The Impact of Natural Gas Consumption on Industry Value Added in the Mediterranean Region

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Abstract:

The current paper assesses the link between natural gas consumption (NGC) and macroeconomic variables for the period between 1980 and 2018 in the Mediterranean region. Analyses accounts for assessing the significance of the natural gas consumption on the industry value added (IVA) using fixed-effects panel data regression. In addition to that, this contribution evaluates the causal link between the variables cited above. Empirical findings indicate that there is a significant relationship between IVA and NGC. Furthermore, these two latter variables showcase a mutual causality in a sense that an increase in each of these variables will lead to the increase of the other one. Results also indicate that GDP causes the increase in natural gas consumption.

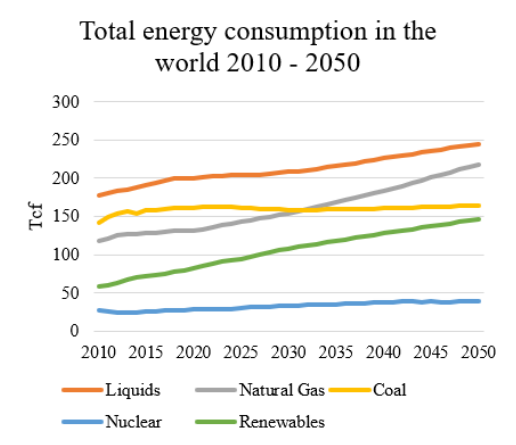
Key words: Mediterranean Region, Causality, Panel Data, Fixed-Effect, Granger Causality, Industry Value Added, GDP, Natural Gas Consumption

JEL: L10, O29, O40, Q30, Q38, Q43

Introduction:

Many economies have been trying to move towards increasing the share of renewable energies among their total energy consumption in order to transition towards a greener energy. But in order to attain this while simultaneously reducing other energies' emissions, natural gas is considered as the best alternative, as it is considered as a complementary green energy source to renewables (IGU, 2015).

Figure 1: Total energy consumption in the between 2010 and 2050 (source: EIA)



Throughout the past decade, total world energy consumption has increased from 523 quad btu in 2010 to 598 in 2018, which corresponds to 14.34% growth, and will reach 814 quad btu in 2050. This growth is mainly driven by the increase of the shares of renewables and natural gas (Figure 1). This latter primary energy source represents 36.98% of the total residential sector energy consumption, 28.12% of the total commercial energy consumption, 22.22% of the total industrial sector energy consumption, 3.65% of the total transport sector energy consumption,19.68% of the total electricity sector energy consumption, and finally, 22.19% of the total world energy consumption.

The main focus of this study is to assess the role of natural gas on different economies in the Mediterranean region. This is by analyzing the impact of natural gas consumption on the industrial sector that is represented by the industry value added on GDP.

The current paper will present a literature review as well as a data and methods section. This will be followed by the results section, and then concluded.

Literature review:

The causal link between natural gas and economic growth has been the point of interest of many scholars that addressed this type of analysis using different approaches such as cointegration (Solarin & Shahbaz, 2015). Lee and Chang (2005) has assessed the causality between natural gas consumption and real GDP using cointegration for the period between 1954 and 2003. Empirical findings indicate that increase of natural gas consumption leads to

higher real GDP. But for Zamani (2007), analysis using error correction model lead to imply only a bidirectional relation between these two latter variables.

In the case of Pakistan, the contribution of Khan and Ahmad (2008) analyzes the link between gas consumption per capita, GDP, and natural gas prices for the period between 1972 and 2007. Results indicate that there is no causal link between these variables. For Işik (2010), natural gas has a positive impact on GDP on the short-run, which is not the case for the long-run in Turkey. Yu and Choi (1985) indicates that for Poland, US, and UK, no causality is found between natural gas consumption and economic variables.

The authors Khoshnevis and Mastorakis (2014) studied the case of Iran and assessed the relationship between natural gas consumption, employment, exports, financial development as well as many other variables. Results show that natural gas is mainly linked to exports and capital formation variables. In the case of Malaysia, Solarin and Shahbaz (2014) used both cointegration and unit root methods to analyze a set of variables including natural gas. This paper concluded that it is natural gas that impacts economic growth.

In France, it's economic variables such as exports and labor that causes the increase of natural gas consumption (Farhani, Shahbaz and Rahman, 2014). The contribution of Öztürk and Usama (2015) analyzes the relationship between natural gas consumption with macroeconomic variables for 12 OPEC countries, but only Kuwait, Libya, Nigeria, Saudi Arabia, and Iraq show that natural gas consumption impacts the economic growth. A similar study was conducted on 26 OECD countries for the period between 1991 and 2013 using panel data and Granger causality (Destek, 2016). This latter study indicates that on the long-term, natural gas consumption impacts economic growth.

The current paper will follow the same model as Destek (2016), Chang, et al. (2016), and will analyze the impact of natural gas on the industry value added besides assessing the causal relationship between these two latter variables in addition to GDP.

Data & Methods:

The data used in this paper is natural gas consumption (NGC) in terms of billion cubic feet (Bcf) that is extracted from Energy Information Administration (EIA) that covers the period between 1980 and 2017. In addition to that, both industry value added (IVA), and GDP are extracted from the World Bank for the same period. The industry value added accounts for the

outputs -without taking into account intermediate output- manufacturing, mining, construction, as well as other sectors in terms of US$.

All of the above data are extracted for countries in the Mediterranean region and excludes those with no natural gas consumption and those with few observations. The covered countries in this paper are: Italy, Egypt, Turkey, France, Algeria, Spain, Israel, Tunisia, Greece, Croatia, Morocco, Slovenia, Bosnia and Herzegovina, and Albania.

The current paper assesses the impact of the GDP and natural gas consumption on the industry value added. For this, the first part of the analysis uses the fixed-effects panels technique that test the existence of individual effects (Simionescu, Dobeš, Brezina, and Gaal, 2016). The selection of this model was based on the Hausman effect that are displayed in the results section (Table 1).

The empirical model can be expressed in the following equation:

$$IVA_{it} = \alpha + \beta_1 NGC_{it} + \beta_2 GDP_{it} + \varepsilon_{it}$$

Where:

i: represents countries.
t: represents years.
α: is the intercept.
β: is the coefficient.
ε: is the error term.

The second part of the analysis relates to the causality factor between the variables. For instance, if x is able to increase the accuracy of y, this means than x causes y and vise versa (Harkat, 2017). The two equations that tests for the causality between each two selected variables of the study are given such as:

$$X_t = \alpha + \sum_{i=1}^{m} \beta_i X_{t-1} + \sum_{j=1}^{n} \tau_j Y_{t-1} + \mu_t \qquad (1)$$

$$Y_t = \theta + \sum_{i=1}^{p} \emptyset_i Y_{t-1} + \sum_{j=1}^{q} \psi_j X_{t-1} + \eta_t \qquad (2)$$

Testing the causality between two variables leads to one of the following 4 main scenarios:

- Unidirectional causality - X causes Y - that is represented such as:

$\sum_{j=1}^{n} \tau_j \neq 0$, and $\sum_{j=1}^{q} \psi_j = 0$

- Unidirectional causality - Y causes X - that is represented such as:

$\sum_{j=1}^{n} \tau_j = 0$, and $\sum_{j=1}^{q} \psi_j \neq 0$

- Bidirectional causality between X and Y that is represented such as:

$\sum_{j=1}^{n} \tau_j \neq 0$, and $\sum_{j=1}^{q} \psi_j \neq 0$

- Independence between X and Y that is represented such as:

$\sum_{j=1}^{n} \tau_j = 0$, and $\sum_{j=1}^{q} \psi_j = 0$

The results section summarizes the main findings that are organized in a way to show the test for the model selection, the fixed-effects panels data regression, and the Granger causality test between the mentioned above data.

Results:

The Hausman test results in a p-value that is lower than the significance level $\alpha = 5\%$ (Table 1). This indicates that the null hypothesis - H_0: Random effect model is appropriate - should be rejected, and thus the fixed effect model will be used for the following section.

Table 1: Test cross-section random effects

Test Summary	**Chi-Sq. Statistic**	**Chi-Sq. d.f.**	**Prob.**
Cross-section random	84.76	2	0

The regression model indicates that both natural gas consumption and GDP variables are significant for the industry value added with the t-statistic values of 7.57 and 23.81, respectively (Table 2). These variables have positive coefficient, which indicates that any unit increase of natural gas consumption, or any unit increase in the GDP significantly leads to increasing the impact of the industry on the GDP.

Table 2: Panels data regression model using fixed effects results

Method: Panel Least Squares

Cross-sections included: 14

Total panel (unbalanced) observations: 409

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-4.75E+10	4.09E+09	-11.61	0.00
NGC	3.85E+07	5.08E+06	7.57	0.00

GDP	0.23	0.01	23.81	0.00

Concerning the causality analysis, Granger causality test indicates that there is a mutual causality between natural gas consumption and industry value added. As the resulted F-statistic is 12.96 that corresponds to a p-value of 4E-06 for hypothesis 1, this latter is rejected, which indicates that natural gas consumption causes the industry value added (Table 3). This is explained such as any increase in natural gas consumption will lead to increasing the industry value added. This is also the case of hypothesis 2 and 4 that have F-statistics with the values of 5.53 and 12.05 that corresponds to p-values of 0.0043 and 8E-06, respectively. This indicates that the industry value added causes the natural gas consumption to grow while also an increase in GDP leads to increasing natural gas consumption (Table 3).

Table 3: Granger causality test between natural gas consumption, industry value added, and GDP

Pairwise Granger Causality Tests

Lags: 2

	Null Hypothesis:	**Observations**	**F-Statistic**	**Prob.**
1	NGC does not Granger Cause IVA	381	12.96	4.00E-06
2	IVA does not Granger Cause NGC		5.53	0.004
3	NGC does not Granger Cause GDP	460	2.13	0.121
4	GDP does not Granger Cause NGC		12.05	8.00E-06

Discussion and Conclusion:

This research has been seeking to find the significance of the impact of NGC on the IVA. Findings indicate that for the Mediterranean region, an increase in natural gas consumption will automatically lead to industrial growth. In addition to that, empirical findings indicate that there is a bidirectional relationship between NGC and IVA while only the GDP causes NGC.

These results should provide guidance to policy makers in the Mediterranean region the effect of the increase of natural gas consumption in a way to switch the current energy sources excluding renewables to natural gas to further expand industrial activities, and thus automatically impacting the total GDP.

Future contributions that assesses the link between natural gas consumption and other macroeconomic variables should be country specific in order to provide more visibility and more guidance to policy makers.

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