Natural gas consumption and economic growth in Iran

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Abstract: - The causality relationship between economic growth and natural gas consumption was investigated using the ARDL (autoregressive distributed lag bounds) testing approach for the 1975 to 2011 period in Iran. Our results show that variables are cointegrated for long run relationship. The results indicate that natural gas consumption, capital formation, employment, financial development, exports are contributing factors to domestic production and hence economic growth in Iran. The unidirectional causality is also found between gas consumption, capital formation and exports to economic growth. The causality analysis indicates that feedback hypothesis is validated between gas consumption and economic growth which indicates that adoption of energy conservation policies should be discouraged.

Key-Words: - Natural gas consumption, Economic growth, Export, Iran, ARDL

1 Introduction

Natural gas is an important source of electricity generation. In order to meet the Kyoto targets in reducing CO2 emissions, many countries are exploring policy options to encourage the use of natural gas as an alternative source [1].

For the Iranian case, the country has been reflected as the second most massive natural gas field and the forth producer of natural gas in the world [2]. These two factors along with other factors led to the replacement of oil products with natural gas consumption as a key policy of government in energy sector during the fourth development plan (2005–2009). Over 40%of total energy consumption in Iran is provided by natural gas, which indicates the importance role of its valuable energy factor in the process of economic growth and development plans [3].

Furthermore, for example, the natural gas consumption in Iran is 1.35 times of natural gas consumption in China (the most populated country in the world) in 2010, and also the equivalent of 25% and 4.5% of natural gas consumption in Europe and the world, respectively. Although Iran is the fourth largest producer of natural gas, its consumption has increased more rapidly than production. So, this trend of production and consumption of natural gas in Iran leads to deficit that, except in 2010, always import of natural gas has been greater than exports. The low growth rate of natural gas production in Iran has two main reasons:(1)Due to economic sanctions, Iran is notable to attract foreign investment.(2)Most of Iran's natural gas reserves are located in sea areas and gas exploitation in these areas is difficult and costly. In the other hand, the increasing rate of natural gas consumption is due to the low price of domestic supply of natural gas that leads to economic justification of the use of wasting energy technologies, non-optimal allocation, in appropriate and abundant use of natural gas. So, unlike the pattern of natural gas consumption in industrialized countries, the highest share of its consumption in Iran is allocated to the household and commercial sectors [3].

In this paper the analysis of causal links between gas consumption and GDP in Iran was performed based on dataset covers the period 1975 – 2011.

2. Literature survey

Literature on the causal relationship between natural gas consumption and economic growth is very sparse compared with literature regarding coal. Energy-growth nexus or natural gas consumption-growth nexus can be described by the following four hypotheses: growth hypothesis, conservation hypothesis, feedback hypothesis, and neutrality hypothesis. According to the growth hypothesis energy/gas use is critical for economic growth. So a reduction in energy/gas use lowers GDP implying that the economy is energy/gas dependent. The conservation hypothesis regards that there exists a unidirectional causality from economic growth to energy/gas use. Therefore, economic growth may not be much affected by any policy to reduce energy/gas consumption. The feedback hypothesis assumes that there exists a bidirectional causality implying that energy/gas consumption and economic growth affect each other. Neutrality hypothesis states that lower energy/gas consumption does not affect economic growth, and vice versa [4].

Yu and Choi [5] found neutral effect between natural gas consumption and economic growth in case of USA and Poland, but unidirectional relationship from economic growth to natural gas consumption for UK. Applying Sims and Granger causality technique on UK time series data for the post-war period from 1950to1976, they find evidence of unidirectional causality running from natural gas consumption to economic growth.

Yang [6] also conducted a study Taiwan's time series data period 1954-1997, and found unidirectional Granger causality from natural gas consumption to economic growth, but no cointegration between two variables. The consumption of aggregate as well as different types of energy including coal, oil, natural gas and electricity. Yang's results suggest bidirectional causality between total energy consumption and GDP, but a unidirectional causality from natural gas consumption to GDP.

Aqeel and Butt [7] studied causal relationships between real GDP and natural gas consumption for Pakistan. The first study used data from 1955 to 1996, and the second study used data from 1970 to 2003. They found absence of cointegration and causality between natural gas consumption and economic growth in Pakistan.

Fatai et al. [8] used data from 1960 to1999 and employed ARDL, Johnson's Maximum Likelihood (JML) and Toda and Yamamoto causality test methods. Fatai reported no cointegration between natural gas consumption and economic growth for New Zealand but found cointegration for Australia while neutral effect is validated between both variables.

Lee and Chang [9] explored the importance of structural breaks using data of 1965 - 2003 in case of Taiwan including adopting export promotion and financial liberalization policies and found that Taiwan natural gas consumption Granger causes economic growth. This implies that a decrease in the volume of natural gas consumption will slow economic growth in case of Taiwan. However, with conventional vector error correction model, the study does not find long-run equilibrium.

Yoo [10] examined short and long–run causal links between GDP and oil consumption in Korea using the two–dimensional VECM approach. He found a feedback relationship in the long–run and causality from GDP to oil consumption in the short–run.

Zamani [11] used the vector error correction model for empirical purpose in case of Iranian economy over the period of 1967-2003. The author found the bidirectional causal relationship between natural gas consumption and economic growth in long run, but a unidirectional causality running from agricultural value added to gas consumption and a unidirectional causality from gas consumption to industrial value added. Therefore, it can be argued that the conversation of natural gas may have no effect on the agricultural output but detrimental effect on the industrial output in Iran.

Sari et al. [12] employed cointegration approach to identify cointegration relationship between natural gas consumption and economic growth, Taking monthly data for the period of 2001:1-2005: applied the ARDL bounds testing approach which can detect cointegration even for small samples. Their findings reveal no significant impact of industrial production on natural gas consumption in long run.

Reynolds and Kolodziej [13] conducted a study on the former Soviet Union to explore cointegration, and use Engle and Granger causality test. They found no causal relationship between natural gas consumption and economic growth mainly because Soviet Union has stable level of natural gas consumption due to low variable costs of production.

Khan and Ahmed [14] found that natural gas consumption Granger causes economic growth for the period of 1972–2007. Their results are biased and inconsistent. Literature noted that economic grow this influenced by capital and labour. The above four studies ignored the role of capital and labour in the production function.

Lean and Smyth [15] correctly identified some problems of using the bivariate framework in analyzing the relationship between energy and GDP. They argued that energy is not the only input to spur aggregate output. Actual output growth depends on the combination of inputs used, and the degree to which energy, capital and labor act as complements.

Işik [15] found a positive impact of natural gas consumption on economic growth in short run, but a negative impact on the growth in long run for Turkey while an Auto-Regressive Distributive Lag (ARDL) model is applied using data of 1977-2008.

Apergis and Payne [1] applied the panel vector error correction model for 67 countries which revealed the bidirectional causality between natural gas consumption and economic growth in both short and long runs. Their results also support the feedback hypothesis in both the short and long run.

Krum et al. [17] found bidirectional causality for France, Germany and the USA, and unidirectional causality from gas consumption to economic growth for Italy and unidirectional causality for economic growth to natural gas consumption in case of the UK. For Italy, they find that the Granger causality runs from natural gas consumption of GDP growth.

Amiri and Zibaei [18] showed a study on France using geostatistical models to examine the Granger causality between energy use and economic growth, but this study suffers from the omitted variable bias as the authors consider two variables only: GDP growth and oil consumption. They find no study for France that extensively examined the causality between natural gas consumption and economic growth.

Pirlogea and Cicea [19] use smaller dataset from 1990 to2010 and find that natural gas consumption causes economic growth in Spain.

Shahbaz et al. [20] used production function to reinvestigate the relationship between natural gas consumption and economic growth in case of Pakistan. They confirmed the presence of cointegration between the variables and found that natural gas consumption contributes economic growth. Their analysis also exposed that exports play their role in affecting economic growth and natural gas consumption.

3. Data, Specification Models and Methodology

3.1. Data

The variables in this study included GC (natural gas energy consumption) and real GDP (real per Capita). This study uses annual time series data for Iran from 1975 to 2011. Natural gas energy consumption is measured in billion cubic meters. Natural gas energy consumption was obtained from the BP Statistical Review of World Energy 2011 and real GDP, measured in constant 2005 US dollars. Gross fixed capital deflated by GDP deflator in constant 2005 prices, real per capita fixed capital formation employment measured by thousands of people in the labor force, financial development, export is the total value of real import and real export as a percentage of real GDP, came from the World Bank WDI (World Development Indicators) [21] and International Financial Statistics of the IMF (International Monetary Fund). All variables were measured in logarithms. We have used Microfit 4 and Eviews 7.1 to conduct the analysis.

3.2 Model

Following the recent empirical works it is possible to test the long-run relationship between economic growth and gas consumption , fixed capital formation , employment financial development and export in a linear logarithmic using the following equation:

$$\mathrm{GDP_t = f(, GC_t, K_t, EMP_t, F_t, EX_t)} \quad (1)$$

In order to find the long-run relationship between economic growth and other variables, the following linear logarithmic form is proposed:

$$\mathrm{LnGDP_t} = \alpha_0 + \alpha_1 \mathrm{LnGC_t} + \alpha_2 \mathrm{LnK_t} + \alpha_3 \mathrm{LnEMP_t} + \alpha_4 \mathrm{LnF_t} + \alpha_5 \mathrm{Ln\ EX_t} \quad (2)$$

The role of exports in boosting economic growth is well documented. Exports increase total factor productivity because of their impact on economies of scale and other externalities such as technology transfer, improving workers and managerial skills and increasing production capacity. It also allows for a better utilization of resources and does not discriminate the domestic market ([22], [23]). In order to achieve the objectives of the study annual time series data, which covers the1975–2011 periods is utilized. All the data are gathered from the central bank of Iran and Ministry of Power in Iran.

Where GDP_t is the real GDP per capita, GC_t is natural gas consumption per capita, K_t is real capital use per capita, EMP_t is the employed labor per capita, Ft financial development and EX_t is real exports per capita. This study covers the sample period of 1975–2011

4. Econometric Techniques

4.1 ARDL bounds testing approach

To study the cointegration approach, we employ the ARDL bounds testing approach developed by Pesaran et al. [24] to explore the existence of long-run equilibrium between the variables. This approach is applied irrespective of whether the variables are purely I (0) or I (1), unlike other widely used cointegration techniques. It is also found that the small sample properties of the bounds testing approach are far superior to that of multivariate cointegration [25]. The estimated model with natural log of real GDP per capita as the dependent variable is specified as follows:

$$\Delta \mathrm{LnGDP}_t = a_0 + \sum_{i=1}^{n} a_{1i}\Delta \mathrm{LnGC}_{t-i} + \sum_{i=1}^{n} a_{2i}\Delta \mathrm{LnK}_{t-i} + \sum_{i=1}^{n} a_{3i}\Delta \mathrm{EMP}_{t-i} + \sum_{i=1}^{n} a_{4i}\Delta \mathrm{LnF}_{t-i} + \sum_{i=1}^{n} a_{5i}\Delta \mathrm{LnEX}_{t-i} + \lambda\, \mathrm{ECM}_{t-1} + u_t \quad (3)$$

a_0 and e_t is the drift component and white noise, respectively. a_1, a_2, a_3, a_4 and a_5 denote the error correction dynamics while a_1, a_2, a_3, a_4, and a_5 correspond to the long-run relationship in baseline Equation 2.Where ECM $_{t-1}$ is the error correction term which is gained from the following estimated cointegration equation:

$$ECM_t = LnGNP_t - a_0 + \sum_{i=1}^{n} a_{1i}\Delta LnGC_{t-i} + \sum_{i=1}^{n} a_{2i}\Delta LnK_{t-i} + \sum_{i=1}^{n} a_{3i}\Delta LnEMP_{t-i} + \sum_{i=1}^{n} a_{4i}\Delta LnF_{t-i} + \sum_{i=1}^{n} a_{5i}\Delta LnEX_{t-i} \quad (4)$$

Where Δ is the first difference operator and μ_t is the error term. The optimal lag structure of the first difference regression is selected based on Akaike Information Criteria (AIC). The lags is induced when noise in the error term. Pesaran et al. [24] suggested F-test for joint significance of the coefficients of the lagged level of the variables. Initially, a joint significance test that implies no cointegration hypothesis.

The Error Correction Term (ECM_{t-1}) indicates the speed of the adjustment and shows how quickly the variables return to the long-run equilibrium and it should have a statistically significant coefficient with a negative sign.

4.2. Granger Causality Analysis

Granger Causality approach has been the most method to determining the causal validity of energy consumption and economic growth. It is important to assess how natural gas consumption. We used the Granger causality test. According to Bahmani-Oskooee and Alse [26], if the variables are cointegrated, then the standard Granger Causality test results will be invalid. In this case, the Vector Error Correction model should be a starting point for the causality analysis.

The advantage of using an error correction term to test for causality is that it allows testing for short-run causality through the lagged differenced explanatory variables and testing for long-run causality through the lagged ECMt-1 term. A statistically significant ECM_{t-1} term determines long-run causality running from all the explanatory variables towards the dependent variable [27].

The test answers the question of whether x causes y or y causes x. x is said to be Granger caused by y if y helps in the prediction of the present value of x or equivalently if the coefficients on the lagged y's are statistically significant. In the presence of long-run relationship between variables in the model, the lagged Error Correction Term (ECMt-1) was obtained from the long-run cointegration relationship and was included in the equation as an additional independent variable. The following model was employed to test the causal relationship between the variables Equation 3:

$$\begin{bmatrix} \Delta \mathrm{Ln}\, GDP_t \\ \Delta LnGC_t \\ \Delta LnK_t \\ \Delta LnEMP_t \\ \Delta LnF_t \\ \Delta LnEX_t \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \\ c_6 \end{bmatrix} + \sum_{i=1}^{p} \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} & \beta_{16} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} & \beta_{25} & \beta_{26} \\ \beta_{31} & \beta_{32} & \beta_{33} & \beta_{34} & \beta_{35} & \beta_{36} \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} & \beta_{45} & \beta_{46} \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & \beta_{55} & \beta_{56} \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & \beta_{66} \end{bmatrix} \begin{bmatrix} \Delta \mathrm{Ln}\, GDP_t \\ \Delta LnGC_t \\ \Delta LnK_t \\ \Delta LnEMP_t \\ \Delta LnF_t \\ \Delta LnEX_t \end{bmatrix} + \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \\ \lambda_4 \\ \lambda_5 \\ \lambda_6 \end{bmatrix} ECM_{t-1} + \begin{bmatrix} \mathring{a}_{1t} \\ \mathring{a}_{2t} \\ \mathring{a}_{3t} \\ \mathring{a}_{4t} \\ \mathring{a}_{5t} \\ \mathring{a}_{6t} \end{bmatrix} \quad (5)$$

ECT_{t-1} is the lagged error-correction term. Residual terms are uncorrelated random disturbance term with zero mean and j's are parameters to be estimated. The direction of causality can be detected through the VECM of long-run cointegration. The VECM captures both the short-run and the long-run relationships. The long-run causal relationship can be established through the significance of the lagged ECTs in equations based on test and the short-run Granger causality is detected through the test of significance of F-statistics of Wald test of the relevant j coefficients on the first difference series.

5. Results and Descriptive Statistics

Table 1 presents some descriptive statistics of the selected variables over the period 1975-2011. The summary common statistics contain the means, maximum and minimum, standard deviation

(Std. Dev), Skewness and Kurtosis of each series after transformation in logarithms form.

Table1. Descriptive statistics for variables

Variables	GDP	GAS CONSUMPTION	CAPITAL FORMATION	EMPLOYMENT	FINANCIAL DEVELOPMENT	REAL EXPORT
Mean	2371.391	12.48351	32.70683	39.11892	23.61426	0.460841
Maximum (Year)	3316.305	40.54000	42.66663	45.90000	37.27846	0.752308
Minimum (Year)	1579.396	0.010000	23.24411	35.30000	12.85270	0.196883
Std. Dev.	495.5663	13.67325	4.756398	2.233811	5.408239	0.132304
Skewness	0.414305	0.917838	-0.012666	1.079200	0.485613	0.091670
Kurtosis	1.924741	2.437768	2.772716	5.940443	3.156088	2.706806

Source: Author's calculation using Eviews 7.1

In this empirical study we used six different unit root tests to check for the integration order of each variable. We apply unit root tests to ensure that no variable is integrated at I (1) or beyond. We have used the ADF unit root test to check for stationarity. The results in Table 2 indicate that all variables are non-stationary at their level form and stationary at their first differences.

Table 2. Augmented Dickey-Fuller Stationary Test

Variable	Constant No Trend	Critical Value	Variable	Constant No Trend	Critical Value
Ln GDP	-0.663392	-2.954021	Δ Ln GDP	-3.720542	-2.954021
Ln GC	-3.525031	-2.948404	ΔLn GC	-3.564860*	-1.950687
Ln K	-3.431537	-2.948404	ΔLn K	-6.982835	-2.948404
Ln EMP	-3.538971	-2.945842	ΔLn EMP	-5.768249	-2.948404
Ln F	-3.455415	-2.951125	ΔLn F	-1.785465**	-1.610907
Ln EX	-4.249626	-2.963972	ΔLn EX	-4.085729	-2.948404

The number inside brackets denotes the appropriate lag lengths which are chosen using Schwarz Criterion.
* Denotes for 5% significance level
**Denotes for 10% significance level

Source: Author's Estimation using Eviews 7.1

The optimum lags are selected relying on minimizing the Akaike Information Criterion (AIC). The maximum lag order two was set. With that maximum lag lengths setting, the ARDL (1, 0, 0, 0, 2, 0)) model is selected using AIC. ARDL (1, 0, 0, 0, 2, 0) represents the ARDL model in which the income and financial development take the lag length 1, 2, 1respectively.

When testing for cointegration, the VAR model with two lags, as suggested by AIC and HQIC is considered. As can be seen from Table 3, 4 the Null Hypothesis of no cointegrating relationship against alternative of at most one cointegrating relationship cannot be rejected in any of the models at a 5% level of significance, suggesting that there is cointegrating relationship among variables.

Table 3 Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.814851	131.8887	83.93712	0.0000
At most 1*	0.586761	72.85794	60.06141	0.0029
At most 2 *	0.502698	41.92741	40.17493	0.0329
At most 3	0.307652	17.47789	24.27596	0.2817
At most 4	0.108933	4.609557	12.32090	0.6229
At most 5	0.016233	0.572812	4.129906	0.5110

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4 Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.814851	59.03075	36.63019	0.0000
At most 1*	0.586761	30.93052	30.43961	0.0434
At most 2 *	0.502698	24.44953	24.15921	0.0457
At most 3 *	0.307652	12.86833	17.79730	0.2364
At most 4 *	0.108933	4.036745	11.22480	0.6226
At most 5	0.016233	0.572812	4.129906	0.5110

Trace test indicates 3cointegrating eqn (s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The null hypotheses of no cointegration are rejected, implying long-run cointegration relationships amongst the variables. Economic growth (GDP), gas consumption (GC) ,fixed capital formation (K), employment (EMP), financial development (F) and export (EX) are stationary over the period 1975- 2011. These variables share a common trend and move together over the long run.

The majority of the studies do not examine the coefficients with respect to both the sign (positive or negative) and the magnitude of the relationship between natural gas consumption and economic growth, but we analyzed long-run and short-run elasticities. The long-run elasticities, along with a number of diagnostic tests for the underlying ARDL model, are displayed in Table 5.

Table 5. Estimated Long Run Coefficients using the ARDL Approach ARDL (1 , 0 ,0 , 0 ,2 ,0) selected based on Akaike Information Criterion

Dependent Variable: Ln GDP

Variable	Coefficient	Std. Error	T-Statistic	Prob
Ln GC	0.11**	0.045220	2.4367	[0.022]
Ln K	0.93**	0.45188	2.0661	[0.049]
Ln EMP	0.71	0.55193	1.2938	[0.207]
Ln F	0.70**	0.31403	2.2383	[0.034]
Ln EX	0.63**	0.24274	2.5935	[0.015]

Note ** significant at 5 % level

The long-run estimated coefficient related to gas consumption shows that, a 1% increase in gas consumption increase GDP by 0.11%. The coefficient of capital implies that 1% increase in

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capital formation contributes to increase real per capita GDP of almost 0.93%. The magnitude is not showing diminishing marginal returns to capital which is consistent with the neo classical school of thought.

On the other hand, the positive sign of employment (0.71) and insignificant. The coefficient on export shows a positive impact on economic growth in Iran. The elasticity of GDP with respect to export is 0.63. The negative sign of F (0.70) implies that the increase in financial development leads to increase economic growth though the result is significant at conventional level.

Table6. Error correction model (ECM) for short-run elasticity ARDL (1 , 0 ,0 ,0 ,2 ,0) selected based on Akaike Information Criterion

Dependent Variable : D(Ln GDP			
Variable	Coefficient	T-Statistic	Probability
D Ln GC	0.02**	4.0236	[0.000]
D Ln K	0.16**	2.5791	[0.015]
D Ln EMP	0.12	1.0165	[.318]
D Ln F	-0.01	-0.26139	[.796]
D Ln EX	0.11**	3.9348	[0.001]
ECM(−1)	-0.17**	-3.3152	[0.003]
The Short-Run Diagnostic Test Results			
R-Squared	0.65478		
Akaike info Criterion -	55.4717		
Schwarz Criterion	49.2503		
F-Statistic	8.5353	[0.000]	
Durbin-Watson	2.0437		

Note: **shows a percent level of 5%, *shows a percent level of 10%,

The sign of the coefficient of the error-correction term must be negative to provide the stability of the error-correction model. We expected to have a negative coefficient and with a value of less than 1. The ECM coefficient for natural gas consumption in Iran was calculated as -0.17 and statistically significant at 5% level. The ECM term of -0.17 shows very low speed of adjustment.

The coefficient gas consumption, capital formation and real exports are insignificant. The coefficient of gas consumption is 0.02, implies that a 1% increase in the volume of gas consumption will lead to 0.02% rise in real per capita GDP. The coefficient of real export is 0.16, implies that a 1% increase in the real export, will lead to 0.2% rise in real per capita GDP. Importantly, our findings are also consistent with Shahbaz (2012) who document that trade has a statistically significant positive impact on the economic growth in the case of Pakistan.

Table7. VECM Granger Causality results

Variable	*Short-run*						*Long run*
	DLn GDP	DLn GC	DLn K	DLn EMP	DLn F	DLn EX	ECM(-1)
DLGDP	-	16.1892*** [0.000]	6.6518** [0.010]	1.0332 [0.309]	6.5211** [0.038]	15.4829*** [0.000]	10.9905*** [0.001]
DLn GC	.34550 [0.557]	-	15.4782*** [0.000]	4.8439** [0.028]	8.4793** [0.014]	18.7379*** [0.000]	10.4082*** [0.001]
DLn K	14.5920*** [0.001]	14.5523** [0.001]	-	14.9670*** [0.000]	17.2724*** [0.000]	7.8398** [0.020]	62.7696*** [0.000]
DLn EMP	6.3118** [0.043]	5.0029** [0.025]	17.6316*** [0.000]	-	5.9850** [0.050]	4.8120* [0.090]	3.3464* [0.067]
DLn F	1.5353 [0.215]	3.6125 [0.057]	5.8916 [0.053]	.073085 [0.787]	-	4.6052 [0.100]	1.2417 [0.265]
DLn X	15.2509*** [0.000]	.024328 [0.876]	3.4485* [0.063]	12.7552*** [0.002]	.93317 [0.334]	-	11.0820*** [0.001]

x → y means x Granger causes y.

Note: ***, ** and * denote the statistical significance at the 1%, 5% and 10% levels, respectively

The unidirectional Granger causality between from consumption to economic growth is summarized in Table 7. This result is significant at the 1 percent level. In terms of long-run causality results and a strong causality result. Our result is similar as that found by Payne [28] for the US and Kum et al. [17] for the UK. Hence, this result on the relationship between natural gas consumption and GDP support the existence of the conservation hypothesis for Iran.

Policy implications and recommendations .Our findings suggest a role of output in the consumption of natural gas in Iran. While these findings rest on several statistical assumptions, they are in force the role of energy conservation in Iran.

To conserve the consumption of natural gas, decision-makers need to implement a number of strategies that promotes efficient use of this scarce resource. First, the price of natural gas in Iran should be market-determined. To promote optimum utilization of natural gas at the household level, government needs to create an efficient pricing system such as pay peruse in which the price of natural gas will be determined by the usage. Second, policies need to be formulated to reduce the use of natural gas as an input of electricity production.

6. Conclusion

This study investigates the relationship between natural gas consumption and economic growth by incorporating capital formation, employment, financial development and real exports in a multivariate framework in case of Iran over the period 1975-2011. ARDL approach was employed to examine the impact of energy natural gas consumption on economic growth in Iran. We tested for economic growth and natural gas using the ARDL method, which determined that I (0) variables can contain useful information. The result of error correction model was found consistent with the theatrically expected.

The estimation results of production model suggest that in the short and long-run, there is long term relationship between natural gas consumption and real GDP. The outcomes also suggest that the long-run impact of real GDP on capital formation is found to be positive. Exports have positive impact on economic growth. If economic growth is declined, the demand for natural gas will also decline. Overall, we can say that natural gas conservation policies will adversely affect exports and economic growth.

According to long-run and strong causality results, there is unidirectional causality between gas consumption and Y for Iran is similar to the result of Yu et al[5].The obtained results imply that reduction of natural gas consumption will decline economic growth and hence exports.

The future development of natural gas in Iran wills inevitability impact other fossil fuel industries. Natural gas has advantages in terms of efficiency and CO2 emissions in terms of sustainable energy. The future development of energy natural gas will inevitably affect fossil fuel industries. New jobs can be created within the growing industries. Strategic planning for meeting rapid energy consumption is imperative for these countries.

The importance of energy natural gas consumption in Iran has made it a foundation for strategic planning. The current energy policy restructuring process should be designed to meet this goal. The appropriate options are energy policies aimed at improving the energy infrastructure in the context of the elasticity and Granger Causality results e and policies aimed at increasing the energy supply. On the other hand, our results showed that natural gas consumption in Iran is a rapidly growing tendency. In this condition, the energy consumption structure in these countries will change over time.

To meet the increasing demands of energy, we must ensure the efficiency and renewable of energy sources. Renewable energy provides the most appropriate energy infrastructure that meets the demand of the current generation without compromising the availability of future generations to meet their energy needs (Omer [54]). Technologies that promote sustainable energy include renewable energy sources, such as hydroelectricity, solar energy, wind energy, wave power, geothermal energy and tidal power. In developing countries like Iran, although crude oil and natural gas will remain as predominant sources of energy for the near future.

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