IJEEP
INTERNATIONAL JOURNAL OF ENERGY ECONOMICS AND POLICY
EJ EconJournals
ISSN: 2146-4553

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2021, 11(3), 301-307.

EJ EconJournals

The Relation between Economic Growth and Oil Production in the Gulf Cooperation Countries: Panel ARDL Approach

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Received: 12 December 2020 **Accepted:** 18 February 2021 **DOI:** https://doi.org/10.32479/ijeep.11048

ABSTRACT

This study investigated the impact of oil Petroleum production on economic growth in the Gulf Cooperation Council countries using panel autoregressive distributed lag model covering the period from 1960 to 2018. The results indicated that oil Petroleum production have significant positive impact on economic growth in both the long-run and the short-run period, also results show that variables are Co integrated by using the pool mean group (PMG) method. Panel Causality Test indicates that there is a causal relationship between Oil production and economic growth. There exists unidirectional causality running from economic growth (GDP) to petroleum production (PP).

Keywords: Economic growth, Petroleum production, CCG countries, Panel co-integration, Panel causality
JEL Classifications: C01, Q40, Q43

1. INTRODUCTION

Energy is a vital input in the production process of an economy, despite considerable increase in the use of alternative sources of energy, As it is the mainstay of agricultural production, transport, industry and home, and thus energy dependency will continue to grow as the world's population grows and economic growth and development continues. As a result of increased mobility and telecommunications, urbanization and an integrated global economy will further accelerate energy consumption and energy dependence. History has shown that increasing energy consumption carries its own burden on the environment, health, safety, lifestyle, and communications (Bildirici and Bakirtas, 2016).

In addition to being the two most important sources of energy, Oil and gas are used as raw materials for countless products that we consume in our daily lives, from medicines, solvents, fertilizers, cosmetics, electronics, building materials, and many other products.

Oil is one of the main energy sources in today's world. It plays a major role in the economic growth process as an input (Gorus, 2017), engines of the industrial economy, accounting for about 60% of the global energy mix, while coal, nuclear, renewable energy, and a host of other secondary sources account for 40% of global energy consumed.

The economies of the GCC countries depend heavily on oil and gas. This sector accounts for about 40% of GDP, and at least 80% of export and revenue revenues. Despite the small geographical area of the Gulf Cooperation Council countries and the small number of their inhabitants, But it accounts for about 20% of global oil production and 34% of its reserves, 9% of global gas production, and 23% of its reserves (Unit, 2020).

The relationship between energy and economic growth have studied by economists for many years (i.e. Soytas and Sari, 2003; Fuinhas and Marques, 2012; Kalimeris et al., 2014; Sunde, 2018; Ssali et al., 2019). According to findings, energy consumption triggers the economic growth of countries.

These results affected the energy policies and growth policies of plenty of countries. However, oil production and economic growth nexus did not examined in the literature adequately but Reynolds and Kolodziej (2008), Ozkan et al. (2012), Alkhathlan (2013), Gorus (2017) are some of the works which examined this relationship. Generally, findings show that oil production affects income level positively, and there is a one-way and/or two-way causal relationship between them.

In this survey, we conducted our analysis with 6 countries of the Gulf Cooperation Council countries include Kuwait, Bahrain, Saudi Arabia, Qatar, Oman, the United Arab Emirates. We selected as they have enough natural petroleum resources, is still committed to an economic diversification plan and to reducing its reliance on the oil sector, but oil prices have begun to affect its efforts toward the development of the non-oil sector.

2. LITTÉRATURE REVIEW

Many studies have been carried out on the relation between energy and the economic growth nexus using various data frequencies, countries, groups of countries, methodologies and periods and a whole gamut of varied results has been obtained. This obviously implies that there is still need for further investigation on the energy, it noted that a large body of published research has been produced investigating the causal nexus between energy consumption and economic growth. This stems from the fact that the direction of causality has important and significant policy implications. If energy is a significant component in economic growth, energy conservation policies that reduce energy consumption may negatively influence real GDP (Eggoh et al., 2011)

One of the first important studies in relationship between oil price and economic growth was explored by Mory (1993) for the US economy. The empirical results show that oil price hikes decrease economic activity and hence economic growth. After this studies Lardic and Mignon (2006) investigated the asymmetric relationship between oil price and economic growth by applying asymmetric cointegration. They found that cointegration exists between the variables and that an oil price increase impedes economic growth (Lardic and Mignon, 2006).

Jayaraman and Choong (2009) attempted to investigate the association between oil price and economic growth in oil-importing economies. Their empirical data reveal that oil price has a negative and significant effect on economic growth and on the unidirectional causality running from oil price to economic growth.

Rafiq et al. (2009) also examined the causal relationship between oil price volatility and other leading economic of Thailand by used Granger causality and the VAR model. They found that GDP growth, investment, unemployment, and inflation are granger caused by oil price volatility. Pekkurnaz (2010) analyzed the linkages between oil price and macroeconomic variables for the Turkish economesy. They applied a structural vector autoregression model (SVAR) and confirmed that oil price leads to a current account deficit that leads to a decline in economic growth. (Shahbaz et al., 2017)

In the same context Ftiti et al. (2016) examined the interdependence between oil price and economic growth using (selected) OPEC countries' monthly data for 2000–2010. They noted that oil price shocks affect the oil-growth nexus in global business cycle fluctuations and the financial crisis turmoil in the OPEC region. Sarwar et al. (2017) investigated 210 countries; they used the findings to show that oil price has a significant effect on economic growth in the short and long run.

Also Nusair (2016) observed an evidence of asymmetries in oil price and real GDP relationship in the Gulf Cooperation Council (GCC) countries. He found that positive oil price changes lead to increase real GDP in all the countries, while negative oil price chnges exerted negative impact on real GDP only in Kuwait and Qatar.

The majority of these studies have examined the relationship between oil and GDP by examined the relation between oil price volatility and GDP but there are few studies that have examined the relationship between oil production and GDP among these studies we find the study of Reynolds and Kolodziej assessed the transition of the Former Soviets Union and oil production decline. The econometric analysis revealed that for Soviet and former Soviet in the 1980s and 1990s fall in GDP did not Granger causality the decline in oil production, but Grange causality from a decline in oil production to fall in GDP was true (Reynolds and Kolodziej, 2008).

Manso and Behmiri (2014) surveyed the Granger causality among crude oil consumption and economic growth in twenty-seven OECD countries for the period of 1976–2009 using a panel multivariate approach, and their findings showed a bilateral causality linkage between crude oil consumption and GDP. But Bildirici and Bakirtas (2016) studied the effects of oil production on the economic growth in major oil exporting Eurasian countries using the Panel ARDL approach for the period of 1993–2010. Results indicated that oil production and economic growth were co-integrated for these countries, and also there was a positive bi-directional causality between these variables both in the short and long run (Bildirici and Bakirtas, 2016).

Gorus (2017) examined the effect of oil production on economic growth in Saudi Arabian economy for the period between 1970 and 2013. Moreover, it investigates the causal relationship between oil production and economic growth applying the ARDL Bound test and Bootstrap Granger causality test. Results show that variables are cointegrated and that the long-run oil production elasticity of economic growth. Meanwhile, Bootstrap Granger Causality Test indicates that there is not any causal relationship between oil production and economic growth.

Also Yuzbashkandi and Sadi (2020) examine the relation between economic growth (GDP) and petroleum production for the Organization of Petroleum Exporting Countries over the period of 2000–2016. The panel co-integration tests were applied to appraise the being of the relationship while the dynamic OLS (DOLS) and fully modified OLS (FMOLS) panel co-integration methods were applied to explore the long-run effect of petroleum production on the GDP growth. Moreover, to estimate the short-run coefficient and causality relationship, the pool mean group (PMG) method was employed. The findings indicated that the GDP and PP are non-stationary and co-integrated series. The estimated panel coefficients using FMOLS, DOLS and PMG were calculated to be 0.64, 0.76 and 0.86, respectively. In addition, there was a unilateral causality from petroleum production to GDP.

3. MATERIAL AND METHODS

In order to examine the relationship between economic growth (GDP) and petroleum production, the study used annual time series data from 1960 to 2018 for six countries of the Gulf Cooperation Council countries include Kuwait, Bahrain, Saudi Arabia, Qatar, Oman, the United Arab Emirates by using Panel ARDL approach. These nations and periods of the study have been selected based on the availability of the data. In this study, the Gross Domestic Product (GDP) is the dependent variable and petroleum production (pp) is the major independent variable. All the data used in this study are collected from the World Development Indicators (World Bank, 2019). The petroleum production data has been collected from International Energy Statistics and OPEC Statistical Review Database. (OPEC, 2019) GDP are expressed in Million USD and petroleum production (pp) is measured in millions of Barrel. All variables were converted to the logarithmic form to minimize skewness of the variable.

The economic growth is a function of petroleum production function in the case of panel data logarithm form can be expressed as follows:

$$\text{Ln GDP}_{it} = f(\ln \text{PP}_{it}) \quad (1)$$

The standard panel data model is as follow:

$$GDP_{it} = \alpha_{it} + \beta\, PP_{it} + \varepsilon_{it} \quad (2)$$

Where, *GDP* is gross domestic product, *PP* is petroleum production. while α_i and β also indicate the individual intercepts and slope coefficients.

From Table 1 show the common sample descriptive statistics. And we deduce that the GDP distribution is approximately symmetric, whereas the PP distributions are highly skewed. This means that the majority of the observations are spread on the right side for the last-two distributions. Also, it is shown, from the Kurtosis statistics, that the GDP distribution is approximately mesokurtic whilst the PP distributions are leptokurtic.

The main conclusion from these shape statistics is that we cannot assert that all these distributions are normal. This is confirmed by the Jarque–Bera test where there is great evidence that the normality null hypothesis is rejected for all these distributions.

The pooled mean group (PMG) approach in the panel ARDL have introduced by Pesaran et al. (1999) to estimate the long-run relationship and the homogeneity which adopts a parametric model to estimate the cointegration vector based on an error correction

Table 1: Common sample descriptive statistics (data in logarithms)

	GDP	PP
Mean	1964.570	71396.87
Median	843.5670	16074.73
Maximum	10460.20	782484.0
Minimum	2.000000	17.00000
Std. Dev.	2597.280	134027.3
Skewness	1.900799	3.169472
Kurtosis	5.597771	14.02124
Jarque-Bera	312.7083	2384.337
Probability	0.000000	0.000000

model in which short-run dynamics are influenced by the deviation from the equilibrium. The panel ARDL method had been used by Asongu et al. (2016) for analyzing the relationship between energy consumption, CO2 emissions and economic growth in 24 African countries; Shahbaz et al. (2017) uses the data from 157 countries from 1960 to 2014 to analyze the relationship between economic growth, electricity consumption, oil prices, capital, and labor; Hasanov et al. (2017) examined the energy-growth nexus in ten oil-exporting developing Eurasian countries.

The methodology of Pesaran et al. (1999), the ARDL model including the long-run relationship between variables may follow as:

$$\Delta GDP_{it} = \alpha_i + \sum_{j=1}^{m=1} B_{ij}\, \Delta GDP_{i,t} + \sum_{r=0}^{p=1} \theta_{it}\, \Delta PP_{it} + \delta_1\, GDP_{it} + \delta_2\, PP_{it} + \varepsilon_{it} \quad (3)$$

Where *GDP* and *PP* are the logarithms of the gross domestic product and petroleum production. Δ and ε k_i, t (k = 1, 2) are the first difference operators and a white noise term. Also, αi denotes in (1), (2), a country-specific intercept. Thereupon, the subscript i denotes a specific unit and is varying from 1 to N. In order to choose the optimal lag length for each variable, we will proceed to a grid search based on the minimization of the Schwarz information criterion (SBIC).

According to Pesaran et al. (2001) the cointegration test from time series to panel data may formulate the null hypothesis of no cointegration between the two variables in Eq. (3) as follows: H_0: $□_1 = □_2 = 0$ against the alternative hypothesis H_1: At least one $□_k \neq 0$ (k = 1, 2). Even though the generalization of this test is possible in this way, we have not yet encountered in the literature the determination of its critical values in a panel data context. Logically, when we have large values of the Fisher statistics, associated with the above tests, we reject the no cointegration null hypothesis. However, in the panel data framework, as far as we know in the empirical literature, we have not seen a cointegration test with defined critical values when the variables are not integrated with the same order. It is for this reason that the majority of works, resorting to the panel ARDL approach, have made use of the cointegration test of Pedroni, 2004 given that the tests with null hypotheses presented above were not well specified in applied works. Furthermore, the Pedroni test is all the more used since we have a set of panel unit root tests that may not give the same conclusion.

As a result, the unit root null hypothesis can be subsequently accepted in several empirical applications, when the null hypothesis of cointegration is not rejected, we estimate the long-run relationship between the two variables the long-run relationship for the ARDL model is written as follows:

$$GDP_{it} = \mu_i + \sum_{j=1}^{m=1} \gamma_{1j}\, GDP_{i,t} + \sum_{l=0}^{n=1} \gamma_{2j}\, PP_{i,t} + \varepsilon_{li,t} \quad (4)$$

Next, the error correction models, used to consider the short-run relationships between the variables, are constructed as follows:

$$\Delta GDP_{it} = \alpha_i + \sum_{j=1}^{m=1} B_{ij}\, \Delta GDP_{i,t} + \sum_{r=0}^{p=1} \theta_{it}\, \Delta PP_{i,t-r} + \alpha\, ECT_{i-t-r} + \varepsilon_{1i,t} \quad (5)$$

Where the residual $\varepsilon\, k_i, t\ (k = 1, 2)$ is independently and normally distributed with zero mean and constant variance, and ECT_{t-1} is the error correction term defined from the long-run equilibrium relationship.

However, it is also important to note that the approach we are using provides evidence of long-term and short-run effects. As far as we know, the approach to dealing with the correlation between the lagged dependent variable and the error term is the generalized method of moments (GMM) estimation techniques. With the GMM approach, the orthogonal or parallel conditions between the error term and the lagged endogenous variable are satisfied by using lagged levels of the regressors as instruments in the difference equation and lagged differences of the regressors as instruments in the level equation.

As we now that the condition for employing a GMM approach is T<N. In this study we cannot employ the GMM approach because of two main reasons. First, while we have N <T (6<58),. Hence, the prime condition for the use of the GMM is not satisfied. Second, mainstream usage of data averages or non-overlapping intervals (NOI) in the GMM approach to satisfy T<N and restrict over identification (or limit instrument proliferation) would result in estimated coefficients being interpreted as short-run effects, since NOI have been used to mitigate short-run or business cycle disturbances that may loom substantially. We set out to assess both long- and short- run effects. Hence, use of the GMM approach is not consistent with our problem statement.

4. THE EMPIRICAL AND ESTIMATION RESULTS

4.1. Panel Unit Root Tests

The first step in cointegration analysis of Panel ARDL approach is testing for panel unit root tests. Unit root analysis is important in that it allows us to better understand the order of integration of each variable because they assumed the independence between cross section units. The IPS test had the objective of rectifying the restrictive LLC hypothesis, namely the homogeneous nature of the autoregressive root under the alternative hypothesis.

The null hypotheses of the other tests are the unit root ones. The use of both types of tests can be advantageous to avoid the loss a power noted when each cross section alternative is near the unit root, the results can be seen in Tables 2 and 3.

We can conclude from Tables 2 and 3 that GDP and PP are integrated variables, and stationary, so that we could use the panel ARDL model. This finding is deduced from the conclusions drawn from the majority of panel unit root tests.

4.2. Cointegration Results

In order to investigate the panel co-integration relationship between variables after we considered the results of panel unit root tests and ensured that all the variables used in this study were integrated in the first order, we assessed the existence of a long-run relationship between them by used two tests of the Pederoni and Koa panel co-integration. The hypothesis of Pedroni and Koa cointegration test H_0 is no cointegration between the series. Table 4 represents the results of Pedroni's and Koa co-integration tests between economic growth and petroleum production series.

According to Table 4, the cointegration analysis showed that six of the seven statistics in the Pedroni cointegration test of economic growth and petroleum production show that there is cointegration relationship between the series the hypothesis H_0 (there is no cointegration between the series) was rejected. According to Kao cointegration test, H_0 hypothesis (there is no cointegration between the series) was rejected. Therefore, the alternative hypothesis (there is cointegration between the series) was adopted. In this context, it can be stated that there is significant relationship between the variables and analyzes show that there is a long-run relationship between variables.

4.3. Panel ARDL Results

4.3.1. PMG long-run estimates

As mentioned before, the PMG estimations were used to estimate long-run and short-run equations, since this estimator estimates error variance, and the coefficients for short-run equation vary by units, while the coefficients for long-run equation are identical. In fact, the PMG estimator is the modified form of the MG estimator by Pesaran and Smith (1995), the results of the PMG estimation are given in Tables 5 and 6.

From Table 5 We can deduce that there is the long-run effects of PP on GDP and was significant at the 5 % level.

4.3.2. PMG short run estimates

The error correction models (ECM) which represent the short-run dynamic coefficients associated with the long-run relationships among GDP and the petroleum production variables. The results of the PMG Short run estimation are given in Table 6.

From Table 6 show that the results of error correction term ect(-1), which represents the speed of adjustment from short run deviation to its long-run equilibrium- are negative and statistically significant at 5% level confirming the existence of stable long-

Table 2: Panel unit root results series in level

	GDP		PP	
	Intercept	Trend	Intercept	Trend
LLC	1.16 (0.12)	0.38 (0.34)	7.58 (1.00)	2.65 (0.99)
IPS	0.32 (0.62)	0.10 (0.45)	8.77 (1.00)	4.06 (1.00)
Breitung	-	–0.87 (0.18)	-	1.13 (0.87)
Hadri	8.02 (0.000)	1.98 (0.02)	9.68 (0.00)	7.88 (0.00)
Choi: Z statistic	0.39 (0.65)	0.03 (0.28)	8.03 (1.00)	4.20 (1.00)
Choi: Fisher	0.31 (0.62)	0.83 (0.79)	7.61 (1.00)	4.31 (1.00)

Table 2 shows the statistics of the panel unit root tests. The values in brackets are the corresponding P-values

Table 3: Panel unit root test results: series in first difference

	Δ GDP		Δ PP	
	Intercept	Trend	Intercept	Trend
LLC	14.18 (0.00)	14.15 (0.00)	–10.74 (0.00)	11.02 (0.00)
IPS	13.15 (0.00)	–12.39 (0.00)	–9.90 (0.00)	10.76 (0.00)
Breitung	-	–12.61 (0.00)	-	–11.93 (0.00)
Hadri	1.79 (0.03)	4.64 (0.00)	5.58 (0.00)	6.19 (0.00)
Choi: Z statistic	–11.22 (0.00)	–10.08 (0.00)	–8.51 (0.00)	–8.43 (0.00)
Choi: Fisher	–11.14 (0.00)	–9.95 (0.00)	–10.92 (0.00)	–10.76 (0.00)

Table 2 shows the statistics of the panel unit root tests. The values in brackets are the corresponding P-values

Table 4: Results of Pedroni's and Koa cointegration test

	Statistics	Probabilities
Panel v-Statistic	2.903**	0.0018
Panel rho-Statistic	–3.018**	0.0013
Panel PP-Statistic	–3.485**	0.0002
Panel ADF-Statistic	–3.675**	0.0001
Group rho-Statistic	–0.781	0.2173
Group PP-Statistic	–1.794**	0.0364
Group ADF-Statistic	–2.630**	0.0043
Koa ADF	–6.180**	0.0000

**, and * imply significance levels at the 1, 5, and 10% levels, respectively

Table 5: PMG long-run estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long run equation				
PP	0.125*	0.030	4.139	0.0000

The values in parentheses are the standard errors * indicate significance levels 5%, respectively

run relationship between the GDP and PP. the error correction term of –0.154 implies that 15.42% of disequilibrium from the previous year shock converges back to the long-run equilibrium in the current year.

4.4. Causality Test

In order to know the direction of causality in a confirmed cointegrating relationship, it is necessary to carry out causality analysis. Causal relationships can be examined in the short-run or the long-run. The short-run is also named as weak Granger causality and is determined through F-statistics or Wald test for the significance of the relevant coefficients on the first-differenced series. Moreover, the long-run causalities are determined in this study by using the panel causality tests where both common coefficient and individual coefficients are used. For the individual coefficient Granger causality test, the pairwise Dumitrescu-Hurlin panel causality test is employed. The lag selection in the panel causality analysis is based on the Akaike information criterion

Table 6: PMG short-run estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Short run equation				
ECT(–1)	–0.154*	0.023055	–6.690401	0.0000
D (GDP(–1)	0.208	0.124097	1.679984	0.0939
D (GDP(–2)	0.013	0.108304	0.122304	0.9027
D (GDP(–3)	–0.010	0.059021	–0.180649	0.8568
D (LPP)	0.234**	0.128085	1.829104	0.0683
C	0.394*	0.077876	5.068383	0.0000

The values in parentheses are the standard errors. ** and * indicate significance levels 10 and 5%, respectively

Table 7: Panel causality tests

Granger causality tests			
Lags: 2			
Null hypothesis	Obs	F-Statistic	Prob
PP does not granger cause GDP	342	0.63003	0.5332
GDP does not granger cause PP		2.66656	0.0710
Pairwise dumitrescu hurlin panel causality tests			
Lags: 2			
Null Hypothesis:	W-Stat	Zbar-Stat	Prob
PP does not homogeneously cause GDP	4.27951	2.48861	0.0128
GDP does not homogeneously cause PP	4.68403	2.94630	0.0032

(AIK), and the number of lags was chosen as two, accordingly. The results of the individual coefficient Granger causality test, the pairwise Dumitrescu-Hurlin panel causality test are given in Table 7.

The results reported in Table 7 reveal that the individual coefficient causality test did not provide any results for the GDP pair and the PP pair that there is no strong causality from petroleum production (PP) to economic growth (GDP) GDP for the whole panel considered but there is a causal relationship between the economic growth variable and the petroleum production significant at 10% significance level.

We also applied the Dumitrescu-Hurlin panel causality test to detect whether there is a relation of causality between economics growth and petroleum production in the short-run. Panel causality tests reveal that the null hypotheses of petroleum production do not cause economic growth can be rejected at the 5% level, implying that the variations in petroleum production in the CCG countries significantly lead to changes in economic growth. Table 7 also reveals that changes in economic growth significantly result in variations in petroleum production.

5. CONCLUSION

This study investigates the relationship between economic growth and petroleum production for six countries of the Gulf Cooperation Council countries covering the period from 1960 to 2018 were studied by applying using a panel ARDL approach. In order to examine the existence of this relationship, PMG co-integration tests were used. Furthermore, were employed to estimate the long-run coefficients, the short-run coefficient and causality relationship were estimated using the PMG method. The results showed that gross domestic production (GDP) and petroleum production (PP) were non-stationary and co-integrated series. Petroleum production had positive effects on economic growth for the pool of CCG members estimated PP coefficients of 0.125 (PMG). For all CCG countries PP positively significantly influenced GDP growth supporting the growth hypothesis for these countries. Therefore, adopting expansionary policies in petroleum sector seems to benefit the country.

The largest contribution of PP to the GDP growth was found for Kuwait and Saudi Arabia with coefficients of 0.81, 0.36, respectively. One can thus conclude that oil policies and investments in the oil sector should be different in these two countries. PP had also long-run and short-run positive effects on economic growth in these countries and the value of ECT was –0.154 are negative and statistically significant at 5% level confirming the existence of stable long-run relationship between the GDP and PP. However, the economic growth only had short-run causality with PP. This causality was, therefore, a unilateral causality from GDP to PP. Overall, petroleum production is one of the most important affecting factors for economic growth in the CCG countries.

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