SBE, Vol.28, No.1, 2025
ISSN 1818-1228
DOI: https://doi.org/10.29117/sbe.2025.0159

MODELLING THE DYNAMIC RELATIONSHIP BETWEEN PRODUCTION OF CRUDE PETROLEUM AND NATURAL GAS AND GROSS DOMESTIC PRODUCT IN QATAR DURING THE PERIOD 2000–2022

Bouzidi Lamdjad
Associate Professor
College of Commerce and Business
Lusail University, Qatar
blamdjad@lu.edu.qa

ABSTRACT

The production of crude oil and natural gas is crucial for Qatar's economy as it supports its indicators of economic development. The gross domestic product (GDP) measures the value added by various economic sectors during a specific period and heavily relies on the surplus generated in Qatar's oil and natural gas sector for growth and development. It is projected that real GDP growth will range between 2% and 2.5% in 2023-2024, driven by strong domestic demand and the ongoing expansion in liquefied natural gas production. Inflation is expected to gradually decline to around 3%. In this study, we used a standardized approach to determine the impact of crude oil and natural gas production on Qatar's GDP. Our methodology involved analyzing data related to the production of crude oil and natural gas, as well as the gross domestic product (GDP) in Qatar. We then constructed a statistical and mathematical model that explains the long-term relationship between these variables. To establish the reliability of our model and interpret the relationship between the variables, we employed causal tests such as the Engle-Granger test and the vector autoregression (VAR) model. Through the response analysis of the model, we found a strong and statistically significant relationship between the production of crude oil and natural gas and Qatar's gross domestic product (GDP).

Keywords: *Oil and gas production, GDP, Engle-Granger test, VAR model, Impulse analysis*

Jel Classification : C53, C82, E61, O11.

1. INTRODUCTION

The State of Qatar aims to achieve high scores in economic indicators, ensure sustainable economic growth, and continue building a knowledge-based economy while enhancing the quality of life in all aspects. This is accomplished utilising the financial surpluses generated from the sale of oil and natural gas to develop economic sectors and improve the country's gross domestic product (GDP). Oil and gas revenues constitute 83.8% of the total government revenues. (Lanouar, 2020).

Qatar seeks to achieve increasing growth rates in terms of its GDP to reach its Vision 2030 and capitalise on the significant economic boom it currently experiences. This boom can be attributed to various factors, most notably the surge in oil and gas revenues due to a substantial rise in energy prices, resulting in a surplus in the trade balance. Through this study, we will attempt to determine the degree of relationship between the development of crude oil and natural gas production and the GDP in Qatar, as well as identify the level of impact between these factors.

Qatar is known to be the world's largest exporter of liquefied natural gas (LNG) since 2006, accounting for 61.5% of the country's total exports in 2018. The country is expected to remain a prominent player in the global energy market for several years to come, as it is the largest supplier of LNG, accounting for up to a quarter of the world's LNG supplies. LNG trade is poised to be an important catalyst for economic growth in many countries. Natural gas and LNG development can enable economic development and stimulate further investment in national infrastructure. (US Department of Energy, 2017)

According to the latest statistics, it is expected that the budgets of oil-producing countries in the Gulf region, especially Qatar, will register a surplus during 2023. This surplus will allow for further support of investments in infrastructure and other strategic sectors. The value added provided by these sectors can have a positive impact on the country's GDP. (Saleh, 2014)

The rationale and motivation for conducting this research is to create a reliable statistical and mathematical model that explains the short- and long-term relationship between oil and gas production development and its contribution to Qatar's GDP. This model will be used in decision-making processes. The aim of this research is to examine the dynamic relationship between oil and gas production development and Qatar's GDP contribution. We will present a statistical and mathematical model that explains this relationship in the medium and long term. Additionally, this study will focus on examining the strength and causality of the relationship between the development of oil and natural gas production in Qatar (the first variable) and Qatar's GDP (the second variable). We will also attempt to identify the mutual influence between them and analyse the degree of responsiveness of these variables. To achieve this, we will rely on time series data for the development of each variable.

The research objectives are to determine the extent to which oil and gas production development contributes to Qatar's GDP, and to assess the impact of fluctuations in global oil and gas prices on the performance and efficiency of the Qatari economy, as well as on economic growth rates. This will be achieved through the analysis of relevant data and the presentation of a statistical and mathematical model that explains the relationship between these factors and allows for the prediction of their mutual influence.

The paper is organized as follows: In the first section, we presented an introduction that explained the relationship between the research variables. Following that, we included a literature review in the second section. The third section discussed the research methodology used in the analysis. Section 4 focused on data analysis, while Section 5 contains the conclusion and recommendations.

2. LITERATURE REVIEW

The inclusion of methods to model the dynamic relationship between the production of crude petroleum and natural gas and gross domestic product (GDP) is crucial for supporting decision-makers, increasing efficiency, and optimizing resource utilization to support economic indicators. Several studies have presented various methods and approaches to study this relationship, but the analysis of the topic has varied among them.

The paper presented by **Lanouar *et al*. (2017)** examined the connection between oil prices, changes in oil and gas revenues, and the level of economic diversification in the Qatari economy. Two econometric approaches were utilized: (1) Structural autoregressive model AB - SVARX with exogenous variables, which incorporated four different measures of asymmetric oil prices and oil and gas revenues, and (2) the nonlinear autoregressive distributed lag (NARDL) model. The findings indicate a notable correlation and asymmetric impact of shocks in the short term.

Kong. *et al* .(2021) paper also presents a study that models the dynamic dependence between crude oil and natural gas return rates. The paper focuses on a time-varying geometric copula approach in an attempt to describe the non-linear relationship between WTI crude oil and gas return rates in New York. The study relies on statistical models to explain the dynamic relationship of changing rates between crude oil and natural gas.

Muhammad. *et al* .(2018) conducted a study on the implications of oil price shocks for the major emerging economies, specifically focusing on a comparative analysis of the BRICS. The objective of this study is to examine the effects of oil price shocks on the economies of the BRICS countries and their interrelationships. In order to achieve this, the researchers employed a structural variable autoregressive (TV-SVA) framework. This framework considers the coefficients and the variance-covariance matrix of innovations as the sources of temporal variation. The results of this study reveal significant differences and asymmetries in the response of these economies to oil shocks, as well as the influence of multiple factors on their outcomes.

Salah .(2016) addressed the topic of "The effects of oil price shocks on the economies of the Gulf Cooperation Council (GCC) countries: Nonlinear analysis" and researched the effects of oil price shocks on the real GDP of the GCC countries. The paper focused on using the nonlinear ARDL model and panel integration analysis. It found that there are significant positive changes in oil prices in all cases with the expected positive sign, which means that increases in oil prices lead to an increase in real GDP.

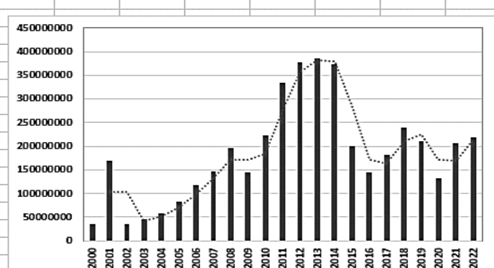
3. METHODOLOGY

3.1 Data and methods

The importance of economic measurement in applied economic studies and research has significantly increased. It has contributed to the understanding of various constituent variables of different economic phenomena. Various standard studies require a substantial amount of data to describe the variables under analysis, providing clear indicators and a real description of them. The accuracy and availability of such data directly influence the results of the applied studies. Testing the nature of the relationship between variables necessitates obtaining accurate statistics that offer a detailed and clear picture of each variable. This is done with the aim of measuring the degree of responsiveness occurring among the variables and developing a model that explains the relationship between them based on statistical and mathematical significance. (Khalid, 2011)

In this study, we aim to understand the interactive relationship between the development of crude oil and natural gas sectors and the GDP in the State of Qatar from the year 2000 to 2022. This is based on the annual data provided by the Qatar's Planning and Statistics Authority and The Annual Bulletin of Industry & Energy Statistics 2023. We obtained data and figures on the evolution of crude oil and natural gas sectors during the period 2000-2022, as shown in Figure 1.

Figure 1. The evolution of crude oil and natural gas sectors in Qatar during the period 2002-2022 in Qatari riyals.

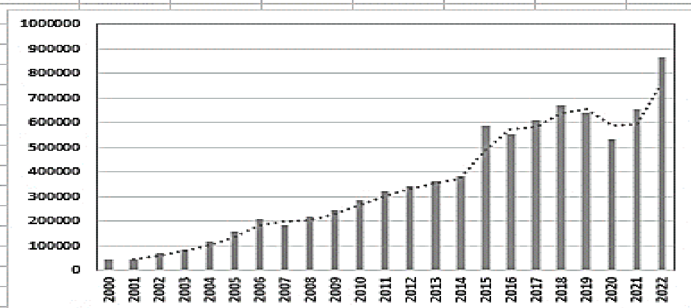


The evolution of the crude oil and natural gas sector ,Value QR. 000	years
35578152	2000
170191841	2001
36265964	2002
46344474	2003
58062630	2004
82841165	2005
117233069	2006
146,587,033	2007
196,218,756	2008
145,071,983	2009
223,377,023	2010
335,248,163	2011
378,018,617	2012
386,566,123	2013
372,692,816	2014
200,467,582	2015
144,164,566	2016
181,537,335	2017
240,483,794	2018
210,803,529	2019
132,519,592	2020
207,034,000	2021
218,876,065	2022

Source: The National Accounts Report for the State of Qatar published by the Planning and Statistics Authority on their official website: https://www.psa.gov.qa/en/statistics1/statisticssite/pages/default.aspx. Accessed on November 10, 2023

We have also compiled the statistics related to the second variable, i.e., GDP, from the National Accounts Bulletin of the State of Qatar, published by the Planning and Statistics Authority on their official website, aggregated during the period 2002-2022. These are illustrated in the following figure:

Figure 2. The evolution of Qatar's GDP during the period 2000-2022 in Qatari riyals.



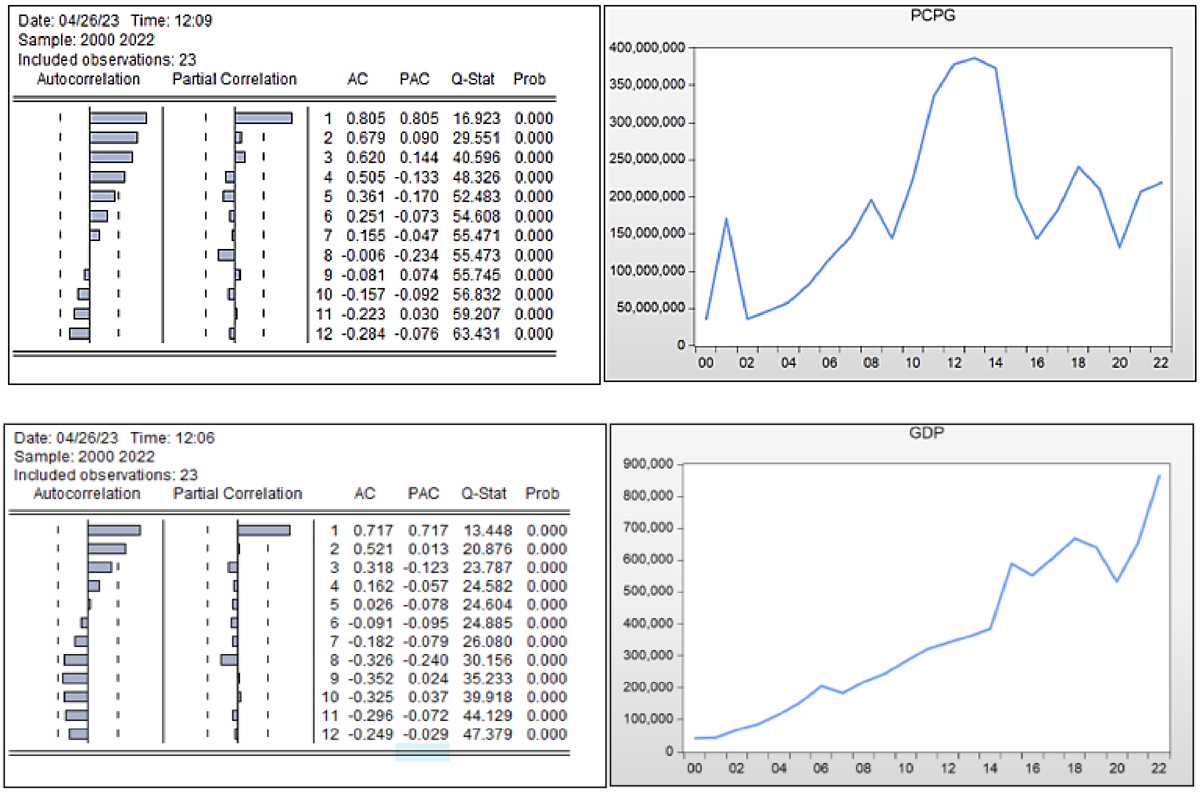
Gross Domestic Product_values in Million Q.R	years
42263	2000
44926	2001
69322	2002
85665	2003
115514	2004
154565	2005
206644	2006
184,839	2007
217,486	2008
243,492	2009
284,232	2010
321,243	2011
340,646	2012
362,180	2013
384,468	2014
588,733	2015
552,305	2016
607,620	2017
667,339	2018
640,049	2019
532,898	2020
655,000	2021
863,200	2022

Source: The National Accounts Report for the State of Qatar published by the Planning and Statistics Authority on their official website: https://www.psa.gov.qa/en/statistics1/statisticssite/pages/default.aspx. Accessed on November 10, 2023

3.2 Testing the Time Series Stability of Study Variables

Testing the stability of time series is a crucial step in developing a mathematical and statistical model capable of explaining relationships scientifically and accurately. This process aims to understand the nature of the changes that occurred in previous time periods, as this can provide insight into future changes through analysis. A time series is considered stable when it fluctuates around a constant mean with variance that is not related to time. Various unit root tests are utilised for this purpose (Min, 2018). In this study, we will initially rely on the graphical representation of time series and its autocorrelation functions, such as simple and partial correlograms, as preliminary tests. Subsequently, stability will be examined using statistical tests such as the augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test, which utilise time gap differences in their models to address the issue of autocorrelation of errors.

Figure 3. The Graph and the Autocorrelation Function of Time Series (PCPG, GDP).



Lag	AC	PAC	Q-Stat	Prob
1	0.805	0.805	16.923	0.000
2	0.679	0.090	29.551	0.000
3	0.620	0.144	40.596	0.000
4	0.505	-0.133	48.326	0.000
5	0.361	-0.170	52.483	0.000
6	0.251	-0.073	54.608	0.000
7	0.155	-0.047	55.471	0.000
8	-0.006	-0.234	55.473	0.000
9	-0.081	0.074	55.745	0.000
10	-0.157	-0.092	56.832	0.000
11	-0.223	0.030	59.207	0.000
12	-0.284	-0.076	63.431	0.000

Lag	AC	PAC	Q-Stat	Prob
1	0.717	0.717	13.448	0.000
2	0.521	0.013	20.876	0.000
3	0.318	-0.123	23.787	0.000
4	0.162	-0.057	24.582	0.000
5	0.026	-0.078	24.604	0.000
6	-0.091	-0.095	24.885	0.000
7	-0.182	-0.079	26.080	0.000
8	-0.326	-0.240	30.156	0.000
9	-0.352	0.024	35.233	0.000
10	-0.325	0.037	39.918	0.000
11	-0.296	-0.072	44.129	0.000
12	-0.249	-0.029	47.379	0.000

Source: Eviews 12

Through the aforementioned figure, which illustrates the structure of the time series, it is evident that the graph and the simple and partial autocorrelation functions (correlogram) of the time series (PCPG, GDP) are unstable. This is indicated by the statistical probability value, which is 0.00, lower than the significance level set at 5%. In addition, there seems to be a general trend. To further confirm this, it is necessary to employ unit root tests using statistical tests such as ADF and PP. Let us start by determining the optimal lag order for each time series using three criteria, namely, Akaike information criterion, Schwarz criterion, and Hannan-Quinn criterion, which take the following forms:

$$AIC = \ln|\sum \hat{\varepsilon}| + \frac{2k^2 + p}{T}$$

$$HQ = \ln|\sum \hat{\varepsilon}| + \frac{2\log\log T}{T} K^2 P$$

$$SC = \ln|\sum \hat{\varepsilon}| + \frac{K^2 P \ln(T)}{T}$$

Table 1. Optimal Lag Order for Each Time Series.

Determining the Lag Order for the Time Series: Evolution of Qatar's Crude Oil and Natural Gas Sector—PCPG.			
p	**Akaike info criterion**	**Schwarz criterion**	**Hannan–Quinn criterion**
0	39.01844	39.11763	39.04181
1	39.06756	39.21678	39.09994
2	38.80791	39.00706	38.84679
3	38.98515	39.23369	39.02722
4	39.08855	39.38534	39.12947
Determining the Lag Order for the Time Series: Evolution of Qatar's GDP.			
p	Akaike info criterion	Schwarz criterion	Hannan–Quinn criterion
0	24.96886	25.11763	25.00390
1	24.98578	25.18473	25.02896
2	25.08989	25.33883	25.13849
3	25.25805	25.55629	25.30852
4	25.38107	25.72733	25.42882

Source: Eviews 12

From the abovementioned table, it is evident that the time series of the study variables (PCPG, GDP) differ in terms of their optimal lag orders. The time series (PCPG) demonstrates the best lag order of (p = 2) according to the Akaike, Schwarz, and Hannan-Quinn criteria. In contrast, the time series (GDP) has an optimal lag order of (p = 0) based on the three criteria Akaike, Hannan-Quinn, and Schwarz.

We will focus on these results in conducting the unit root tests through the ADF test to determine the stationarity degree of each time series (Dickey, 2006). This analysis of time series stability relies on the following models:

$$model(i): \Delta xt = \lambda . X_{t-1} - 1 \sum_{j=2}^{p} \phi j \, \Delta xt - j + 1 + \varepsilon t \dots \dots \dots \dots \dots \dots \dots (3)$$

$$model(ii): \Delta xt = \lambda . X_{t-1} - 1 \sum_{j=2}^{p} \phi j \, \Delta xt - j + 1 + c + \varepsilon t \dots \dots \dots \dots \dots \dots (4)$$

$$model(iii): \Delta xt = \lambda . X_{t-1} - 1 \sum_{j=2}^{p} \phi j \, \Delta xt - j + 1 + c + bt + \varepsilon t \dots \dots \dots \dots (5)$$

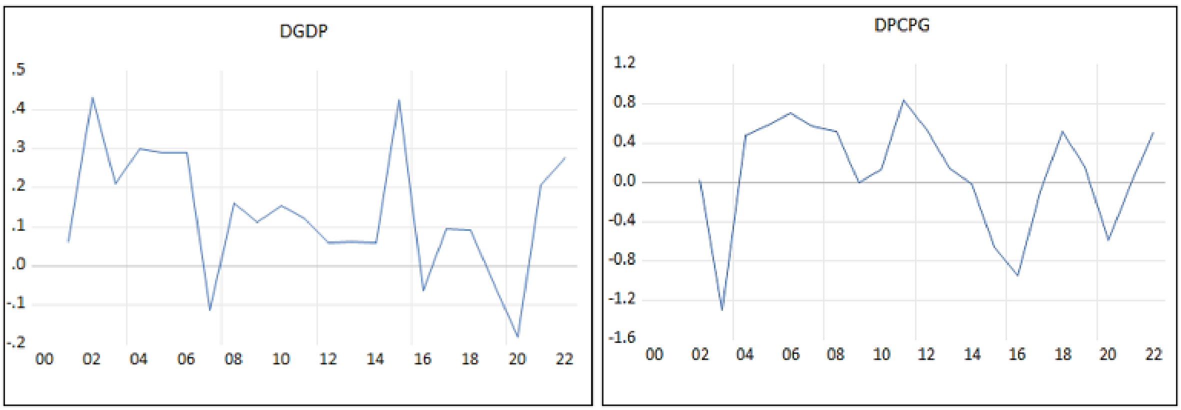
Table 2. Determining the Stationarity Degree of the Time Series PCPG and GDP Through Unit Root Tests.

Unit Root Tests for time series—PCPG					
2nd difference	**1st difference**	**Level**	**The value**	**Model type**	**Test type**
-3.947949	-2.768425	-0.278080	Calculated value	**The first model**	**Augmented Dickey-Fuller (ADF) test**
-1.961409	-1.960171	-2.685718	Critical value		
0.0005	0.0084	0.5730	prob		
-3.813822	-2.736146	-2.123040	Calculated value	**The second model**	
-3.040391	-3.029970	-3.020686	Critical value		
0.0109	0.0865	0.2383	prob		
-3.692293	-2.836398	-1.750069	Calculated value	**Third model**	
-3.690814	-3.673616	-3.658446	Critical value		
0.0499	0.2025	0.6902	prob		
Unit Root Tests for time series—GDP					
2nd difference	**1st difference**	**Level**	**The value**	**Model type**	**Test type**
///	-2.921475	2.335891	Calculated value	**The first model**	**Augmented Dickey-Fuller (ADF) test**
///	-1.958088	-1.957204	Critical value		
///	0.0056	0.9932	prob		
///	-3.907465	0.466464	Calculated value	**The second model**	
///	-3.012363	-3.004861	Critical value		
///	0.0077	0.9813	prob		
///	-3.935972	-2.785701	Calculated value	**Third model**	
///	-3.644963	-3.632896	Critical value		
///	0.0287	0.2163	prob		

Source: Eviews 12

From the abovementioned table, it is evident that the PCPG time series becomes stationary at the second difference, given that the computed F-statistic values exceeded the critical values at the 5% significance level in all three ADF test models. Therefore, it can be concluded that the time series is devoid of a unit root at the second difference. As for the GDP time series, it achieved stationarity at the first difference, as indicated by the computed F-statistic values being greater than the critical values. This is consistent with the presence of a unit root at the level, as the computed F-statistic values were lower than the critical values at the 5% significance level. After conducting the tests, the time series are illustrated as follows:

Figure 4. Time Series Plot After Applying the Differences.



Source: Eviews 12

3.3. Granger Causality Test Between Variables

The issue of causality is one of the most important aspects in determining the formulations of economic models. It aims to investigate the reasons behind economic phenomena and understand them, to distinguish between dependent and independent variables. The Granger causality test is employed to confirm the presence of a feedback relationship or mutual causality between two variables. In this context, we will determine the direction of the causal relationship between the variables: the evolution of crude oil and natural gas production in Qatar and the value of GDP during the period 2002-2022 (as illustrated in Table 3).

Table 3. Results of Granger Causality Test.

Pairwise Granger Causality Tests
Date: 04/26/23 Time: 12:35
Sample: 2000 2022
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
PCPG does not Granger Cause GDP	19	6.24109	0.0087
GDP does not Granger Cause PCPG		0.13859	0.9641

Source: Eviews 12

As per the results of the Granger causality test, a causal relationship directed from the variable 'evolution of crude oil and natural gas sector' (PCPG) to the variable 'evolution of GDP' was noted. This is supported by the critical probability value corresponding to the F-statistic, which is lower than the 5% significance level. However, no causal relationship was reported in the opposite direction. To further clarify the relationship between these variables, we will proceed to our estimation using a vector autoregression (VAR) model.

4. DATA ANALYSIS

4.1 Identification and Estimation Using the VAR Model

Vector autoregression model is a statistical analysis method used for modelling, describing, and forecasting time series data. It treats all variables symmetrically without exclusion conditions, incorporating lagged factors for each variable and in all equations. (Othman, 2012) This imparts dynamism to the system, shaping the distribution of time lags. This approach aims to confirm the presence of both short-term and long-term relationships among the study variables by considering a sufficient number of time lags to obtain a robust dataset. (Saddam, 2019)

A VAR model consists of a system of equations where each variable is a linear combination of its past values and the past values of other variables, along with random errors. The VAR model is typically expressed in the following formulation: (Jan , 2001)

$$\hat{Y}_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} \dots + \beta_p Y_{t-p}$$

Based on this, test results and estimates of the VAR self-regression model were obtained, as shown in Table 4. We derived the relationship between the GDP variable and the variable representing the development of the crude oil, gas, and natural gas sector (PCPG) in Qatar according to the VAR model. This relationship is illustrated in Table 4.

VAR Model—Substituted Coefficients:

===============================

GDP1 = 0.711542968401*GDP1(-1) + 0.1769522699*GDP1(-2) + 0.0189820720265*PCPG1(-1) - 0.036051167911*PCPG1(-2) + 1.87816740835

Table 4. The Results of the Relationship Between the Variables Using the VAR Model.

Vector Autoregression Estimates
Date: 04/28/23 Time: 16:43
Sample (adjusted): 2002 2022
Included observations: 21 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	GDP1	PCPG1
GDP1(-1)	0.711543 (0.25213) [2.82212]	0.163518 (0.70071) [0.23336]
GDP1(-2)	0.176952 (0.23310) [0.75912]	0.159387 (0.64782) [0.24604]
PCPG1(-1)	0.018982 (0.07406) [0.25631]	0.414517 (0.20582) [2.01396]
PCPG1(-2)	-0.036051 (0.07086) [-0.50874]	0.108672 (0.19694) [0.55180]
C	1.878167 (1.11885) [1.67865]	5.010583 (3.10944) [1.61141]
R-squared	0.965871	0.690933
Adj. R-squared	0.957338	0.613666
Sum sq. resids	0.350606	2.707930
S.E. equation	0.148030	0.411395
F-statistic	113.2011	8.942160
Log likelihood	13.17474	-8.290162
Akaike AIC	-0.778547	1.265730
Schwarz SC	-0.529851	1.514426
Mean dependent	12.65032	18.90433
S.D. dependent	0.716689	0.661877

Source: Eviews 12

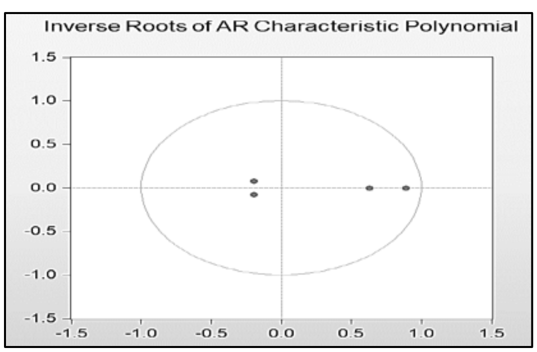
4.2 Diagnostic Tests for the VAR Model

The standard study requires conducting diagnostic tests to diagnose the VAR model, assessing its validity and reliability for prediction and analysis. The following tests will be performed accordingly:

4.2.1 Residual Model Stability Study

To test the stability of the model residuals, we employ tests for multiple roots. The autoregressive model results are considered stable if all roots are less than 1 (as illustrated in Figure 5).

Figure 5. Model Residual Stability According to Multiple Root Tests.



Source: Eviews 12

From the figure, it is evident that the inverses of the univariate roots lie within the unit circle, which led us to conclude that the model is stable according to this method.

4.2.2. Examining the Autocorrelation of Model Residuals

To examine the presence of autocorrelation in the model residuals, we will rely on the LM Tests (as illustrated Table 5).

Table 5. LM Test Results.

VAR Residual Serial Correlation LM Tests
Date: 08/23/23 Time: 17:31
Sample: 2000 2022
Included observations: 21

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	5.679500	4	0.2244	1.521729	(4, 26.0)	0.2250
2	8.907326	4	0.0635	2.540397	(4, 26.0)	0.0639
3	0.959935	4	0.9158	0.235253	(4, 26.0)	0.9159

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	5.679500	4	0.2244	1.521729	(4, 26.0)	0.2250
2	13.51001	8	0.0955	1.970909	(8, 22.0)	0.0993
3	16.25755	12	0.1797	1.541392	(12, 18.0)	0.1973

*Edgeworth expansion corrected likelihood ratio statistic.

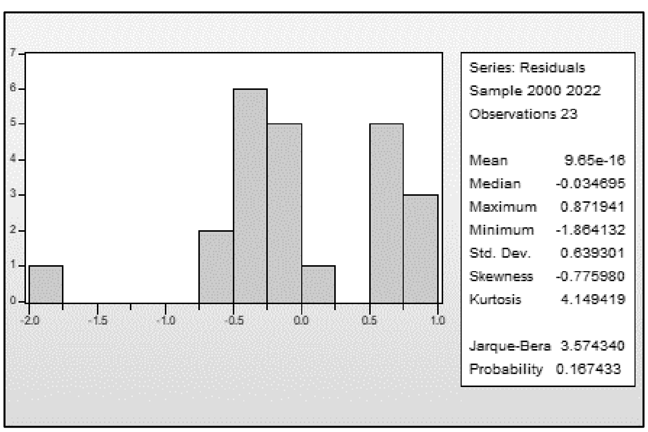
Source: Eviews 12

The abovementioned table indicates the absence of autocorrelation in the model residuals, as the p-value is greater than the 5% significance level according to the LM test results.

4.2.3 Testing the Normal Distribution of Residuals Using the Jarque–Bera Test

The Jarque-Bera test is used to verify the distribution nature of the residuals in the model; the results are illustrated in Figure 6.

Figure 6. Results of the Normal Distribution Test for Residuals.



Source: Eviews 12

The abovementioned table indicates that the p-value is greater than the 5% significance level according to the Jarque-Bera test, implying that the residual distribution series follows a normal distribution.

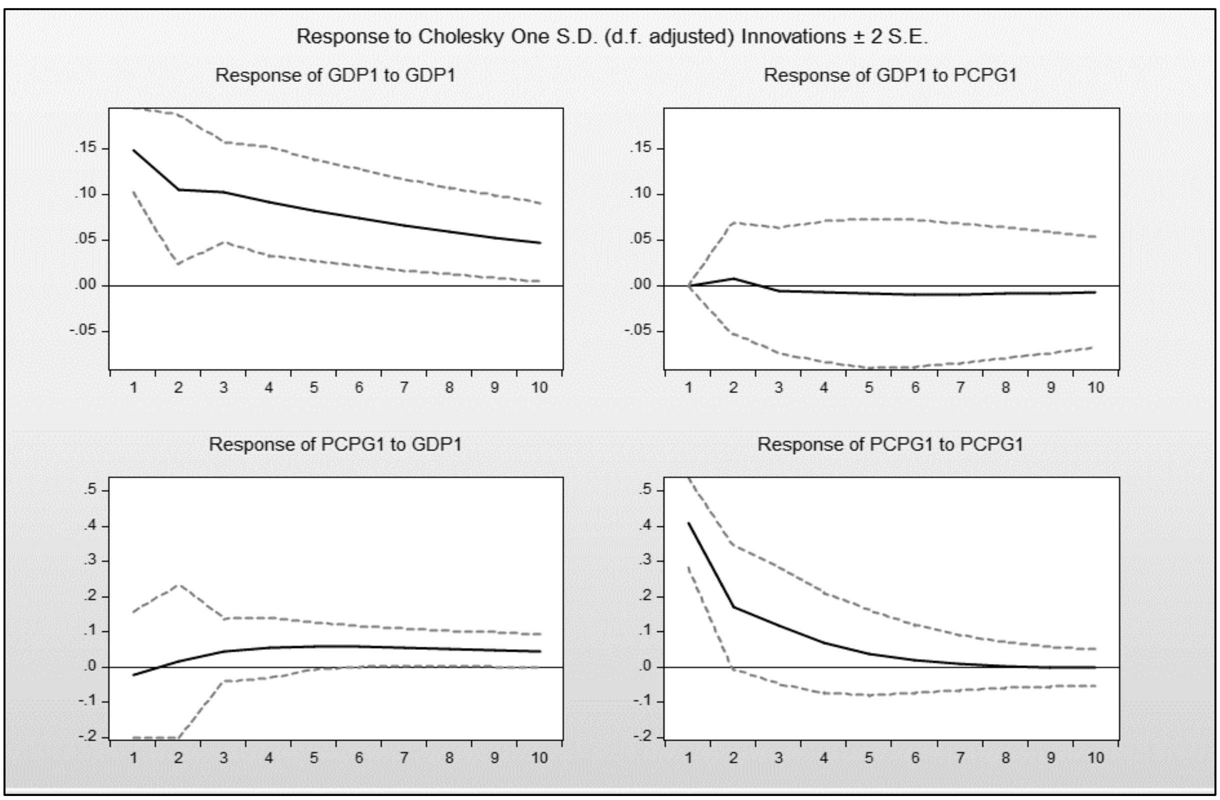
Through the aforementioned tests, especially the autocorrelation tests of the residuals and the normal distribution test, all of them deemed acceptable. Therefore, we conclude that the estimated VAR model between the two variables, namely, GDP and the development of crude oil, gas, and natural gas sector (PCPG) in Qatar, possesses an acceptable statistical quality and can be relied upon for analysis.

4.2.4 Impulse Analysis and Response Functions

The impulse analysis test enables the study and measurement of the impact of a sudden change in a specific variable on the remaining variables by inducing a certain shock (Kamal, 2017).

Through this analysis, we will assess the effects of the sudden changes in crude oil and natural gas production on the evolution of Qatar's GDP over a 10-year period. The results are illustrated in the following figure:

Figure 7. Impulse Analysis and Response.



Source: Eviews 12

Through the shock test and impulse analysis, as illustrated in the aforementioned figure, it can be concluded that the evolution of Qatar's GDP is influenced by fluctuations in the annual production of crude oil and natural gas sectors in the short-term horizon, estimated over a 10-year period. This impact is characterised by a positive direction, as evidenced by the increasing values. It persists consistently throughout the study period, indicating a correlated relationship between them.

4.2.5 Economic and Statistical Interpretation of the VAR Model

The equation in the VAR model explains the relationship between Qatar's GDP and its previous values, as well as the past values of crude oil and natural gas production. The high determination coefficient value, R-squared = 0.96, indicates that the model has a strong explanatory power. This means that 96% of the variations in Qatar's GDP can be attributed to changes in crude oil and natural gas production. This suggests that the greatest factors influencing the improvement of crude oil's contribution to Qatar's GDP are largely associated with the surplus generated from the annual export of crude oil and natural gas. The Fisher's F-statistic confirms the statistical acceptability of the model. The calculated F-statistic = 113.20 is greater than the F-table value = 4.38 at a 5% significance level. Therefore, the model can effectively explain the relationship between the variables and can be relied upon for analysing their interrelationship. The Durbin-Watson statistic value, approximately 1.825, indicates the absence of autocorrelation among the values included in the model.

5. DISCUSSION

Through this research, we have found that there is a relationship between the evolution of the crude oil and natural gas sector and the annual growth of GDP in Qatar. This relationship exhibits a positive trend and varies in strength over different time periods. This analysis is based on a statistical model, specifically the VAR model. Furthermore, we have determined that the increase in Qatar's GDP is primarily attributed to the improvement in the revenue generated from the development of the crude oil and natural gas sector.

This research reveals that Qatar has effectively utilised the returns generated from the development of the crude oil and natural gas sector to advance various sectors contributing to the country's GDP. These combined factors have collectively facilitated investment growth across diverse economic sectors and attracted numerous multinational energy companies. In February 2021, Qatar Petroleum announced the creation of the world's largest LNG project. This monumental LNG project is set to increase the country's production capacity from 77 million tons to 110 million tons annually.

Through this research, we have determined that 96% of the variations in Qatar's gross national product can be attributed to changes in the crude oil and natural gas sector. This result arises from the presence of a statistically significant and causal relationship between them, which is attributed to the substantial economic growth Qatar has experienced in recent times due to various factors. One of the most significant factors is the considerable increase in oil and gas revenues resulting from the significant rise in energy prices, leading to a trade surplus.

5.1 Theoretical Implications

The theoretical implications of this research depend on demonstrating the dynamic relationship between Qatar's GDP and the crude oil and natural gas sector. To achieve this, a standard and statistical model based on VAR models is established. The research has found a statistically significant relationship between the two variables, with a strong degree of response. Specifically, the crude oil and natural gas sector in Qatar have a significant impact on various economic indicators, most notably Qatar's GDP. This research underscores the importance of developing a diversified economy and securing a favorable position to maximize the benefits from the high global demand for liquefied natural gas. Additionally, it emphasizes the need to utilize the returns from this sector in order to diversify national income sources.

5.2 Implications for practice

This paper provides support for the decision maker to understand the development of the dynamic relationship between crude oil and natural gas production in Qatar and Qatar's GDP. It presents a statistical model that explains the strength of the influence between them and is used to make informed decisions, as well as gain insight into the complex systems and various data of Qatar's strategy and vision for 2030.

5.3 Limitations and future research

This study was limited to determining the degree of response between the development of oil and crude production in Qatar and Qatar's GDP rate through a statistical model, and it can be considered a starting point for other studies that take into account the integration of factors into this relationship, such as indicators of sustainable development, feeding energy-intensive industries, and the impact of changes in global demand and supply of energy and gas prices, future industrial development, and the impact of global economic turmoil.

6. CONCLUSION

Over the past two decades, Qatar has emerged as a major global leader in liquefied natural gas production and has successfully positioned itself to capitalize on the high levels of global demand for this resource. Qatar has utilized the financial returns from its liquefied natural gas exports to bolster economic indicators and promote sustainable development. This study examines the contribution of crude oil and natural gas production in Qatar to GDP rates and establishes a statistically and economically significant relationship between the two. Additionally, Qatar is actively diversifying its economy and natural gas resources through investments in various sectors with the aim of reducing reliance on oil and gas, creating alternative and sustainable sources of income, and mitigating the negative impact of oil and gas price fluctuations on economic activity.

The study introduces a statistical and mathematical model that clearly elucidates the relationship between crude oil and natural gas production in Qatar and GDP rates. This model serves as a reliable tool for decision-making and the formulation of future economic strategies. Moreover, it emphasizes the importance of harnessing the financial returns from oil and gas production to build a robust economic foundation across all sectors.

References

1- Lanouar, C., Karim, B. (2020), "Short- and long-run asymmetric effect of oil prices and oil and gas revenues on the real GDP and economic diversification in oil-dependent economy", Energy Economics, Volume 86, February 2020, 104680. https://doi.org/10.1016/j.eneco.2020.104680.

2- Kong-Sheng, Z., Yan-Yong, Z. (2021), "Modeling dynamic dependence between crude oil and natural gas return rates: A time-varying geometric copula approach", Journal of Computational and Applied Mathematics Volume 386, April 2021, 113243 https://doi.org/10.1016/j.cam.2020.113243.

3- Muhammad, A., Lutchmee, N. (2018), "Implications of oil prices shocks for the major emerging economies: A comparative analysis of BRICS", Energy Economics,Volume 76, October 2018, Pages 76-88, https://doi.org/10.1016/j.eneco.2018.09.023.

4- Salah, N. (2016), "The effects of oil price shocks on the economies of the Gulf Co-operation Council countries: Nonlinear analysis", Energy Policy,Volume 91, April 2016, Pages 256-267, https://doi.org/10.1016/j.enpol.2016.01.013.

5- US Department of Energy. (2017), "Global LNG Fundamentals", available at: https://www.energy.gov/sites/prod/files/2017/10/f37/Global%20LNG%20Fundamentals_0.pdf, (accessed on September 20, 2023).

6- Saleh, M., Matej, K. (2014), "Relationship between GDP Growth and Oil and Natural Gas Consumption in EU Countries", Ekonomický Casopis, Vol. 62, pp. 249-250.

7- Khalid, H. (2011), "Eviews and Economic Measurement", National Library Department, Amman, pp. 1-3.

8- Min, B., Guna, R. (2018), "Selecting appropriate methodological framework for time series data analysis". The Journal of Finance and Data Science Volume 4, Issue 2, June 2018, Pages 71-89. https://doi.org/10.1016/j.jfds.2017.11.001.

9- Dickey, D. A, Fuller, W. A. (2006), "Distribution of the Estimators for Autoregressive Time Series witha Unit Root", Journal of the American Statistical Association, London, Vol. 22, pp. 3-4.

10- Othman, N. (2012), "The use of VAR models in forecasting and studying the causal relationship between Gross Domestic Product and Gross Fixed Capital Formation in Syria", Damascus University Journal of Economic and Legal Sciences, Vol. 28, Issue 02, Syria, Damascus University, p. 3.

11- Saddam, R. (2019), "The Reality of the Hydrocarbon Sector in Algeria and Its Role in the National Economy Transformation - A Quantitative Study Using the Autoregressive Distributed Lag (ARDL) Method for Fractional Integration Gaps, (ARDL) for the period 1990-2015, in the financial and markets sectors", Finance & Markets Journal, Vol. 05, Issue 10, pp. 2-3.

12- Jan, B., Tom, E. (2001), "A revival of the autoregressive distributed lag model in estimating energy demand relationships", Energy Volume 26, Issue 1, January 2001, Pages 45-55. https://doi.org/10.1016/S0360-5442(00)00052-9.

13- Kamal, Z. (2017), "Study and Analysis of the Shocks of Economic Stability Variables on the Banking Distress Index in Algeria during the Period 1980-2015", Journal of Economic Sciences, Management, and Business Studies, Vol. 05, Algeria, p.1.

14- Tao, N., Wu, T., & Yan, G. (2001). "To the test of economic recovery: The swings in energy resource prices". Resources Policy, 89, 104593.

15- Bibi, S. (2024). Oil revenues, "FDI and Balance of Payment dynamics: the case of Kazakhstan between the Supercycle Commodity boom and Financial Subordination". Resources Policy, 90, 104789.

16- Afees, A., Kazeem, O. (2017). "Revisiting the oil price and stock market nexus: A nonlinear Panel ARDL approach ". Economic Modelling ,Volume 66, November 2017, Pages 258-271.

17- Afees, A., Tirimisiyu, F. (2015). "Modelling oil price–US stock nexus: A VARMA–BEKK–AGARCH approach ". Energy Economics, Volume 50, July 2015, Pages 1-12, https://doi.org/10.1016/j.eneco.2015.03.031.