at a certain level (Kuznets, 1955). The

Kuznets Environmental Curve was first proposed by Grossman and Krueger (1991) and replenished by Grossman and Krueger (1995) and was named the Environmental Kuznets Curve (EKC) by Panayotou (1993) and its states that the relationship between economic growth and pollution is an inverted U-shaped curve. In the early stages of development, by increasing economic growth, pollution levels will increase. Pollution will also decrease after reaching a certain level of development. Thus, the EKC hypothesis shows a long-term relationship between environmental impacts and economic growth. As economic growth increases with the development of industry, agriculture, and the intensification of resource extraction, the rate of resource depletion exceeds the rate at which resources are regenerated, and the use of pesticides and waste generation increases. At higher levels of development, structural changes and shifting to information-focused industries and services, increasing environmental awareness, setting and implementing environmental regulations, improving and upgrading technology levels, and higher costs to protect the environment, leading to a gradual reduction in degradation. Thus, in the EKC curve, from the turning point of the curve, with the increase in economic growth and income, the movement toward the improvement of the environmental situation begins (Boopen and Vinesh, 2011). Pao and Tsai (2010) in BRIC countries, Saboori and Sulaiman (2013) in Association of Southeast Asian Nations (ASEAN) countries, Apergis and Ozturk (2015) in Asian countries, Kasman and Duman (2015) in European Union countries, have confirmed the existence of the Environmental Kuznets Curve. Also, Al-Mulali et al. (2015) in Vietnam, Aye and Edoja (2017) in 31 Developing countries, and Aung et al. (2017) in Myanmar, have concluded that the EKC Hypothesis is not validated.

Pao and Tsai (2010) examined the relationship between $CO_2$ emissions, energy consumption, and economic growth during the years 1971-2005 in the BRIC countries and concluded that in the long run energy consumption has a positive effect and economic growth has a negative effect on carbon emissions. Boopen and Vinesh (2011) examined the relationship between $CO_2$ emissions and economic growth for the Republic of Mauritius. According to the research, the $CO_2$ curve and GDP time path present a strong similarity. The flexibility of emission on income increases over time. By using the ARDL approach, Alam et al. (2016) examined the relationship between carbon emissions, economic growth, energy consumption, and population growth in Brazil, China, India, and Indonesia during the years 1970-2012. They concluded that in all four countries by increasing economic growth and energy consumption, carbon emissions have increased. Aye and Edoja (2017) investigated the effect of economic growth on carbon dioxide emission using the dynamic panel threshold framework in 31 developing countries. The results indicate that economic growth has a negative effect on $CO_2$ emission in the low growth regime but a positive effect in the high growth regime with the marginal effect being higher in the high growth regime. Gozgor et al. (2018) in a study of 25 member countries of (OECD) during the years 1990-2013 and using the ARDL and panel quantile regression approach, concluded that both the non-renewable and the renewable energy consumption are positively associated with a higher rate of economic growth.

## Methodological Framework

### *Lee-Strazicich Unit root test*

Conventional unit root tests suffer from small sample bias. One important reason for failing to find evidence of stationarity could be that they don't take structural breaks into account. However, most time series are affected by multiple breaks. Lee and Strazicich (2003) suggest a two-break minimum LM unit root test in which the alternative hypothesis unambiguously

implies that the series is trend stationery. In contrast to the ADF-type endogenous break tests, the LM unit root test has the advantage that it is unaffected by breaks under the null hypothesis, with two breaks and one break, respectively. The LS unit root tests with one break and two structural breaks, based on the Lagrange Multiplier (LM) principle, are modified versions of Schmidt and Phillips (1992) unit root test by incorporating structural break(s) in mean (Model A), both in mean and in trend (Model C) (Altinay, 2005). Consider the following unobserved components model:

$$Y_t = \delta' Z_t + X_t \text{ , } X_t = \beta X_{t-1} + e_t$$

Where $Z_t$ is a vector of exogenous variables and $e_t \sim$ iid $N(0, \delta^2)$. One structural break can be considered as follows (Lee and Strazicich, 2004). Model A allows a shift in level is described by $Z_t = [1, t, D_t]'$ , and Model C allows for a shift in mean and the trend is described as $Z_t = [1, t, D_t , DT_t]'$ , where $D_t = 1$ if $t \geq T_B + 1$; $T_B$ is the time period of trend break; $\delta'$ is a vector of parameters, $DT_t = t - T_B$ if $t \geq T_B + 1$. The rejection of the null hypothesis in this test will indicate that the variables are stationary at the level with the presence of break.

**Maki Cointegration Test with Multiple Structural Breaks**

Traditional cointegration tests like Engle and Granger (1987), Johansen (1991), Banerjee et al. (1998) and Boswijk (1995) break down when there are structural breaks in the series. Hence, leading to erroneous estimates of the relationship among variables equilibrium relationship. The reverse is the case for tests like Gregory and Hansen (1996), Hatemi-j (2008), and Westerlund and Edgerton (2007) which account for one or two structural breaks in the series. However, the probability of the existence of more than two structural breaks is higher and, if they are not detected, may compromise the reliability of the results. In this study, Maki (2012) test with multiple structural breaks was used to investigate Cointegration. Due to using predetermined structural break number, Maki (2012) criticized Gregory-Hansen (1996) with one break and Hatemi-j (2008) with two breaks cointegration tests and put forward cointegration tests whose structural breaks can be determined internally. According to this model, the main hypothesis is the non-existence of cointegration between variables, the alternative hypothesis is the existence of cointegration with structural breaks whose number is determined by the model. Maki cointegration test considers up to five structural breaks in the series. As a prerequisite for adopting this test, the selected variables are expected to be nonstationary but integrated at I(1). There are four alternative models proposed by the test shown in the following Equations (Hamisu Sadi et al., 2020).

Model (0) Break in intercept and without trend:

$$y_t = \mu + \sum^{k} \mu_i D_{i,t} + \beta' x_t + u_t \quad (1)$$

Model (1) Break in intercept and coefficients and without trend:

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \beta' x_t + \sum_{i=1}^{k} \beta' x_t D_{i,t} + u_t \quad (2)$$

Model (2) Break only in intercept and coefficients, but the model has a trend

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \gamma t + \beta' x_t + \sum_{i=1}^{k} \beta' x_t D_{i,t} + u_t \quad (3)$$

Model (3) Break in intercept, coefficients and trend:

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \gamma t + \sum_{i=1}^{k} \gamma_i t D_{i,t} + \beta' x_t + \sum_{i=1}^{k} \beta_i' x_t D_{i,t} + u_t \quad (4)$$

We will use model (3) in this study which lets us change in level, trend and independent variables.

*Toda-Yamamoto Causality Test*

Toda and Yamamoto (1995) propose an interesting yet simple procedure requiring the estimation of an augmented VAR which guarantees the asymptotic distribution of the Wald statistic (an asymptotic $\chi^2$-distribution) since the testing procedure is robust to the integration and Cointegration properties of the process. Also, the Toda-Yamamoto approach is useful because it fits a standard vector autoregressive model in the levels of the variables (rather than the first differences, as the case with Granger causality tests) thereby minimizing the risks associated with the possibility of wrongly identifying the order of integration of the series (Toda and Yamamoto, 1995). Toda and Yamamoto procedure uses a Modified Wald (MWALD) test for restrictions on the parameters of the VAR (p) model. Two stages are involved in implementing the procedure. In the first stage, test each of the time series to determine the maximum order of integration dmax (dmax is the maximal order of integration) of the variables in the system. The second stage includes the determination of the optimal lag length (p). The optimal lag length is equal to k = (p + dmax) (Alimi and Ofonyelu, 2013). In order to test for Toda-Yamamoto based Granger causality between two variables the study estimates the following bivariate VAR (k) Model:

$$X_t = \omega + \sum_{i=1}^{p} \theta_i X_{t-i} + \sum_{i=p+1}^{p+dmax} \theta_i X_{t-i} + \sum_{i=1}^{p} \delta_i Y_{t-1} + \sum_{i=p+1}^{p+dmax} \delta_i Y_{t-i} + V_1 \quad (6)$$

$$\mathrm{Y_t} = \varphi + \sum_{i=1}^{p} \emptyset_i Y_{t-i} + \sum_{i=p+1}^{p+dmax} \emptyset_i Y_{t-i} + \sum_{i=1}^{p} \beta_i X_{t-i} + \sum_{i=m+1}^{p+dmax} \beta_i X_{t-i} + V_{2t} \quad (7)$$

**Model specification**

*Data*

In this study, the time series data of Iran (yearly data) during the years 1971-2017 have been used. Model variables include carbon dioxide emission ($CO_2$), globalization (GLOB), Economic growth (GDP), energy consumption (EN), and value added of the industrial sector (VA). Carbon dioxide emission data have been collected from the international energy agency and globalization variables collected from the Swiss Economic Institute. Other variables were collected from the World Bank.

**Table 1.** Data Description

| variable | Variable Code | description | Source |
|---|---|---|---|
| Environmental degradation | $(CO_2)$ | carbon dioxide emission Per capita | international energy agency |
| globalization | GLOB | KOF Index of Globalization overall dimensions of economic, social and political | Swiss Economic Institute |
| Economic growth | GDP | Gross Domestic Product per capita (constant 2010 US$) | World Bank |
| Square of Economic Growth | $GDP^2$ | The squared term of Gross Domestic Product (GDP) per capita (constant 2010 US$) | World Bank |
| Energy consumption | PENC | Energy consumption in Kg of oil equivalent per capita | World Bank |
| Value-added | VA | Industry value added (% of GDP) | World Bank |

**Source:** Research finding.

**Notes:** KOF Index: This index was first introduced in 2002 and the further updates and details were provided in 2008 by Dreher, Gaston and Martens. This index encompasses all three economic, social and political dimensions of globalization. The index portrays the globalization as a process in which the national borders are eroded; economies, cultures, national technologies, and governments are integrated; and complex relationships of interdependences are established. In general, the KOF globalization index identifies three dimensions of globalization which include the economic, social, and political ones. The economic globalization is divided into two subgroups: trade globalization and financial globalization. Also, social globalization is divided into interpersonal, informational, and cultural globalization (Gygli et al., 2018).

In this study, we modified the conventional EKC hypothesis, and the variables globalization, energy consumption, and value added of the industrial sector entered the model as the three factors influencing the emission of pollution. Following the empirical work of Rafindadi and Usman (2019), model estimation framework is presented as follows:

$$\mathrm{LCO}_2 = \beta_0 + \beta_1 \mathrm{LPGDP} + \beta_2 \mathrm{LPGDP}^2 + \beta_3 \mathrm{LGLOB} + \beta_4 \mathrm{LPENC} + \beta_5 \mathrm{LVIS} + \varepsilon_t \qquad (5)$$

In the above equation, (L) denotes logarithms, $CO_2$, PGDP, $PGDP^2$, GLOB, PENC and VIS denote respectively per-capita Carbon dioxide emission, per capita Gross domestic production, Square of Economic Growth, per capita energy consumption, and Industry value added. The coefficients of $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$ and $\beta_5$ are obtained from the Fully Modified Ordinary Least Square (FMOLS) approach. Various modern econometric techniques were introduced to investigate the existence of a long-run relationship among variables. The FMOLS method was originally introduced and developed by Philips and Hansen (1990) for estimating a single co-integrating relationship that has a combination of I(1). The FMOLS method has an advantage over the Engle-Granger (EG) techniques in introducing appropriate correction to overcome the inference problem in EG method and hence, the t-test for long-run estimates is valid (Himansu, 2007). So the FMOLS is one of the most feasible options for estimating the long-run elasticities as it controls for the endogeneity and autocorrelation problems in the data.

## Empirical Results

The first step in Model estimation is investigating the stationarity of variables. So we used that Lee-Starzicich test with two structural breaks. The results of this test are indicated in table (2). According to the results of Table (2), all variables at the level have unit roots and are stationary with a first difference. So all variables are ($I_1$).

**Table 2.** Lee-Strazicich Unit Root Test

| variable | lag | T-statistic | Critical value (5%) | Break Years | Status |
|---|---|---|---|---|---|
| $LCO_2$ | 2 | -5.14 | -6.15 | 1978-2005 | $I_1$ |
| $DLCO_2$ | 3 | -7.42 | -6.15 | - | |
| LGLOB | 2 | -5.01 | -6.17 | 1977-1993 | $I_1$ |
| DLGLOB | 4 | -6.26 | -6.17 | - | |
| LPGDP | 3 | -6.07 | -6.10 | 1978-1986 | $I_1$ |
| DLPGDP | 3 | -7.52 | -6.10 | - | |
| $LPGDP^2$ | 8 | -6.36 | -6.37 | 1991-2006 | $I_1$ |
| $DLPGDP^2$ | 3 | -7.55 | -6.10 | - | |
| LPENC | 3 | 5.18 | -5.91 | 1982-2007 | $I_1$ |
| DLPENC | 0 | -8.08 | -6.10 | - | |
| Vis | 8 | -5.83 | -6.17 | 1982-1988 | $I_1$ |
| DVis | 3 | -8.73 | -6.31 | - | |

**Source**: Research finding (with Eviews 10).

The results based on the Maki cointegration test (with multiple breaks) showed that in table (3). According to the null hypothesis (no cointegration) and results of the Maki test with five breaks, all of the models confirm the existence of the Cointegration between variables. We use the 3 models in our estimation and analysis because it lets us change in level, trend, and independent variables. Different cases of break years were estimated and according to the significance of the model coefficients, in 1984, 1991, and 2010, it entered the model as Dummy variable. The 1984 structural break refers to Iraq's imposed war on Iran. The break of 1991 marks the end of the war in Iran and the pursuit of policies to rebuild production and infrastructure. Regarding the break of 2010, we can mention the increase in the price of Iranian oil and the rich foreign exchange earnings from the sale of oil, and the beginning of the payment of cash subsidies.

**Table 3.** Maki Cointegration Test

| Model | Test Statistics (Critical Values of Cointegration test) | Break-Years |
|---|---|---|
| 0 | -10.166763 (-6.3) | 1973-1977-1987-1991-2015 |
| 1 | -9.522176 (-6.49) | 1973-1976-1991-2013-2015 |
| 2 | -13.29389 (-8.86) | 1976-1983-1993-2004-2010 |
| 3 | -12.752971 (-9.48) | 1977-1984-1991-2003-2010 |

**Source**: Research finding (with Eviews 10).

The results of the long-term estimation of coefficients are presented in Table (4). The effect of globalization on $CO_2$ emissions is positive and significant, and as globalization increases by one percent, environmental pollution increases by 0.06 percent. This is in line with the results of Leal and Marques (2019) and Shahbaz et al. (2019) research. Also, this is not in line with the results of the study by Rafindadi and Usman (2019) and Rahman (2020). This means that the quality of Iran's environment has declined due to globalization. The relationship between energy consumption and carbon dioxide emissions is significant and positive. As energy consumption increases by one percent, $CO_2$ emissions increase by 0.7 percent. In fact, it was found that energy consumption is a very influential factor in Iran's environment. The relationship between GDP and the square of GDP and carbon emissions is negative and positive, respectively. This result shows that the hypothesis of the

Environmental Kuznets curve (U-shaped inverse) in Iran is not confirmed and this in Iran is U-shaped. In other words, in the short term, economic growth in the form of globalization reduces carbon emissions and in the long run increases it. As expected, the effect of industrialization on the environment has been positive and significant. If the industrialization index increases by one percent, CO2 emissions will increase by 0.01 percent. Naturally, industrialization is not a negative factor in the economy and the environment, but when the manufacturing and industrial sectors are deprived of new technologies and the investment needed to improve their infrastructure, industrialization is a factor in destroying the environment. Long-run estimations indicate that Dummy 1984, Dummy 1991 are positive and Dummy 2010 is negative. Regarding the positive effect of the 1984 break, it can be said that the war and its problems, such as the destruction of infrastructure, and the increase in pollution, such as air and water pollution, have ultimately led to further environmental degradation and increased pollution. On the other hand, in the break of 1991, Iran was trying to solve the problems and backwardness caused by the war by reviving the infrastructure and increasing production, which led to a decrease in the quality of the environment. Regarding the break of 2010, we can mention the increase in the price of Iranian oil and the rich foreign exchange earnings from the sale of oil, and the beginning of the payment of cash subsidies. It can be argued that these two factors have led to an improvement in the per capita income of the people and ultimately to an improvement in the state of the environment. Of course, this can be further explored by future research by researchers.

**Table 4.** FMOLS Test Long-Run Coefficients

| Variable | Coefficient | Std. Error | Test Statistics | probability |
|---|---|---|---|---|
| Lglob | 0.06 | 0.02 | 2.52 | 0.017 |
| Lpenc | 0.7 | 0.01 | 35.8 | 0.00 |
| Lpgdp | -1.3 | 0.02 | -65.11 | 0.00 |
| $Lpgdp^2$ | 0.09 | 0.002 | 42.8 | 0.00 |
| Vis | 0.001 | 0.0004 | 2.4 | 0.01 |
| $Dummy_{1984}$ | 0.2 | 0.007 | 28.2 | 0.00 |
| $Dummy_{1991}$ | 0.02 | 0.006 | 3.1 | 0.004 |
| $Dummy_{2010}$ | -0.02 | 0.006 | -3.7 | 0.00 |

**Source**: Research finding (with Eviews 10).

The results of the Toda Yamamoto causality test are presented in Table (5). According to the results, there is a one-way causality from energy consumption to carbon emissions. This result points to the importance and significant role of energy and its effects on the environment. There is also a one-way causality from energy consumption, GDP, the square of GDP, and industrialization to globalization. By proving the causal relationship between the variables, the importance of globalization became clearer. The issue of globalization cannot be hidden and ignored, and countries must apply appropriate programs and policies to take advantage of the benefits and prevent the negative effects of globalization. On the other hand, there is unidirectional causality from carbon dioxide emissions and energy consumption to GDP. This result again highlights the importance of energy consumption and its impact on production and the environment. Also, the existence of causality from carbon emissions to GDP indicates that the destructive effects of production can be minimized by pursuing economic policies to protect the environment.

The Impulse Response Functions of carbon Dioxide emission are presented in figure (3). Due to the use of reaction functions that show how the impulse of each variable affects other variables over time, the effect of the explanatory variables of the estimated model on environmental pollution (carbon emissions) has been determined.

**Table 5.** Toda-Yamamoto Causality Test Results

| Variable | Chi-sq | Prob | Status |
|---|---|---|---|
| Dependent variable: $LCO_2$ | | | |
| LGLOB | 2.96 | 0.39 | No causality |
| LPENC | 7.32 | 0.06 | Unidirectional causality |
| LPGDP | 2.59 | 0.45 | No causality |
| $LPGDP^2$ | 2.57 | 0.46 | No causality |
| Vis | 0.13 | 0.98 | No causality |
| Dependent variable: LGLOB | | | |
| $LCO_2$ | 4.8 | 0.18 | No causality |
| LPENC | 12.5 | 0.00 | Unidirectional causality |
| LPGDP | 13.8 | 0.00 | Unidirectional causality |
| $LPGDP^2$ | 13.3 | 0.00 | Unidirectional causality |
| Vis | 13.5 | 0.00 | Unidirectional causality |
| Dependent variable: LPENC | | | |
| $LCO_2$ | 1.00 | 0.8 | No causality |
| LGLOB | 4.3 | 0.23 | No causality |
| LPGDP | 2.57 | 0.46 | No causality |
| $LPGDP^2$ | 2.42 | 0.48 | No causality |
| Vis | 0.31 | 0.95 | No causality |
| Dependent variable: LPGDP | | | |
| $LCO_2$ | 7.5 | 0.05 | Unidirectional causality |
| LGLOB | 6.02 | 0.11 | No causality |
| LPENC | 7.01 | 0.07 | Unidirectional causality |
| $LPGDP^2$ | 5.65 | 0.12 | No causality |
| Vis | 2.89 | 0.4 | No causality |
| Dependent variable: $LPGDP^2$ | | | |
| $LCO_2$ | 7.2 | 0.06 | Unidirectional causality |
| LGLOB | 5.9 | 0.11 | No causality |
| LPENC | 6.8 | 0.07 | Unidirectional causality |
| LPGDP | 5.6 | 0.13 | No causality |
| Vis | 2.8 | 0.41 | No causality |
| Dependent variable: Vis | | | |
| $LCO_2$ | 2.2 | 0.53 | No causality |
| LGLOB | 2.49 | 0.47 | No causality |
| LPENC | 1.95 | 0.58 | No causality |
| LPGDP | 1.41 | 0.7 | No causality |
| $LPGDP^2$ | 1.49 | 0.68 | No causality |

**Source**: Research finding (with Eviews 10).

The duration of the course is 20 years. Globalization in the fourth period has the most positive effect on carbon emissions, and in the eighth period has zero effect. In the thirteenth period, the negative (reducing) effect of carbon emissions reached its maximum, and finally, at the end of the twentieth period, the effect of globalization on the environment reached zero and was completely adjusted. Therefore, to neutralize the positive effect of globalization on increasing pollution, it is necessary to make precise and codified planning so that the technological effect is superior to the scale effect. Naturally, with the increase in imports of new technologies or their product knowledge, while increasing efficiency and productivity, the environmental situation will also improve. The effect of energy consumption on carbon emissions over 20 periods is always positive for Iran as expected. This result shows that due to the significant role of energy in the production process and the small share of renewable energy in the total energy consumption in the country (about one percent), energy consumption has always had an increasing effect on pollution. Therefore, it is necessary to pursue incentive policies to increase the production of clean energy in Iran or the import of these technologies. It is also necessary to consider control policies for the consumption of

non-renewable energy sources such as fossil fuels. According to the chart, the negative effect of GDP in the fifth period has reached its maximum and in the twelfth period has been completely neutralized to zero. Therefore, in the short term, the effect of GDP is negative, which confirms the results of estimating long-term relationships.

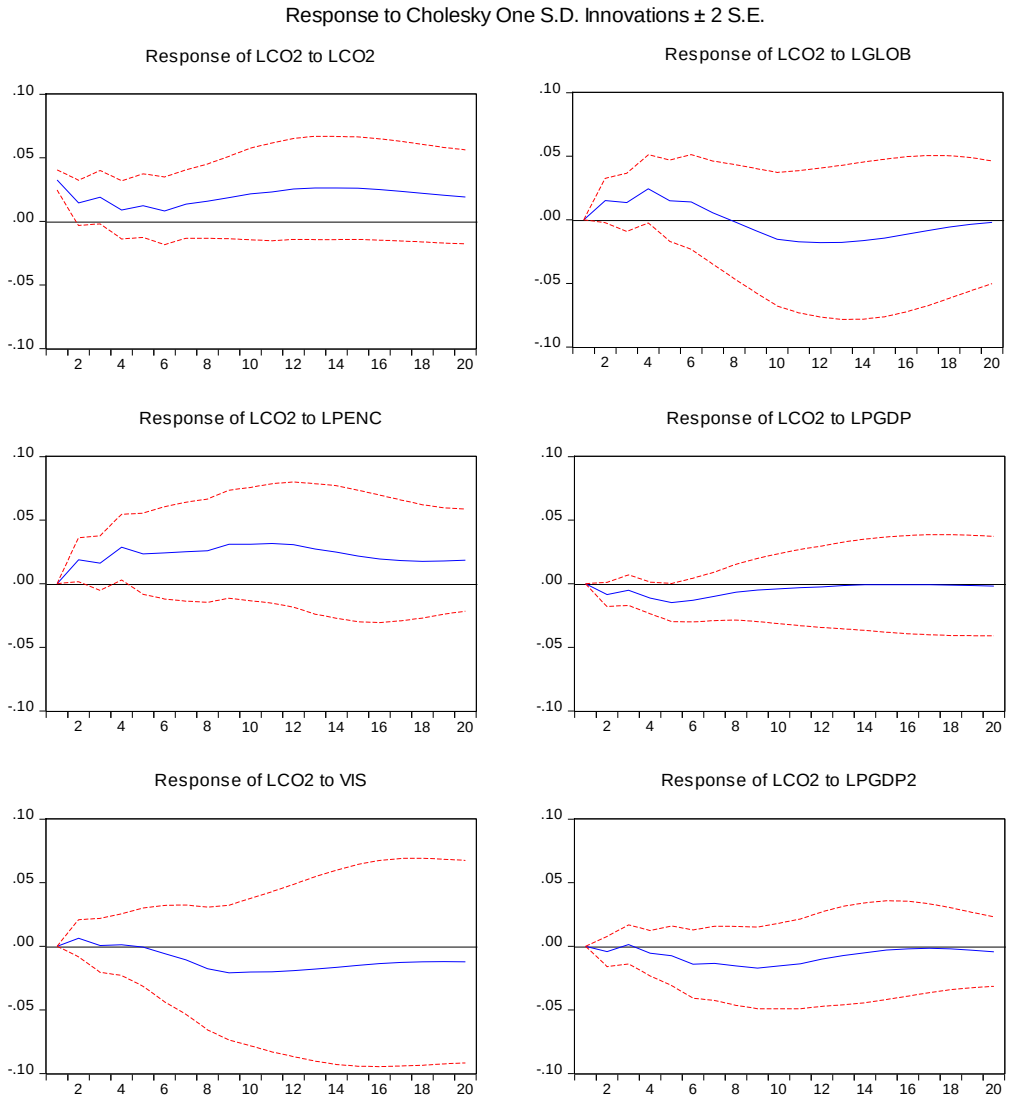


**Figure 3.** Impulse Response Functions of $CO_2$
**Source:** Research finding.

Table (6) indicated that variance decomposition Analysis uses 15 periods. By analyzing the variance decomposition, the share of the variables in the pattern of the changes in each of the variables over time is determined. Ranking of effect variables can also be done in this method. That is, the higher the percentage of a variable, the greater its effectiveness. According to the results, over time, the share of energy consumption in explaining the emission of pollution has increased from 17.91% in the second period to 39.06% in the 15th period. Also, the share of the industrialization index has increased significantly from 1.99% to 11.89%. The third factor influencing $CO_2$ emissions is globalization, which accounts for 12.95 percent in the 15th period. The effect of GDP during the period under review has not changed much and has decreased from 3.37 percent to 3.29 percent. Therefore, according to the values obtained from the analysis of variance, it can be claimed that energy consumption variables, industrialization index, and globalization have the greatest effect on carbon dioxide emissions in Iran,

respectively.

**Table 6.** Variance Decomposition of $LCO_2$

| Period | S.E. | $LCO_2$ | LGLOB | LPENC | LPGDP | VIS | $LPGDP^2$ |
|---|---|---|---|---|---|---|---|
| 1 | 0.032547 | 100 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0.04451 | 64.0966 | 11.5619 | 17.9185 | 3.579186 | 2.143291 | 0.700515 |
| 3 | 0.053091 | 57.81334 | 14.73652 | 21.91284 | 3.452688 | 1.517014 | 0.567597 |
| 4 | 0.066904 | 38.21091 | 22.52747 | 32.26621 | 4.981056 | 1.005805 | 1.008553 |
| 5 | 0.075382 | 32.779 | 21.71415 | 35.16253 | 7.7722 | 0.792971 | 1.779156 |
| 6 | 0.083255 | 27.85243 | 20.64255 | 37.30377 | 8.776182 | 1.000176 | 4.424899 |
| 7 | 0.090396 | 25.88097 | 17.89406 | 39.3893 | 8.653259 | 2.020964 | 6.161453 |
| 8 | 0.098435 | 24.44935 | 15.11293 | 40.14357 | 7.756226 | 4.555504 | 7.982424 |
| 9 | 0.108742 | 22.98873 | 12.99781 | 41.04946 | 6.560475 | 7.041863 | 9.361659 |
| 10 | 0.118996 | 22.49197 | 12.51127 | 41.10937 | 5.589691 | 8.524217 | 9.773481 |
| 11 | 0.128852 | 22.43387 | 12.46899 | 41.0936 | 4.823784 | 9.508435 | 9.671312 |
| 12 | 0.137807 | 23.03998 | 12.59564 | 40.88862 | 4.248067 | 10.11255 | 9.115142 |
| 13 | 0.145333 | 23.985 | 12.82885 | 40.31123 | 3.829148 | 10.52849 | 8.517283 |
| 14 | 0.151662 | 25.00722 | 12.95278 | 39.71895 | 3.519116 | 10.81989 | 7.982039 |
| 15 | 0.156834 | 26.16192 | 12.95022 | 39.06448 | 3.292817 | 11.00675 | 7.523815 |

**Source**: Research finding (with Eviews 10).

## Discussion and Policy Implications

In this article, we have tried to examine the effects of globalization on the quality of Iran's environment. In fact, in the context of the Kuznets environmental curve, the effects of economic growth and globalization on carbon emissions were examined. So we used the annual data for 1971-2017. In the first step, the stationarity of the variables was performed using the Lee-Strazicich test with two structural breaks and it was determined that all variables are ($I_1$). Then we used a Maki cointegration test with multiple structural breaks, and the cointegration between the variables was confirmed. To ascertain the long-run coefficients of the model, the study applied fully Modified Least Square (FMOLS). The causality of Toda-Yamamato was used to investigate the causal relationship between the variables which showed results there is a one-way causality from energy consumption to carbon emissions. There is also a one-way causality from energy consumption, GDP, the square of GDP and industrialization to globalization. As well as there is unidirectional causality from carbon Dioxide emissions and energy consumption to GDP.

Increasing production, economic growth, and improving per capita income are among the goals of any country today. However, achieving these goals requires energy consumption and the discharge of natural resources in various ways. Countries, after reaching a certain level of growth, seek to reduce the devastating environmental consequences caused by economic growth and energy consumption, and in this regard, try to reduce carbon emissions by enacting environmental laws. Due to their high dependence on natural energy sources (fossil fuels), this is more common in developing countries that Iran is one of these countries, where only one percent of total energy consumption is renewable energy according to the International Energy Agency report (2017) that is an important factor in increasing carbon emissions. On the other hand, by raising standards and improving the quality of life, developing countries are trying to start economic development with less damage to the environment. However, this has not been the case in Iran, because, on the one hand, the per capita income has always been at a low level in Iran during the years under study due to

economic and political shocks such as sanctions, currency fluctuations, oil price fluctuations, and so on. On the other hand, the factors such as population growth, weak environmental laws, lack of proper policy to neutralize the Externality effects of production and economic activities, weak education system, and lack of technological infrastructure in industry and production, have led to increased pollution. Also, the political tensions in the region have prevented the transfer of capital and environmentally friendly technologies to the country. It is worth noting that according to the results of impulse response functions, the negative effect of GDP on carbon emissions has a decreasing trend from the seventh period and it is discharged in the twelfth period that confirms that per capita income in Iran is not stable it changes with changes in foreign exchange earnings resulted from oil and gas sales and the negative effects of economic growth on the quality of the environment become apparent in the long run. Therefore, the above mentioned are quite justified in terms of globalization. Iran has not been able to present itself as a stable economy despite having unique economic potential, high human capital, rich natural resources, geopolitical position, etc. infrastructural weaknesses in the manufacturing and industrial sectors require the import of new and environmentally friendly technologies to increase productivity and reduce the destructive effects of environmental and economic activities. On the other hand, Iran's position in an inflamed and tense region called the Middle East has deprived it of attracting foreign investment, which is a proxy of globalization. One cannot deny that Iran needs capital to rebuild its infrastructure, especially in the industrial and energy sectors. The country has not been able to take advantage of the positive aspect of globalization in this area either. According to statistics, the net amount of foreign direct investment entering the country has always been less than one billion dollars during the years 1971-2000. The amount of capital inflows has always fluctuated between 2 and 5 billion dollars during the period 2001-2017. On the other hand, according to World Bank data (2018) Iran's share of global exports has always been less than one percent which is a small figure given Iran's economic potential and geographical location.

Now, the three channels of the impact of economic growth in the form of globalization on the quality of the environment should be mentioned separated by the effect of composition, scale, and technique. The effect of composition can be recognized by the share of economic sectors. If a country moves from agriculture to industry, CO2 will start to rise. Conversely, if the industry moves toward services, CO2 emissions will be reduced (Shahbaz et al., 2018). To better understand the issue, figure (4) is provided for Iran. According to this chart, the share of industry and services in Iran's economy has always fluctuated, and in some periods the share of industry and some periods the share of services has been higher. Accordingly, it can be argued that the effect of composition on the Iranian economy has not been stable, and this may be the reason for the negative impact of economic growth on carbon emissions during the period under review.

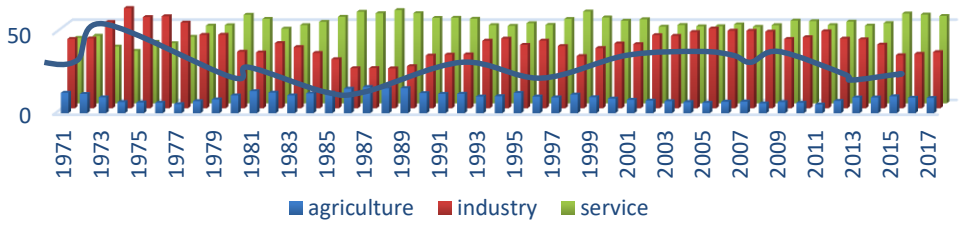


**Figure 4.** The Share of Value Added in Agriculture, Industry, and Services (% GDP)
**Source:** World Bank.

In terms of the scale effect, globalization leads to economic growth and increased energy consumption, which in turn increases environmental pollution (Dedeoglu & Kaya, 2013). Investigating Iran's energy consumption and economic growth over the years under study shows that energy consumption has increased and economic growth has fluctuated. On the other hand, the economic and political constraints of the international community have deprived Iran of the opportunity to use capital and technology. Therefore, high energy consumption due to technological weakness has led to an increase in $CO_2$ emissions. The technique effect is created when globalization reduces energy consumption and emissions due to the transfer of advanced technologies, and facilitates knowledge and access to international markets, which can also lead to economic growth (Rafindadi and Osman, 2019). Due to the existence of economic sanctions and narrowing the channel for the transfer of knowledge and new technologies, the rate of productivity and efficiency in the manufacturing, industrial, and especially energy sectors have been low, and this has led to increased pollution and reduced the quality of the environment. The low share of clean and new energy production from total energy production in Iran, which is 0.34 percent indicates the fact that Iran needs to establish stronger economic and scientific diplomacy with other countries. Therefore, the technique effect in Iran is also fundamentally weak and has often been influenced by Iran's political relations with other countries. The environmental Kuznets curve (EKC) was not confirmed in the present study due to the positive relationship between globalization and carbon dioxide emissions and it was determined that this relationship is U-shaped. In other words, globalization has increased the quality of the environment in the short term, but this relationship has been reversed in the long run and the stage of economic development in a country like Iran and globalization has caused reducing the quality of the environment (increasing $CO_2$ emissions). Results indicate that the scale effect outweighs the technique effect. As the increase in production is due to the consumption of more inputs such as energy, and not because of new technology. Therefore, efficiency and productivity are at a low level and ultimately lead to further destruction of the environment. Some suggestions can be provided to make the most of the globalization capacity and improve the quality of the environment.

Globalization and consequently increased trade between countries naturally increases the use of land, air, and sea transport on the international and domestic scales. On the other hand, a high percentage of environmental pollution is caused by transportation, and of course, the depreciation of this fleet will lead to more pollution. Due to its geopolitical position and good transportation capacity, Iran should provide the ground for the modernization of transport fleets by creating negotiation channels and concluding a memorandum of understanding. On the other hand, Iran must pursue appropriate policies to improve its maritime and air transport infrastructure and develop ports and airports in order to make the most of the economic potential of the country's existing transportation capacity. Another policy of the government could be to impose taxes and allocate environmental subsidies to the economic sectors. Environmental taxes should be levied on sectors or industries that create levels of pollution beyond a certain threshold, while subsidies should be given to sectors or industries that use clean and environmentally friendly technologies. In fact, with this policy, while neutralizing the externality effects of pollutants, the amount of clean government revenue will also increase. Reducing production, rationalizing consumption and inducing a higher level of environmental awareness in the current and future generations, reducing fuel consumption through culture and employment, and utilizing new technologies and renewable energies are essential to achieve the desired balance between environmental and economic activities in Iran. Despite the climatic conditions and having the capacity to produce a variety of renewable energy (wind, solar, geothermal, etc.), the share of renewable energy consumption in total energy consumption in Iran is very low. Therefore, it is necessary for policymakers and planners in the field of energy and environment to provide a clear and codified plan to get out of the current situation. Iran's location in the densely populated region of the Middle East

creates the opportunity to maximize the use of demographic capacity (demand capacity) of neighboring countries using bilateral or multilateral agreements with these countries is a golden opportunity to stimulate supply and currency for Iran. Also, considering the sanctions imposed on Iran, it is necessary to create positive relations with neighboring countries with common interests and resources and transfer knowledge and experience in various fields such as the environment and energy-related technologies. Considering the sanctions against Iran and the restriction of capital inflows into the country, it is necessary that while building trust and comprehensive negotiations for reach countries, the purposeful diplomacy pave the way for attracting foreign capital and technology inflow for the country.

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