Investigating the relationship between energy consumption and economic growth of the industrial sector in Iran

Abstract

Efficient use of energy resources and savings in the use of energy carriers is important, especially in the industrial sector. Therefore, understanding the type of relationship between growth energy consumption and industrial production is essential to achieving this goal. In this research, due to the close relationship between energy consumption and the economic growth of the industrial sector in Iran, we have investigated a long-term relationship through the Vector Explanation Model with Long Intervals (ARDL). We have also examined the causal relationship between energy consumption in the industrial sector and the economic growth of the industrial sector from the years 1981-to 2017. The results of the self-explanatory vector pattern with wide intervals showed: All coefficients are significant at a 95% confidence level. The results showed that employment in the industrial sector, in the long run, has a positive and significant effect on the economic growth of the industrial sector in Iran. Energy consumption of the industrial sector, in the long run, has a positive and significant effect on the economic growth of the industrial sector in Iran. In the long run, the capital of the industrial sector has had a positive and significant effect on the economic growth of the industrial sector in Iran. According to the results, the energy consumption of the industrial sector does not rule out the economic growth of the industrial sector is rejected. But we cannot reject the second hypothesis that the economic growth of the industry is not a Granger cause of energy consumption. Therefore, the one-way cause of the energy consumption of the industrial sector to the economic growth of the industrial sector is established. Considering the one-way causal relationship between energy consumption in the industrial sector and economic growth in the industrial sector, we can conclude that increasing energy consumption will stimulate economic growth.

Keywords: *Energy consumption, economic growth, industry sector, employment, capital*

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Introduction

As a developing country with rich and extensive energy resources and its large oil reservoirs, huge underground mines, and potential energy potential, Iran is one of the examples of a growth model with pressure on natural resources. Therefore, planning for energy production and consumption is very important and must be done very carefully. The close relationship between energy consumption and economic growth - can help effectively explain the policies of the energy sector (Armen and Zare, 2005).

Global warming is one of the issues due to the increase in greenhouse gas emissions. In recent years, many treaties and agreements have been signed by various countries for this problem, including the Kyoto Protocol and the Control. The goal of all these treaties is to try to reduce greenhouse gas emissions such as carbon dioxide. However, it should be noted that the emission of these pollutants has a direct relationship with the energy consumption of countries, and energy is considered one of the factors of production and the driving force of economic growth. (Mohammadi et al., 2012).

On the other hand, the industry is one of the most vital sectors of the economy of any country, which has significant effects on social, political, and economic relations within the country and abroad. Therefore, paying attention to industry for growth and development has been one of the goals of most societies, and considering that developing countries, including our country, have been pursuing economic growth and development through the development of this sector for many years, and many money and foreign exchange costs to solve its problems and create industries. Have spent new (Izadi, 2011).

Hence, the relationship between economic growth and the consumption of various energy carriers such as petroleum products, natural gas, and electricity as important factors of production has attracted the attention of many economic analysts. Iran is a growing country with rich and extensive energy resources, large oil capacitors, huge underground mines, and high energy potential. This has made Iran a suitable and different position compared to many other countries. These huge resources can play an effective role as an important factor in the economy if they are used optimally and appropriately. Therefore, Iran, as a developing country with rich and extensive energy resources and potential energy, is one of the examples of a growth model with pressure on natural resources. Therefore, determining the relationship between energy consumption and economic growth can help explain the policies of the energy sector. Restricting energy consumption, especially petroleum products such as gasoline, has been at the top of the government's economic policies for some time. On the other hand, the problems caused by the decrease of natural gas pressure, such as gas cut-off in different provinces or reduction of electricity production in factories whose main fuel is natural gas, are faced by our country from time to time. Determining the relationship between energy consumption and economic growth in the industrial sector can be a good guide for policymakers in the energy sector and the country's economy in the industrial sector. The importance of energy in the production process of various products, on the one hand, and its scarcity, on the other hand, require more and more attention from economic actors to use this factor more efficiently. In addition, due to the differences in the structure of countries due to different energy resources and also the different performance of countries in the use of energy resources technically and technologically, the study of the relationship between energy consumption and economic growth is an important issue and the value of research. . In this study, an attempt is made to investigate the relationship between energy consumption and economic growth in the industrial sector of Iran using the self-explanatory pattern with wide intervals (ARDL). In this study, we investigated the causal relationship between the energy consumption of the industrial sector and the economic growth of this sector using the Granger (1969) linear causality test.

Theoretical Foundations:

Relationship between economic growth and energy consumption

According to the theory of consumer behavior, which is based on the mechanism of maximizing utility about the budget, the demand for energy carriers, like the demand for other consumer goods, will be a function of price and income. On the other hand, according to firm theory, a manufacturing firm can seek to maximize profits, maximize production by a certain amount of cost or minimize cost by a certain amount of production. Thus, the amount of demand for energy carriers as Production input can be a function of input price, price of other inputs, and the amount of good production (Molaei et al., 2015).

Changes in energy prices affect economic activity in two ways. The first is through the effect on aggregate demand, which these changes occur in the short run. The term demand is used because the supply capacity of an economy (abundance of capital, labor, and raw materials, as well as the productivity of each of them) changes only slightly in the short run. Therefore, sharp fluctuations in energy prices can lead to unemployment and underemployment of factors of production, except for the energy sector. The second way energy price shocks can affect the economy is through supply-side effects on the economy. Some economists believe that the energy sector's share of GDP is as small as energy price shocks. They have had very little impact on economic growth. It remains to be seen whether energy price shocks can affect economic activity on the supply side of the economy and ultimately on economic growth.

The most important way that energy price shocks can affect the supply side is through the impact on productivity growth. Many economic analyzes that examine the effects of oil shocks begin with a production function that shows that the product is dependent on capital, labor, and energy data. An exogenous reduction in energy supply reduces the product directly by reducing productivity, indirectly reduces wages, and thus reduces labor and production. Studies show that rising energy prices drove the industrial sector during the 1970s that oil-consuming countries save on energy consumption. The direct effect of changes in oil prices on economic growth for both exporting and importing countries in the first stage is that changes in oil prices, especially their increase, cause inflationary conditions in the economy. This, in turn, can affect the process of changing interest rates and investments. But how GDP is affected by changes in oil prices indirectly can also be from the budget balance channel. Because oil is an important export material for exporting countries and an important imported commodity for the industries of importing countries, Therefore, its price changes affect the export and import reaction functions; as a result, it affects the trade balance and, ultimately, GDP (Bahmanyar and Fitras, 2012).

The degree of access of enterprises to factors of production affects the level of their production, and any allocation of factors of production will have different results on the production levels of goods and services. The output of firms determines total output and, ultimately, the level of economic growth. Therefore, factors of production affect economic growth through a change in the production of firms. Thus, if we consider the production of each firm as a function of using different factors, we will have:

$Q=f(x_i)$

Where Q is the total domestic production and xi are the various factors of production. It is also assumed that there is a direct relationship between the use of these factors of production and the level of production. That is, increasing each of these inputs increases production. In other words, along with economic growth increases the demand for factors of production.

One of the factors used as a factor of production is energy in its various forms, and it has a special place in most production and service activities. It plays an effective role in the economic growth of countries. In neoclassical growth models, only capital and labor are the most important factors affecting economic growth. However, in new theories of growth, the energy factor has also been considered with varying degrees of importance. Stern and Klund (2004) have used neoclassical production function research to investigate the factors that can influence the relationship between energy consumption and economic activity. And state the general state of a production function as follows:

$(Q_1,\ldots,Q_m)=f(A,X_1,\ldots,X_n,E_1,\ldots,E_P)$

Qi is various economic products such as goods and services, Xi is factors of production such as capital and labor, Ei is energy factors such as oil, and A is a sign of technological status and productivity index. In this function, the relationship between energy and total production (GDP) with factors such as substitution between energy and other factors, technological change (changes in A), changes in the composition of the energy factor, changes in the composition of the product and changes in the amount and composition Factors are affected. Thus, if we consider production as only a function of labor (L), capital (K), and various forms of energy (E), we will have:

$Q=f(L,K,E)$

Capital and labor force, both specialized and non-specialized, are the most important factors affecting economic growth that is considered in growth functions. In new theories, the growth of the energy factor is also included in the model, but its importance is not the same in different models. Stern (1993), quoting Ayers and Nier (1984), states that in the biophysical model of growth, energy is the only and most important factor for growth. Labor and capital are mediators that need energy to use. Stern (1993) also quotes neoclassical economists such as Brent (1987) and Denison (1979, 1985), who argue that energy indirectly affects economic growth through its effect on labor and capital and it has no direct effect on economic growth.

Nowadays, in addition to labor and capital inputs, energy is also one of the important inputs of production in macroeconomic discussions. Production is considered a function of labor, capital, and energy inputs. It is also assumed that there is a direct relationship between the level of use of these inputs and the level of production. On the other hand, energy consumption is an inverse function of its price, and the change in energy prices has an important effect on energy consumption and GDP (Maleki, 1999).

If we assume that in determining the total supply in the macro economy, labor is variable, and the rest of the factors of production are constant, then an increase in energy prices and a decrease in demand for it will cause a decrease in labor productivity. As a result, the labor demand curve shifts to the left, resulting in reduced employment. As the employment level of the national product decreases, prices increase, and prices increase. In this case, the total supply curve is shifted to the left. Energy price shocks can also increase the general level of prices by increasing the cost of production, which in turn reduces the components of aggregate demand. And shifts the aggregate demand curve in macroeconomics to the left and reduces the real national product (Ahmadian, 2009).

As for further analyzing the relationship between energy consumption and economic growth, we examine the views of several theorists. Pindik (1979) believes that the effect of energy prices on economic growth depends on the role of energy in the structure of production. According to him, in industries where energy is used as an intermediate input in production, increasing its price (reducing energy consumption) will affect the facilities and the amount of production and reduce national production. Douglas (1991), quoting Brandt and Wood (1975), states that in the pan of production, the total energy is a factor of production that has a weakly separable relation to work. In their proposed production function, energy is first combined with capital, and the result of their combination, after combining it with the labor factor, creates the product. Therefore, energy consumption affects the final production of capital without affecting the final production of labor.

According to the neoclassical growth model, capital and labor are the most important factors affecting economic growth. Stern and Cellland (2004) state that in the biophysical model, energy growth is the most important and only growth factor. Since every production process requires energy, energy is a key factor in the production process. According to them, labor and capital are intermediate factors that need energy to be employed. Using the neoclassical production function literature, Stern and Cellland (2004) have examined the factors that can influence the relationship between energy consumption and the activity of economic sectors. They present the general state of a production function as follows:

$(Q_1, Q_2,\ldots,Q_n)=F(A,X_1,X_2,\ldots,X_n,E_1,E_2,\ldots,E_n)$

Which defines Qi products of different economic sectors (goods produced by industry, services, etc.), Xi factors of production (capital, labor, etc.), Ei factors (carriers) of energy (oil products, gas, Etc.), and A technological status as an indicator of total factor productivity.

In this function, the relationship between energy and value-added of the industrial sector, which is the subject of research, can be under the influence of the following factors:

• Substitution between energy and other factors, for example, in the long run, substitution of capital factor instead of energy due to an increase in the price of various types of energy
• Technological changes (changes in A)
• Change in the composition of different energies
• Change in the composition of the product
• Change in the amount and composition of factors of production.

Research background:

Mehrara et al. (2011) investigate the relationship between energy consumption and economic growth in 11 oil-exporting countries using the single root test and co-integration analysis with panel data. The results show that there is a strong one-way causal relationship between GDP per capita to energy consumption per capita in oil-exporting countries.

Emami and Adibpour (2009) in a study investigated the asymmetric effects of oil shocks on production. The results of their study showed that the effect of oil shocks in the short and long term on asymmetric production and in the short run, the effect of positive shocks is greater than negative shocks, but in the long run, the effects of negative shocks are greater than positive shocks. The effect of positive shocks and negative shocks on production intensifies over time.

Jikissen and Jin (2011) conducted a study entitled "Causal relationships between energy consumption and economic growth" using data from Shandong Province from the period 1980 to 2008. They examined the relationship between the two variables of energy consumption and economic growth. To investigate the relationship between the two variables of economic growth and energy consumption in this study, Granger causality and inclusive tests have been used. The results show that energy consumption and economic growth have a long-term relationship with each other, and there is a two-way causal relationship between them.

Apergis and Payne (2011), in a study unlike previous studies on renewable energy consumption and growth, examined the relationship between renewable and non-renewable energy consumption and economic growth for 80 countries within a multivariate panel Tested for the period 2007-1999. The results of the error correction model in this study reveal the two-way causality between renewable and non-renewable energy and economic growth in both the short and long term. There is a negative two-way causality between renewable and non-renewable energy, indicating a switch between the two sources.

Materials and methods

Model specification

The approach ARDL is done in two steps. In the first stage, the existence of a long-term relationship between the variables under study is tested. Thus, if the sum of the satisfied coefficients related to the intervals of the dependent variable is less than one, the dynamic pattern tends towards long-run equilibrium. The null and contrast hypothesis for long-term aggregation detection in the model is defined as follows. The holistic test of the following hypothesis is necessary:

There is no long-term aggregation between model variables

$$\{H_\circ : \sum_{i=1}^{p} a_i - 1 \geq 0$$

There is a long-term synergy between model variables

$$\{H_1 : \sum_{i=1}^{p} a_i - 1 < 0$$

The statistical quantity for testing the hypothesis of long-term aggregation is calculated as follows:

$$t = \frac{\sum_{i=1}^{p} \hat{a}_i - 1}{\sum_{i=1}^{p} S\hat{a}_i}$$

In this statistic, the sum of the coefficients of the intermittent variables is related to the dependent variable that appears to the right of the equation and is the sum of the standard deviations of these coefficients. If the absolute value of the calculated quantity is greater than the critical quantity presented by Banerchi, Dolado, and Master at the desired confidence level, the assumption is rejected. As a result, there is a long-term equilibrium relationship between pattern variables (Hooshmand et al., 2008).

To examine the relationship between energy consumption in industry and economic growth in this sector is as follows:

LIGDP= F (IL, LIC, IEN)

where in:

LIGDP: The logarithm of GDP in the industrial sector of Iran at a fixed price in 1997

IL: Employment logarithm in Iran's industrial sector

LIC: Logarithm of capital stock in the industrial sector of Iran at a fixed price in 1997

IEN: The logarithm of the final consumption of total energy and the final consumption of various energy carriers, including oil products, gas, and electricity (in a million barrels equivalent to crude oil) in the industrial sector of Iran. The final energy consumption refers only to the part that has been used as energy and not the part that has entered the energy conversion process and has been converted to other energy models.

The statistical data used in this study are time series and the study period is from 1981 to 2017. The econometric model used in this research is the Wide Interval Self-Explanation (ARDL) model.

Results and discussion

The generalized Dickey-Fuller test was used to test the reliability of the variables. The results of the Augmented Dickey-Fuller test show the stagnation of the energy consumption variable (IEN) at the level, and the instability of the variables of economic growth of the industrial sector (LIGDP), employment of the industrial sector (IL), and capital stock of the industrial sector (LIC). Therefore, according to

Table 1, all variables except the energy consumption variable (IEN) are stacked to the first degree or I (1).

Table 1- Results of variables reliability test based on Augmented Dickey-Fuller (ADF) test

First-order difference				level				variables
Critical value 10%	Critical value 5%	Critical value 1%	value of computational statistics ADF	Critical value 10%	Critical value 5%	Critical value 1%	value of computational statistics ADF	
2.6090	2.9411	3.6155	4.6756	2.6090	2.9411	3.6155	1.5104	LIGDP
2.6090	2.9411	3.6155	5.1241	2.6079	2.9389	3.6104	2.0627	IL
2.6079	2.9389	3.6104	4.3371	2.6079	2.9389	3.6104	2.2197	LIC
-	-	-	-	2.6068	2.9369	3.6055	3.7658	IEN

Source: Research Findings

One of the great advantages of ARDL over other aggregate methods is that it can estimate long-term and short-run relationships in situations where even the variables of the model are not reliable zero-orderly and are reliable first-orderly and provide efficient and consistent estimates.

At this stage, the dynamic ARDL model or the intervals determined by the Schwartz-Bayesian criterion by the system are estimated to ensure a long-term relationship. This criterion gives a break of one to the export sector of the industry sector, a break of zero to the variable of production of the industry sector, and a second break to the variable of the real exchange rate. By specifying the pattern variables, the result of estimating the model by the ARDL method is as follows:

Table 2 - Results of conditional convergence test of ARDL dynamic model (2,3,0,3)

Variable	Satisfied coefficient	Deviation	(probability) of T statistic
LIGDP(-1)	0.447959	0.176245	2.541679(0.0173)
LIGDP(-2)	0.502995	0/163578	-2/502949(0/0189)
IL	-09E-2/05	-08E3/29	-0/062184(0/9509)
IL(-1)	-08E-2/61	-08E4/77	-0/547409(0/5888)
IL(-2)	-09E2/06	-08E4/87	0/042282(0/9666)
IL(-3)	-08E-4/02	-08E3/35	-1/200342(0/2408)
IEN	0/000175	-05E3/28	5/356247(0/0000)
LIC	-06E3/95	-06E2/11	1/874910(0/0721)
LIC(-1)	-06E-5/56	-06E4/35	-1/278581(0/2123)
LIC(-2)	-06E7/64	-06E4/35	1/755883(0/0909)
LIC(-3)	-06E-6/00	-06E2/35	-2/558604(0/0167)
C	4/239343	0/799084	5/305254(0/0000)
R^2= 0.994	$\bar{R}^2 = 0.992$	DW= 2.14	F= 430/7624 (0/000000)

Source: Research Findings

The long-term relationship must first be examined. Now, according to the obtained results, we examine the inconsistency between the pattern variables. The desired quantity t for this test is calculated as follows:

$$t = \frac{\sum_{i=1}^{p} \hat{\alpha}_i - 1}{\sum_{i=1}^{p} \delta \hat{\alpha}_i} = \frac{0/502995 - 1}{0/163578} = -3/0383364$$

Because this number (3-083364 /) is less than the critical value of Banarji, Dolado and Master table (3-27.27) in terms of absolute value, Therefore, the null hypothesis that there is no long-term relationship is accepted And so the existence of a long-term relationship is confirmed. After ensuring the existence of a long-run relationship, this cumulative relationship is estimated by the ARDL model with specific intervals as follows. The results of long-term relationship estimation are shown in Table 3:

Table 3- Results of ARDL long-term pattern estimation (1,0,2)

Variable	Satisfied coefficient	Deviation	(probability) of T statistic
IL	0.004512	0.000000	2.583258(0.0158)-

IEN	0.000181	0.000013	13.654322(0.0000)
LIC	0.006327	0.000000	0.154414(0.0084)
C	4.368630	0.013292	328.659923(0.0000)

Source: Research Findings

All coefficients are significant at a 95% confidence level. The coefficient of employment in the industrial sector is equal to 0.004512. It shows that employment in the industrial sector, in the long run, has a positive and significant effect on the economic growth of the industrial sector in Iran. That is if the employment of the industrial sector increases by one percent, the economic growth of the industrial sector in Iran will increase by 0.004512 percent. The coefficient of variable energy consumption of the industrial sector is equal to 0.000181. This shows the energy consumption of the industrial sector, in the long run, has a positive and significant effect on the economic growth of the industrial sector in Iran; that is, if the energy consumption of the industrial sector increases by one percent, the exports of the industrial sector in Iran will increase by 0.000181 percent. Finally, the coefficient of variable capital of the industrial sector is equal to 0.006327. It shows that the capital of the industrial sector, in the long run, has a positive and significant effect on the economic growth of the industrial sector in Iran; that is, if the capital of the industrial sector increases by one percent, the economic growth of the industrial sector in Iran will increase by 0.006327 percent.

To estimate the vector error correction pattern, the first step is to determine the appropriate interval for the difference of the variables in the model. But because the number of interruptions in the VECM model in the difference of the variables is related to the number of interruptions in the level of the variables in the VAR model, by knowing the number of interrupts in this model, the number of interrupts of the difference of variables is also identified in the VECM model.

There are several criteria for determining the optimal number of interruptions, including the likelihood ratio criteria, Akaik, Schwartz-Bayesian, and Hannan Quinn. Based on the above, the optimal interval is determined by the criteria of Akaik, Schwartz Bayzin, and Hanan Quinn. SBC usually saves the number of interruptions. In this research, the optimal number of interruptions is selected based on SBC The existence of an interrupt is the optimal interrupt in this model.

Table 4: Determination of interruption using three criteria Akaike, Schwartz, Hannan Quinn

Hannan Quinn Criterion)HQC(	Schwarz's Bayesian Criterion) SBC(	Akaike information criterion) AIC(	Likelihood Ratio Test)LR(	Pause
-17.65224	-17.46079	-17.75937	NA	0
-2956312	-28.03147	-30.42017	470.3821	1
-29.77972	-26.90786	-31.38668	83.50390	2
-29.30804	-25.09598	-31.66492	47.44802	3

Source: Research Findings

Since the optimal interrupt of model one is selected so the interrupt will be the variable difference in the VECM pattern one. The existence of a combination of a set of economic variables provides the statistical basis for using the VECM error correction model. These patterns, which relate short-term fluctuations of variables to their long-run equilibrium values, are, in fact, a kind of partial adjustment model, which include static residuals of a long-run relationship as an independent variable. Using these models, effective forces are measured in the short term and the speed of approaching long-term equilibrium values. This section examines how to adjust short-term imbalances in economic growth to long-term equilibrium using the VECM model. The VECM sentence coefficient shows that in each period, a few percent of the short-term imbalance of economic growth is adjusted to achieve long-term equilibrium. This coefficient indicates how long it takes for economic growth to return to its long-term trend. The error correction factor in this model is -0.177330 and is statistically significant. Therefore, the short-term and long-term patterns are related, and in each period, 17% of the imbalance in the next period is corrected. The results of the error correction factor are shown in Table 5:

Table 5 - Results related to the error correction factor

Variable	Satisfied coefficient	Deviation	of T statistic
VECM	-0.177330	0.03486	-5.08718

$R^2=0.82$	$\bar{R}^2 = 0.70$	F= 7.133912

Source: Research Findings

The Granger causality test begins with the logical assumption that the future cannot be the cause of the past. In other words, if the current values (Yt) are predicted using the past values (Xt) more accurately than when those values are not used, in this case, (Xt) is called the cause of gangrene (Yt). But according to Granger, if there is a co-integration relationship between two variables, there will be causality in the Granger concept at least in one direction (one-way or two-way) between them. Although the co-integration test can determine the presence or absence of a Granger causal relationship between variables, it cannot determine the direction of the causal relationship. Therefore, Engel and Granger (1987) state that if two variables are stacked, there will always be a vector error correction pattern between them. As a result, this type of model can be used to investigate the Granger causality relationship between variables. In this test, the zero hypothesis in each regression is that the first variable is not the Granger causality of the second variable.

According to the results of Table 6, Granger causality test, this hypothesis is rejected that the energy consumption of the industrial sector (IEN) is not the Granger Causality of industrial sector economic growth (LIGDP). But cannot reject the second hypothesis that industrial sector economic growth (LIGDP) is not the cause of energy consumption of the industrial sector (IEN). Thus the one-sided Granger causality from industrial energy consumption (IEN) to industrial sector economic growth (LIGDP) is established.

Table 6- Granger causality test results

Hypotheses	Hypotheses
0.0196	Energy consumption of the industrial sector is not the cause of economic growth in the industrial sector
0.2253	Economic growth of the industrial sector is not the cause of energy consumption in the industrial sector

Source: Research Findings

Conclusion

The purpose of this research was to investigate the relationship between energy consumption and the economic growth of the industrial sector in Iran. The results with a self-explanatory vector pattern with wide intervals showed that all coefficients are significant at a 95% confidence level. The results showed that employment in the industrial sector, in the long run, has a positive and significant effect on the economic growth of the industrial sector in Iran. Energy consumption of the industrial sector, in the long run, has a positive and significant effect on the economic growth of the industrial sector in Iran. The capital of the industrial sector, in the long run, has had a positive and significant effect on the economic growth of the industrial sector in Iran. According to the results, the energy consumption of the industrial sector is not the cause of the economic growth of the industrial sector is rejected.

The second hypothesis that the economic growth of the Granger industry is not a causality of energy consumption cannot be rejected. Thus, Granger causality is one-way from the energy consumption of the industrial sector to the economic growth of the industrial sector. Given the one-way relationship between the Granger causality from energy consumption in the industrial sector to the economic growth of the industrial sector, we can conclude that increasing energy consumption will stimulate economic growth.

The results of this study are somewhat consistent with the results of Sotas and Sari (2003). In their study, they examined the causal relationship between energy consumption and GDP for the G7 and newly industrialized countries. Granger causality tests show that in Argentina, there is a two-way causal relationship between energy consumption and per capita GDP. In Italy and Argentina, there is a one-way causal relationship between GDP per capita and energy consumption, and in Turkey, France, Germany, and Japan, there is a causal relationship between energy consumption and GDP per capita. The results of this study are also consistent with the results of the study of Waled Raphael (2006). Using the Toda and Yamamoto modified Granger causality test and the self-explanatory vector (VAR) model, they examined the causal relationship between the consumption of industrial energy types and GDP for Shanghai during the period 1952-to 1999. His findings show that there is a one-way causal relationship between the consumption of coal, charcoal, and electrical energy and GDP. Using the Toda and Yamamoto modified Granger causality test and the self-explanatory vector (VAR) model, they examined the causal relationship between energy industry consumption and GDP for Shanghai from 1952-to 1999. His findings show that there is a one-way causal relationship between the consumption of coal, charcoal, and electrical energy and GDP.

The results of this study are consistent with the results of Lee and Chang (2005). In an article entitled "Structural Failure, Energy Consumption, and Economic Growth in Taiwan," they examined the relationship between energy consumption and GDP for Taiwan from the period 1995-to 2003. The results of this study indicate that in the long run, energy acts as a driver of economic growth.

The results of this study are consistent with the results of Khalilpour (2006). He examines the relationship between energy consumption and economic growth in Iran. The results of his research show a positive relationship between total energy consumption and economic growth in Iran

The results of this study are consistent with the results of the study by maleky (1998). Using the vector error correction model, he investigates the relationship between Granger causality between energy consumption and economic growth in Iran during the period 1981-1998. The studies performed in this study show that all variables are (1) I, and there is an all-inclusive relationship between them. The findings of this study show that in the short and long term, there is a one-way causal relationship between energy consumption and GDP.

The results of this study are consistent with the results of the study of Mohammadi et al. (2012). In their study, they examined the relationship between economic growth and energy consumption in Iran (analysis of linear and nonlinear causality models). The results of their study showed that there was no causal relationship between economic growth and energy consumption in Iran with both linear and nonlinear tests. The results of the linear (at a significance level of 10%) and nonlinear test (at a significance level of 5%) showed that there is a one-way causal relationship between energy consumption and economic growth in Iran.

According to the obtained results, we suggest that in implementing any energy-saving policy in the industrial sector, it is necessary to act with extreme caution in such a way that the implementation of such policies does not have a contractionary effect on economic growth. According to the obtained results, we recommend, in this regard, adopting appropriate policies to increase productivity in consumption. Optimal use of energy carriers will have a higher priority than policies based on quantitative reductions in the consumption of these carriers. Given that energy carriers are production inputs, any restriction on their consumption will also have a limit on production. Considering that the country's industry has so far had the advantage of cheap energy if this advantage is taken from the industry, its competitive power will be lost, and recession and unemployment (reduction of production) will be its natural consequence. Therefore, we suggest that to avoid the contractionary effects of the energy-saving policy, we should move towards a reduction in consumer demand. Such policies will be enforceable through appropriate combinations of taxes and subsidies on energy carriers. Reducing energy consumption is only justified if it does not interfere with the achievement of the main goal (economic growth and development), so it is suggested that reduce energy consumption by increasing efficiency. The following suggestions can also advance the goals and executive policies of the country's energy: In determining the fuel consumption standards of the country's industries, it is recommended to consider the results of studies such as this research. To implement fuel-saving policies, it is important to increase the awareness of managers and industry planners in the country.

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