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THE INTERACTION BETWEEN NATURAL GAS ENERGY CONSUMPTION AND ECONOMIC GROWTH IN MIDDLE EAST COUNTRIES

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Öz

The study aims to investigate the interaction between economic growth and natural gas energy consumption by including gross capital formation, trade in goods and services, and total labor which are the main determining factors of GDP growth.into a multivariable model in the Middle East Countries (United Arab Emirates, Iraq, Iran, Israel, Kuwait, Saudi Arabia, Syria, Oman, Jordan). For this purpose, panel data analysis was applied with annual data covering 1980-2014 period as econometric analysis. As a result of the analysis carried out using the xtpedroni command through the stata program, it has been found that the natural gas energy consumption has a positive impact on the Middle Eastern countries' GDP growth in the long-run. The panel Granger causality test also show that there is a bi-directional Granger causality between natural gas energy consumption and GDP growth. Using this information, energy policy implementation of policy decision makers is important in terms of increasing economic effectiveness in the Middle East countries.

Anahtar Kelimeler: Economic Growth, Natural Gas Energy Consumption, Energy, Middle East, Panel Data.

ORTA DOĞU ÜLKELERİNDE DOĞALGAZ ENERJİ TÜKETİMİ VE EKONOMİK BÜYÜME ARASINDAKİ ETKİLEŞİM

Abstract

Çalışma veri temininde sıkıntı yaşanılmayan Orta Doğu ülkelerinde (Birleşik Arap Emirlikleri, Irak, İran, İsrail, Kuveyt, Suudi Arabistan, Suriye, Umman, Ürdün) GSYİH'nın büyümesindeki temel belirleyiciler olan brüt sabit sermaye oluşumu, mal ve hizmet ticareti ile toplam işgücünü çok değişkenli modele dahil ederek doğalgaz enerji tüketimi ve ekonomik büyüme arasındaki ilişkiyi araştırmayı amaçlamaktadır. Bu amaç doğrultusunda ekonometrik analiz olarak 1980-2014 dönemini içeren yıllık verilerle panel veri analizi uygulanmıştır. Stata programı aracılığıyla xtpedroni komutu kullanılarak gerçekleştirilen analiz sonucunda doğalgaz enerji tüketiminin uzun dönemde araştırılan Ortadoğu ülkelerinin GSYİH büyümesini olumlu yönde etkilediği bulgusuna ulaşılmıştır. Ayrıca yapılan panel Granger nedensellik testi doğalgaz enerji tüketimi ile GSYİH büyümesi arasında çift yönlü bir Granger nedensellik olduğunu da ortaya koymuştur. Politika karar vericilerin bu bilgileri kullanarak Ortadoğu ülkelerinde enerji politikaları uygulaması ekonomide etkinliğin sağlanması açısından önem arzetmetkedir.

Key Words: Doğalgaz Enerji Tüketimi, Ekonomik Büyüme, Enerji, Orta Doğu, Panel Veri.

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1.Introduction

The energy word originates from the Greek "energeia" word. In general, energy is defined as the ability to produce heat, which is obtained by means of different methods of direct sunlight or direct sunlight. Economically, it is defined as the ability of a system of object or substances to function (Bhattacharyya, 2011; Berberoğlu, 1982). The most important energy source necessary for sustainable life in the world is the sun. However, with the growing population, economies increasingly use energy sources such as geothermal, nuclear and natural gas intensively (Fisher, 1990: 186). Today, energy has become an important element that directs the world and the economy politics. States have aimed at sustainable energy to produce the energy they need, to spread the use of energy to a greater number of people, and to achieve economic development.

Energy was used to spread heat and light around in the early ages. For this reason, it is estimated that the historical process of the energy has started with the fire of mankind (Demir, 2010: 15-21). In order to take advantage of the fire, wood was used as fuel for a long time in the early ages. Humankind meets basic household needs such as heating and cooking with the sound. Because of its abundance and comfort in the country, wood has been an important source of energy for people in the early ages. However, when this energy source proved that it could not support the growing economies in Europe and America, the 19th century was headed by the petroleum and the 20th century by oil and natural gas (Timmons, 2014: 3).

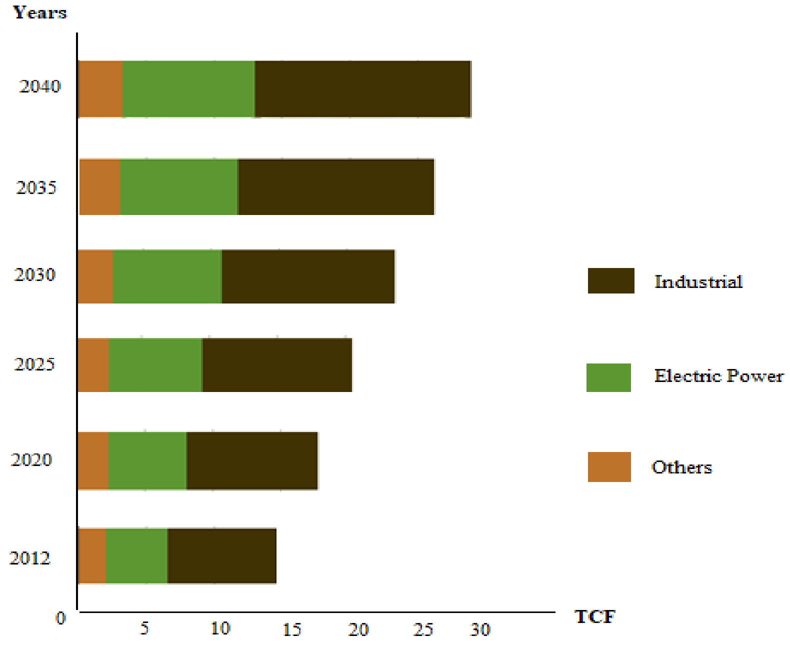
Natural gas is an important resource for generation of energy and electricity at the same time. To reduce the CO2 emissions aimed at the Kyoto Protocol, many countries are exploring alternative energy policies that encourage the use of natural gas (Apergis and Payne, 2010). According to the International Energy Agency's 2016 report, natural gas consumption in the electricity energy sector will tend to increase by an average of 2.2% per annum, while natural gas consumption for industrial use increases by an average 1.7% per annum between 2012 and 2040. When the industry and the electricity sector are considered together, the world accounts for 73% of the total in the increased natural gas energy consumption. This ratio is expected to reach 74% by 2040 (IEA, 2016).

Natural gas consumption in the Middle East region in 2012 accounted for nearly half of total energy consumption. This rate is higher than the other regions. While the consumption of natural gas is expected to increase by an average of 2.5% per year from 2012 until 2040, the industrial sector, where a significant share of natural gas consumption takes place, has an important role in this increase (Figure 1).

Natural gas usage in the industrial sector has increased by 7.7 trillion cubic feet from 2012 to 2040, making up a majority of the total of 14.2 trillion cubic feet increase in natural gas energy consumption. The use of natural gas in the electricity sector will increase by 5.2 trillion cubic feet from 2012 to 2040, while total natural gas energy consumption is 9.8 trillion cubic feet. Natural gas-fired production is steadily increasing due to the decrease in the use of crude oil in electricity generation (IEA, 2016).

According to the statistics released by the Organization of Petroleum Exporting Countries (OPEC) published in the year 2017, the region with the highest proven reserves in the world is the Middle East. The province of Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates has a total of 80 trillion 60 billion cubic meters of proven natural gas reserves. Given the statistics, Iran is the first country with 33 trillion 721 billion cubic meters of proven reserves, Qatar is the second country with 24 trillion 72 billion cubic meters. The second largest gas reservoir after the Middle East is Eastern Europe and the Eurasia region with 66 trillion 291 billion cubic meters of reserves.

Figure 1: Natural Gas Consumption in the Middle East 2012-2040 (Trillion Cubic Fit, TCF)



Source: International Energy Outlook, 2016.

It is important to analyze the interaction between natural gas energy consumption and economic growth, as the increasing use of natural gas in the industry and electricity sector, one of the leading sectors in economic growth, is a cheap and clean energy source.

When the relevant literature is examined, there are few studies on the interaction between natural gas energy consumption and economic growth towards the Middle Eastern countries. There is no consensus on the findings obtained from the present studies. Determination of causality relation between the two variables is important for energy politics. If there is a one-way causality from natural gas energy consumption to economic growth, it can be said that a decrease in natural gas energy consumption will have a negative effect on economic growth. On the contrary, if a causality relationship from economic growth to natural gas energy consumption is detected, it can be said that the policies applied to reduce natural gas energy consumption have little or no impact on economic growth. Otherwise, if there is no causality between the variables, any economic policies towards natural gas consumption may not impact on economic growth. Conversely, if there is a two-way causality relationship between the variables, natural gas energy consumption may encourage economic growth and economic growth may increase natural gas consumption demand.

This article aims to establish an econometric model to investigate the interaction between economic growth and consumption of natural gas energy in the Middle East. For this purpose, the interaction between natural gas consumption, real gross fixed capital formation, total goods and services trade, labor force and real gross domestic product has been tried to be analyzed by Panel data analysis.

2.Literature Review

Many of the studies in the literature have taken different approaches to the interaction between natural gas consumption and economic growth. For instance, Yu and Choi (1985) for the United Kingdom, USA and Poland; Yang (2000) for Taiwan; Aqeel and Butt (2001) for Pakistan; Fatai, Oxley and Scrimgeour (2004) for New Zealand and Australia; Lee and Chang (2005) for Taiwan; Ewing, Sari and Soytas (2007) for USA; Zamani (2007) and Amadeh, Morteza and Abbasifar (2009) for Iran; Hu and Lin (2008) and Sari, Ewing and Soytas (2008) for USA; Reynolds and Kolodziej (2008) for Soviet Union; Zahid (2008) for five South Asian countries; Adeniran (2009) and Clement (2010) for Nigeria; Apergis and Payne (2010) for 67 countries; Isık (2010) for Turkey; Kum, Ocal and Aslan (2012) for G-7 countries; Shahbaz, Lean and Farooq (2013) for Pakistan; Bildirici and Bakirtas (2014) for BRICTS countries; Dogan (2015) for Turkey; Solarin and Ozturk (2016) for OPEC countries; Destek (2016) for OECD countries have been in the search. Table 1 summarizes the main findings and results of this empirical literature.

When literature review is examined, three important traits are observed. First, the findings do not include consensus and country-specific shortcomings. Secondly, some studies are not considered very appropriate in terms of methods. Variables neglected, especially in bivariate models, can lead to deviations in the results. Thirdly, the recent economic crises and climate changes have significantly influenced the fuel policy of countries. For this reason, working with current data will increase the reliability of the results. Looking at the literature, it is seen that the work done for Turkey is limited. Isik (2010) found that natural gas consumption has a positive impact on economic growth in the short term, while natural gas consumption has a negative impact on economic growth in the long-run. Apergis and Payne (2010) found a two-way causality relationship between consumption of natural gas and economic growth in the 1992-2005 period for 67 countries, including Turkey. The Bildirici and Bakirtas (2014) have concluded that there is a two-way causality between natural gas consumption and economic growth for the BRICTS countries where Turkey is also involved. Dogan (2015) pointed out that there is a mutual causal relationship between natural gas consumption and economic growth in Turkey, using data for the years 1995-2012. Finally, Destek (2016) found that in the 1991-2013 analysis of OECD countries where Turkey is a member, Turkey has one-directional causality relationship from natural gas consumption to economic growth in the short term; and has bi-directional causality relationship between the variables in the long term. Table 1 shows a brief survey in the relevant literature.

Table 1: Literature Review

Author(s)	*Countries*	*Period*	*Method*	*Used Variables*	*Causality Relation*
Yu and Choi (1985)	United Kingdom	-	Granger Causality	Real GNP, NGC	GNP ⇨ NGC
Yang (2000)	Taiwan	1954-1997	Granger Causality	Real GDP, NGC	NGC ⇨ GDP
Aqeel and Butt (2001)	Pakistan	1955-1996	Granger Causality	Real GDP, NGC	GDP X NGC
Fatai et al. (2004)	New Zealand and Australia	1960-1999	ARDL, JML, TY Causality	Real GDP, NGC	GDP X NGC
Lee and Chang (2005)	Taiwan	1954-2003	JML, WE	Real GDP, NGC	NGC ⇨ GDP
Ewing et al. (2007)	USA	2001-2005	GFEVD	Industrial Production, NGC	NGC ⇨ GDP
Zamani (2007)	Iran	1967-2003	JML, VECM	Real GDP, NGC	NGC ⇨ GDP
Hu and Lin (2008)	Taiwan	1982-2006	VECM	Real GDP, NGC	NGC ⇔ GDP
Sari et al. (2008)	USA	2001-2005	ARDL, VECM	Industrial Production, NGC	GDP ⇨ NGC
Reynolds and Kolodziej (2008)	Soviet Union	1928-2003	Granger Causality	Real GNP, NGC	NGC ⇨ GNP
Zahid (2008)	Pakistan, Bangladesh, India, Nepal, Sri lenka	1971-2003	TY	Real GDP per capita, NGC	For Bangladesh, NGC ⇨ GDP For other countries, GDP X NGC
Amedah et al. (2009)	Iran	1973-2003	ARDL, VECM	Real GDP, NGC	GDP ⇨ NGC
Adeniran (2009)	Nigeria	1980-2006	VECM	Real GDP, NGC	GDP ⇨ NGC

Clement (2010)	Nigeria	1970-2005	JML, VECM	Real GDP, NGC	NGC ⇨ GDP
Apergis and Payne (2010)	67 Countries	1992-2005	Pedroni, Granger Causality	Real GDP, NGC, Labor, Capital	NGC ⇔ GDP
Işık (2010)	Turkey	1977-2008	ARDL	Real GDP, NGC	NGC ⇔ GDP
Kum et al. (2012)	G-7 Countries	1970-2008	Bootstrapping Granger Causality	Real GDP, NGC, Capital	Japan, Canada: GDP X NGC USA, France and Germany: NGC ⇔ GDP Italy: NGC ⇨ GDP United Kingdom: GDP ⇨ NGC
Shahbaz et al. (2013)	Pakistan	1972-2010	ARDL, VECM	Real GDP per capita, NGC, Capital, Labor, Real exports	NGC ⇨ GDP
Bildirici and Bakırtaş (2014)	BRICTS Countries	1980-2011	ARDL, Granger Causality	Real GDP and Coal, Oil or NGC	NGC ⇔ GDP
Doğan (2015)	Turkey	1995-2012	ARDL, Granger Causality	Real GDP per capita, NGC, Labor, Capital	NGC ⇔ GDP
Solarin and Ozturk (2016)	12 OPEC Countries	1980-2012	Dumitrescu and Hurlin Granger Causality	Real GDP per capita, NGC	NGC ⇔ GDP
Destek (2016)	OECD Countries	1991-2013	FMOLS, DOLS, VECM Granger Causality	GDP growth, NGC, gross fixed capital formation and commercial openness	Short-Run: NGC ⇨ GDP Long-Run: NGC ⇔ GDP

NOTE: NGC Natural Gas Consumption, GDP Gross Domestic Product and GNP Gross national product. " ⇦ " and " ⇨ " represent one-way granger causality relations, while " ⇔ " symbol represent two-way granger causality relationships. The " X " symbol indicates that there is no granger causality among the variables. GFEVD is a generalized forecast error variance decomposition, JML Johansen maximum likelihood method, WE weak externality test, VECM vector error correction method, ARDL Autoregressive distributed lag model to cointegration, TY Toda and Yamamoto causality test, FMOLS fully modified ordinary least squares method and DOLS dynamic ordinary least squares.

3.Data, Methodology and Results

Annual data for the period 1980-2014 used in the study were obtained from the World Bank Development Indicators, Energy Information Administration and Thomson Datastream database. Ten Middle East countries with no difficulties in providing analytical data have been included: Iran, Iraq, Israel, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Syria and United Arab Emirates.

Empirical studies conducted in recent years such as Stern (2000), Ghali and El-Sakka (2004), Lee and Chang (2005), Beaudreau (2005), Sarı and Soytaş (2007), Yuan and et al. (2008), Apergis and Payne (2010), Menyah and Wolde-Rufeal (2010), Shahbaz and Lean (2012), Öcal and Aslan (2013), Shahbaz and et al. (2014), Rafindadi and Öztürk (2015) and Balitskiy and et al. (2016) used conventional Neo-Classical production model to analyze the interaction between energy consumption and economic growth.

According to the existing literature, the real gross domestic product per capita (GDP), consumption of natural gas determined by dry natural gas in billions of cubic feet (NGC), real gross fixed capital formation (GFC), trade in goods and services (TGS) as an opennes indicator and total labor force (LF) in millions are treated as separete coventional Neo-Classical production factors as below:

$$GDP_{it} = f\,(NGC_{it}, GFC_{it}, TGS_{it}, LF_{it}) \quad (1)$$

The logarithmic linear characteristic of equilibrium (1) is as follows:

$$\ln GDP_{it} = \beta_{1i} \ln NGC_{it} + \beta_{2i} \ln GFC_{it} + \beta_{3i} \ln TGS_{it} + \beta_{4i} \ln LF_{it} + \varepsilon_{it} \quad (2)$$

The $\beta_{1i}, \beta_{2i}, \beta_{3i}$ and β_{4i} represent the slop of coefficients, *i* represent the cross section or countries, *t* is the time period (1980-2014) and ε is the error term in the Equilibrium (2).

The first step of the econometric analysis is to analyze the variables stationarity using panel unit root tests. These tests are evaluated by a individual unit root tests combination to arrive at panel results. Panel unit root tests operates under null and alternative hypotheses. In general, the panel unit root test is more prevalent due to its high potency in comparison with the evidence of root of the unity of the normal time series among researchers (Baltagi, 2009).

Macroeconomic variables have long-term cyclical fluctuations around a trend. To measure the movement in these macroeconomic variables, it is necessary to distinguish the seasonal fluctuations and trends mentioned above. In the long term, the series will not be stationary, so it needs to be seasonally seasonal and trend-free. The effect of a shock on a stationary series will be temporary while the effect of a shock on a non-stationary series will be continuous. Because, in the long run, the stationary series will return to their mean levels (Enders, 2004: 171). In addition, false regressions can occur in analyzes where non-stationary series are applied. Although R2 has high and statistically significant t values, statistically insignificant parameter estimates indicate the presence of false regression (Hendry et al., 1984).

Stationary test is the most important concept in time series analysis. In econometric analyzes it is assumed that the variables are separated in time, their averages and variance are constant. However, this assumption is not always valid as a result of unit root tests. Over time, variance and averaging, trend-containing variables, ie non-stationary variables, are emerging. The constant and variance of the series observed for a given time means that the stochastic process leading to that series is stable (Bowerman and O'Connel, 1979: 340).

Fixed Average: E (Yt) = μ

Constant Variance: Var (Yt) = E (Yt - μ) 2 = σ2

Covariance: Ɣ.k = E [(Yt - μ) (Yt + k - μ)]

If a time series is stationary, the variance, the mean and the covariance variance in different delays will always be the same (Gujarati, 2012: 740). CD test is performed and first-generation unit root tests are used because it is determined that there is no cross section dependency. The Dickey Fuller Test (DF), the Augmented Dickey Fuller Test (ADF), the Im Pesaran & Shin Test, the Levin Lin & Chu Test and the Phillips-Peron Test (PP) are used to determine whether variables are stationary in econometric analyzes.

Table 2 shows the results of unit root test. All variables are not significant in levels, which indicates that the null hypothesis is not rejected. For this reason, variables have panel unit root. However, when the first difference of the variables is taken, it is seen that the null hypothesis is rejected. In other words, variables are stationary.

Table 2: Panel Unit Root Tests Results

Levin, Lin & Chu t				
Variables	Level-I(0)		First Difference-I(1)	
	Intercept	Intercept-Trend	Intercept	Intercept-Trend
GDP	-2,15675**	-1,60059	-10,0509***	-9,10969***
NGC	5,58842	1,13824	-13,7331***	-14,5888***
GFC	1,30555	-1,22236	-18,0007***	-17,1127***
TGS	-1,16780	-1,19408	-12,6998***	-10,9595***
LF	2,95602	2,18198	-3,68514***	-3,71373***
Im, Pesaran and Shin				
Variables	Level-I(0)		First Difference-I(1)	
	Intercept	Intercept-Trend	Intercept	Intercept-Trend

GDP	-1,52861*	-110426	-9,94529***	-8,77628***
NGC	7,62979	4,39794	-12,6209***	-13,3598***
GFC	-0,04863	-0,78550	-15,9726***	-15,0534***
TGS	-1,23672	-1,44119*	-12,0150***	-10,3122***
LF	4,15259	3,45128	-4,64083***	-4,24199***
ADF				
Variables	Level-I(0)		First Difference-I(1)	
	Intercept	Intercept-Trend	Intercept	Intercept-Trend
GDP	39,8523**	28,2949	120,804***	102,783***
NGC	4,77553	5,33087	167,612***	172,637***
GFC	39,1434**	31,7989	194,646***	323,272***
TGS	28,3295	26,3140	157,442***	127,972***
LF	12,8961	8,49819	59,2496***	53,1685***
PP				
Variables	Level-I(0)		First Difference-I(1)	
	Intercept	Intercept-Trend	Intercept	Intercept-Trend
GDP	37,8664*	29,9831	124,132***	122,528***
NGC	4,92927	5,89884	175,309***	264,634***
GFC	39,7823*	31,9148	231,833***	636,958***
TGS	30,1118	28,8457*	171,599***	370,868***
LF	14,3914	10,1224	60,2135***	54,0212***

The unit root tests are conducted with individual trends and intercept for each variable. Length of lag is automatically selected using the Schwarz Information Criteria (SIC).
*** Indicates statistical significance at the 1% levels.
** Indicates statistical significance at the 5% levels.
* Indicates statistical significance at the 10% levels

The pedroni cointegration test is used to determine the long-run relationship between the variables used in the study because they are stationary when the first-order difference is taken. The Pedroni cointegration test, commonly used between panel cointegration tests, depends on the pooled Phillips and Perron type test. Seven panel cointegration tests, four panel test and three group test statistics, are derived. The four statistics in the first category are defined as statistical bounds within the dimension. Variance ratio statistics, nonparametric Philips-Perron type ρ statistics, non-parametric Philips-Perron type statistics and Dickey Fuller type statistics are included in this category. The other three panel cointegration tests constitute the second category and are statistical dependent on the size. The Philips-Perron type ρ statistic in this category is based on the Philips-Perron type statistic and the ADF type statistical group average approach (Bildirici et al., 2010: 49).

$$y_{it} = \alpha + \beta X_{it} + e_{it}$$

$$y_{it} = y_{it-1} + v_{it} \qquad i = 1,2\ldots,N$$

$$X_{it} = X_{it-1} + \varepsilon_{it} \qquad t = 1,2\ldots,T$$

$$\hat{e}_{it} = p\hat{e}_{it-1} + u_{it}$$

Here are some random walking exhibits. Calculation of the panel variance ratio statistic in the first category is as follows:

$$Z_{\hat{U}NT} = \frac{1}{(\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{L}_{11i}^{-2}\hat{e}_{it-1}^{2})}$$

$$Z_{\hat{p}NT} = \frac{\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{L}_{11i}^{-2}(\hat{e}_{it-1}\hat{e}_{it}-\hat{\lambda}_i)}{(\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{L}_{11i}^{-2}\hat{e}_{it-1}^{2})}$$

$$Z_{\hat{p}NT} = \frac{\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{L}_{11i}^{-2}(\hat{e}_{it-1}\hat{e}_{it}-\hat{\lambda}_i)}{\sqrt{\hat{\sigma}_{NT}^{2}(\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{L}_{11i}^{-2}\hat{e}_{it-1}^{2})}}$$

The results suggested by the Pedroni Cointegration test are shown in the equations below.

$$TN^{3/2}Z_{\hat{U}NT} \rightarrow \frac{1}{\frac{1}{N}\sum_{i=1}^{N}Q_i^2}$$

$$T\sqrt{N}\left(Z_{\hat{p}NT}-1\right) \rightarrow \frac{\frac{1}{N}\sum_{i=1}^{N}\int Q_i dQ_i}{\sqrt{\left(\frac{1}{N}\sum_{i=1}^{N}\int Q_i{}^2\right)\left(1+\frac{1}{N}\sum_{i=1}^{N}\hat{\beta}_i{}^2\right)}}$$

$$T \rightarrow \infty, TN^{3/2}Z_{\hat{U}NT} - \frac{\sqrt{N}}{\theta_1} => N\left(0, \phi_{(1)}\psi_{(1)}\phi_{(1)}\right)$$

$$T\sqrt{N}\left(Z_{\hat{p}NT}-1\right) - \frac{\sqrt{N}\theta_2}{\theta_1} => N\left(0, \phi_{(2)}\psi_{(2)}\phi_{(2)}\right)$$

$$Z_{t\hat{p}NT} - \frac{\sqrt{N}\theta_2}{\sqrt{\theta_1(1+\theta_3)}} => N\left(0, \phi_{(3)}\psi_{(3)}\phi_{(3)}\right)$$

After this step in the Pedroni cointegration test, a fully predicted FMOLS (Fully Modified Ordinary Least Squares) predictor is proposed. Equal to the average value of the trainer FMOLS (Bildirici et al, 2010: 50). The $\hat{\beta}_{ij}$, in the following equation represents the FMOLS estimator.

$$\hat{\beta}_j = \frac{1}{N}\sum_{i=1}^{N}\hat{\beta}_{ij}$$

In the dynamic ordinary least squares method (DOLS), long run analysis is performed by adding the leading and delayed differences of the regression independent variables. In the case of serial correlation, the leading and delayed differences of the dependent variable are added. The regression model used for the pedron cointegration test in the dynamic panel is shown in the following equation.

$$Y_{it} = \alpha_i + \beta_i X_{it} + \sum_{k=Ki}^{Kt}\gamma_{ik}\Delta X_{it-k} + \mu_{it}^{*}$$

The equation for obtaining the β estimation coefficient is as follows.

$$\beta_{DS}^{*} = N^{-1}\sum_{i=1}^{N}(\sum_{t=1}^{T}Z_{it}Z_{it}')^{-1}(\sum_{t=1}^{T}Z_{it}Y_{it}^{*})$$

$Z_{it} = \left(X_{it} - \bar{X}, \Delta X_{it-k,\dots,}\Delta X_{it+k}\right)$ expresses the regression vector. The panel assumes that the dynamic least squares method is a homogeneous cointegration vector. In the pedroni cointegration test, zero hypothesis is in the data models "no cointegration".

The alternative hypothesis is that data models have "cointegration". The asymptotic distributions and critical values of the seven tests based on the error terms in the Pedroni cointegration test are shown in the work titled "*Critical values for cointegration tests in heterogeneous panels with multiple regressors*" (Pedroni, 1999). According to these critical values, zero hypothesis is accepted or rejected and it is analyzed whether there is cointegration. Pedroni offers several co-integration tests that allow heterogeneous intercepts and trend coefficients on cross-sections. Based on the following regression equation:

$$y_{it} = \theta_i + \vartheta_{it} + \beta_1 x_{1,it} + \beta_2 x_{2,it} + \cdots + \beta_k x_{k,it} + \varepsilon_{it} \quad (3)$$

t = 1, ..., T; i = 1, ..., n; j = 1, ..., k; and y and x are supposed to be integrated of the order 1, that is to say I (1). The parameters θ_i and ϑ_{it} are respectively individual and time effects, which can be set to zero if desired. Under the null hypothesis of the absence of cointegration, the residuals ε_{it} I(1). Pedroni creates various statistics to check the null hypothesis about the absence of cointegration: Panel v-statistics, panel p-statistics, panel t-statistics (nonparametric), panel t-statistics (parametric), group p-statistics, group t statistics (nonparametric) and group statistics (parametric). The first four statistics are called measurement criteria by within dimension or panel statistics test, and the remaining tests are called measurement criteria by between dimension test (Pedroni, 2004).

Table 3: Pedroni's Panel Cointegration Tests Results

Tests	Individual Intercept		Individual Intercept and Individual Trend	
	Statistics	p Values	Statistics	p Values
Panel v-statistic	0.643223	0.2600	-0.612236	0.7298
Panel p-statistic	-1.159520	0.1231	0.104896	0.5418
Panel PP-statistic	-5.958213***	0.0000***	-6.387623***	0.0000***
Panel ADF-statistic	-6.046820***	0.0000***	-6.420296***	0.0000***
Group p-statistic	1.650842	0.9506	2.322621	0.9899
Group PP-statistic	-4.221069***	0.0000***	-4.535437***	0.0000***
Group ADF-statistic	-3.665269***	0.0001***	-3.788620***	0.0001***

*** Denotes significance at the 1% levels.

Length of lag and bandwidth are selected according to Schwarz Information Criterion (SIC) and the Bartlett Kernel Newey-West estimator.

Table 2 shows Pedroni Panel cointegration test results, which indicates that four statistics are significant; therefore, zero hypothesis in the absence of cointegration is rejected. In other words, gross domestic products, gross fixed capital formation, natural gas consumption, total trade of goods and services and labor force are cointegrated.

As a result of the Pedroni panel cointegration test, the variables used in the analysis are cointegrated with each other, so the dynamic ordinary least squares (DOLS) method can be continued. DOLS, proposed by Pedroni, is a cointegration equation used to show the long-running relationship between dependent and independent variables (Pedroni, 2004). The mean panel DOLS estimator proposed by Pedroni (2004) requires estimation of the following regression model:

$$y_{it} = X'_{it}\beta + D'_{1it}\sigma_1 + \sum_{j=-k}^{k} \Delta X_{it+j}\theta + \varphi_{1it} \qquad (4)$$

In equation (4) –k and k show the number of leads and lags respectively.

Table 4 shows the DOLS test results using the "*xtpedroni*" command with the Stata 12 program. The results show that natural gas consumption has a positive effect on GDP for all countries involved in the analysis. The natural gas consumption in Iran, Iraq, Israel, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates is found to be significant at the 1% significance level, while it is significant at the 5% significance level for Jordan and at the 10% significance level for Syria. When we look at the natural gas energy consumption impacts on economic growth, Qatar shows the most impact. It is followed by United Arab Emirates, Iraq, Saudi Arabia, Kuwait, Oman, Jordan, Iran, Israel and Syria respectively.

Table 4: Panel Group Mean DOLS

Country	Dependent Variable: GDP			
	NGC	GFC	TGS	LF
Iran	0.2180 (-92.99) ***	0.2802 (-49.8) ***	0.07363 (-263.3) ***	0.05288 (-15.43) ***
Iraq	0.5495 (-6.946) ***	0.4478 (-6.553) ***	0.08906 (-10.56) ***	0.00471 (-1.06)
Israel	0.06363 (-141.3) ***	0.7797 (-3.565) ***	0.2906 (-10.58) ***	1.055 (-15.1) ***
Jordan	0.3535 (-2.35) **	-06268 (-1.12)	0.5388 (-5.05) ***	0.2684 (-1.21)
Kuwait	0.4357 (-8.245) ***	-0.3184 (-48.27) ***	0.3283 (-37.37) ***	0.01217 (-407.7) ***
Oman	0.4209 (-75.98) ***	-0.00367 (-63.53) ***	0.05337 (-120.9) ***	0.09751 (-58.35) ***
Qatar	1.1780 (-5.095) ***	0.3785 (-1.9814)*	0.5184 (-1.64)	0.01268 (-3.33) ***
Saudi Arabia	0.5026 (-19.35) ***	-0.06754 (-60.94) ***	0.05132 (-65.18) ***	0.1171 (-35.77) ***
Syria	0.04194 (-1.881) *	0.7536 (-3.504) * * *	0.3057 (-1.43)	0.3295 (-2.38) **
United Arab Emirates	0.6395 (-4.12) ***	0.3527 (-5.11) ***	0.5821 (-2.46) **	0.00128 (-0.46)
Group Panel	0.4894 (-64.84) ***	0.00351 (-6.784) ***	0.05128 (-14.82) ***	0.04673 (-16.72) ***

The values in parentheses ( ) indicates the t statistics. ***Denotes significance at the 1% levels. ** Denotes significance at the 5% levels. * Denotes significance at the 10% levels.

When gross fixed capital formation's impact on gross domestic product is examined, gross fixed capital appears to have a positive impact on economic growth in Iran, Iraq, Israel, Qatar, Syria and the United Arab Emirates, but appears to have a negative effect on other countries involved in the analysis. When measured in absolute terms, the country where gross fixed capital has the greatest impact on economic growth is Israel. It is followed by Jordan, Syria, Iraq, Qatar, United Arab Emirates, Kuwait, Iran, Saudi Arabia and Oman respectively. While gross fixed capital is significant at 1% level of significance in Iran, Iraq, Israel, Kuwait, Oman, Saudi Arabia, Syria, United Arab Emirates, it is statistically significant at 10% level of significance in Qatar. However, it has been found that gross fixed capital does not have a significant effect on economic growth in Jordan.

Given the results in Table 4, it appears that total goods and services trade has a positive effect on gross domestic product in all countries involved in the analysis. The greatest impact is seen in the United Arab Emirates. It is followed by Jordan, Qatar, Kuwait, Syria, Israel, Iraq, Iran, Oman and Saudi Arabia respectively. While the trade of total goods and services is statistically significant at 1% significance level in Iran, Iraq, Israel, Jordan, Kuwait, Oman and Saudi Arabia, the United Arab Emirates is statistically significant at 5% significance level. Besides, total goods and services trade is not statistically significant on economic growth in Qatar and Syria.

The labor force has a positive impact on economic growth in all the countries analyzed. The biggest impact of the labor force is seen in Israel over economic growth. It is followed by Syria, Jordan, Saudi Arabia, Oman, Iran, Qatar, Kuwait, Iraq and United Arab Emirates respectively. When the labor force variable is statistically significant, it is significant at 1% significance level in Iran, Israel, Kuwait, Oman, Qatar, Saudi Arabia and at 5% significance level in Syria. On the other hand, Labor force is not statistically significant variable in Iraq, Jordan and the United Arab Emirates.

Panel Data shows that consumption of natural gas, gross fixed capital, total goods and services trade, and labor force have a significant positive effect on the growth of gross domestic product in the long run at a statistically significant 1% significance level. In ten Middle Eastern countries included in the analysis, 1% increase in natural gas consumption will increase the growth of GDP by 0.4894%, 1% increase in the formation of gross fixed capital will increase GDP growth by 0.00351%, also 1% increase in total goods and services trade will increase GDP growth by 0.05128%. Finally, 1% increase in the labor force will increase GDP growth by 0.04673%. In summary, among the variables considered in the selected Middle East countries, natural gas consumption is the biggest effect on economic growth followed by total goods and service trade, occupation and gross fixed capital formation respectively.

Because cointegration is detected between variables, vector error correction model (VECM) based Granger causality test is used. VECM Granger causality can catch short and long term relationships based on F statistics and lagged error correction (-1). The model of VECM Granger causality is shown in the equation (5) below:

$$\begin{bmatrix} \Delta GDP_{it} \\ \Delta NGC_{it} \\ \Delta GFC_{it} \\ \Delta TGS_{it} \\ \Delta LF_{it} \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \end{bmatrix} + \sum_{p-1}^{r} \begin{bmatrix} \beta_{11p} & \beta_{12p} & \beta_{13p} & \beta_{14p} & \beta_{15p} \\ \beta_{21p} & \beta_{22p} & \beta_{23p} & \beta_{24p} & \beta_{25p} \\ \beta_{31p} & \beta_{32p} & \beta_{33p} & \beta_{34p} & \beta_{35p} \\ \beta_{41p} & \beta_{42p} & \beta_{43p} & \beta_{44p} & \beta_{45p} \\ \beta_{51p} & \beta_{52p} & \beta_{53p} & \beta_{54p} & \beta_{55p} \end{bmatrix} \begin{bmatrix} \Delta GDP_{it-p} \\ \Delta NGC_{it-p} \\ \Delta GFC_{it-p} \\ \Delta TGS_{it-p} \\ \Delta LF_{it-p} \end{bmatrix} + \begin{bmatrix} \theta_1 \\ \theta_2 \\ \theta_3 \\ \theta_4 \\ \theta_5 \end{bmatrix} ect_{it-1} + \begin{bmatrix} \varepsilon_{1it} \\ \varepsilon_{2it} \\ \varepsilon_{3it} \\ \varepsilon_{4it} \\ \varepsilon_{5it} \end{bmatrix} \quad (5)$$

The i represents the countries, t donates the time (1980-2014), ε_{it} is the error term and the ect is the lagged error correction term. Table 5 shows the tests of panel Granger causality results.

Table 5: Panel Granger Causality Test Results

Dependent Variables	Independent Variables					
	Short-run Causality					Long-run Causality
	ΔGDP	ΔNGC	ΔGFC	ΔTGS	ΔLF	ect (-1)
ΔGDP	-	35.84256***	5.41658***	34.26514***	1.06531	-4.3264864***
ΔNGC	32.21546***	-	4.6594***	35.4775***	0.38457	-3.872135***
ΔGFC	2.16321**	1.28468	-	1.7296	2.20124*	-3.642152***
ΔTGS	27.87452***	39.32465***	5.7961***	-	0.86423	-2.286475**
ΔLF	0.62134	0.78546	2.62754**	2.38456**	-	-1.994525*

*** Denotes significance at the 1% levels.
** Denotes significance at the 5% levels.
* Denotes significance at the 10% levels.

In the short term, there is a two-way Granger causality between GDP and NGC, GFC, TGS; there is no Granger causality relationship between GDP and LF. The main finding to be drawn from short-term results is that the feedback hypothesis is valid between GDP and NGC. In other words, a bi-directional Granger causality is found between the GDP and the NGC that is significant at the 1% significance level.

Furthermore, when we look at long-term causality analysis based on lagged error correction ect (-1), a two-way Granger causality is found among all variables involved in the analysis.

4.CONCLUSION

The aim of this study is to examine the interaction between natural gas consumption and economic growth in the Middle East (Iran, Iraq, Israel, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Syria and United Arab Emirates) which has the most natural gas reserves in the world. It is important to investigate this interaction because the use of natural gas in the Middle East region is increasing in the industrial and electricity industries and the studies are not sufficient for the Middle East in the economic literature.

For this purpose, a panel data analysis is carried out using annual data including 1980-2014 period, Gross Domestic Product, natural gas consumption, gross fixed capital formation, total trade of goods and services and labour force variables. First, panel unit root tests are applied to examine the variables stationarity. As a result of unit root tests, the variables are not stationary at the level, but they are stationary when the first degree differences are taken. Then the Pedroni cointegration test performed shows that the variables used in the analysis have cointegrated vectors. Thus, when we look at the results of DOLS method, it is seen that the relevant variables have a positive effect on economic growth in the Middle East countries. In addition, the results of the Granger causality test showed a bi-directional Granger causality between real gross domestic product and natural gas consumption, gross fixed capital, total goods and service trade in the short term, while the Granger causality between real gross domestic product and labor force is not detected. In the long term, bi-directional Granger causality is determined between all variables. The relationship between real gross domestic product and natural gas consumption, which constitutes the main subject of this study, appears to be valid in the feedback hypothesis (bi-directional Granger causality).

It is important to increase the use of natural gas in agriculture and industry due to the abundant natural gas reserves in the Middle East region and to be cheaper and healthier than alternative energy sources. Although energy policies to increase energy efficiency in this region are useful in providing the most benefit from natural gas consumption, protective policies applied to save energy can have a negative effect on natural gas consumption and consequently on economic growth. The fact that policy decision makers shape energy and growth policies by taking into consideration this information as a result of the study is important for ensuring efficiency in the economy and for the realization of economic growth.

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