JEER http://jeer.kmsu.ac.ir 10.22113/jeer.2024.207822
Journal of Empirical Economic Research, 2024, 1(1), 17- 30. Original Paper

The impact of macroeconomic influencing factors on Iran's gas exports

Seyed Jassem Mousavi, Hamidreza Abdollahian *, Fatemeh Hosseinpour

Department of Economics and Maritime Insurance, Khorramshahr University of Marine Science and Technology, Khorramshahr, Iran.

✉ **Responsible author email:** hr.abdollahian@kmsu.ac.ir

Received: 1 August 2024 **Revised:** 29 August 2024 **Accepted:** 9 September 2024

ABSTRACT

Natural gas is an important energy source on a global scale. Iran can play a pivotal role in the global gas industry and has the potential to become a major exporter of natural gas. As the second largest holder of natural gas reserves in the Middle East and the world, Iran has the potential to generate significant revenues from the export of this commodity. Given its proximity to countries that seek and use natural gas, Iran is well positioned to play a significant political and economic role. To this end, this study examines the impact of macroeconomic factors on Iran's gas exports. The analysis considered a number of factors, including the gross domestic product of Iran and the countries importing gas from Iran, the price and other factors influencing gas consumption, production and reserves. Eviews software was used to calculate the logarithms of the specified variables, to estimate the ARDL model for the specified period (1991-2019), and to determine the impact of these variables on Iran's gas exports. The results show that each of the aforementioned criteria has a significant impact on Iran's gas exports. The analysis shows that domestic gas consumption, Turkey's GDP and Iran's GDP have a negative and significant impact on Iran's gas exports. Conversely, changes in the country's gas reserves, world gas prices and changes in gas production have a positive and significant impact on gas exports.

Keywords: export gas, iran, turkiye, ARDL model.

1. INTRODUCTION

In recent years, natural gas has emerged as a dominant energy carrier due to its status as a clean fuel. From one perspective, natural gas offers several advantages, including affordability, minimal environmental impact, low processing costs, resource distribution, and the remaining finite reserves of this energy source globally. Conversely, the decline in world oil reserves has prompted many countries and major energy consumers to prioritize natural gas, leading to an increase in its share of the global primary energy portfolio. This shift is expected to continue in the coming years, with natural gas becoming a more prominent energy source in various fields, according to numerous experts. It is anticipated that the energy supply will demonstrate.

Iran is the second country in the world, after Russia, in terms of proven natural gas reserves, with an estimated 31.9 trillion cubic meter, representing 16.9% of the total world reserves. Additionally, Iran is the leading gas producer in the Middle East, with an estimated production volume of 239.5 billion cubic meters of natural gas (BP, 2018). In the context of the global gas industry, BP (2018) has a distinctive competitive advantage, as well as unique characteristics that are conducive to gas export. This is due to the company's advantageous geopolitical location. Conversely, Iran's strategic location along a key oil and gas transit route, with a border spanning

980 kilometres, affords it one of the shortest routes for oil and gas transmission. In recent years, the global demand for natural gas has experienced the most rapid growth of all energy carriers, with an increase of 1.4%.

The international sanctions imposed on Iran in relation to its nuclear energy program and associated domestic, foreign, political, economic and security concerns have resulted in the country being unable to maintain its position in the global energy supply and exert influence over it effectively. In accordance with the JCPOA agreement of June 2014 and Iran's subsequent withdrawal from international sanctions, this possibility was reserved for Iran. In order to ensure the security of its energy supply, the European Union has adopted a multi-faceted approach, which includes diversifying its sources of gas. Apart from its existing relationship with Russia, the EU has also explored the potential of Iran as a gas supplier. This is partly due to the disruption of gas supplies from Russia in 2006 and 2009, as well as the political differences between Russia and Ukraine. The EU's strategy has also been influenced by the long-term sanctions imposed on Iran due to its nuclear program. Consequently, the possibility of gas transmission through Iran to Europe can be predicted for the next few decades. Consequently, a strategy has been devised to import gas through Iran to Europe.

The consumption of fossil fuels has increased significantly since the beginning of the century as a consequence of the sustained growth of the global economy (Braungardt et al., 2019). The extensive utilization of fossil fuels has resulted in a multitude of environmental concerns, including acid rain, air pollution and global warming (Pachiannan et al., 2019). It is imperative that clean and renewable energy sources be developed in order to mitigate the energy crisis and environmental issues (Dostál and Ladányi, 2018). In recent years, a fundamental approach to economic development has been the adoption of a low-carbon mode of operation in an increasing number of countries (Zhao et al., 2019). In the context of low-carbon development, natural gas offers a number of advantages over other fossil fuels and renewable energy sources (Furuoka, 2016). As the primary component of natural gas is methane, it emits less carbon dioxide and other pollutants than other fossil fuels, such as oil and coal, in terms of environmental protection (Yang et al., 2017). Natural gas has the advantage of being a more cost-effective and dependable energy source than renewable energy sources, including solar, wind, geothermal, ocean, hydroelectric, and bioenergy resources (Miller and Carriveau, 2018 and Mac-Kinnon et al., 2018). The utilization of natural gas is currently regarded as a pivotal juncture in the transition from fossil fuel energy to renewable energy sources (Gillessen et al., 2019). It is commonly accepted that renewable energy has an important role to play in enhancing the energy system and safeguarding the environment. Consequently, the proportion of renewable energy sources in overall energy consumption has been increasing in recent times (Ullah Khan et al., 2017; Zeren and Akkus, 2020). In the global energy consumption structure, coal, fossil fuels, and natural gas continue to be the top three energy sources, accounting for 27.21%, 33.63%, and 23.87% of the total annual energy consumption in 2018, respectively (BP, 2020). During the past ten years, the use of compressed natural gas (CNG) has expanded significantly in response to the growing need for environmental protection. The CNG rose by 28.35% in 2018 as compared to 2008. The CNG will also keep growing in the future because of its strong potential for environmental preservation and minimal carbon dioxide emission (Chen et al, 2018).

Iran's macro-level natural gas policies may be historically divided into three primary time periods. This conclusion is based on an analysis of Iran's national development plans, energy development roadmaps and visions, and interviews with specialists from the National Iranian Gas Corporation[1] (Iranian Government Report, 2011).

[1] NIGC

1. Natural gas output was relatively low throughout the 1960s and 1970s, with some exports to Russia.

2. From the 1980s to the 2000s, natural gas was the preferred energy source for meeting domestic energy demands as part of the country's energy policy. As a consequence of the release of greater quantities of crude oil for export, Iran was able to negotiate more favorable terms on the international oil market.

3. In 2010, Iran adopted a strategy to increase its market share in the international natural gas market through the development of gas fields, a policy that remains in place to this day.

As natural gas in the world has increased for use in the combination of fuel, and countries tend to reduce the use of crude oil in the future, Iran can reduce its dependence on oil exports with proper planning. As well as guarantee the security of the country's demand (Balsalobre et al., 2019). Natural gas (NG) is a vital non-renewable energy source that may be utilized to boost the economic activity of all nations, whether they are emerging, developing, or developed, according to the research by Apergis et al., (2010), Shahbaz et al., (2013a) and Shahbaz et al., (2013b). Several of the economies of the world are becoming interested in the possibility of adopting NG as an alternative due to the reduction of oil reserves in the majority of oil-producing countries. Due to this circumstance, it is necessary to investigate the causal connections between macroeconomic factors (Roumi et al., 2021).

Notwithstanding Iran's substantial gas reserves, which represent the second largest in the world, the country has not yet become a significant exporter. It is therefore important to examine the macroeconomic factors affecting gas exports and identify these factors. The objective of this study is to examine these factors and their impact on gas exports, which appear to be crucial. The variables under examination in this study include the national export and importer country per capita, domestic gas consumption and demand, and supply variables (international gas prices, gas reserves, and gas importers from Iran). This study will utilize ARDL method data from 1991 to 2019. In comparison to the cointegration methodology proposed by Johansen and Juselius, the ARDL approach is more reliable when the sample size is limited. Furthermore, it offers two additional benefits: the capacity to test hypotheses based on the estimated long-run coefficients and the simultaneous estimation of short- and long-run effects. The structure of the study is as follows. The literature review is included in the "Literature review" section. The data and technique approach are covered in the "Methods and Material" section. The "Results and Discussion" part presents the findings and discussions; the "Conclusions and Policy Implications" section draws conclusions and suggests policy changes.

This research examines the natural gas export for the Iran due to its geostrategic position in the Middle East and the world, according to the theoretical foundations of measurable macro-influencing factors.

According to the statistics of the British Petroleum Company, primary energy consumption has increased by 2.9% in 2018. This growth rate is almost twice the average growth figure of 10 years ago (1.5%) and has been recorded as the fastest growth since 2010. The main growth in world energy consumption was from natural gas, which accounted for about 45% of this growth in 2018. This rapid growth of energy consumption is influenced by the growth of natural gas consumption (BP, 2020).

The contribution of each sector in energy consumption can be seen as follows in the Fig. (1).

According to this report, the consumption of natural gas from the total energy consumed for 2018 and 2019 is 68% and 66%, respectively, which shows the high importance of this sector in energy consumption in Iran.

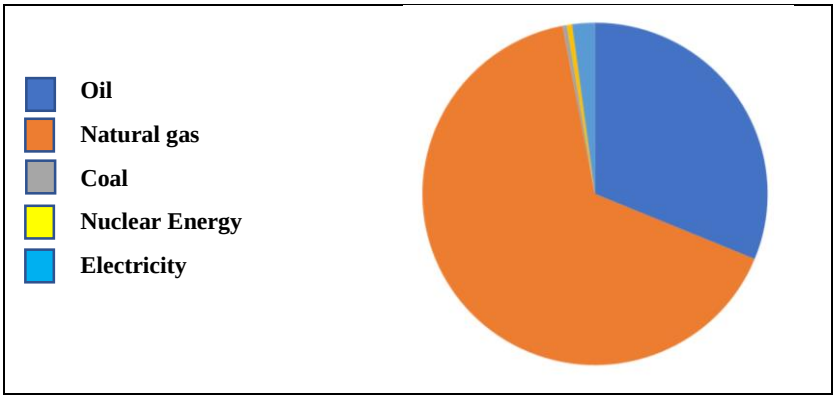

Fig. (1): The Contribution of Different Sectors in Energy Supply – 2019 (Source: Statista - World Energy Statistical Review, 2020)

The expansion of CNG can offer the dual benefits of economic growth and environmental conservation (Wu et al., 2021; Feng et al., 2015; Guan et al., 2018). The causal link between CNG and economic growth has been the subject of several academic studies, primarily at the national level and in comparison with outcomes in other nations. For example, evidence from 67 countries for the period 1992 to 2005 indicated a two-way causal relationship between CNG and economic growth in both the short and long term (Apergis and Payne, 2010). The causal relationship between CNG and economic growth across G7 member countries can be classified into three main categories: unidirectional causality, reverse causality, and bidirectional causality (Kum et al., 2012). In regard to the relationship between CNG and economic growth, the findings of various studies yielded disparate conclusions (Solarin & Shahbaz, 2015), While several studies indicated that CNG had a beneficial impact on economic growth, others posited that economic growth exerted a detrimental effect on CNG in the short term (Khan and Ahmad, 2008; Sari et al., 2008).

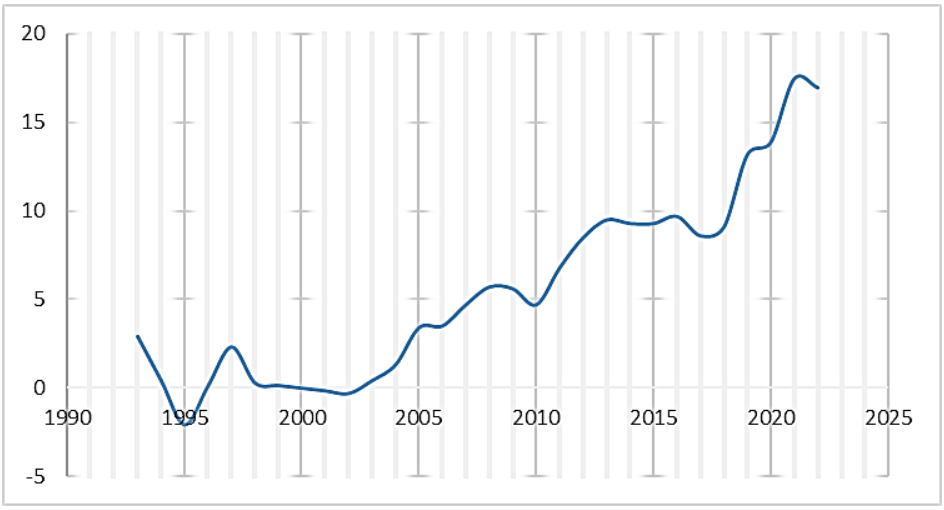

Fig. (2): Iran's natural gas export curve (Source: Statista - World Energy Statistical Review, 2023)

As can be seen in the Fig. (2), Iran's gas exports had a downward trend in the period 1995-1993 and then an upward trend until 1997. It continues to grow from 2003 to 2021, although there are many ups and downs during this long period. From 2021 onwards, the upward trend in Iran's gas exports will stop due to domestic demand.

Export Price of Natural Gas

The price and the quantity of supply and demand have a reciprocal and decisive relationship. In the case of oil and gas, the price is set by the group of producers, in effect the cartel. In the case of gas demand, the economics of gas trading in any given case depends on the market conditions of the consuming country. The market value of gas is actually the maximum price the consumer is willing to pay to substitute gas for another fuel. The higher the market value of gas in the consuming country, the more economical a gas trading project will be. It will be beneficial. The impact of gas exports on its price is undeniable: natural gas is not traded globally, so its price can vary significantly from one region to another. At present, Europe, Asia and America each have their own pricing mechanisms.

The main approaches to pricing and gas price formula structures are as follows:

1- Fixed pricing: This method considers a fixed price for gas in a given period.

2- Cost-based pricing: an approach based on covering all investment costs, operations, financing, risk compensation and reasonable profit margins, regardless of the market value of the commodity.

3- Market value pricing: an approach based on accepting the market value of gas.

4- Pricing based on gas-to-gas competition: in this method, the price is determined by the interaction of supply and demand and gas-to-gas competition, and gas varies over time.

According to previous research, factors affecting natural gas prices include the cost of crude oil, climate, the amount of natural gas available for supply, demand and storage (Brigida, 2014). Empirically, Brown & Yucel (2008) and Ramberg and Parsons (2012) use the VECM model to examine the correlation between Henry Hub natural gas prices and international oil prices in the US, highlighting the fact that domestic natural gas prices are influenced by domestic natural gas reserves, shortages, and the environment, in addition to oil prices.

Fig (3) shows the trend of natural gas prices in different global markets. After the high growth of gas prices in 2012 and 2013, we have seen a decrease in prices in recent years.

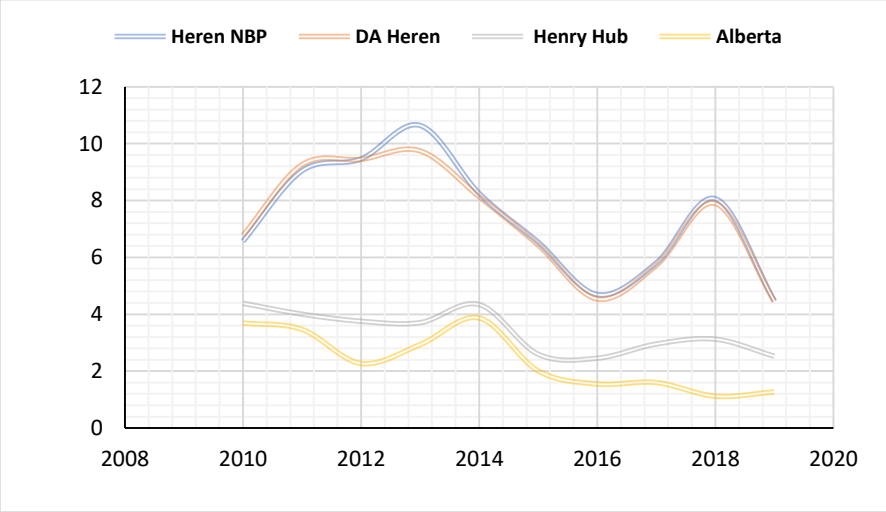

Fig. 3- Trend of Natural Gas Prices (Source: Statista - World Energy Statistical Review, 2020)

natural Gas Proven Reserves

The last three decades have seen an increase in natural gas production as a result of the rising energy demands of nations undergoing economic growth and development as well as a shift in the energy mix due to a decreased reliance on oil. British Petroleum figures indicate that this resource's global proved reserves expanded by nearly 66% between 1999 and 2019, from 170.5 trillion cubic meters in 2009 to 198.8 trillion cubic meters in 2019 (BP, 2020). So, there is a positive association between the volume of output and the level of reserves based on the mining and reserves data. The quantity of reserves is another important element in determining how much is produced. It appears natural that mining and reserve levels have a favorable connection. Thus, variations in the ratio of reserves to extraction indicate how long the reserves will last (assuming no new discoveries and continuous output), and this ratio is altering dramatically over time for all nations. For instance, it was 21.26 for England, 10.26 for America, and 16.21 for Australia in 1980. This ratio fell to 4.88 for England, 11.55 for America, and 65.53 for Australia by the end of 2008 (EIA,2019).

According to estimates in the 2020 BP report, the world's stable natural gas reserves in 2020 were 198.8 trillion cubic meters, with the following shares of global reserves by region: Africa is 7.5%, North America is 6.8%, Central and South America is 4%, the Middle East is 38%, Europe and Eurasia are 34%, Asia and Pacific are 8.9%. For the entire planet, the ratio of reserves to extraction or output is 50 years. In different parts of the world, the ratio of reserves to extraction is as follows: 144 years for South and Central America, 12 years for Europe, 108.7 years for the Middle East, 75.8 years for Central Asia, and 12 years for Russia. Iran has a reserve-to-extraction ratio of 131.1 years (EIA,2019).

The three nations of Iran, Russia, and Qatar collectively have around half of the world's natural gas reserves. By the year 2020, Iran will have around 32 trillion cubic meters of proved natural gas reserves, which is more than 16.2% of the total proven natural gas reserves in the globe. With Qatar sharing more than 47% of Iran's gas reserves in the South and North Pars fields, Iran intends to generate 273 billion cubic meters of gas annually over the course of 30 phases from this field. Gas trading operations have increased in frequency and scale as a result of the uneven distribution of gas reserves and the sharp rise in gas demand in nations with small domestic reserves. The volume of the global natural gas trade increased by 5.1% on average between 2000 and 2016, and it is anticipated that the trade in natural gas will continue to rise in the future (Zhao et al., 2019). Ben-amirouche & Moussi (2018) examined the Dynamics of Algerian Gas Exports to Europe and stated that there is a long-term and short-term relationship between Algerian gas exports and influencing factors (demand and supply variables such as GDP, relative price, European local production, international gas price, gas reserves, and domestic consumption), with domestic gas consumption and Algerian gas reserves having the largest effects on gas exports.

Natural Gas Production

According to the Cedigaz (2020) report, gas output on the global market increased by 3.5 percent in 2019. With the rise in natural gas production from gasses linked with oil and shale gas and regular production, America alone had an increase in output of 136 billion cubic meters, or a %10 increase in gas supply. Natural gas output has also grown in Australia, China, Iran, Russia, and Egypt. The output of natural gas has dropped by %7 in Europe, Central and South America. In 2019, there was a decline in the demand for natural gas worldwide, but the two biggest consumers—the United States and China—saw increases of %31 and %27 respectively. Iran generated the most natural gas in the Middle East in 2018, at roughly 239.5 billion cubic meters. 6.2% of the natural gas produced worldwide is produced in Iran. Russia (34 billion cubic meters), Iran (19 billion cubic meters), and Australia (17 billion cubic meters) contributed the most to the rise of natural gas production after the United States (ICCIMA, 2019). According to BP (2020) report, Iran's natural gas output increased by 6.8% on average from 2008 to 2018. Natural gas output

increased by 2.4 percent in 2019 compared to 2018. Pick et al (2020) looked at Iran's potential as a natural gas supplier to Europe. His research indicates that Iran will produce more gas between 2025 and 2030, with the South Pars field producing the most. Domestic consumption will rise to meet consumption despite the rise in output. The predictions in this article state that investments in the natural gas industry will rise, and that the potential for natural gas export will materialize after 2020 due to forecasts of declining demand. Assuming other factors are constant, the increase in natural gas production in gas exporting countries can increase the export capacity of these countries.

Natural Gas Consumption

According to global statistics, Iran is the fourth largest consumer of natural gas in the world. Iran's natural gas consumption is divided into two categories: final consumption and consumption of energy producing sectors. The final consumption of natural gas is also divided into two categories of final consumption of energy, including residential, commercial and public sectors, industry, transport, agriculture and petrochemical fuel and non-energy final consumption (petrochemical feedstock). Consumption by the energy producing sectors includes fuel for oil and gas refineries, pressure boosting stations, fuel for turbines and diesel generators in the pipeline route and gas used in power plants, consumption for blast furnace units, coking units, consumption for pump houses and feed for hydrogenation units. Domestic consumption of natural gas increased from 147 billion cubic meter in 2007 to 223 billion cubic meter in 2016. In fact, it can be said that the average annual growth rate of consumption during this period was 4.7% and the total consumption of natural gas in Iran increased by 52% during this nine-year period (Zhi-Guo et al., 2018).

Iran is the world's fourth-largest user of natural gas, according to global statistics. Iran divides its natural gas usage into two categories: final consumption and consumption by industries that produce energy. Moreover, the ultimate consumption of natural gas is separated into two categories: final consumption of energy, which includes consumption by the private, public, and industrial sectors as well as by industry, transportation, agricultural, and petrochemical fuel (petrochemical feed).

Fuel for oil and gas refineries, pressure booster stations, fuel for turbines and diesel generators along pipeline routes, gas used in power plants, consumption for blast furnace units, coking units, consumption for pump houses, and feed for hydrogenation units are all included in the consumption of the energy-producing sectors. Statistics depict the evolution of the nation's natural gas consumption from 2007 to 2016. Domestic natural gas consumption rose from 147 billion cubic meters in 2007 to 223 billion cubic meters in 2016. In reality, it can be claimed that throughout this time, the average annual growth rate of consumption was 4.7%, and over these nine years, Iran's total natural gas consumption rose by 52%. Although natural gas production is increasing rapidly, most of this production is spent on domestic demand. so that even natural gas is imported. This contrast shows that the domestic demand is rapidly surpassing the production of natural gas in Iran.

2. MATERIALS AND METHODS

This section discusses the method of the study, and the model and its variables. The current study explores macroeconomic issues and how they affect Iran's gas export in face of increased international commerce, Iran's current development, and Iran's intention to join the World Trade Organization. The years 1991 to 2019 were chosen as the study's time frame. In the current study, an effort has been made to look at these aspects and their impact on Iran's gas exports while taking into account Iran's large share (second rank) of the world's gas reserves and in contrast to the country's modest position in the worldwide gas market.

The model used in the present research is in the form of Eq. (1)

$$LEX_t = \beta_0 + \beta_1 LRSV_t + \beta_2 LCN_t + \beta_3 LGI_t + \beta_4 LGT_t + \beta_5 LP_t + \beta_6 LPRO_t + \varepsilon_t \quad \text{Eq. (1)}$$

Where EX, gas export, RSV, gas reserves, CN, gas consumption, GI, Gross Domestic Product of iran, GT Gross Domestic Product of Turkish, P, gas price, and PRO, gas production. All variables are considered as natural logarithms.

To estimate the model of this research, the Autoregressive Distributed Lag (ARDL) approach has been used to extract long-term and short-term functions.

Data

A number of macroeconomic factors and their effects on Iran's gas export are the hypotheses put forward in this study. The aim of this study is to analyze these elements and their effects on Iran's gas export. For this purpose, data on gas export (EX), consumption (CN), reserves (RSV), and production (PRO) in million cubic meters, gas price (P), Iran's gross domestic product (GI), and Turkey's gross domestic product (GT), are used. The data of the variables of this research are collected annually from foreign and domestic websites such as the website of International Monetary Fund[2], OPEC[3], World Bank[4], Central Bank of Iran[5] and the website of Iran Statistics Center[6] for the economy of Iran and Turkey for the period 1991-2019.

3. RESULTS

This section discusses the estimation of the model and the interpretation of the coefficients of the economic model. Before estimating the model, it is necessary to first check the descriptive statistics of the variables and to perform the Mana test on all the variables used in the research, in order to prevent the creation of spurious regressions.

Descriptive statistics relating to the variables used in the economic model are presented in Table (1). The results show that the research variables are associated with a combination of high skewness and low variance. Based on this, it seems that the logarithmic transformation of the research data is useful to reduce this inappropriate characteristic, as it reduces these characteristics.

Table (1): Descriptive statistics of the logarithm of variables (Source: Research Results)

variables	mean	standard deviation	Skewness coefficient	Kurtosis coefficient
LEX	4.33	0.82	-1.22	3.87
LRSV	7.35	0.13	-0.62	2.13
LPRO	5	0.30	-0.12	1.52
LP	0.81	0.30	0.08	1.58
LGT	3.77	0.26	-0.65	3.32
LGI	5.33	0.35	-0.50	2.84
LCN	4.96	0.29	-0.43	2.02

Unite Root Test

Prior to any type of test on the time series data used in scientific research, the Unit Root test was performed on the data using Eviews software. The Augmented Dicky- Fuller (ADF) test was used for this purpose. The results of the Unit Root test on the examined data are shown in Table (2).

According to the results presented in Table. 2, the logarithm of gas export (LEX), gas consumption (LCN) and Turkey's gross domestic product (LGT) are stationary at the level and do not suffer from unit root problems. The logarithm of the variables gas price (LP), gas production (LPRO), gas reserves (LRSV) and Iran's gross domestic

[2] www.imf.org
[3] www.opec.org
[4] www.worldbank.org
[5] www.cbi.ir
[6] www.amar.org.ir

product (LGI) are stable in the first difference but non-stationary at the levels (integrated of order 1).

Estimation of Ardl Model

Autoregressive Distributed Lag Approach (ARDL) was used to estimate the long-run and short-run relationships between model variables and dynamic analysis, and the Schwartz-Bayesian (SCB) statistic was used to determine the optimal number of lags in the ARDL model.

The results of the ARDL (1,2,2,0,1,0,1) model estimation are presented in Table (3).

Table (2): Unite Root Test (Source: Research Results)

variables	t-Statistic	Prob	I (.)
LEX	-10.374	0.0000	I (0)
LCN	-4.262	0.0027	I (0)
LGT	-3.048	0.0426	I (0)
LRSV	-1.625	0.0611	I (1)
D(LRSV)	-4.625	0.0011	
LPRO	-1.976	0.0804	I (1)
D(LPRO)	-5.047	0.0002	
LP	-1.971	0.0712	I (1)
D(LP)	-4.579	0.0012	
LGI	-1.981	0.0726	I (1)
D(LGI)	-8.182	0.0000	

Table (3): ARDL (1,2,1,0,1,0,2) model estimation results (Source: Research Results)

variables	Coefficient	Std. Error	t-statistic	Prob.
C	-52.577	18.8020	-4.1068	0.0015
LEX (-1)	0.3420	0.1288	2.7885	0.0732
LRSV	-3.9007	2.8038	-1.3912	0.1894
LRSV (-1)	8.7543	3.2983	2.6541	0.0210
LRSV (-2)	5.6331	2.9834	1.8881	0.0834
LCN	0.2321	4.0738	2.2369	0.0448
LCN (-1)	-7.1001	3.6746	-1.9321	0.0773
LGI	0.3096	0.270	-1.1179	0.2855
LGT	-1.0600	0.5368	-1.9748	0.0717
LGT (-1)	-1.4308	0.5827	-2.4550	0.0303
LP	0.9887	0.5382	1.8370	0.0911
LPRO	-4.6736	3.9345	-1.1878	0.2579
LPRO (-1)	1.3790	4.4059	0.3129	0.7597
LPRO (-2)	8.8077	3.9413	1.4264	0.0319

The results obtained in table (3) show that the logarithm of gas price and the second interval of gas production with coefficients of 0.9887 and 8.8077, respectively, have positive and significant effects on Iran's gas export as well as the logarithm of gas consumption variables. The first and second breaks of gas reserves have positive and significant effects on Iran's gas exports with coefficients of 0.23, 8.75 and 5.63 respectively. The logarithm of the first break in gas production has a positive and insignificant effect on Iran's gas exports with a coefficient of

1.37. Other results show that the logarithm of Turkey's GDP variable and the first intercept of this variable have negative and significant effects on Iran's gas exports with coefficients of -1.06 and 5.63 respectively, and the logarithm of the first intercept of gas consumption variable with a coefficient of -7.10 It has a negative and significant effect on Iran's gas exports. Also, the log of the variables of Iran's GDP, gas production and gas reserves have negative and insignificant effects on Iran's gas exports with coefficients of -0.30, -4.67 and -3.90 respectively.

The results of the diagnostic tests for the goodness of fit of the ARDL (1,2,1,0,1,0,2) model are presented in Table (4).

Table (4): Diagnostic Tests (Source: Research Results)

Test	Statistics	Prob
Autocorrelation test	$\chi^2(2) = 2.4231$	0.1386
Heteroscedastic test	F (1,23) = 2.6751	0.1155

The results of Table (4) show that the classical assumptions of non-existence of autocorrelation and homogeneity of variance of the model have been met. These results indicate the goodness of fit and the adequate description of the investigated model.

Long-Run Coefficients

In order to check the existence of a long-run equilibrium relationship between the variables under study, the bounds cointegration test should be applied. The results of this test are presented in Table (5).

Table (5): Bounds Test (Source: Research Results)

Test Statics	value	k
F	4.2587	6
Significance level	I (0)	I (1)
0.01	3.15	4.01
0.05	2.45	3.61
0.10	2.12	3.23

The results of the bounds cointegration test in Table (5) confirm the existence of at least one long-run equilibrium relationship in the model. Since the value of the F-statistic is greater than the values of the zero and one bands at all levels, the null hypothesis of no long-run relationship is rejected. The results of the bounds cointegration test in Table (5) confirm the existence of at least one long-run equilibrium relationship in the model. Because the value of the F-statistic is greater than the values of the zero and one bands at all levels, the null hypothesis that there is no long-run relationship is rejected. Therefore, the long run relationship of the research model is estimated. The results of this estimation are presented in Table (6).

The long run relationship estimation results in table (6) show that in the long run, the variables of gas reserves and gas prices have a positive and significant effect on Iran's gas exports. Other results show that in the long run, the variables of Iran's GDP and Turkey's GDP have negative and significant effects on Iran's gas exports. However, the variables of gas production and consumption have no effect on Iran's gas exports in the long run.

Table (6): Long-Run Coefficients ARDL (Source: Research Results)

Variables	Coefficients	Std. deviation	T-Statistic	Prob.
C	-6.2802	15.7687	-3.6544	0.0033
LRSV	12.2227	3.2792	3.7273	0.0029
LCN	-8.0048	2.6490	-3.0217	0.0106
LGI	-0.3609	0.3206	-1.1256	0.2823
LGT	-2.9032	0.9840	-2.9502	0.0121
LP	1.1524	0.5145	2.2398	0.0448
LPRO	5.6098	2.0002	2.8045	0.0159

Error Correction Model (Ecm)

The ECM error correction model relates short-run fluctuations in the model variables to their long-run equilibrium values. The results of the estimation of the ECM model are shown in table (7).

The results of Table (7) show that the ECM coefficient in the model studied is equal to a high value. This coefficient shows the high speed of the model's short-term adjustment to the long-term equilibrium. That is, if we move from period T to period T+1, 0.8579% of the deviation of Iran's gas export function from its long-term path will be corrected by the variables of the equation in the next period.

Table (7): Estimation of ECM model (Source: Research Results)

Variables	Coefficients	Std. Error	T-Statistic	Prob.
D(LRSV)	-3.9007	2.8038	-1.3912	0.1894
D(LRSV(-1))	-5.6331	2.9834	-1.8881	0.0834
D(LCN)	0.2321	4.0738	0.0569	0.9555
D(LGI)	-0.3096	0.2770	-1.1179	0.2855
D(LGT)	-1.0600	0.5368	-1.9748	0.0717
D(LP)	0.9887	0.5382	1.8370	0.0911
D(LPRO)	-4.6736	3.9345	-1.1878	0.2579
D(LPRO(-1))	-8.1077	3.3413	-2.4264	0.0319
Coint. Eq.(-1)	-0.8579	0.1801	-4.7634	0.0005

Stability Test (Cusum & Cusum Squares)

The parameters estimated in an economic model react to changes caused by economic policies and cause structural instability in the model. CUSUM curves and CUSUM squares have been used to test the structural stability of the model. These curves are shown in Fig. (4) and (5). Based on these tests, the CUSUM curves and CUSUM Squares are within the upper and lower lines. This result indicates the existence of structural stability in the model studied.

4. DISCUSSION AND CONCLUSION

Iran is the world's second largest gas reserve holder, after Russia. However, it has a relatively minor share of the international trade in this commodity. The low price of gas and the lack of consumer awareness of its economic importance are among the most significant factors. In addition, economic sanctions and a lack of adequate investment in the industry are also important considerations. The present study examines the impact of various macroeconomic variables on Iranian gas export. To this end, we employed the ARDL model over the period 1991 to 2019. The results indicate that the natural

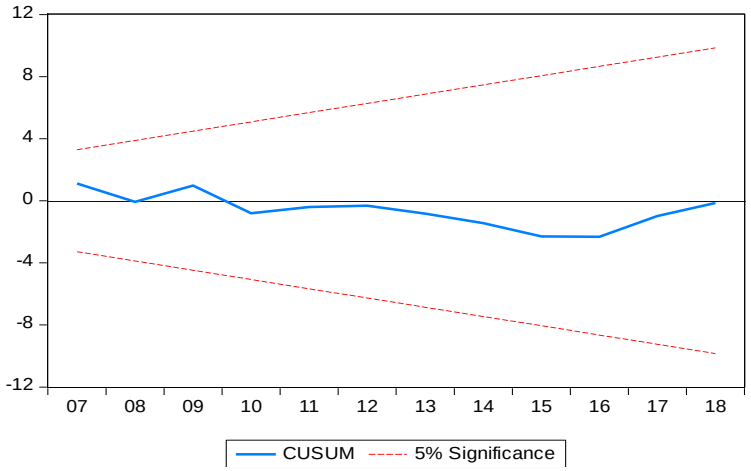

Fig. (4): CUSUM Test (Source: Research Results)

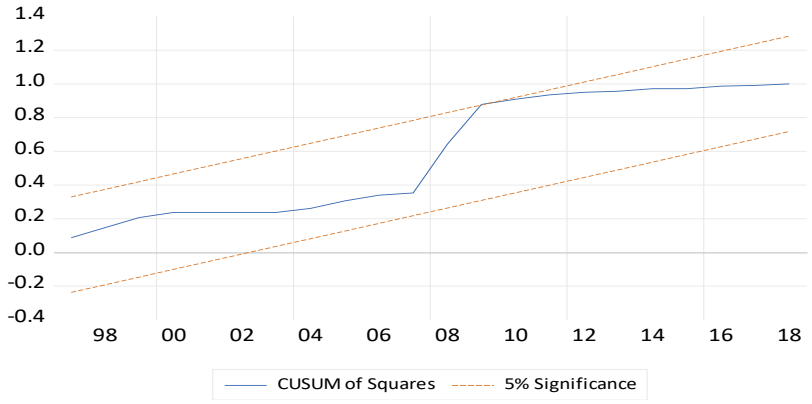

Fig. (5): CUSUM Squares (Source: Research Results)

logarithm of gas price and the second lag of gas production exert a significant influence on Iranian gas export, with respective coefficients of 0.9887 and 8.8077. Furthermore, the natural logarithm of gas consumption and the first and second lags of gas reserves have a positive and significant effect on gas export. Furthermore, with regard to the influence of foreign countries on gas export, our findings indicate that the gross domestic production of Turkey, along with its initial lag, has a detrimental impact on Iranian gas export. The results indicate that, in the long run, both the natural logarithms of gas reserves and gas prices exert a positive influence on gas export. Furthermore, in the long run, both Iranian and Turkish gross domestic products have a detrimental impact on gas export. The results of the error correction model indicate the existence of long-run associations between the variables and a high pace of corrections.

The potential for foreign exchange earnings from gas exports to Iran presents both opportunities and challenges for Iran. To ensure the optimal exploitation of this resource, it is essential for economic policymakers to consider the development of knowledge and technologies pertinent to this industry. This will help prevent the wasteful utilization of gas within Iran and facilitate the implementation of necessary measures in this regard. In order to advance these goals, it is essential that the government fosters a culture of continuous improvement with regard to

reducing domestic gas consumption. Furthermore, it is necessary to revise the standard price and amount of gas, and to receive surplus surcharges on standard consumption. Furthermore, it is of paramount importance for the country's economic policymakers to determine how the revenue from gas exports will be spent. Also, for future research, it is proposed that the impact of Western economic sanctions on Iran's gas industry and its exports be considered by researchers.

REFERENCE

Apergis, N. and Payne, J., 2010. Natural gas consumption and economic growth: a panel investigation of 67 countries. *Applied Energy*, 87(8), pp. 2,759-2,763. https://doi.org/10.1016/j .apenergy.2010.01.002

Apergis, N., Bowden, N., & Payne, J. E., 2015. Downstream integration of natural gas prices across US states: Evidence from deregulation regime shifts. *Energy Economics*, 49, pp. 82-92. https://doi.org/10.1016/j.eneco.2015.01.020

Balsalobre-Lorente, D., Bekun, F. V., Etokakpan, M. U., & Driha, O. M., 2019. A road to enhancements in natural gas use in Iran: A multivariate modelling approach. *Resources Policy*, 64, 101485. https://doi.org/10.1016/j.resourpol.2019.101485

Ben-amirouche, H., & Moussi, O. E., 2018. The Dynamics of Algeria's Natural Gas Exports to Europe: Evidence from ARDL Bounds Testing Approach with Breakpoints. *International Journal of Economics and Management Engineering*, 12(6), pp. 875-883. https://doi.org/10.5281/zenodo.1474321

BP., 2020. BP Statistical Review of World Energy, China Statistics Press, Beijing, http://www.bp.com/statisticalreview

BP., 2018. Statistical Review of World Energy. British Petroleum (BP); June. Available at: http://www.bp.com/statisticalreview

Braungardt, S, van den Bergh, J. T. Dunlop, 2019. Fossil fuel divestment and climate change: reviewing contested arguments, *Energy Res. Soc. Sci.*, 50. Pp. 191–200. https://doi.org/10.1016/j.erss.2018.12.004.

Brigida, M., 2014. The switching relationship between natural gas and crude oil prices. *Energy Economics*, 43, pp. 48-55. https://doi.org/10.1016/j.eneco.2014.01.014

Brown, S. P., & Yucel, M. K., 2008. What drives natural gas prices? *The Energy Journal*, 29(2), pp.45-60. https://doi.org/10.5547/ISSN0195-6574-EJ-Vol29-No2-3

CEDIGAZ, 2020. Underground Gas Storage in the World - 2022 Status. https://www.cedigaz.org/

Chen, J. Yu, J. Ai, B. Song, M. Hou, W., 2018. Determinants of global natural gas consumption and import–export flows, *Energy Economics*, 83, pp. 588-602. https://doi.org/10.1016/ j. eneco.2018.06.025.

Dostál, Z, Ladányi, L., 2018. Demands on energy storage for renewable power sources. *Journal Energy Storage*, 18, pp. 250–255. https://doi.org/10.1016/j.est.2018.05.003.

EIA., 2019. U.S Energy information Administation - Country Analysis Executive, Summary: Iran.

Furuoka, F., 2016. Natural gas consumption and economic development in China and Japan: an empirical examination of the Asian context, Renew. *Sustain. Energy Rev.* 56, pp. 100–115. https://doi.org/10.1016/j.rser.2015.11.038.

Gillessen, B., Heinrichs, H., J. Hake.F., H.- Allelein, 2019. Natural gas as a bridge to sustainability: infrastructure expansion regarding energy security and system transition, *Appl. Energy*, 251, 113377. https://doi.org/10.1016/j. apenergy.2019.113377

ICCIMA., 2019. Iran Chamber of Commerce, Industries, Mines and Agriculture.

Iranian-Government, 2011. Iran's Fifth National Plan, M.a.P.O.o.I.R.o. Iran, Tehran, Iran.

Khan, M. A., & Ahmad, U., 2008. Energy demand in Pakistan: a disaggregate analysis. *The Pakistan Development Review*, 47(4), pp. 437-455. https://www.jst or.org/stable/41261233

Kum, H., Ocal, O., & Aslan, A., 2012. The relationship among natural gas energy consumption, capital and economic growth: Bootstrap-corrected causality tests from G-7 countries. *Renewable and Sustainable Energy Reviews*, 16(5), pp. 2361-2365. https://doi.org/10.1016/j.rser.2012. 01.041

Mac Kinnon, M.A., Brouwer J., Samuelsen S., 2018. The role of natural gas and its infrastructure in mitigating greenhouse gas emissions, improving regional air quality, and renewable resource integration. *Prog. En. Combust. Sci.*, 64, 62–92. https://doi.org/10.1016/j.pecs.2017.10.002

Miller, L., Carriveau, R., 2018. A review of energy storage financing—Learning from and partnering with the renewable energy industry. *J. Energy Storage*, 19, pp. 311–319. https://doi.org/10.1016/j.est.2018.08.007.

Pachiannan, T. Zhong, W. Rajkumar, S He., Z. Lang, X. Wang, Q., 2019. A literature review of fuel effects on performance and emission characteristics of low-temperature combustion strategies, *Appl. Energy*, 251, p.113380. https://doi.org/10.1016/j.apenergy.2019.113380.

Pick, S., Anderson, D. G., Asadi-Pooya, A. A., Aybek, S., Baslet, G., Bloem, B. R., ... & Nicholson, T. R., 2020. Outcome measurement in functional neurological disorder: a systematic review and recommendations. *Journal of Neurology, Neurosurgery & Psychiatry*, 91(6), pp. 638-649.

Ramberg, D. J., & Parsons, J. E., 2012. The weak tie between natural gas and oil prices. *The Energy Journal*, 33(2), pp. 13-35. https://doi.org/10.5547/01956574.33.2.2

Roumi, S., Yousefi, H., Aslani, A., & Bekhrad, K., 2021. Effects of natural gas supply on macro-economic: comparative analysis. *International Journal of Ambient Energy*, 42(5), pp. 483-490. https://doi.o rg/10.1080/01430750.2018.1525582

Sari, R., Ewing, B. T., & Soytas, U., 2007. The relationship between disaggregate energy consumption and industrial production in the United States: an ARDL approach. *Energy Economics*, 30(5), pp. 2302-2313. https://doi.org/10.1016/j.eneco.2007.10.002

Shahbaz, M., Hye, Q., Tiwari, A. and Leitão, N., 2013a. Economic growth, energy consumption, financial development, international trade and CO2 emissions in Indonesia. *Renewable and Sustainable Energy Reviews*, 25, pp. 109-121. https://doi.org/10.1016/j.rser.2013.04.009

Shahbaz, M., Khan, S. and Tahir, M., 2013b. The dynamic links between energy consumption, economic growth, financial development and trade in China: fresh evidence from multivariate framework analysis. *Energy Economics*, 40, pp. 8-21. https://doi.org/10.1016/j.eneco.2013.06. 006

Solarin, S. A., & Ozturk, I., 2016. The relationship between natural gas consumption and economic growth in OPEC members. *Renewable and Sustainable Energy Reviews*, 58, pp. 1348-1356. https://doi.org/10.1016/j.rser.2015.12.278

Solarin, S. A., & Shahbaz, M., 2015. Natural gas consumption and economic growth: The role of foreign direct investment, capital formation and trade openness in Malaysia. *Renewable and Sustainable Energy Reviews*, 42, pp. 835-845. https://doi.org/10.1016/j.rser.2014.10.075

Ullah Khan, I. Hafiz Dzarfan Othman, M. Hashim, H. Matsuura, T. Ismail, A. M, Rezaei-DashtArzhandi, F, Wan Azelee, I., 2017. Biogas as a renewable energy fuel – A review of biogas upgrading, utilization and storage. *Energy Conversion Management*, 150, pp. 277–294. https://doi.org/10.1016/j.enconman.2017.08.035

Yang, X, Li, H, Wallin, F, Yu, Z., 2017. Wang, Impacts of emission reduction and external cost on natural gas distribution. *Appl. Energy*, 207, pp. 553–561. https://doi.org/10.1016/j.apenergy.2017.06.005

Zeren, F. Akkuş, H.T., 2020. The relationship between renewable energy consumption and trade openness: new evidence from emerging economies. *Renew. Energy*, 147, pp. 322–329. https://doi.org/10.1016/j.renene.2019.09.006

Zhao Z. Gao, L., Zuo J., 2019. How national policies facilitate low carbon city development: a China study. *Journal of Cleaner production*, 234 (2019), pp. 743–754. https://doi.org/ 10.1016/ j.jclepro.06.116

Zhi-Guo, L., Cheng, H., & Dong-Ming, W., 2018. Empirical research on the relationship between natural gas consumption and economic growth in the Northeast Asia. *Energy & Environment*, 9(2), pp. 216-231. https://doi.org/10.1177/0958305 X1774527.