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An Analysis of the Effect of Tourism Revenues, Exchange Rates, and Oil Prices on GDP in Kazakhstan Using the Quantile Regression Method

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ABSTRACT

This study investigates the impact of international tourism revenues, the real effective exchange rate, and oil revenues on economic growth in Kazakhstan using the quantile regression method. Unlike traditional linear models that primarily focus on average effects, analyzing the determinants of economic growth across different distribution points (or quantile levels) provides more nuanced and valuable insights for policymakers. The research utilizes annual time series data from 1995 to 2023. After testing the stationarity of the variables using the Augmented Dickey-Fuller (ADF) test, both least squares regression analysis and quantile regression models were applied. The results indicate a positive and statistically significant effect of oil revenues on Gross Domestic Product (GDP) at all quantile levels. In contrast, while tourism revenues and the real effective exchange rate index also had a positive impact on economic growth, these effects were not found to be statistically significant in the quantile regression models. These findings suggest that the Kazakh economy remains heavily reliant on energy revenues, which may heighten its economic vulnerabilities. The study emphasizes the need for increased economic diversification, support for the tourism sector through effective policies, and a review of exchange rate policies. It also highlights the importance of tailoring growth strategies not just based on average performance but also according to different levels of economic outcomes.

Keywords: Quantile Regression, Economic Growth, Tourism Revenues, Exchange Rate, Oil revenues, Kazakhstan
JEL Classifications: C13, C20, C22

1. INTRODUCTION

After declaring its independence on December 16, 1991, Kazakhstan implemented comprehensive structural reforms aimed at transitioning to a free market economy (Taibek et al., 2023; Sabenova et al., 2024). This process involved controlling inflation, ensuring price stability, privatization, and financial reforms. Although it initially led to various economic challenges, Kazakhstan has experienced sustainable growth dynamics since the 2000s (Sultanova et al., 2024). The country's economy is largely dependent on natural resources, particularly oil and natural gas, with approximately 3% of the world's oil reserves (Mudarissov and Lee, 2014; Xiong et al., 2015). This reliance makes the macroeconomic structure vulnerable to fluctuations in energy prices (Corden and Neary, 1982; Hamilton, 1983). Additionally, exchange rate movements and tourism revenues, which are among the key sectors open to the global market, significantly impact Gross Domestic Product (GDP). Analyzing

these diverse dynamics, particularly through nonparametric statistical techniques such as quantile regression, allows for examination of how these variables affect GDP at different income levels (Talimova et al., 2025).

On a global scale, the tourism sector is recognized as one of the largest export items after fossil fuels and chemicals. It is considered a crucial tool for economic transformation in developing countries (Serikbayeva et al., 2025). Tourism not only generates foreign exchange inflow but also plays a strategic role in enhancing the country's image and supporting local development. For instance, Southeast Asian countries like Thailand and Vietnam have effectively leveraged this sector to accelerate economic growth and increase infrastructure investments, resulting in job creation and improved tourist infrastructure (Balginova et al., 2024). Kazakhstan also possesses significant tourism potential, thanks to its geographical location, rich natural resources, and historical heritage. The country offers a wide range of tourism opportunities, from ecotourism in the Altai Mountains and national parks to cultural heritage sites along the Silk Road and business tourism in major cities like Almaty and Astana (Glukhovtsev and Yermekbayeva, 2001). However, despite this potential, the contribution of tourism to GDP remains low on an international scale. Challenges such as inadequate infrastructure, insufficient practices for environmental sustainability, and a lack of effective global promotion strategies hinder sector growth. Conversely, improving international transport connections, supporting small and medium enterprises (SMEs) in tourism, and implementing policy initiatives to position Kazakhstan as a competitive global tourism destination show promise for the development of sustainable tourism (UNDP, 2021).

The exchange rate is a crucial determinant of macroeconomic stability in energy export-based economies, having both direct and indirect effects on economic growth. In Kazakhstan, the exchange rate influences not only the foreign trade balance but also the income flow from sectors that generate foreign exchange, such as energy and tourism. Empirical studies indicate a causal relationship between the exchange rate and GDP (Dikkaya and Doyar, 2017). Notably, the implementation of a free exchange rate regime in 2015 has made the impact of the exchange rate on economic growth more pronounced. Moreover, the exchange rate's sensitivity to oil prices demonstrates that fluctuations in energy prices are transmitted to macroeconomic variables through the exchange rate channel. Consequently, the exchange rate is a fundamental economic indicator in both domestic and foreign demand-driven growth strategies and should be considered when analyzing the effects of tourism revenues on GDP.

Oil prices are a primary determinant of global economic fluctuations and significantly affect the macroeconomic indicators of oil-exporting countries, particularly. In energy-rich economies like Kazakhstan, variations in crude oil prices directly impact national income, the foreign trade balance, and the public budget. Geopolitical crises in 1970's, such as the 1973-74 Arab-Israeli War and the 1979 Iranian Revolution, have constrained global oil supply and driven up energy prices (Nandha and Faff, 2008; Lee and Ni, 2002). These structural breaks illustrate that oil prices are influenced not only by supply and demand but also by political risks. As shown in Table 1, oil prices have experienced significant fluctuations over the past decade, with marked declines, especially during the COVID-19 pandemic (Wheeler et al., 2020). In 2020, oil prices fell by more than 20%, alongside a global decrease in energy consumption, creating pressure on the GDP of energy-dependent economies like Kazakhstan (Nyga-Łukaszewska and Aruga, 2020). Thus, it is vital to assess the impact of oil price volatility on economic growth not only through averages but also at various points in the distribution, employing the quantile regression method.

While economic growth signifies the sustainable increase in a country's production capacity, it is influenced by various factors, including the labor force, capital accumulation, foreign trade, energy use, and foreign direct investment. This growth process is typically measured by the Gross Domestic Product (GDP), which represents the total market value of all final goods and services produced within a country over a given period (Lukhmanova et al., 2025). Globalization and digitalization are transforming economic growth structures by enhancing productivity and efficiency. Consequently, GDP has become a key indicator of not only economic performance but also international competitiveness and welfare (Issayeva et al., 2023; Abdibekov et al., 2024; Aidarova et al., 2024; Baimagambetova et al., 2025). In this context, variables such as tourism revenues, exchange rates, and oil prices - whose impacts on GDP are explored in the case of Kazakhstan - are regarded as external factors influencing the direction, pace, and vulnerabilities of growth.

Table 1: The changes in crude oil prices over the last decade

Crude oil prices - historical annual data						
Year	**Average closing price**	**Year open**	**Year high**	**Year low**	**Year close**	**Annual % change**
2025	$67.57	$71.72	$80.04	$57.17	$62.81	−12.61%
2024	$75.83	$71.65	$87.01	$66.37	$71.87	0.76%
2023	$77.64	$80.26	$93.84	$66.74	$71.33	−11.40%
2022	$94.53	$76.08	$123.70	$71.59	$80.51	7.05%
2021	$68.17	$47.62	$84.65	$47.62	$75.21	55.01%
2020	$39.68	$61.17	$63.27	$11.26	$48.52	−20.64%
2019	$56.99	$46.31	$66.24	$46.31	$61.14	35.42%
2018	$65.23	$60.37	$77.41	$44.48	$45.15	−25.32%
2017	$50.80	$52.36	$60.46	$42.48	$60.46	12.48%
2016	$43.29	$36.81	$54.01	$26.19	$53.75	44.76%

Source: https://www.macrotrends.net/1369/crude-oil-price-history-chart (Access date: April 01, 2025)

This study aims to analyze the effects of the relationships between tourism revenues, exchange rates, and oil prices on Gross Domestic Product (GDP) in the Kazakh economy using the quantile regression method. It will highlight how the effects of these variables on GDP differ not only at the average level but also across different quantiles of distribution. Thus, the study seeks to assess the extent to which these economic factors are pivotal to Kazakhstan's growth dynamics from a multidimensional perspective. The research intends to investigate asymmetric effects, moving beyond traditional linear approaches in the literature, ultimately providing more comprehensive and targeted policy recommendations.

2. LITERATURE REVIEW

Numerous academic studies have been conducted on Kazakhstan, which has undergone significant economic development since independence, utilizing various statistical and econometric methods. However, due to space constraints, this overview will only include fundamental studies relevant to the purpose and scope of this research.

Balginova et al. (2024) analyzed the effects of tourism on the economy, employment, and service exports in Kazakhstan using official statistical data from 2012 to 2022. The researchers began by conducting descriptive statistical analyses of variables related to tourism employment, gross value added (GVAT), and exports. These analyses yielded significant findings, including differences in female and male employment, a GVAT to GDP ratio of 2.9% to 4.1%, and a peak GVAT value of 3,270.1 billion Tenge in 2022. Following this, empirical analysis was performed on time series data using the ARIMA model. This model was used to evaluate the relationships between GVAT, tourism consumption (both domestic and international), gender distribution in employment, and service exports. The findings indicated that foreign tourist expenditures significantly boosted GVAT, whereas the impact of domestic expenditures was limited. Additionally, a strong correlation was observed between tourism exports and GVAT, with male employment growth proving more decisive for economic growth. Yet, the increase in female employment did not equally strengthen these effects. The results emphasize the importance of attracting high-spending foreign tourists, expanding service exports, and implementing gender-equal employment policies for sustainable tourism growth. This study also recommends addressing environmental factors and social barriers in greater detail in future research.

Serikbayeva et al. (2025) explored the economic determinants of tourist flow in Kazakhstan, including fluctuations and future forecasts using econometric methods. The primary aim of the research was to identify the key factors influencing the profitability of the tourism sector and to make predictions about the sector's sustainability. The authors developed a comprehensive empirical framework employing quantitative analysis techniques, such as demand elasticity, revenue sensitivity to various variables, and future trend estimation through the Markov model. Their findings revealed that tourist mobility in Kazakhstan is highly variable and subjected to both seasonal and crisis-related fluctuations. Specifically, it was found that a 1% decrease in airline ticket prices resulted in an increase in the number of tourists ranging from 0.75% to 11.3%, depending on the year. Furthermore, the most significant factors affecting the sustainability of tourism revenues were identified as the number of tourists, accommodation costs, and international flight frequency. Estimates made with the Markov model suggest a 73.5% probability of growth in the 2024-2025 period, though they also highlight a potential decline after 2026. The study recommends reducing dependency on external crises and developing sustainability-oriented management strategies.

Kuang and Tsai (2016) aimed to examine the impact of increasing tourism revenues on economic growth in the Taiwanese economy from 1965 to 2005 at various growth levels. They utilized a panel data set that included annual tourism revenues and GDP growth rates. The quantile regression method, which reveals the effects of economic growth at different distribution points, was selected for the analysis. The research findings indicated that an increase in tourism revenues positively and statistically significantly affected the middle and upper quantiles (0.3-0.9) of economic growth. Conversely, this effect was not statistically significant in the lower quantiles (0.1-0.2). These results suggest that tourism contributes to economic growth primarily during periods of high growth performance, while its impact remains limited in low-growth periods.

Akhmedov (2019) examined the effects of oil price shocks on several selected macroeconomic indicators within the Kazakh economy. This study used a quarterly data set that included variables such as GDP, consumption, investment, export, import, and exchange rates from 2003 to 2016. The Vector Autoregression (VAR) model, which allows for evaluating the dynamic relationships between these variables, was used for analysis. The findings revealed that oil price shocks have a strong short-term effect on GDP, investment, and consumption (lasting one to two quarters), although these effects diminish over time. Additionally, it was found that the impacts are more pronounced during crisis periods. Based on these results, it is recommended that Kazakhstan pursue economic diversification policies to reduce its dependence on oil and implement stabilizing measures for managing exchange rates and public finances to mitigate economic vulnerabilities.

Abubakirova et al. (2016) aimed to assess the role of tourism in Kazakhstan's national economy in the post-1991 period by examining the impact of tourism sector on the economic structure. The research provides a quantitative analysis based on key economic indicators, including tourism's share in fixed capital, foreign capital investments, contributions to GDP, and the foreign trade balance. The evaluations of official statistical data indicate that there was a decline in tourism's share of GDP between 1991 and 1999. However, as of 2012, this rate had risen to 0.68%, positioning Kazakhstan 54th in the world rankings for tourism. Although there was a 53.8% increase in tourism investments and a significant rise in visitor numbers, challenges such as infrastructural deficiencies, weak marketing strategies, and poor service quality hinder the sustainable development of the sector. The study suggests that Kazakhstan could reduce its economic dependency by diversifying its tourism sector. Recommendations

include enhancing tourism awareness, developing vocational training, improving security and visa facilities, increasing state support, and strengthening international promotional activities.

3. METHODS

Examining the stationarity of time series is the first step in econometric analysis. This examination is crucial, as most statistical methods assume that the series is stationary (Schlitzer, 1995). Common methods for testing the stationarity of time series include the ADF (Augmented Dickey-Fuller) test, Phillips-Perron (PP) test, and Kwiatkowsky-Phillips-Schmidt-Shin (KPSS) test. In this study, the ADF test was utilized to assess the stationarity of the series. The test statistics are represented by the following equation:

$$\Delta Y_t = \beta_0 + \beta_1 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

If the null hypothesis is rejected for the $k = 0,1,3,\ldots$ values, the series is accepted as stationary at the relevant level (Dickey and Fuller, 1979).

The least squares regression (LSR) model is based on three assumptions: the expected value of the errors is zero, the error variance is constant, and the errors are not autocorrelated. When these assumptions hold true, the conditional mean function - which describes how the mean of the dependent variable (y) changes with the independent variables (x) - becomes a mathematical expression that conveys important information about the relationship between the dependent and independent variables (John and Nduka, 2009).

$$\hat{y} = E\left(y|x\right) = a_0 + a_1 x_1 + a_2 x_2 + \ldots + a_2 x_2 \quad (2)$$

Therefore, when the model assumptions are satisfied, LSR produces statistically valid results. However, if these assumptions are violated, using alternative regression models, such as quantile regression models, can yield more reliable outcomes.

Since Koenker and Bassett (1978) introduced linear quantile regression theory, quantile regression (QR) has emerged as a rapidly evolving and widely applied method in recent years.

Quantile regression models enhance the understanding of traditional regression analysis and broaden the types and applications of regression models, allowing for a more accurate and detailed examination of statistical data (Koenker and Bassett, 1978).

$$Q_y\left(\tau|x\right) = a_0 + a_1 x_1 + a_2 x_2 + \ldots + a_2 x_2 + Q_u\left(\tau\right) \quad (3)$$

Quantile regression uses estimators based on general convex loss functions and order statistics. This approach enables the estimation of quantiles of the dependent variable using the quantiles of the explanatory variable. In this method, quantile estimation equations are created, and linear programming or nonparametric estimation methods are employed to estimate coefficients or unknown parameters corresponding to different quantiles (Xu, 2023). Quantile regression not only addresses the limitations of ordinary least squares (OLS) assumptions but also mitigates estimation biases caused by outliers in OLS regression. Additionally, it facilitates analysis from multiple perspectives by allowing the creation of models at various quantile levels (percentile points).

4. DATA AND FINDINGS

There are various factors that influence economic growth, depending on the economic and social structure of different countries. In the context of international trade, the exchange rate is regarded as a key indicator affecting economic growth. Additionally, it is essential to investigate whether tourism revenues have an impact on economic growth, as this is a research problem that can be analyzed statistically from a scientific perspective. Especially for Kazakhstan, examining the effect of oil revenues on economic growth is a significant research question. To minimize bias that may arise from using absolute numerical values, this study utilized the ratio of tourism and oil revenues to national income. Similarly, the real effective exchange rate index was employed to represent the exchange rate. Economic growth was monitored by analyzing the annual changes in Gross Domestic Product (GDP). The research period spans from 1995 to 2023. Data were collected from https://data.worldbank.org (Access date: April 01, 2025). Brief definitions and sources of the variables are provided in Table 2.

In the data analysis, descriptive statistics and a time path graph were presented first. Following this, a unit root test was applied to examine the changes in the data over time more closely and to prepare for the analysis of the research model. The results obtained from Ordinary Least Squares (OLS) regression and quantile regression were evaluated comparatively.

The descriptive statistics for the research period are summarized in Table 3. Upon examining the average values, we observe that the average GDP is 4.67, the average tourism revenues are 3.42, the average oil revenues are 14.16, and the average value of the real exchange rate is 90.42. Furthermore, the proximity of the average and median values supports the conclusion that the data

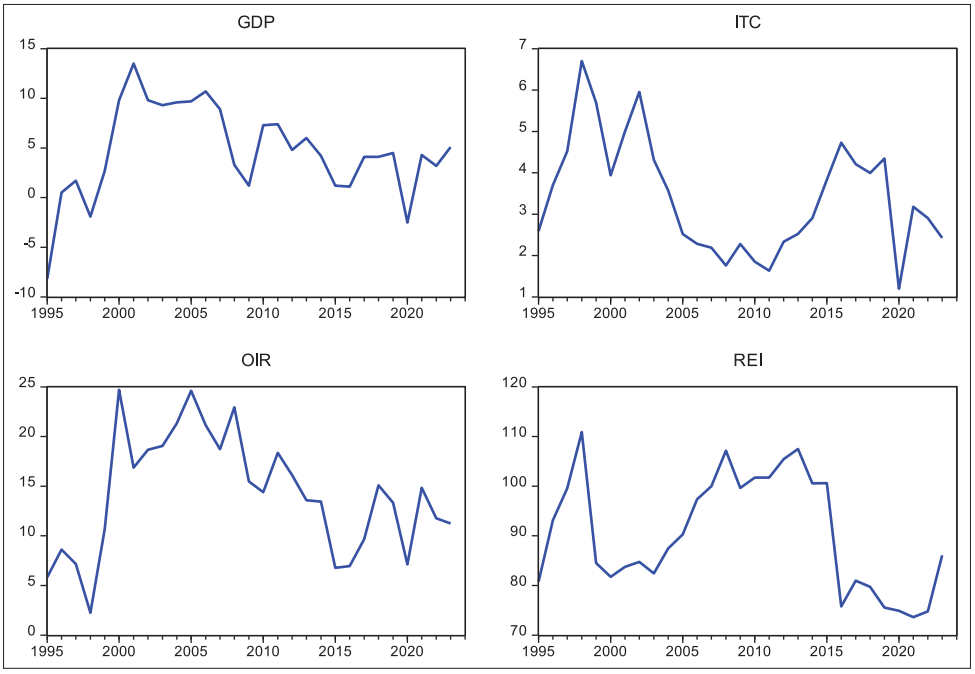
Table 2: Variable definitions and sources

Variable	Definition	Source
ITC	International tourism, receipts (% of total exports)	https://data.worldbank.org
OIR	Oil rents (% of GDP)	https://data.worldbank.org
GDP	GDP growth (annual %)	https://data.worldbank.org
REI	Real effective exchange rate index (2010=100)	https://data.worldbank.org

Table 3: Descriptive statistics findings for the variables

Statistics	GDP	ITC	OIR	REI
Mean	4.668966	3.416442	14.16292	90.42457
Median	4.300000	3.177721	14.38765	87.46652
Maximum	13.50000	6.701305	24.70221	110.8759
Minimum	−8.20000	1.195372	2.252188	73.63010
Standard Deviation	4.646205	1.381208	5.944989	11.60723
Skewness	−0.50119	0.541225	0.003260	0.131885
Kurtosis	3.468376	2.592711	2.194241	1.639443
Jarque-Bera	1.479151	1.616246	0.784559	2.320832
Probability	0.477316	0.445694	0.675515	0.313356

Graph 1: Time path graph for research variables



are normally distributed during the analysis period. According to the Jarque-Bera test for normality, all four data sets conform to a normal distribution.

The changes in the research variables over time are illustrated in Graph 1. The GDP variable shows a steady increase from 1995 to 2003, reaching a peak of 13.5. In the subsequent years, GDP exhibited a stable trajectory between 4 and 6. While tourism revenues were notably high during this time, they also displayed significant volatility, peaking at 6.7 in 2003. However, between 2007 and 2012, tourism revenues declined sharply. The lowest point occurred in 2020, when revenues fell to 1.2, likely influenced by the pandemic. Oil revenues, initially low and dropping to their lowest level of 2.3, surged significantly between 2000 and 2008, with a peak value of 24.7. From 2010 to 2015, oil revenues fell, then began to fluctuate between 5 and 15. The real exchange rate index displayed a variable trend, increasing steadily until 1998 (reaching 110.9), then declining to around 80 between 1998 and 2004. From 2005 onwards, the index rose again, consistently ranging between 100 and 110 from 2007 to 2014, before dropping below 80 after 2015.

The findings of the ADF unit root test, which examined the stationarity of the research variables, are presented in Table 4. It was found that three of the variables are stationary at the GDP level in their first difference. Accordingly, the first difference of the variables was utilized in both least squares and quantile regression analyses.

The results of the least squares linear regression analysis regarding the effect of tourism revenues, exchange rates, and oil prices on GDP are presented in Table 5. The analysis indicates that while the effect of oil revenues on GDP is positive and statistically significant, the impacts of tourism revenues and the real exchange rate index on GDP are positive but not statistically significant.

Table 4: ADF unit root test findings for the variables

Variable code	Level		1st difference	
	t- Statistics	P	t- Statistics	P
GDP	−3.61309	0.0120	−5.7631	0.0001
ITC	−2.24922	0.1946	−5.89881	0.0000
OIR	−2.63125	0.0988	−5.51167	0.0001
REI	−2.14138	0.2310	−5.60821	0.0001
Test critical values				
1% level	−3.68919		−3.69987	
5% level	−2.97185		−2.97626	
10% level	−2.62512		−2.62742	

ADF: Augmented Dickey-Fuller

Table 5: Linear regression analysis findings for the effect of tourism revenues, exchange rate, and oil price on GDP

Variable	Coefficient	SE	T-statistic	P
DITC	0.78586	0.58874	1.334801	0.1945
DOIR	0.41708	0.13379	3.117341	0.0047
DREI	0.02118	0.07561	0.2802	0.7817
C	0.39504	0.63817	0.61902	0.5417
R^2	0.29992	Prob (F-statistic)		0.033142
Adjusted R^2	0.21241			
F-statistic	3.42731			
Durbin-Watson stat	2.15629			

SE: Standard error

The quantile regression analysis calculated R-squared values of 0.171, 0.184, and 0.297 for the 0.25, 0.50, and 0.75 quantile levels, respectively. When the independent variables evaluated based on the findings presented in Table 6:

i. The effects of tourism revenues and the real effective exchange rate index on GDP were found to be insignificant at all three quantile levels
ii. Similarly, the impact of the real effective exchange rate index on GDP was also deemed insignificant at all three quantile levels

Table 6: Findings from quantile regression analysis on the effects of international tourism receipts, real effective exchange rate, and oil rents on GDP

Variable	Coefficient	SE	T-statistic	P
τ=0.25				
DITC	0.403404	0.653487	0.61731	0.5428
DOIR	0.468229	0.187974	2.490927	0.0201
DREI	−0.04533	0.088488	−0.51226	0.6131
C	−1.66946	0.908794	−1.83701	0.0786
Pseudo R2	0.171219	Quasi-LR statistic		5.710574
Adjusted R2	0.067621	Prob (Quasi-LR stat)		0.126573
τ=0.50 (Median)				
DITC	0.852046	0.815078	1.045356	0.3063
DOIR	0.569701	0.1828	3.116532	0.0047
DREI	0.071109	0.10109	0.703421	0.4886
C	0.8034	0.97571	0.8234	0.4184
Pseudo R^2	0.183815	Quasi-LR statistic		5.845309
Adjusted R^2	0.081792	Prob (Quasi-LR stat)		0.119384
τ=0.75				
DITC	0.715141	0.846731	0.844591	0.4067
DOIR	0.488467	0.155154	3.14827	0.0044
DREI	0.070637	0.0825	0.856208	0.4004
C	1.701242	0.868745	1.958274	0.0619
Pseudo R^2	0.296812	Quasi-LR statistic		11.63891
Adjusted R^2	0.208914	Prob (Quasi-LR stat)		0.008728

SE: Standard error

iii. The effect of oil revenues on GDP was determined to be significant and positive across all three quantile levels, with the strongest impact observed at the median quantile (0.50)
iv. A comparison of these findings with the least squares linear regression results shows that the findings from both methods are compatible. Furthermore, the coefficients of determination (R-squared values) for the 75% quantile regression and the least squares regression are notably close to each other.

5. CONCLUSION AND RECOMMENDATIONS

This study evaluates the effects of tourism revenues, exchange rates, and oil revenues on economic growth in the Kazakh economy utilizing the quantile regression method. The aim is to assess how these variables influence GDP at various income levels. The research is based on annual data spanning from 1995 to 2023. After testing the stationarity of the variables using the Augmented Dickey-Fuller (ADF) test, both traditional least squares (OLS) regression and quantile regression models were employed for analysis.

The findings indicate that oil revenues have a positive and statistically significant effect on GDP, consistent across all quantile levels (τ = 0.25, 0.50, 0.75), with the strongest effect at the median quantile (τ = 0.50). In contrast, while tourism revenues and the real effective exchange rate index showed a positive effect on GDP across all three quantiles, their impacts were not statistically significant. The analysis also confirmed that only the effect of oil revenues was significant in the OLS analysis. The alignment of findings from both analysis methods supports the reliability of the methodological approach applied.

Based on these results, the following policy recommendations can be proposed:

1. Reduce Dependency on Oil Revenues: The significant impact of oil revenues on economic growth highlights the Kazakh economy's heavy reliance on energy resources. To mitigate this dependency, strategies for economic diversification should focus on specific sectors, promoting investments in areas such as manufacturing, renewable energy, and the digital economy.
2. Take the Tourism Sector as a Strategic Priority: The lack of a statistically significant impact from tourism revenues indicates that the sector's potential remains underutilized. To address this, investments in infrastructure and international promotion campaigns should be increased, and projects that create employment should be supported by facilitating access to financing for SMEs in the tourism sector.
3. Review Exchange Rate Policies to Reduce Macroeconomic Fragility: The absence of a significant impact from exchange rates on economic growth suggests limited interaction between monetary policy and the real sector. Therefore, policies aimed at macroeconomic stability should be developed to reduce exchange rate volatility. Additionally, a detailed analysis of how exchange rate fluctuations affect foreign trade and investment decisions should be conducted, along with an enhancement of institutional capacity.
4. Consider Different Growth Levels for Inclusive Economic Policies: The use of the quantile regression method in this study reveals that economic variables have varying effects at different growth levels. Consequently, instead of focusing solely on average effects, policymakers should develop differentiated policy tools tailored to low and high growth periods.

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