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ScienceDirect

Energy Procedia 100 (2016) 480 – 483

Energy Procedia

3rd International Conference on Power and Energy Systems Engineering, CPESE 2016, 8-12 September 2016, Kitakyushu, Japan

Relationships between Natural Gas Production in Persian Gulf States and Natural Gas Consumption in the European Union

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Abstract

Qatar, Saudi Arabia, United Arab Emirates, Iraq and Kuwait hold abundant natural gas reserves. This study examines the long-run and short-run relationships between natural gas production in the five Gulf states and consumption in the European Union (EU). The data consist of yearly time series covering the period from 1970 to 2012. We tested for cointegration and the Granger causality in a first-differenced VAR. The tests did not indicate a long-run equilibrium or any short-run dynamics. We suggest that the Gulf states have a huge potential to increase and establish a stable gas supply to the EU.

Peer-review under responsibility of the organizing committee of CPESE 2016

Keywords: consumption; Persian Gulf states; natural gas; production; reserves

1. Introduction

In 2012, proven natural gas reserves in Qatar accounted for 13.4% of the world's total reserves (187.3 trillion cubic meters or tcm), ranking third after Iran (18.0%) and Russia (17.6%) [1]. Proven gas reserves in Saudi Arabia, the United Arab Emirates, Iraq, and Kuwait constituted 4.4%, 3.3%, 1.9%, and 1.0% of the world's total reserves, respectively. Therefore, excluding Iran, these five Persian Gulf states held 24% of the world's proven reserves. With the deteriorating Ukraine crisis, the EU urgently expects to decrease its heavy reliance on Russian gas [2]. It has been suggested that significant potential suppliers include Gulf states, e.g. [3]. This study investigates the long-run and short-run relationships between natural gas production in the five Persian Gulf states and consumption in the EU in order to provide more evidence for the substitution of gas suppliers.

2. Methodology

We estimate the Johansen trace statistics and cointegrating vector(s) [4]. The Phillips-Ouliaris test can provide clues to the cointegration [5]. The study tests for unit root using both the Augmented Dickey-Fuller (ADF) and

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Peer-review under responsibility of the organizing committee of CPESE 2016
doi:10.1016/j.egypro.2016.10.206

Phillips-Perron (PP) techniques. Moreover, Perron structural break tests are conducted using the mixed innovational outlier (IO) model C [6]. If series are cointegrated, an error-correction model (ECM) can be used to represent the long-run relationship [7]. An Engle-type ECM in first differences is formulated as follows:

$$\Delta y_t = \lambda + \sum_{i=1}^{p1} \alpha_i \Delta y_{t-i} + \sum_{j=1}^{p2} \beta_j \Delta x_{t-j} + \phi \, \mathbf{z_{t-1}} + \varepsilon_t \, , \tag{1}$$

where $\mathbf{z_{t-1}}$ is a cointegrating vector or error-correction (EC) term. However, if the series are integrated of order one but not cointegrated, we estimate a traditional vector autoregressive (VAR) model in first differences by removing the EC term from Equation (1). In the ECM or VAR model, short-run and/or long-run effects in terms of elasticity and Granger causality can be determined [8]. Wald-χ^2 statistics are estimated for the null hypothesis of no Granger causality from x to y:

$$\boldsymbol{H_0} : \beta_j = 0 \tag{2}$$

3. Data

The data were gathered from BP [1]. Natural gas production (*PRODUCTION*) represents the total natural gas production of Qatar, Saudi Arabia, United Arab Emirates, Iraq, and Kuwait, while natural gas consumption (*CONSUMPTION*) represents the total natural gas consumption in the EU. The data were transformed into natural logarithms before they were used to conduct empirical tests and were presented as yearly series covering the period from 1970 to 2012. Natural gas production and consumption seemed to trend together since the mid-1990s (Fig. 1).

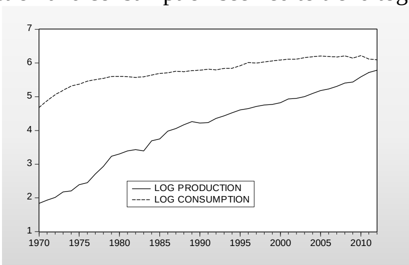

Fig. 1. Natural gas production and consumption in logarithms.

4. Empirical Results

Table 1. Unit root tests

	ADF		PP
Log variable		Statistic (*k*, *p*-value)	Statistic (*k*, *p*-value)
PRODUCTION	Level	-2.32(2, 0.41)	-1.65(2, 0.75)
	First difference	-3.45(2, 0.06)	-6.42(2, 0.00)
CONSUMPTION	Level	-1.22(2, 0.89)	-4.58(3, 0.00)
	First difference	-3.36(2, 0.07)	-

Notes: For ADF tests, we selected the lag length *k* using SIC; for PP tests, the Newey-West method was used [9]. However, the number of lags was set between two and eight on a general-to-specific principle [10]. MacKinnon one-sided *p*-values were used [11].

For the variable *PRODUCTION*, ADF and PP tests consistently suggested one unit root. For the variable *CONSUMPTION*, the ADF test suggested one unit root, but the PP test suggested no unit roots. Moreover, we did not detect a break date in the data (Table 2). Hence, we considered these two variables as $I(1)$ series based on the recommendation in [12].

Table 2. Structural break tests

Log Variable	α	t_{α}^{*}	p-value	Lag length	$\hat{T}_b$
PRODUCTION	-0.02	-0.05	0.96	7	1990
CONSUMPTION	0.85	4.44	0.00	5	1984

Notes: We chose lag length between two and nine on a general-to-specific basis [10]. The *t*-statistic in absolute value was above or equal to 1.8. $\hat{T}_b$ was the possible break date detected. The break date was selected between 1984 and 2000. One-sided test critical values for the sample size of 70 were -6.32, -5.59, and -5.29 at the 1%, 5%, and 10% significance levels, respectively [6].