

MODELING OPTIMAL OIL PRODUCTION AND EXPORT LEVELS IN IRAQ: IMPLICATIONS FOR FIRM PROFIT MAXIMIZATION, GOVERNMENT REVENUE, AND GLOBAL ENERGY MARKETS

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Abstract: The oil industry operates through contracts among the governments and multi-national corporations. It involves different types of agreements such as serving contracts and production sharing contracts. In this regard, Iraq is a significant player within the oil market. Due to the concerns of sovereignty, it utilizes the contracts of technical services. There is an increasing concern towards exploring different structures of contract through which the production of oil can be optimized. Despite of the economic challenges and fluctuations in the prices of oil, Iraq intends to enhance its industrial prospects and economic resilience through the diversification in investment and strategic planning. For this purpose, the present research seeks to develop a comprehensive model to increase the production of oil and its export in Iraq. In this regard, it seeks to benefit both the businesses and governments while addressing the evolving requirements of energy markets. For conducting this research, a secondary quantitative research design was implemented in the study. Autoregressive distributed lag approach was implemented to analyze the influence of oil production, exports and political stability on the oil real GDP growth in Iraq. Results revealed that each unit increase in the level of oil exports results in a significant increase in the real GDP growth of oil. Therefore, the results highlight a significant role of oil exports in increasing the GDP of country like Iraq. The study enriches the existing literature regarding GDP growth of Iraq. Practically, this research offers valuable insights regarding the practices and strategies of oil exports in Iraq to attain optimal outcomes. Research limitations and future indications have also been explained in the last section.

1. INTRODUCTION

To facilitate the extraction of oil, the governments of countries that host oil fields enter into oil production contracts with multinational oil corporations (IOCs). An worldwide oil corporation furnishes the necessary technologies and funds the first

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investment [9]. Within the oil industry, there are two main types of agreements: service deals and production sharing pacts. Service contracts come in two types - technical service agreements (TSCs) and buy-back deals.

Ghandi and Lawell [9] stated that production sharing contracts first started in Indonesia back in 1966. They quickly spread to every oil-producing part of the world, except for western Europe. Some countries now favor service contracts over production sharing agreements more often used in the oil business. In the 80s and early 90s, some big oil-producing countries' political economies started to include service contracts while overseas. In 1995, Iran signed their first service contracts. Kuwait did the same in 1992 and Venezuela followed suit in 1983. A Kassem, et al. [1] found that some countries have recently become more interested in signing service deals. These include Iraq, Bolivia, Ecuador, Mexico, and Turkmenistan had increased their interest later on.

Article 9 of Iraq's peace-time constitution talks about the many choices that the government has for deals with foreign oil businesses. This includes service contracts and production sharing contracts [9]. But the government of Iraq has regularly used technical service contracts. This might be because they worry about sovereignty issues. But, if deals for tech services are not good enough, the Iraqi government may need to find ways to make their oil production contracts better. They might reconsider how the contracts are built or look at different structures.

With the adoption of cutting-edge manufacturing technologies, Iraq is sure to be one of the nations with bright industrial prospects in the years to come. To protect themselves from economic downturns like the recent drop in oil prices and others, businesses should invest their profits in expanding into other areas of the economy [2]. Many specific factors, according to economists, appear to be the foundation of any economic sector's development. These include, but are not limited to, the transcription of modern technology, the strategies applied in investment and saving, and the realization of high levels from accumulated material capital. It has been found that there is a positive and strong link between economic development in Iraq and oil prices, licensing rounds, oil demand, oil output, and oil sector development [10]. After the Iraq War in March 2003, the country's economy was in a state of constant turmoil. After this, there was a rise in oil exports and capital account liberalization [4]. Furthermore, due to Iraq's status as an emerging economy and net oil exporter, any decline in oil prices had a detrimental impact on the country's financial market performance due to government austerity measures [4].

Increasing output and making the most of exports is a tough task for Iraq's oil industry. To make money for companies, get income from the government and manage world energy market needs a complete plan. This study looks for a complicated model to increase oil exports and production in Iraq. The goal of the study is to model how much oil should be produced and sold in Iraq. This can help companies earn more money, governments get tax income, and world energy markets change too. Goals include looking at world energy markets, raising money for the government and making company profits better. This study's main goal is to give oil businesspeople the information they need. It will help them understand money, politics, and markets so that everyone can succeed in future for a long time.

2. LITERATURE REVIEW

2.1. Theory of Comparative Advantage

In 19th century the “theory of comparative advantage” was developed by the David

Ricardo. David Ricardo a British economist presented this theory that is famous for its implication in the economic world [17]. In an economic model the comparative advantage is the advantage that a country holds in the production of certain goods as compared to others. This theory actually emphasizes that for a country to have comparative advantage over the others it should have proficiency in developing goods in such a way that its production cost is minimized and they can generate more revenue from the trade of these good as compared to other countries [3]. Cost efficient method of production is highlighted in this theory. The country should focus on the production of those goods that the country can develop efficiently at a much lower cost as compared to the global market. The trade of these goods in which the country has relative advantage will maximize the revenue generated from export as the production cost is low [18]. Production of oil and its export by countries rich in oil resources gives them such a comparative advantage. Oil production and its trade is a significant factor impacting not only the firm's profit but also the government revenue. Being a non-renewable natural resource extraction of oil and its export must be checked, maintained, and controlled so that its resources are not exhausted and a balance in the global energy markets is maintained. Thus, oil production and export also contribute towards the stability in global energy markets [14].

2.2. Optimal Oil Production and Export Levels

Countries rich in oil reserves such as Saudi Arabia, Kuwait, Iran, Iraq etc. are responsible for the global oil production and its export or trade. These countries rich with oil reserves tend to produce oil by extraction from natural reserve and export it to other countries so that they can also meet their energy demands. By trading oil these countries generate enough revenue and usually have comparative advantage to the countries with no or little oil reserves [6]. Optimal oil production is the implementation of the techniques by which a balance is maintained between the production and consumption. It is actually a continual supply of oil without being over supplied and shortage. Optimal oil production is derived by multiple factors. These include the global demands, production and extraction costs, management of oil reserves, government policies, and environmental considerations [13]. Moreover, the technological advancement also contribute to optimal oil production by bringing cost and energy efficiency in production [24]. Countries like Saudi Arabia and Iraq which significantly rely economically on oil production and its export prefers the optimal oil production so that the global demands are met without any shortage of oil. The optimal oil production ensure a stable, balanced and reliable supply of oil so that the global energy markets' needs are met in the best possible way and in a continuum [21].

2.3. The Nexus Between Oil Production, Export Levels, Government Revenue and Global Energy Markets

Optimal oil production draws attention towards a balanced production and supply of oil and export levels represent the frequency as well as amount of oil export that is too much export or too little export [13].

Firm's profit is the total revenue generated from the export or sales minus the firms cost utilized in production. Firm profit maximization is thus the increase in the profit of the firm by increasing sales and bringing cost efficiency. Firms producing oils aim to maximize their profits by determining the right production level that is optimal production [23]. Producing too much oil lead to oversupply and thus a decrease in the price which result in decreased profit. Similarly, producing too low oil could lead to decline of opportunities and thus hindering the road to maximum profit [23]. Firms can maintain a balance in the

production by considering various factors such as the global demands for oil, market trends for production and cost of production. This optimal production maximize the firm's profits by knowing balance between demand and supply. The oversupply or over-export lead to decrease demand in the market which in turn reduce the cost leading to minimum profit. Similarly, the less supply or shortage of production not only impact the firm's profit but lose the stability of the market is compromised due to increased demand and decreased production. Therefore, the firm profit maximization is significantly derived by optimal production and balanced exports [16].

Government revenue is the revenue created by the government to meet the public expenditures. It is basically the money that a government receives from taxes, royalties, and other sources of income for government. Government revenue also called as national revenue is the driving force for the well-being of nation [16]. Implications of optimal oil production and export levels are significant for government revenue. The optimal production and balance export of oils help a country to make substantial revenue from the taxes and non-taxes resources [12]. Oil being a non-renewable natural resource is considered a gem by the countries who don't have oil reserves. Therefore, countries like Iran, Iraq, Kuwait, and Saudi Arabia that rely on the oil export generate maximum revenue through its export by maintaining optimal production. Management of oil production by energy efficient and cost-efficient method and its trade with increased market demand help the government of these countries to generate maximum revenue which is then used for the development of the country. The development policies, infra-structure, social services and many public services are then performed by this revenue generated by optimal oil production and balanced export according to demands and needs [5].

Global energy markets are the markets in which the globally used energy resources like heat, oil, gas, electricity, fuels etc. are traded. The selling and buying of the energy commodities between different countries round the globe make what is called as global energy market [15]. The global energy markets are not always steady or stable but face fluctuations due to change in the supply and demand trend, different government policies, and various innovations in trade sector. These fluctuations are meant to be avoided or resolved as global energy markets are significant contributor to global economy [22]. The stability in global energy market and optimal oil production and its export are greatly related. By managing a balanced and optimal production of oil and a balanced export level by avoiding over and undersupply globally help to maintain the stability by balancing the supply and demand in market which could otherwise result not only in the disturbance in market but also a threat of depletion. A reliable supply of oil and stability in the global energy market is thus attributed to the optimal production and balanced export level [7].

3. METHODOLOGY

This investigation was carried out to scrutinize the impact of the oil sector, including production and export, and political environmental on the Oil Real GDP Growth in Iraq. In doing so, the data for the evaluation is acquired from World Bank databases as well as FRED Economic Data. The data extracted ranged from 2000 to 2023 as per the availability of the required data. The following equation presents the model specification:

$$OIL_t = \beta_0 + \beta_1 OILEXP + \beta_2 OILPROD + \beta_3 PSTAB + \beta_4 GPU + \varepsilon_t$$

where the error term is given by ε and the variables are as follows:

- OIL: Oil Real GDP Growth of Iraq
- OILEXP: Oil export levels, indicating the quantity of oil exported by Iraq.

- OILPROD: Oil production levels which show the amount of oil produced by the country.
- PSTAB: Political stability captures the changes in regulations or government policies related to the oil industry in the country.
- GPU: Global Economic Policy Uncertainty is taken as the control variable.

3.1 Econometric approach

This research work was primarily aimed to demonstrate the influence of the oil production, export and political stability on the Oil Real GDP Growth of Iraq which prompted the implementation of the autoregressive distributive lag (ARDL) [20]. The ARDL approach provides benefits over other approaches, for instance, it enables researchers to apply the technique even when the variables have a mix order of integration [11, 19]. Another noteworthy feature of this technique is its ability to efficiently resolve endogeneity issues and delivers reliable results even in the case of small sample size [11]. Due to these advantages, the present study applied the ARDL technique. To further validate the findings, the study also undertook diagnostic analysis consisting of gauging the residuals' normality, correlation and variance as previously done in studies [19].

4. RESULTS

4.1 Descriptive Summary

The statistical characteristics of all the factors in the study are presented in the table below, with values displayed for mean, median, range, skewness, and kurtosis. The Jarque-Bera values indicate that from the five variables, oil export, production, political stability, and global policy uncertainty follow a normal distribution. Only oil real GDP growth is non-normally distributed with a large JB value.

Table 1. Descriptive Statistics.

	OIL (-1) *	OILEXP	OILPROD	PSTAB	GPU (-2)
Mean	12.85274	2.407527	3077886.	2480512.	152.7939
Median	7.393012	2.473925	2950000.	2390522.	135.7219
Maximum	99.32859	3.180352	4633250.	3968250.	278.6028
Minimum	0.661149	1.601287	1160841.	1053908.	57.63362
Std. Dev.	20.15005	0.331578	1076398.	1015919.	71.84488
Skewness	3.439582	-0.29956	0.088836	0.111217	0.471806
Kurtosis	14.95887	3.653515	1.602401	1.448249	1.941333
Jarque-Bera	198.2681	0.818778	2.067551	2.559799	2.094980
Probability	0.000000	0.664056	0.355662	0.278065	0.350817
Sum	321.3185	60.18817	76947149	62012807	3819.847
Sum Sq. Dev.	9744.592	2.638652	2.78E+13	2.48E+13	123880.5
Observations	25	25	25	25	25

4.2 Stationarity and Cointegration

The analysis of the stationarity confirmed the absence of unit root as all the tests in Table 2 showed statistical significance, leading to the conclusion that all variables are stationarity at level.

Following the stationarity analysis, the cointegration relationships were assessed among the variables. Table 3 reveals that at each significance level, the F-statistic value surpass the asymptotic critical bound values. Consequently, long-run relationships are present

between the variable's understudies.

Table 2. Unit Root Test.

Method	Statistic	Prob.**	Cross- sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-10.2542	0.0000	5	112
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-9.34276	0.0000	5	112
ADF - Fisher Chi-square	83.6559	0.0000	5	112
PP - Fisher Chi-square	141.421	0.0000	5	115

Table 3. Bounds Test.

Test Statistic	Value					
F-statistic	35.19171					
	10%		5%		1%	
Sample Size	I (o)	I (1)	I (o)	I (1)	I (o)	I (1)
30	2.525	3.56	3.058	4.223	4.28	5.84
Asymptotic	2.2	3.09	2.56	3.49	3.29	4.37

* I(o) and I(1) are respectively the stationary and non-stationary bounds.

Similarly, the table below validates the long-run associations among variables.

Table 4. Cointegration.

Variable *	Coefficient	Std. Error	t-Statistic	Prob.
OIL (-1)*	286.93	78.07	3.68	0.00
OILEXP	-315.35	80.37	-3.92	0.00
OILPROD	23.99	9.29	2.58	0.02
PSTAB	-0.15	0.06	-2.39	0.03
GPU (-2)	490.15	121.96	4.02	0.00

4.3 ARDL Estimation

The ARDL approach enables the assessment of long-term and short-term impacts depicted in Table 5 and 6, respectively. In Table 5, it can be seen that the current OIL real GDP growth value is dependent on prior value with a significant and positive influence of the lagged value on the current. The findings verified a positive and significant association between oil exports and oil real GDP growth. Nevertheless, oil production was not positively associated with oil real GDP growth, representing increasing oil production reduces oil real GDP growth. In contrast to this outcome, political stability is positively and significantly associated with oil real GDP growth. This indicates that in the long-run, ensuring and increasing political stability is critical to increasing oil real GDP growth. Controlling for global policy uncertainty, the study showed a negative long-term association between policy uncertainty and oil real GDP growth. Rising uncertainty lowers oil real GDP growth. In addition, it must be noted that the model presented in the study holds good predictive power given that 87% of the change in the dependent variable can be expounded by the predictors in the model.

As for the short-term impact, Table 6 shows that the error correction term is negative and significant. Thus, this confirms the short-term association between the variables. The negative sign demonstrates a corrective mechanism, showing the adjustment of variables in the short run to restore the equilibrium.

Table 5. Long-run Estimation.

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
OIL (-1) *	0.41	0.10	3.95	0.00
OILEXP	169.90	22.82	7.45	0.00
OILPROD	-186.73	22.21	-8.41	0.00
PSTAB	14.20	6.26	2.27	0.04
GPU (-2)	-0.09	0.03	-2.75	0.01
C	290.25	69.79	4.16	0.00
R-squared	0.90	Mean dependent var		13.32
Adjusted R-squared	0.87	S.D. dependent var		21.44
S.E. of regression	7.62	Akaike info criterion		7.13
Sum squared resid	929.81	Schwarz criterion		7.42
Log likelihood	-72.40	Hannan-Quinn criter.		7.20
F-statistic	30.03	Durbin-Watson stat		2.11
Prob(F-statistic)	0.00			

Table 6. Short-run Estimation.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIL (-1)*	-0.59	0.1	-5.74	0.000
OILEXP	169.9	22.82	7.45	0.000
OILPROD	-186.73	22.21	-8.41	0.000
PSTAB	14.2	6.26	2.27	0.040
GPU (-2)	-0.09	0.03	-2.75	0.010
COINTEQ*	-0.59	0.04	-16.65	0.000
C	290.25	69.79	4.16	0.000
R-squared	0.9295	Mean dependent var		-0.5344
Adjusted R-squared	0.9075	S.D. dependent var		25.0658
S.E. of regression	7.6232	Akaike info criterion		7.1273
Sum squared resid	929.8106	Schwarz criterion		7.4248
Log likelihood	-72.4000	Hannan-Quinn criter.		7.1974
F-statistic	42.2084	Durbin-Watson stat		2.1095
Prob(F-statistic)	0.0000			

4.4 Diagnostic Tests

The diagnostic tests confirmed the robustness of the analysis. First, the histogram in Fig. 1 showed an almost bell-curved plot, suggesting normal distribution. This is confirmed with a small and insignificant JB value. Tables 7 and 8 validate the absence of autocorrelation and heteroskedasticity in the residuals.

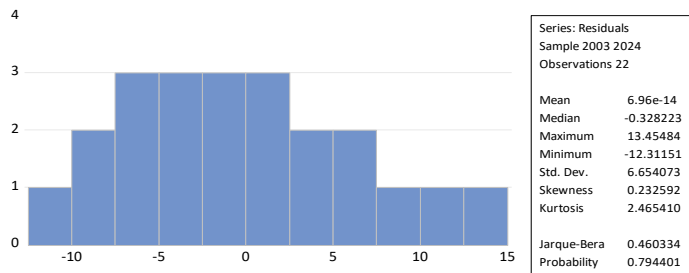


Figure 1. Distribution of Residual

Table 7. Autocorrelation.

F-statistic	2.35	Prob. F (2,14)	0.13
Obs*R-squared	5.53	Prob. Chi-Square (2)	0.06

Table 8. Heteroskedasticity.

F-statistic	0.72	Prob. F (2,17)	0.50
Obs*R-squared	1.57	Prob. Chi-Square (2)	0.46

5. DISCUSSION

The present study aimed to model optimal oil production and export levels in the context of Iraq and present valuable implications to maximize firm profit by generating government revenue. The statistical analysis of the collected data helped analyze the relationships between the variables under study. The co-integration test indicated a statistically significant relationship between oil export levels and Oil Real GDP Growth in Iraq. The findings show that each unit increase in oil export levels brings about a significant increase in the oil real GDP growth. This statically significant impact of oil export levels on oil real GDP growth in Iraq indicates a significant role of oil export in increasing the GDP growth of countries like Iraq who rely on their oil exports to a great extent. The findings entail that oil exporting nations rely on the performance of their oil sector to a great extent. Thus, in the context of Iraq, the GDP depends on the revenue generated by the oil exports. Oil exports emerge as a major source of GDP for Iraq as the high level of oil exports can lead to an increased revenue generation for the country. This influx of revenue can lead to growth in the GDP and help the country maximize its profit generation. Moreover, the revenue generated through oil exports can be invested into other economic ventures, which can lead to real GDP growth in the country. The impact of oil production on the oil real GDP growth of Iraq also turns out to be significant. The findings reflected that oil production was not positively associated with oil real GDP growth, indicating that increase in oil production would reduce oil real GDP growth. This can be attributed to the mismanagement or lack of resource diversification in oil-rich countries. This can lead to a reduction in country's GDP. In addition, an increase in oil production can also result in currency appreciation. This can lead to reduction in the country's economy and cause a downfall in the non-oil sectors of the country. Furthermore, the analysis revealed a significant and positive relationship between political stability and oil real GDP growth. The finding suggests that politically stable environment helps boost the economic growth of oil-rich countries. A country that politically stable, offers a favorable environment for business investment by local as well as foreign investor. Investors prefer to invest in a politically stable country and show their commitment to engage in long-term relationships. In addition, a politically stable country is better able to export its oil and generate revenue out it. A politically stable country can invest a great portion of its budget in developing its infrastructure and forming robust trade relations with foreign countries. In addition, politically stable countries seldom have to introduce abrupt changes in their economic policies, which help sustain their robust relationships with domestic and foreign investors. Moreover, political stability empowers the government to establish a robust supervision of the country's oil sector and its impact on the country's GDP. A politically stable country can implement effect resource management to ensure conservation of its non-renewable sources, leading to a growth in its GDP. Furthermore, the relationship between the control variable, global policy uncertainty and oil real GDP growth was significant and negative, which indicated that uncertainty in global policy would lead to a decline in the country's GDP. Any uncertainty in global policy can obstruct trade relations and international investments, leading to reduced opportunities of economic growth for the country. A similar study conducted by Eregba and Mesagan [8], suggested that the panel, Algeria, Angola, Egypt, and Libya all exhibited positive effects of oil production on GDP growth, with the exception of Nigeria.

5.1 Conclusion

The present study provided the stakeholders from the oil industry with the useful

information to understand the impact of oil production and export levels on GDP growth in Iraq. The study relied on the secondary data collected from the World Bank database and used the ARDL approach to analyze the relation between the variables under study. The oil export levels emerged as a significant determinant of oil real GDP growth in Iraq. The study affirmed the notion that oil exports would lead to increased revenue generation and GDP growth for oil-rich countries like Iraq. However, oil production turned out to have a negative impact on the oil real GDP growth. On the other hand, political stability had a positive and significant impact on oil real GDP growth. The present study, thus, regarded a politically stable environment as crucial for increasing the GDP of a country. The study selected global policy uncertainty as a control variable and its impact on the dependent variable was significant but negative.

5.2. Theoretical and Practical Implications

The present study helps enhance the existing empirical literature concerning the dynamics between oil exports and GDP growth of oil-rich countries. The study adds to existing empirical literature concerned with the determinants of GDP growth. Moreover, the present study provides empirical evidence of how oil exports can bring about significant increase in a country's GDP. The study draws on the Comparative Advantage Theory originally proposed by David Ricardo and enhances the existing theoretical literature of this theory by showing its validity to study the linkage between oil exports and oil real GDP growth.

In addition to its theoretical implications, the present study also offers valuable practical implications for policymakers. The study offers a comprehensive overview of how oil sector can play a significant role in boosting the economic growth of a country. The study emphasizes the need for a political stable environment for ensuring a boost in the GDP of a country. The finding is particularly in the context of post-conflict countries like Iraq.

5.3. Limitations and Future Directions

The present study holds certain limitations, which should be addressed to present guidelines for future studies in the area. The study focuses on the particular context of Iraq therefore, its findings may not reflect the determinants of other countries. Future studies can focus on the other oil-rich countries like the Kingdom of Saudi Arabia, Kuwait, Iran, and the UAE. Moreover, a comparative analysis can be drawn to analyze the impact of oil exports on GDP growth in Iraq and in other countries. This cross-cultural approach would introduce more comprehensive findings. In addition, the methodological choices taken for this study also posed certain limitations. The secondary data related to oil exports was limited in terms of its extent. Future studies can adopt some primary methods of data collection to overcome this challenge. Future studies can adopt either a quantitative or a qualitative approach to collect the primary data.

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