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OIL PRODUCTION, INVESTMENT AND EXCHANGE RATE AS THE KEY DRIVERS OF KAZAKHSTAN'S ECONOMY

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Abstract. The study assesses the impact of crude oil production, oil exports, inflation, Brent crude oil prices and fluctuations in the exchange rate on the real GDP of Kazakhstan. The research aim is to evaluate how these key macroeconomic variables influence on the economic growth of a resource dependent nation. The study used time series data from 1995 to 2023 and multiple regression analysis with several model specifications to understand the effects of oil related factors, exchange rates, inflation and investment on real GDP growth. Furthermore, four model specifications were utilized, a baseline model with Brent crude oil prices, exchange rates and inflation, an extended model including oil production, its alternative specification which replaces oil production with oil exports and a comprehensive model integrating investment whilst accounting for auto regressive effects. Diagnostic tests confirm the absence pf multicollinearity and autocorrelation, strengthening the validity and reliability of the findings.
Key words: real GDP, oil production, Brent, inflation, investment, regression analysis.

Introduction

The choice of the research topic is justified by the fact that oil, its production and export, as well as exchange rate, inflation and investment have an important role when it comes to the economic trajectory, structure and development of resource rich countries such as Kazakhstan. Being one of the world's leading oil-producing nations with substantial oil reserves, the country's economy is heavily influenced by fluctuations in these indicators. Despite the extensive body of literature examining the relationship between oil prices and economic growth, the gap in understanding how these variables influence the real GDP within the unique context of Kazakhstan still remains. In addition, few studies have provided a comprehensive analysis that incorporates exchange rates and inflation for Kazakhstan's economy.

This study seeks to address the gap by analyzing the effect of crude oil production, inflation, exchange rate fluctuations, investment and Brent crude oil prices on Kazakhstan's real GDP by employing several model specifications that allow to gain a more detailed understanding of their relationships. The object of this study is Kazakhstan's economy while the subject is the impact of the aforementioned variables on real GDP. The primary goal of the research is to understand how and to what extent the key macroeconomic variables influence Kazakhstan's economic output. To achieve this, the study employs time-series data between 1995 and 2023 and utilizes multiple regression analysis to determine the combined effects of the indicators.

The urgency of the topic is underscored by the global economic volatility and the increasing importance of economic diversification for resource-dependent nations. The relevance of the research is further supported by its theoretical and practical significance. From a theoretical perspective, a detailed comprehension of the mechanism of the influence of key macroeconomic indicators may offer a foundation and insights, which could be applied to similar studies. Practically, the findings have implications for policymakers in Kazakhstan, particularly in terms of the exchange rate management and strategies for economic diversification. The study's originality lies in its unique model specifications, which adds exchange

rate, investment, inflation and previous GDP growth impact for a more comprehensive understanding, which differentiate it from prior research. The article could potentially assist policymakers and country authorities who pursue economic resilience and long-term stability amid external shocks and global market fluctuations.

Literature Review

The associations among oil production and export, inflation and investment, exchange rates and GDP has been explored substantially since the last century researchers. In particular, Hamilton (1983:228) analyzed the consequences of oil price shocks on the U.S. economy and determined that increase in oil prices has an important role in starting recessions in the post-World War II period. Adding to this, Mork (1989:740) introduced an asymmetric approach to oil price changes by finding that GDP reacts more strongly to price increases than decreases. Lardic and Mignon (2006:846) inspected the long-term links between oil prices and growth of the European economy and concluded that increasing prices of oil negatively affect the GDP. Blanchard and Gali (2007:145) explored the evolution of oil price fluctuations and macroeconomic variables and concluded that improved monetary policies and decrease in dependence on oil production have the ability to reduce the impact of price shocks while Killian (2008:1054) have dived into the details of the differences between supply and demand driven oil price increases, showing that demand shocks possess a more serious negative influence on real GDP. Similarly, Berument et al (2010:169) who studied Middle Eastern economies found that oil-exporting nations benefit from higher oil prices whilst countries that import oil face economic downturns. Alvarez et al. (2011:518) focused on specific economies (Spain) and explored its economic response to oil price fluctuations and highlighted that rising oil prices caused inflation increase and slow in GDP growth while exchange rate movements amplified these effects. The same year Bodenstein (2011:110) analyzed oil supply shocks in the USA and revealed that they contributed to inflation and lower economic output, with exchange rates being a key transmission mechanism. Filis et al. (2011:124) studied the dynamic link between oil prices and stock markets, noting that volatility increases uncertainty, discourages investment and indirectly affects GDP. Joets et al. (2012:65) assessed the interaction between oil prices and GDP in developed economies, highlighting the role of inflation and exchange rate fluctuations in shaping economic outcomes, while Peersman et al. (2012:153) who also focused on the European nations came to a conclusion that oil price shocks have a completely different influence on GDP as well as inflation, and that distinction is caused by the nature of the oil price shocks. Jo (2014:150) by studying nations who export oil have shown that fluctuations in exchange rate considerably affect oil prices and GDP growth as well. Arezki et al. (2014:3) investigated the decline in oil prices during the 2014 crises and linked it to the factors of the supply of the product. He also found that oil-importing economies benefited from the situation but exporters exhibited significant revenue losses. Cashnin et al. (2014:88) explored exchange rate volatility and its effect on the prices of the products and revealed the significance of currency fluctuations when it comes to GDP growth of countries that are oil exporters and importers. Aastveit et al. (2015:275) explored inflation expectations caused by oil price shocks, finding a direct link between oil price movements and nominal GDP, emphasizing vulnerability to market instability. Sarmah et al. (2021:1) analyzed India's experience with crude oil price fluctuations, showing that its volatility has a direct impact on the macroeconomic situation of the country, specifically inflation and growth of GDP. The Federal Reserve (2023:1) assessed the second round effects of oil price shocks on inflation in advanced economies, showing that oil price surges such as those seen in 2022 exert upward pressure on global inflation rates. Sule-lko et al. (2023:125) examined the impact of international crude oil prices on Nigeria's GDP between 1985 and 2020 by employing an Auto-Regressive Distributed Lag (ARDL) model with findings indicating that a 1% increase in oil prices raises real GDP by 1.528% in the short-run, and 14.67% in the long-run which reinforces Nigeria's economic dependence on crude oil revenue. Regarding domestic investment, Morina et al. (2023:7) explored the long-term relationship between investment and economic growth in OECD countries from 2000 to 2020 with data from World Bank, IMF and OECD and found that domestic investment is a key driver of economic growth, which emphasizes the importance of internal capital formation. In a more contemporary analysis, The

Guardian (2024:1) reported on how geopolitical tensions in the Middle East led to a sharp rise in global oil petrol prices, particularly affecting Australian consumers including business and households.

These studies collectively enhance our understanding of the complex interaction of oil prices, inflation, exchange rates investment and real GDP. They highlight the importance of the direct and indirect links between the aforementioned factors and the significance of the monetary and other policies to mitigate the adverse effects. Nevertheless, several areas remain unexplored. First, existing studies usually focus on developed economies, leaving a gap in understanding the effects in emerging and developing nations. Furthermore, previous studies often overlook the need for multiple specifications to capture the different perspectives on the relationship between oil-related factors, macroeconomic variables and economic growth. Thus, our research seeks to fill these gaps by utilizing diverse modelling approaches to offer deeper insights into the connections between oil-related factors, macroeconomic variables and economic growth in an emerging economy.

Materials and methods

This study investigates the following key questions:

1. How does crude oil production and export influence Kazakhstan's real GDP growth?

2. What is the relationship between exchange rate fluctuations and Kazakhstan's real GDP growth?

3. To what extent inflation, real Brent crude oil prices and investment influence economic growth?

H_0: Real Brent crude oil prices, inflation, investment, exchange rate, crude oil production and its export do not significantly affect real GDP growth of Kazakhstan.

H_1: Crude oil production, oil export, inflation, investment, exchange rate and real Brent crude oil price significantly affect Kazakhstan's real GDP growth.

The research uses time-series data from 1995 to 2025, collected from reputable organizations such as the Bureau of National Statistics of Kazakhstan, U.S. Bureau of Labor Statistics, International Monetary Fund, Ministry of Energy of the Republic of Kazakhstan and National Bank of Kazakhstan. The data includes:

1) Real GDP of Kazakhstan calculated by Nominal GDP and GDP Deflator, measured in USD billion.

2) Real GDP = $\frac{Nominal\ GDP}{GDP\ Deflator} \times 100$

3) GDP Deflator (index)

4) Exchange Rate as in 1 USD in Kazakhstani tenge

5) Real Brent Crude Oil Price, computed by the nominal Brent Oil Price and CPI of the USA, measured in USD per barrel, the annual average

6) Real Brent Crude Oil Price = $\frac{Nominal\ Brent\ Crude\ Oil\ Price}{USA\ CPI} \times 100$

7) Crude oil production, measured in USD billion

Real GDP and Real Brent Crude Oil price were calculated to remove inflationary effects and reflect actual market trends rather than general price level shifts. The dataset was compiled in MS Excel, which ensured consistency in data formatting before being imported in EViews for further analysis. EViews is a specialized econometric software widely used for time-series analysis and forecasting and was chosen for its robust statistical and econometric tools, user-friendly interface and ability to handle large datasets efficiently.

To capture economic dynamics, ensure stationarity in the time series and allow for easier interpretation of percentage changes growth rates of all variables were computed using first differences of their natural logarithms:

$$X_{Growth} = \ln(X_t) - \ln(X_{t-1}),$$

where X_{Growth} – logarithmic growth rate of the variable X, X_t – Value of the variable at time t, X_{t-1} – Value of the variable at time t-1 (previous period)

This transformation is preferred over simple percentage change calculations because it approximates continuous growth rates and stabilizes variance in economic data. What is more, by doing so we are able to have coefficients as elasticities (i.e. how a 1% change in an independent variable affects the dependent one).

In this study, we developed four distinct econometric models using the Ordinary Least Squares (OLS) method to analyze the key drivers of real GDP growth in Kazakhstan, an oil-dependent economy where fluctuations in oil prices (RPOIL),

oil production (OILPROD) and oil exports (OILEXP) play a critical role in shaping macroeconomic stability. Given the country's heavy reliance on oil revenue changes in these variables can have far reaching effects on economic performance. By constructing separate models, we aimed to capture the diverse transmission mechanisms through which the oil sector impacts GDP. Beyond the oil sector, macroeconomic factors such as inflation (DEFL) and exchange rate movements (EXCH) significantly influence economic growth, since inflation could distort real incomes, increase costs of doing business and decrease investment confidence which results in the economic problems while the currency depreciation can lead to higher import costs, financial instability for open economies which in turn also negatively affects GDP. Recognizing the importance of investment (RINVEST), our model adds this variable to evaluate if capital formation can stimulate economic growth factor due to it serving as a key driver of productivity and economic diversification. Moreover, to account for economic inertia and historical trends, we include lagged GDP growth terms (AR(1) and AR (2)) in models since it reflects the lasting effects of past growth. To validate the robustness of our findings, we applied White heteroskedasticity-consistent standard errors & covariance and Variance Inflation Factor (VIF) analysis to address potential heteroskedasticity and detect potential multicollinearity among independent variables, improving the reliability of statistical inference and confirming that each coefficient reflects a distinct and meaningful relationship with GDP growth.

The models equation are as follows:

1) $\Delta ln\ (RGDP)_t = \beta 0 + \beta 1 \Delta ln\ (RPOIL)_t + \beta 2 \Delta ln\ (EXCH)_t + \beta 3 \Delta ln\ (DEFL)_t + \phi \mathrm{AR}(1) + \varepsilon_t$

2) $\Delta ln\ (RGDP)_t = \beta 0 + \beta 1 \Delta ln\ (OILPROD)_t + \beta 2 \Delta ln\ (EXCH)_t + \beta 3 \Delta ln\ (DEFL)_t + \phi \mathrm{AR}(1) + \varepsilon_t$

3) $\Delta ln\ (RGDP)_t = \beta 0 + \beta 1 \Delta ln\ (OILEXP)_t + \beta 2 \Delta ln\ (EXCH)_t + \beta 3 \Delta ln\ (DEFL)_t + \phi \mathrm{AR}(1) + \phi \mathrm{AR}(2) + \varepsilon_t$

4) $\Delta ln\ (RGDP)_t = \beta 0 + \beta 1 \Delta ln\ (RPOIL)_t + \beta 2 \Delta ln\ (RINVEST)_t + \beta 3 \Delta ln\ (EXCH)_t + \beta 3 \Delta ln\ (DEFL)t + \phi \mathrm{AR}(1) + \phi \mathrm{AR}(2) + \varepsilon_t$

Results and Discussion

The first model examines the impact of real oil prices, exchange rate and inflation of Kazakhstan's real GDP and explains 94.47% of real GDP fluctuations, with all variables showing strong statistical significance. To be specific, a 1% increase in real oil prices raises real GDP by 0.13% while a 1% depreciation of the tenge reduces it by 1.11%. Similarly, a 1% rise in inflation lowers real GDP by 0.72% and the autoregressive term of 0.42 suggests that past growth influences current performance. The F-statistic (93.90, p = 0.0000) confirms the model's reliability, while a Durbin-Watson score of 1.81 suggests no severe autocorrelation. The second model assesses the relationship between oil production, exchange rates and inflation on Kazakhstan's GDP growth, explaining 95.06% of variations. Furthermore, a 1% increase in oil production raises real GDP by 0.14% whilst a 1% growth in inflation and depreciation of tenge lowers it by 0.73% and 1.13% respectively. The autoregressive term of 0.30 suggests weak momentum from past growth. The F-statistic (105.83, p = 0.0000) confirms the robustness of the model, while a Durbin-Watson coefficient of 1.73 indicates no severe autocorrelation. The third model examines the effects of oil exports, exchange rates and inflation of Kazakhstan's real GDP, accounting for 92.72% of variations. A 1% increase in oil exports raises real GDP by 0.07%, though the effect is statistically insignificant. In contrast, a 1% rise in inflation and tenge depreciation decrease real GDP by 0.58% and 1.10% respectively, with strong significance. The autoregressive term of 0.33 suggests moderate persistence in growth fluctuations. The F-statistic (70.04, p = 0.0000) validates the model's strength, while a Dubrin-Watson statistic of 1.75 indicates no severe autocorrelation issues. The fourth model evaluates the impact of oil prices, investment, exchange rates and inflation on Kazakhstan's real GDP and explains 95.93% of variations. A 1% increase in oil prices and investment raises GDP by 0.10% and 0.19%, respectively, while inflation and tenge depreciation lower it by 0.44% and 1.12%, with all coefficients being statistically significant. The inclusion of two autoregressive terms (AR (1) = 0.46, AR (2) = -0.32) captures past GDP fluctuations, where the positive AR (1) term implies

short-term persistence in growth, while the negative AR (2) suggests that past growth leads to some degree of adjustment or slowdown. The F-statistic (74.71, p = 0.0000) confirms model reliability and the Durbin-Watson statistic of 1.89 suggests no significant autocorrelation. (Table 1).

Table 1 – The results of the regression analysis

	Dependent Variable			
	D(LGDP)			
	Model 1	Model 2	Model 3	Model 4
D(LRPOIL)	0.132*** (0.038)	-	-	0.103** (0.037)
D(LOILPROD)	-	0.136*** (0.034)	-	-
D(LOILEXP)	-	-	0.074 (0.048)	-
D(LRINVEST)	-	-	-	0.191** (0.076)
D(LEXCH)	-1.114*** (0.051)	-1.132*** (0.065)	-1.101***(0.078)	-1.121*** (0.060)
D(LDEFL)	-0.722*** (0.111)	-0.733*** (0.118)	-0.581*** (0.123)	-0.444*** (0.155)
Constant	0.168*** (0.017)	0.159*** (0.015)	0.163***(0.023)	0.140*** (0.021)
AR(1)	0.417** (0.156)	0.301* (0.158)	0.334** (0.152)	0.465*** (0.160)
AR(2)	-	-	-	-0.321** (0.120)
R2	0.945	0.951	0.927	0.959
Adj. R2	0.935	0.942	0.914	0.947
F-statistic	93.90***	105.83***	70.04***	74.71***
D-W statistic	1.808	1.729	1.748	1.889

Notes: Standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. F-Statistics are significant at the 1% level.

In addition, all centered VIF values were below 5, indicating that multicollinearity is not a severe concern.

Conclusion

The research set out to examine how key economic factors – crude oil production, oil export, Brent crude prices, inflation, exchange rate fluctuations and investment shape Kazakhstan's real GDP. By employing four econometric models on time-series data spanning from 1995 to 2023, the study provided a comprehensive analysis of the interplay between these variables in a resource-driven economy. Statistical robustness checks confirmed the reliability of the results, ensuring that the findings accurately reflect Kazakhstan's macroeconomic reality.

The study's results reinforce the critical influence of oil-related dynamics on GDP growth, with crude oil production showing a stronger correlation with economic expansion than oil exports. Notably, exchange rate depreciation emerged as a significant constraint on growth, underlining the vulnerability of Kazakhstan's economy to currency fluctuations while inflation demonstrated a strong negative influence, necessitating monetary policies, which assist in maintaining price stability. On the contrary, investment also reflected its crucial role in improving economic performance, signifying its ability to achieve long-term growth and development in non-oil sectors. Therefore, these findings overwhelmingly support the alternative hypothesis that these macroeconomic indicators play a significant role in shaping the economic performance of Kazakhstan.

These findings also carry meaningful implications for economic strategy. Country authorities and the National Bank of Kazakhstan must aim for a more predictable environment by maintaining the exchange rate and inflation within suitable ranges as well as prioritize strategic investment, with economic diversification being a key policy objective to reduce over- reliance on oil revenues. Additionally, the findings imply that while oil is still the country's one of the most important sectors and priorities, investments may

help the nation to be more economically resilient against external factors and oil market fluctuations.

Moving forward, further research could explore the evolving role of renewable energy and technological innovation in diversifying Kazakhstan's economic base as well as incorporating geopolitical factors and global oil market trends into future analyses could provide deeper insights into the external forces that also might affect the country's growth trajectory.

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