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Investigation Asymmetric Relationship between Urbanization and Carbon Dioxide Emissions in Iran

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ABSTRACT

The growth of urbanization has been the most important feature of socio-economic developments of the last two centuries in different countries of the world. Urbanization process is the kind of moving population and workforce from rural areas to urban areas. It's mainly including farmers entering cities and their employment in the industry sector as well as service jobs related to it. Nowadays, environmental degradation and pollution is one of the most important issues in countries. Urbanization as a part of the growth process in Third World countries, despite advantages, creates social and environmental costs such as high energy consumption, greenhouse gas emissions and air pollution. So, the purpose of this study is to investigate the asymmetric relationship between urbanization and carbon dioxide emissions in Iran during 1970-2018. For this purpose, the required information is collected from the Central Bank of Iran and the World Bank. In order to analyze data, Non-Linear Autoregressive Distributed Lag (NARDL) is used. The results show that the relationship between urbanization growth rate and carbon dioxide emissions in Iran is asymmetric; i.e., increase and decrease of the growth rate of urbanization have a different effect on carbon dioxide emissions. So, increase of the growth rate of urbanization significantly reduces carbon dioxide emissions, but decrease of the growth rate of urbanization does not have a significant effect on emissions of such a greenhouse gas. Also, the effect of per capita GDP is non-significant and the effect of per capita variables of factory production, export and population ratio between 15-64 years on carbon dioxide emissions are positive and significant.

KEYWORDS: Urbanization, Carbon Dioxide Emission, Asymmetric Relationship

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1. Introduction

The growth of urbanization has been the most important feature of socio-economic developments in the last two centuries. Urbanization is the process of transferring the country's population and workforce from rural areas to urban areas, and it mainly includes the arrival of farmers to the city and their employment in the industry sector as well as related service occupations. Urbanization that takes place after the industrialization of a country is one of the main features of economic development (Jones, 2004). Urbanization is a rapidly increasing phenomenon. Although the phenomenon of urbanization has increased in developed countries, it is expected that developing countries will experience the greatest increase in urbanization, as the United Nations population division has predicted, urbanization in the less developed areas of the world has more than tripled and from 18% in 1950 to 67% in 2050 (Panahi et al., 2017). In Iran, according to the reports of Iran Statistics Center, the rate of urbanization has increased from 31.4% in 1956 to 74% in 2016. Currently, urbanization is considered as part of the growth process in third world countries, so that based on historical documents, cities have been the driving force of economic and social development of countries (Barzegar, 2012); More income, improved health, better life and remaining opportunities are all drivers of the rapid growth of urbanization, despite all these benefits, urbanization also brings social and environmental costs, which include high energy consumption, greenhouse gas production, and increased air pollution, some of the consequences of urbanization. are (Ehrlich and Ehrlich, 2004).

Overall, there are two different views on the relationship between urbanization and environmental pollution. According to the first point of view, increasing urbanization increases environmental pollution; because with the increase in urbanization, the use of transportation infrastructure and energy increases. Transfer from agriculture to industry also increases pollution. According to the second point of view, urban culture makes energy consumption more efficient in cities compared to villages and energy consumption decreases. Therefore, the relationship between urbanization and air pollution can be positive or negative (Alam et al., 2007).

In this regard, researchers have used a variety of complex statistical modeling techniques to understand the relationship between urban development and the production of greenhouse gases such as carbon dioxide (CO_2). Most modeling techniques implicitly assume a symmetrical relationship between growth and decline in urban development and CO_2 emissions. While, theoretically, the relationship between urbanization and CO_2 emissions is ambiguous; The assumption of symmetry in the relationship between urbanization and CO_2 gas emissions indicates that the impact of urbanization growth on the amount of greenhouse gas production is equal to the impact of the reduction of urbanization on the production of greenhouse gases. Nevertheless, there are logical reasons for the asymmetry of the relationship between urbanization and greenhouse gas emissions. York (2012) explains the asymmetric relationship between economic growth and CO_2 emissions using the infrastructural movement model; He argues that with the increase in economic growth, infrastructures such as transportation networks, housing and sewage systems are created, which increases energy consumption and, as a result, increases the emission of greenhouse gases such as CO_2, but on the other hand, with a decrease in economic growth, these infrastructures remain and therefore, the reduction of energy consumption does not occur much.

However, there are reasons that in less developed countries the relationship between urbanization and CO_2 emissions is contrary to the pattern of infrastructure movement, which means that reducing urbanization may have a large effect on reducing energy consumption and CO_2 emissions. Since in less developed countries, energy-intensive technologies (e.g., electricity and transit systems) are typically concentrated in cities and less available in rural areas, therefore, population migration from cities to rural areas Non-urban areas lead to a sharp drop in energy consumption and CO_2 emissions. In contrast, urban population growth may not have a large immediate impact on greenhouse gas production, as integrating immigrants into the urban economy and establishing an urban lifestyle is energy-intensive and often time-consuming (McGee and York, 2018).

The consequences of change in urban populations are sure to be complex, the exact consequences of urbanization remain unknown. However, the issue of damage to the environment, which is mostly the result of human actions and activities, is one of the most important issues of countries, especially developing countries. The importance of this issue is not only from the environmental aspect and its effects on the natural resource systems, but also from the economic point of view. Therefore, since in the process of sustainable development, attention to the environment has an undeniable role (Fotros et al., 2012). Economic growth and population increase require more energy consumption, and it is important to pay attention to the fact that cities are the largest energy consumers. and emit greenhouse gases (Ishi et al., 2010). Studying the relationship between urbanization and environmental pollution is an important issue that justifies conducting research in various aspects. As a result, investigating the effects of urbanization, as one of the topics raised in population discussions on energy consumption and the environment, is worthy of consideration. In the meantime, in Iran as a developing country, in order to achieve continuous growth along with preserving the environment and ultimately sustainable development, it is necessary to pay attention to the issue of greenhouse gas emissions and the expansion of urbanization. In this regard, in the current research, considering the ambiguities in the relationship between air pollution and urbanization, an attempt has been made to investigate the asymmetric relationship between urbanization and carbon dioxide emissions in Iran.

2. Theoretical foundations and research background

During the last decades, the temperature of the earth has been continuously increasing. In addition to the scientific importance of this issue, global warming caused by greenhouse effects has also been raised as a political and economic issue (Common and Stagl, 2005). CO_2 gas is one of the most important gases that lead to climate change and global warming. About 60% of greenhouse gas effects are caused by CO_2 emissions. Among other gases, this gas has a high contribution to causing air pollution (Heidarzadeh et al., 2017). Several factors are involved in the emission of CO_2 gas, some of which are mentioned below.

Economic growth: Environmental Kuznets Curve (EKC) is a hypothesis that expresses the relationship between environmental indicators and per capita income. The concept of EKC was proposed in the early 1990s by Grossman and Krueger (1991) and popularized by the World Bank's 1992 World Development Report. This hypothesis states that the relationship between environmental indicators and per capita income is inverted U-shaped, meaning that initially due to the increase in per capita income, the amount of pollution increases, but after reaching a certain level of per capita income, pollution decreases. Regarding the reduction of pollution after reaching a certain per capita income level, various reasons can be stated; If no changes are made in the existing structure or technology in the economy, the expansion of production and economic growth will cause the growth of pollution and harmful environmental effects, which is called the scale effect theory. The traditional view of the conflict between economic development goals and environmental quality is based on the scale effect (Stern, 2004).

Trade liberalization: In the late 1970s, environmentalists acknowledged that due to trade liberalization, the volume of economic activities (including polluting activities) expanded and the use of resources and energy increased inappropriately. Also, the expansion of free trade and the increase of competitive pressures between domestic companies and foreign competitors lead to the softening of appropriate environmental policies and even delays the approval and implementation of national environmental laws in the face of the trade liberalization process. But some supporters of free trade are not only opposed to the view that trade liberalization causes the destruction of the environment, but also introduce trade liberalization to improve the environment. According to their argument, due to the countries' response to the competitive pressures caused by the expansion of free trade and access to comparative advantage, the use of resources has become efficient, and thus the waste of resources and energy and the pollution related to them are reduced (Barghi Oskouei, 2008).

Population: There are two Malthusian and Bousrapian perspectives on how population affects the quality of the environment. According to Malthus, the growth of population has reduced the capacity of land resources and caused a decrease in the productivity of the labor force and consequently the food supply has decreased and the supply does not increase in proportion to the increase in population. On the other hand, Boserup believes that high population density is a prerequisite for technological innovations in agriculture, that these innovations increase the efficiency of production and distribution of agricultural products and enable nature to cover a larger proportion of the population. Although Malthus and Boserap have focused on agricultural products regarding environmental issues, two views have been formed in recent environmental discussions. In Malthusian's point of view, the ratio of increase in greenhouse gas emissions will be higher than the ratio of population increase, while in Buserapin's point of view, there is no relationship between population changes and greenhouse gas emissions, or even the direction of this relationship may be negative (Heidarzadeh et al., 2017).

Urbanization: In order to investigate the relationship between urbanization and the environment, three theories of ecological renewal, changing the environment into an urban space, and urban density are used. The theories of ecological (ecological) renewal and urban environment change both show that urbanization can have negative and positive effects on the natural environment with a net effect, so that if urbanization has a positive and significant effect on It has CO_2 emissions, so it can affect climate change forecasting models and policies, and as a result, CO_2 emission forecasting models that are unable to calculate the impact of urbanization on CO_2 emissions will be able to predict CO_2 emissions. If urbanization has a negative and significant impact on CO_2 emissions, then it will make it easier to achieve sustainable development goals. Also, if urbanization has a statistically insignificant effect on CO_2 emissions, as a result, it will not have an important and significant effect on CO_2 emissions, which is compatible with the negative and positive effects of urbanization on CO_2 emissions, which cancel each other out (McGranahan and Songsore, 1994). In the theory of urban density, high urban density has led to the exploitation of economies of scale for public urban infrastructure (such as: public transportation, schools and water supply), car dependence, long transportation routes, and distribution losses. It reduces electricity and ultimately leads to a reduction in energy consumption and CO_2 emissions caused by energy consumption (Panahi et al., 2017).

In recent years, with the importance of the impact of urbanization on environmental pollution in sustainable development programs and its role in urban management, many researchers have explained its place, topic and content, some of these studies are mentioned in Table (1).

Table 1. Internal and external background of the research

Authors	Goal	Result
Chen et al. (2019)	Investigating the relationship between urbanization, CO_2 greenhouse gas emissions and energy consumption structure in 188 Chinese cities	There is an inverted U-shaped curve between urbanization and CO_2 emissions in the western region of China.
Rafaqet et al. (2019)	Investigating the impact of urbanization on CO_2 emissions in Pakistan using ARDL and VECM methods	Urbanization increases CO_2 gas emissions in the long and short term, and in the short term there is a one-way causality relationship from urbanization to CO_2 gas emissions.
McGee and York (2018)	Investigating the asymmetric effects of urbanization on CO_2 emissions in less developed countries	The effect of urban population growth/decrease on CO_2 emissions is asymmetric; In this way, the reduction of urbanization causes the reduction of

		CO_2 gas emissions to a much greater extent than the increase of CO_2 gas emissions as a result of the increase in urbanization.
Al-mulali et al. (2013)	Investigating the relationship between urbanization, energy consumption and CO_2 emissions in MENA member countries	There is a long-term relationship between urbanization, energy consumption and CO_2 emissions. The significance of the long-term relationship between urbanization, energy consumption and CO_2 emissions varies based on countries' levels of income and development.
Poumanyvong and Kaneko (2010)	Empirical study of the effects of urbanization on energy consumption and CO2 emissions considering different stages of development in 99 countries using the STIRPAT model and balanced panel data	The impact of urbanization on energy consumption and greenhouse gas production is different in different stages of development. Urbanization reduces energy consumption in the group of low-income countries.
Martínez (2008)	Investigating the impact of urbanization on CO2 emissions in developing countries	The effect of population growth on CO_2 emission for countries with different income levels has almost equal elasticity and more than unity.
Sayehmiri and Nazari (2020)	Investigating the impact of urbanization on environmental pollution in developed and developing countries using a panel model with random effects.	The variables of urbanization, energy consumption and real GDP per capita had a positive and significant effect on CO_2 emissions in developing and developed countries.
Tarazkar et al. (2018)	Investigating the effect of economic development and urbanization on environmental pollution in Iran using the ARDL method	The results of the study showed an inverted U relationship between the expansion of urbanization and the spread of pollution. Also, the variable effect of per capita national income, per capita energy consumption and trade liberalization were positive and significant.
Panahi et al. (2017)	Investigating the impact of urbanization on CO_2 emissions in member countries of the Organization of Islamic Conference using the panel data approach and using the STIRPAT model	Increasing urbanization, GDP per capita and energy intensity have increased CO_2 emissions.
Fotros and Ghorban Seresht (2012)	Investigating the effects of urbanization growth on energy consumption and CO_2 emissions in countries with and without oil exports using balanced panel data.	The effect of urbanization growth on the amount of energy consumption and the amount of CO_2 emission was positive and significant, and the amount of this effect is greater for oil-exporting countries compared to countries without oil exports.
Fotros and Maaboudi (2010)	Investigating the existence and direction of causality between energy consumption, urbanization, economic growth and CO_2 emissions in Iran using Yamado-Toda econometric approach	There is a causal relationship between energy consumption, urbanization and GDP to CO_2 emissions.

3. Research Methods

In this research, in order to investigate the asymmetric relationship between urbanization and carbon dioxide emissions in Iran, according to the theoretical foundations and research background of the variable of carbon dioxide emissions per capita ($CO_2percapita_t$) as a dependent variable and also from Variables of increasing urbanization growth rate ($urban_t^+$), decreasing urbanization growth rate ($\text{population age15} - 64_{\ t}$), population between 15-64 years old (GDPpercapita_t), gross domestic product per capita ()manufacturing_t) , the share of factory production from GDP (expors_t() and the share of exports from GDP (expors_t() were used as independent variables. The required statistics and information in the period of 1970-2018 were extracted from the Central Bank of Iran time series database and the World Bank website. In order to investigate the relationships between the variables, the self-explanatory model with non-linear distribution breaks (NARDL) was used with Eviews software, which is explained below.

A new and alternative version of co-clustering techniques was introduced by Pesaran and Shin (1999), which is known as the self-explanatory model with distributed discontinuities (ARDL). Among the advantages of this model, we can mention better performance in small samples, the absence of the condition that the degree of accumulation of all model variables is the same, and that the research variables can have different optimal intervals. ARDL estimations are unbiased and efficient due to avoiding problems such as autocorrelation and endogeneity. Also, this method estimates the long-term and short-term relationships between the dependent variable and other explanatory variables of the model simultaneously. The general form of the ARDL(p,q) model is as follows:

(1)

$$Y_t = \mu + \sum_{j=1}^{p} \gamma_j Y_{t-j} + \sum_{j=0}^{q} \beta_j X_{t-j} + u_t$$

The self-explanatory model with nonlinear distributional lags (NARDL) presented by Shin et al. (2014) is the asymmetric mode of the ARDL model, which is one of the latest techniques presented to investigate nonlinear and asymmetric relationships between economic variables in the short-term and long-term.

In this model, it is possible to represent positive and negative changes asymmetrically using partial sum decomposition. The relation of asymmetric convergence is expressed as follows:

(2)

$$\begin{aligned} CO_2percapita_t = {} & \beta^+ urban_t^+ \\ & + \beta^- urban_t^- \\ & + \delta_1 \text{GDPpercapita}_t \\ & + \delta_2 \text{manufacturing}_t \\ & + \delta_3 \text{population age15} \\ & - 64_{\ t} + \delta_4 \text{exports}_t + \text{U}_t \end{aligned}$$

Equation (2), U_t is the error component and β^+ and β^- are long-term asymmetric parameters. $urban_t$ is decomposed as follows:

(3) $urban_t = urban_0 + urban_{\ t}^{+} + urban_{\ t}^{-}$

So, $urban_{\ t}^{+}$ and $urban_{\ t}^{-}$ the total process is a component of positive and negative changes in $urban_t$, which are defined as follows:

(4)

$$urban_t^+ = \sum_{i=1}^{t} \Delta urban_t^+ = \sum_{j=1}^{t} \max(\Delta urban_j, 0)$$

(5)

$$urban_t^- = \sum_{i=1}^{t} \Delta urban_i^- = \sum_{j=1}^{t} min(\Delta urban_j, 0)$$

In this way, the error correction model (ECM) is expressed as follows:

(6)

$$\Delta(CO_2percapita_t) = \rho(CO_2percapita_{t-1}) + \theta^+ urban_{t-1}^+ + \theta^- urban_{t-1}^- + \sum_{i=1}^{\rho-1} \emptyset_j \Delta\left(CO_2percapita_{t-j}\right) + \sum_{j=0}^{q} (\pi_j^+ \Delta urban_{t-j}^+ + \pi_j^- \Delta urban_{t-j}^- + \varphi \Delta GDPpercapita_{t-j} + \mu \Delta manufacturing_{t-j} + \sigma \Delta population\ age15-64_{t-j} + \tau \Delta exports_{t-j}) + \varepsilon_t$$

In equation (6), ε_t is error component and $\beta^+ = -\theta^+/\rho$ and $\beta^- = -\theta^-/\rho$ are long-run asymmetric parameters. Next, it is necessary to examine the co-accumulation of variables; In this regard, we can use the test presented by Pesaran et al. (2001) used it under the title of bound test. The null and counter hypotheses of this test are as follows:

$H_0: \rho = \theta^+ = \theta^- = 0$

$H_1: \rho \neq \theta^+ \neq \theta^- \neq 0$

The null hypothesis indicates the absence of co-accumulation relationship. Since the F distribution is asymmetric, Pesaran et al. (2001), estimated the critical values for the F statistic in two steps; First assuming that all variables are I_0 and then assuming that all variables are I_1. Then they defined the lower limit for I_0 variables and the upper limit for I_1 variables. If the calculated F-statistic is greater than the upper limit value, the null hypothesis is rejected, and if it is smaller than the lower limit, the null hypothesis is not rejected, and if the F-statistic is between the two limits, the test is inconclusive.

Wald's test can also be used to check short-term and long-term symmetry. The null hypothesis and the opposite hypothesis of the Wald test in order to check the long-term symmetry of x_t are as follows:

$H_0: \theta^+ = \theta^-$

$H_1: \theta^+ \neq \theta^-$

The null hypothesis indicates long-term symmetry, therefore, if the null hypothesis is rejected, it indicates long-term asymmetry.

4. Research Findings

Considering that the main goal of this study is to investigate the relationship between urbanization and carbon dioxide gas emissions in Iran, in this section, the trends of these two variables in the period from 1960 to 2018 were investigated and reported in graph (1). According to the graph (1), until 1986, the rate of urbanization in Iran increased with a gentle slope and after this year, it decreased. This decrease was done with a steep slope at first and then its slope decreased. It should be noted that the decrease in the rate of urbanization in Iran since 1986 does not mean a decrease in the urban population in Iran, but it shows that urbanization has increased at a lower rate. Also, graph (1) shows that the per capita production of CO_2 gas in Iran has always been on the rise except for a few years.

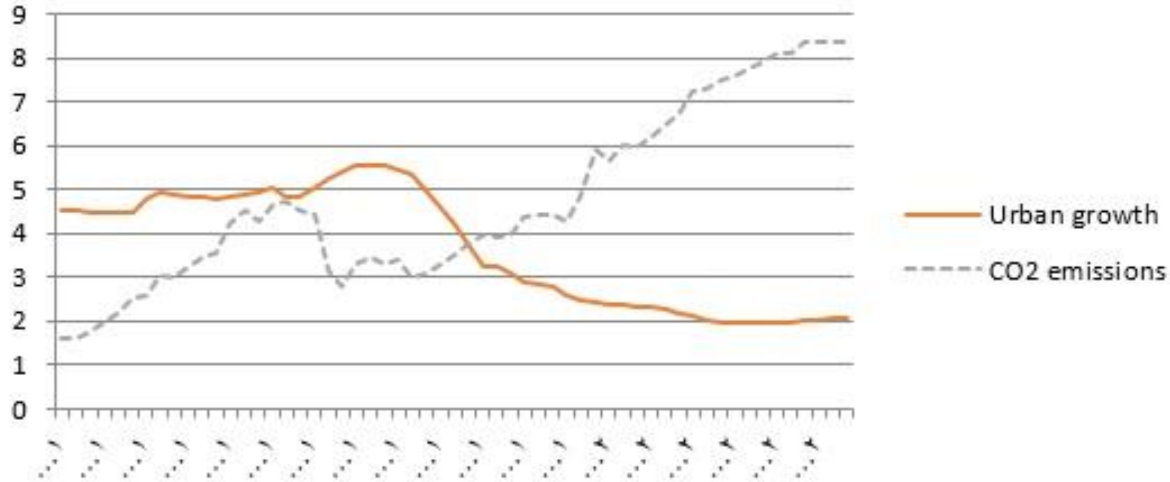

Chart 1. Urbanization growth rate and CO_2 per capita released in Iran in 1960-2018

Before estimating the model, it is necessary to check the significance of the model variables in order to prevent false regression. It is considered meaningful data that the mean, variance and covariance of that variable are equal during the same intervals. There are various tests to check the mean, but in this study, the Augmented Dickey-Fuller Test (ADF) was used. The null hypothesis and counter hypothesis of this test are as follows:

$H_0 : \rho = 1$ is not stable

$H_1 : \rho < 1$ is stable.

ADF results are given in Table (2). The results showed that the population variable between 15-64 years old is at the level of stable or in other words it is I_0. Also, the variables of GDP per capita, exports, the share of factory production in GDP, CO2 gas emissions and urbanization growth rate are not at the level of significance.

Table 2. Augmented Dickey-Fuller Test (ADF) generalized on the level of variables

Variable name		ADF test	Test result
$CO_2percapita_t$	The value of the test statistic	-1.68	not stable
	prob	0.43	
Urban	The value of the test statistic prob	-2.85	not stable
		0.059	
$populationage15-64_t$	The value of the test statistic	-4.19	stable
	prob	0.000	
$expors_t$	The value of the test statistic	-2.85	not stable
	prob	0.056	
$GDPpercapita_t$	The value of the test statistic	0.45	not stable
	prob	0. 98	

$manufacturing_t$	The value of the test statistic	-1.98	not stable
	prob	0.30	

Due to the uncertainty of most of the variables, the ADF test was repeated once again on the first order difference of these variables and its results are presented in table (3). The results show that these variables are equal after differentiating once, and in other words, they are I_1.

Table 3. Augmented Dickey-Fuller Test (ADF) generalized on the first order difference of variables

Variable name		ADF test	Test result
$\Delta CO_2percapita_t$	The value of the test statistic	-6.12	stable
	prob	0.00	
$\Delta Urban$	The value of the test statistic	-5.47	stable
	prob	0.00	
$\Delta expors_t$	The value of the test statistic	-5.47	stable
	prob	0.00	
$\Delta GDPpercapita_t$	The value of the test statistic	-4.72	stable
	prob	0.00	
$\Delta manufacturing_t$	The value of the test statistic	-7.71	stable
	prob	0.00	

Although there are many methods, such as the Johanson-Jusilius method, to investigate long-term relationships between variables, in this study, considering that some variables of the model are I_0 and some are I_1, the NARDL method was used to estimate the model parameters. became. For this purpose, before estimating the relationships, variance tests of heteroscedasticity, autocorrelation and structural failure were investigated.

In order to check the heterogeneity variance, ARCH test was used. The null hypothesis of this test implies the existence of homogeneity of variance. The value of the F statistic and the level of probability in this test were obtained as 0.47 and 0.49, respectively, and since the calculated probability for the test statistic is greater than 0.05, therefore, the null hypothesis cannot be rejected. As a result, the variance There is a similarity. In order to check autocorrelation, Brosch-Godfrey LM test was used. The null hypothesis of this test indicates the absence of autocorrelation. For this test, the F statistic and probability level were calculated as 0.20 and 0.81, respectively, which shows that the null hypothesis cannot be rejected. Also, in order to check the structural failure in the data, the CUSUM test was used, and the related results in graph (2) showed that the statistical graph is between the upper and lower limits, and as a result, the existence of structural failure in the model data is not confirmed.

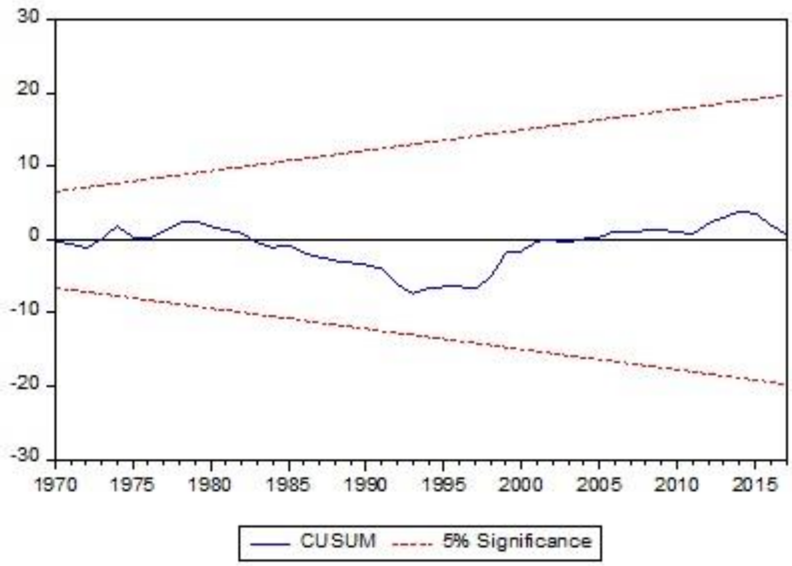

Figure 2. CUSUM test to check the structural failure in the data

As it was said, in order to check the co-accumulation and the long-term balance test, Pesaran et al. (2001) was used. The results of this test at a significance level of 5% are shown in table (4). As can be seen, the value of F_{PSS} statistic is greater than the value of the upper band, and therefore the existence of a long-term relationship is confirmed.

Table 4. Test of edges to check the existence of long-term relationship

Test	null hypothesis	χ^2 statistics	prob	Test result
Long-term symmetry	$\theta^{+} = \theta^{-}$	2.84	0.00	Asymmetry

In order to estimate the long-term coefficients, the logarithmic form of the variables was used and the corresponding results were reported in Table (6). Since the variables of the model are logarithmic, the obtained coefficients show the elasticity. As can be seen, the coefficient of increase in urbanization growth rate was estimated as -0.22, which means that a one percent increase in urbanization growth rate has caused a 0.22 percent decrease in CO_2 emissions in Iran. The estimated coefficient for reducing the growth rate of urbanization is calculated very little and is not significant. In other words, the decrease in the growth rate of urbanization has not had a significant impact on CO2 emissions.

Table 6. Estimation of long-term coefficients using the NARDL approach

Variable	Coefficient	t statistics	prob
Constant	28.93	3.9	0.00
$urban_t^+$	-0.22	3.45	0.00
$urban_t^-$	-0.07	1.3	0.2
GDPpercapita_t	-0.11	1.52	0.14
manufacturing_t	+0.45	-4.62	0.00
$\text{population age15} - 64_{\ t}$	+1.64	-3.33	0.00
expors_t	+0.26	-3.65	0.00
	The value of the F statistic	prob	
ARCH test	0.47	0.49	
LM test	0.20	0.81	

The coefficient calculated for the per capita GDP variable is also not significant, as a result, this variable does not have a significant effect on CO_2 emissions. The estimated coefficients for the variables of the share of factory production in GDP, the population between 15-64 years and the share of exports in GDP are all positive and significant. The estimated coefficient for the variable of the share of factory production in GDP is 0.45, which indicates that with an increase of one percent in the share of factory production, the emission of carbon dioxide gas increases by 0.45 percent. Also, with a one percent increase in the population between 15-64 years old, CO_2 emissions increase by 1.64 percent. In fact, this variable contributes the most to CO_2 emissions in Iran. Also, the value of the coefficient for the variable of export share of GDP was estimated as 0.26, which indicates that with an increase in exports by one percent, CO_2 emissions increase by 0.26 percent.

5. Conclusion and suggestions

Urbanization is part of the growth process in third world countries and cities are the driving force of economic and social development in these countries. But despite all the benefits, urbanization entails social and environmental costs, such as the production of greenhouse gases and increased air pollution. Therefore, it is very important to study the relationship between urbanization and environmental pollution. In this regard, this study was designed with the aim of investigating the asymmetric relationship between urbanization and CO_2 emissions in Iran in the period of 1970-2018. The required data were collected from the website of the Central Bank and the World Bank. In order to analyze the results, an inferential analytical method and an econometric model based on a self-explanatory model with non-linear distribution breaks (NARDL) were used. This method enables the investigation of the asymmetry hypothesis. In order to investigate the relationship between urbanization growth rate asymmetry and CO_2 emissions, Wald's test was used. The results of Wald's test confirmed the asymmetry hypothesis and showed that the increase in the growth rate of urbanization and the decrease in the growth rate of urbanization have different effects on CO_2 emissions in Iran.

The results of NARDL's long-term relationship estimation showed that the decrease in urbanization growth rate has no significant effect on CO_2 emissions. However, the relationship between increasing urbanization growth rate and CO_2 emissions was negative and significant. The effect of the per capita GDP variable was not significant either, in other words, this variable does not have a significant effect on CO_2 emissions in Iran. Also, the per capita variables of factory production, exports and population ratio between 15-64 years had a positive and significant effect on CO_2 emissions in Iran.

The results of this study indicate that with the increase in the growth rate of urbanization, the emission of CO_2 gas has decreased in Iran; This result is consistent with the theory of urban density; according to this theory, high urban density makes it possible to take advantage of economies of scale for public urban infrastructures, and in this way, by reducing energy consumption, it leads to a reduction in CO_2 emissions. This finding is consistent with the results of studies by Tarazkar et al. (2018) and Poumanyvong and Kaneko (2010) pain matching. According to this result, it is suggested that urban planners and policy makers, while supporting the growth of urbanization, provide public infrastructure to benefit from the benefits of urban density.

The results related to the non-significant effect of the per capita GDP variable on CO_2 emissions in Iran with the study of Sharzehi and Haghani (2009) on Iran, Cowan et al. (2014) in the case of India and China and Soytas and Sari (2009) in the case of Turkey. The lack of a causal relationship between economic growth and CO_2 emissions can have various reasons, such as the fact that energy consumption, as one of the factors affecting pollution, has not been efficient in Iran, so that the energy intensity in Iran is much higher than in other countries (according to published statistics). by the International Energy Agency) and this has caused more pollution does not necessarily mean more production. As a result, policies related to reducing air pollution can be applied without reducing economic growth. In this regard, it is recommended that the government, while providing the necessary infrastructure, by implementing policies such as carbon tax, determining technical standards and discount or tax incentives on products with lower pollution levels in order to modify the pattern of energy production and consumption in favor of clean energy and Less polluting has taken steps and provides the basis for reducing the amount of pollution.

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ETHICAL CONSIDERATION

Authenticity of the texts, honesty and fidelity has been observed.

CONFLICT OF INTEREST

Author/s confirmed no conflict of interest.