Energy Price and Economic Growth in Kazakhstan, Uzbekistan, and Azerbaijan

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Abstract

Sustained economic growth in any nation is primarily propelled by an expanded industrial sector. Crude oil stands out as a vital prerequisite for a thriving industrial sector, making an increase in oil prices initially impact the industrial sector and subsequently influence economic growth. Therefore, the utilization of fossil oil by Kazakhstan, Uzbekistan, and Azerbaijan republics from 1991 to 2015, comparing it with the global average was approximately 1.3 times higher than the world's average, underscoring the significance of oil for these nations. Specifically, oil consumption in these countries steadily rose from 1992 to 2008, with a slight decline post-2009, nonetheless, the oil consumption of Kazakhstan, Uzbekistan, and Azerbaijan countries remains significantly higher within Central Asia, highlighting oil and gas as a key driving force for their economies.

Keywords: Economic growth, Oil price, Renewable energy, Kazakhstan, Uzbekistan, Azerbaijan

1. Introduction

In the beginning of 1991s, the use of crude oil in Kazakhstan, Uzbekistan, and Azerbaijan has increased significantly, establishing oil and gas as a critical factor driving the economies of these former CIS countries. Furthermore, the instability of oil prices has encountered fluctuation a wide range of economic and social consequences. This study looks into the influence of oil prices on economic growth of these three republics from 2013 to 2021. The analysis considers four independent variables as potential factors influencing the connection between energy prices and economic development in this context: real interest rate, exchange rate, government expenditure, and investment.

To achieve its objectives, the analysis uses a fixed effect model, and it discovers a complex interaction among energy prices and economic prosperity. It notes, in particular, that rising cost of oil only have a beneficial effect on economic output when viewed through the lens of interest rates. On the other hand, a rise in oil prices has an adverse effect on economic gain due to a several factors, including exchange rates, investment, and government spending. Since the overall impact of the study is more negative than positive, it is strongly recommended that policies be placed into effect to reduce fluctuations in oil prices. Additionally, it suggests promoting renewable energy sources that are unique to each nation (Abdelsalam, M.A.M., 2020).

Moreover, in the present context, the volatility of oil prices has been highlighted as notably high (Dehn, J. 2001). Recognizing the inherent volatility of oil prices there is a growing acknowledgment of the advantages associated with implementing appropriate energy price policies that are grounded in an understanding the link among oil prices and economic growth. Notably, between 1991 and 2011, Kazakhstan, Uzbekistan, and Azerbaijan experienced a consistent rise in their oil consumption. However, post-2013, a slight decline in oil usage was observed, which could be attributed to a shift towards the adoption of renewable energy sources.

The study's results suggest that the influence of oil prices extends beyond their direct effect on economic growth. Instead, oil prices initially influence the fundamental aspects controlling of economic sector, which then regulate the impact of oil price fluctuations on economic growth. In detail, an increase in oil prices favorable contributes to economic growth solely over its effect on interest rates. In contrast, it has a negative impact on economic sector across other factors such as exchange rates, government spending, and investment.

2. Literature Review

In the past, researchers like Darby, M.R. (1982), Hamilton, J.D. (1983), Koenker, R.; Bassett, G. (1978) have studied the connection among energy cost and economic rise. Mostly significant inquiries have highlighted how energy prices can impact economic activity from both supply and demand angles. In particular, Okonjo-Iweala (2009) and Rasche & Tatom (1974) underlined that increased unrefined oil prices might cause a lack of energy, which in turn impacts supply-side economic growth. In line with the past discussion around a connection between oil prices and economic growth, ayres and Warr (2009) noted a decrease in oil prices essentially stimulates economic development, a result that Hamilton, J.D. (1983) also empirically verified. The correlation among oil prices and economic prosperity was explored empirically for both states involved in oil inbound and outbound trade. Researchers like Jahangir, S.M.R., Dural, B.Y. (2018); Ismail, S., Farouq, I.S., Jakada, A.H., Kabiru, K. (2020); Akpan, E.O. (2009); Dabachi, U.M., Mahmood, S., Ahmad, A.U.; and others have shown that a surge in oil cost has a beneficial result on the economic growth of nations that export oil. On the other hand, researchers like Arouri, M.E.H. (2010) said that rising oil prices have a substantial effect on the industrial expansion of governments that engaged in energy resources import. Nonetheless, a numerous empirical studies, including that set by Hamilton, J.D. (1983), Bjřrnland [2000], Cavalcanti, Mohaddes, K.; Raissi, M. (2015), and others, stressed that upturn in oil prices is detrimentally affect economic growth irrespective of the circumstances and type of nation.

According to Lee and Ni (2002), energy prices primarily affect the amount that consumers and companies spend on consumption because rising oil prices have a substantial influence on consumer demand. According to Kilian (2008) and Kilian and Park (2009), the price of oil can negatively impact economic sector not solely via production costs conversely also through domestic and corporate consumption. Furthermore, Kilian (2008) emphasized that household spending might be impacted by oil prices through five different effects: income, uncertainty, precautionary, durable, and reallocation effects. The result of shifts in oil prices on actual production has been studied by academics like Bjřrnland (2000) and Akinlo, T.; Apanisile, o.T. (2015). Okonju (2009) states that there is a lot of volatility in oil prices, which is undesirable for economic activity. While Jarrett, U.; Mohaddes, K.; Mohtadi, H. (2018) explored the possibility of reducing the impact of oil price volatility on economic

growth through established financial institutions, El-anshasy et al. (2017) proposed that the adverse effects of oil price fluctuation can be prevented through effective and appropriate fiscal policies.

According to Kilian and Lewis (2011), an increase in the price of oil raises a nation's general price level, which in turn causes inflationary pressure to impact that nation's economic activity. In a similar vein, Nordhaus (2007) claimed that increases in oil prices primarily impact headline inflation as opposed to core inflation, which means households may be impacted. But according to Bernanke et al. (1997), the price of oil influences economic growth not only by raising inflation but also by raising interest rates. In order to reduce inflationary pressure, central banks raise interest rates, which may have an impact on economic growth since higher interest rates prevent investment. additionally, Liaqat, M.; Ashraf, a.; Khursheed, A. (2022) found an escalation in oil prices has a detrimental implication on country's short- and long-term economic growth while also raising the risk of inflation.

Although an extensive amount of research has shown the price of energy has a significant, adverse outcome on economic sector, several studies have generated different findings. Whereas Olomola and Adejumo (2006) and Oriakhi and Osaze (2013) demonstrated relative to other macroeconomic factors, there exists an advantageous correlation among oil prices and economic growth, Chang and Wong's (2003) study on the relationship between oil price and prosperity in Singapore found no relevant correlation among oil prices and economic expansion. Taking into account the researches on this topic, with the reference to the republics Kazakhstan, Uzbekistan, Azerbaijan, studies will be conducted on the tie among the energy rates and the economic increase of these countries.

3. Data and Methodology

The study spans the years 2013 to 2021 and focuses on three Central Asian countries: Kazakhstan, Uzbekistan, and Azerbaijan. The primary goal is to investigate the influence of rising energy rate to economic prosperity, not only by way of direct effects but also through various independent variables. According to the previous researches, oil prices are linked to key macroeconomic factors, and these variables, hence, have a plain effect on economic growth. The study investigates the relationship among crude oil prices and macroeconomic parameters such as GDP, inflation rate, interest rate, and exchange rate, using the theoretical framework recommended by Frimpong et al. (2017) with some revisions. The information for these variables was sourced from databases maintained by the World Bank and the International Monetary Fund. Actually, five variables were employed by Frimpong et al. (2017):

government consumption, inflation, interest rates, currency rates, and investment. Since inflation has a strong correlation with a few of the predictor variables in the regression model, it is not taken into account as a variable in the current research.

An uptick in oil value prompt the demand for foreign currency to rise, which in effect causes the raise in the exchange rate (depreciate), particularly in nations that import oil. The trade balance and the importing country's economic growth could both suffer from the depreciated exchange rate. The devalued exchange rate may also have an impact on investments. In addition, a higher oil price raises inflationary pressure, which in turn lowers the real interest rate. The potential for capital outflows due to a lower real interest rate has an impact on both investment and economic growth. A crucial aspect of economic prosperity is government expenditure. A surge in oil prices undoubtedly results in higher government spending, which limits the resources volume accessible in other sectors of the economy. Therefore, an uptick in oil prices may also impacts economic growth through higher government spending. One of the critical factors affecting economic growth is investment, and a higher price for oil has a negative shape on both investments and economic prosperity. Indeed, an expansion in energy rates basically raises production expenditures, discouraging investment. In this case, the previously mentioned theoretical structure can be utilized to quantify how the cost of oil or natural gas affects GDP growth by looking at how variables like the real interest rate, exchange rate, government expenditure, and investment are transmitted.

3.1 An Empirical Model

As indicated by the application, Openness (Total Trade) is regarded as an independent variable besides to the factors that is highlighted in the theoretical structure.

Table 1 Operationalization of Variables

Variable name	Description	Source
Log of RGDP	Logarithm of Real Gross Domestic production	World Development Indicators
Oil rents	Oil rents (%)	World Development Indicators
Real interest rate	Real Interest Rate (%)	International Monetary Fund
Log Government expenditure	Logarithm of Government expenditure	International Monetary Fund

Log exchange Rate	Logarithm of exchange Rate (USD)	International Monetary Fund
Log Investment	Logarithm of Foreign direct investment	World Development Indicators
Inflation	consumer price Index (%)	World Development Indicators
Openness	Total Trade (%)	World Development Indicators
Natural Gas rents	Natural Gas rents (%)	World Development Indicators

By the results of tests with absence of multicollinearity, autocorrelation, and heteroscedasticity, fixed-effects (Fe) model test was applied whenever there is an interest in examining the influence of variables that fluctuate over time (Kohler, Ulrich, Frauke Kreuter 2012). Fixed effect models are particularly valuable when dealing with panel data, where observations are made on multiple entities over time (cohen J. ,1987).

Aligning with Fe analysis, the linear regression can be expressed above:

Y = B0 + B1 + B2 + B3 + B4 + B5 + B6 + &

Here Y illustrates dependent variable, B illustrates the coefficients, B0 and & illustrate constant term and error term in turn.

Y RGDp= B0+ B1 (Oil rent) + B2(Real interest rate) + ß3 (Log Government expenditure) + B4(Log exchange rate) + ß5(Log Investment) + ß6(Inflation) + ß7(Openness) +B8 (Natural gas rents) + & (1)

The equation (1) empirically estimates the effect of independent variables on economic development.

4. Empirical results

Above provided the outcomes of the descriptive examination of the variables under consideration. The primary reason for considering the taking the logarithm of all the variables is that it smooths the data series and minimizes unwarranted variation and fluctuations in the variables. The results of stationarity, multicollinearity, autocorrelation and heteroscedasticity tests are presented below:

Figure 1 - Summary statistics of the variables

Variable	Obs	Mean	Std. Dev.	Min	Max
GDPgrowtha~l	27	3.40917	3.210836	-4.3	7.403368
Oilrentsof~P	27	10.01232	7.896137	.3568018	24.17241
Realintere~e	27	7.662731	8.336482	-5.481123	28.94544
lnRealeffe~U	27	-3.637812	3.696317	-12.8598	.571375
lnForeignd~o	25	16.87175	5.977343	.2744113	21.96874
lngovernme~U	27	19.64541	5.374674	11.82278	23.90438
Inflationc~u	27	11.18316	16.87639	1.373442	92.7613
TradeofGDP	27	60.51761	19.76331	1.628937	91.67258
Naturalgas~P	27	3.216449	2.833585	.438569	11.04127

Every variable, with the exception of the log of inflation and the Openness (total trade) variable, which exhibit slightly higher standard deviations than the other variables, has less variation from its mean values, as per the summary statistics' standard deviation. The Fixed effect panel regression (F-test) model is applicable only when referring to absence of multicollinearity, autocorrelation, and heteroscedasticity results. Figures 3 through 8 display the findings of the diagnostic tests.

Figure 2 - Correlation matrix

	GDPgro~l	Oilren~P	Realin~e	lnReal~U	lnFore~o	lngove~U	Inflat~u	Tradeo~P	Natura~P
GDPgrowtha~l	1.0000								
Oilrentsof~P	-0.3028	1.0000							
Realintere~e	-0.3868	0.3345	1.0000						
lnRealeffe~U	-0.1351	0.4618	0.2471	1.0000					
lnForeignd~o	0.0770	0.1329	-0.1268	-0.3452	1.0000				
lngovernme~U	0.4631	-0.7401	-0.4525	-0.8176	0.2964	1.0000			
Inflationc~u	-0.0494	-0.1224	0.3641	0.1123	-0.4028	-0.1284	1.0000		
TradeofGDP	-0.0556	0.5247	0.2901	0.2446	0.4449	-0.3677	0.1087	1.0000	
Naturalgas~P	0.5807	-0.2768	-0.3847	0.1283	-0.1854	0.0772	0.0205	0.0499	1.0000

The correlation analysis indicates that there is a positive correlation between independent variables, the natural gas rents and economic growth of 58 %, and independent variables oil rents and Total Trade of 52 %. However, it shows contrary association, especially in connection with Real effective exchange rate and log of government expenditure (-81,76 %), oil rents and LnGovernemnent expenditure (-74%).

Figure 3: Levin-Lin-chu unit-root test

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Levin-Lin-Chu unit-root test for GDPgrowthannual
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Ho: Panels contain unit roots                Number of panels  =      3
Ha: Panels are stationary                    Number of periods =      9

AR parameter: Common                         Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 6.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t         -5.8689
 Adjusted t*          -2.1997        0.0139
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When the p-value falls below a selected significance level (usually 1%/5%/10%), it implies the non-stationarity null hypothesis ought to be rejected. The p-value of 0.0139 in this instance proposes that stationarity is possible.

Figure 4 - Variance Inflationary Factor (VIF)

Variable	VIF	1/VIF
lngovernme~U	8.60	0.116266
Oilrentsof~P	4.26	0.234710
lnRealeffe~U	3.86	0.259335
lnForeignd~o	3.11	0.321386
TradeofGDP	3.05	0.327339
Realintere~e	1.92	0.521159
Naturalgas~P	1.78	0.563193
Inflationc~u	1.77	0.565895
Mean VIF	3.54	

The findings show that every variable has a mean VIF of less than 5, which is a respectable degree of multicollinearity.

Figure 5 - Autocorrelation for GDP growth

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Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,       2) =      0.942
           Prob > F =      0.4342
```

The computed p-value of 0.4342 indicates the dataset does not appear to contain any significant autocorrelation.

Figure 6: The test determines if the residuals of the models indicate homoscedasticity (homo) or heteroscedasticity (hetero).

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. lrtest hetero homo, df(24)

Likelihood-ratio test                                 LR chi2(24) =      1.59
(Assumption: homo nested in hetero)                   Prob > chi2 =    1.0000
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Considering the p-value of 1.0000, the test indicates the absence of heteroscedasticity. After conducting all required tests and obtaining results indicating the absence of autocorrelation, heteroscedasticity, and multicollinearity, the Hausman test was conducted.

Figure 7 - Hausman test

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                 ---- Coefficients ----
                 (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                  fe           re         Difference          S.E.
-------------------------------------------------------------------------------
Oilrentsof~P     .7095036     .3082482       .4012554               .
Realintere~e     .0686496     .0538301       .0148195               .
lnRealeffe~U     .4665567     .6346341      -.1680774               .
lnForeignd~o     .0550638    -.0146508       .0697146               .
lngovernme~U     .7598888     .9776488      -.2177599        .6659873
Inflationc~u     .0533502     .0199933        .033357               .
  TradeofGDP    -.042048    -.0173719      -.0246761               .
Naturalgas~P     .3818628     .7209501      -.3390873               .
-------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       41.25
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

In the Hausman test, obtaining a p-value of 0.0000 suggests strong evidence against the null hypothesis concerning the consistency of coefficients between the models with fixed effects and random effects. This implies that, in this particular case, the fixed effects model is more reliable than the random effects model.

Figure 8 - Fe model, with Time dummy variables

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Fixed-effects (within) regression               Number of obs      =        25
Group variable: ID                              Number of groups   =         3

R-sq:                                           Obs per group:
     within  = 0.9318                                         min =         7
     between = 0.2128                                         avg =       8.3
     overall = 0.3354                                         max =         9

                                                F(12,10)           =     11.38
corr(u_i, Xb)  = -0.8799                        Prob > F           =    0.0003
```

GDPgrowthannual	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
OilrentsofGDP	.4259238	.127021	3.35	0.007	.1429034	.7089442
Realinterestrate	.1354234	.0428882	3.16	0.010	.0398625	.2309844
lnRealeffectiveexchangerateU	.1856958	.1482124	1.25	0.239	-.1445419	.5159335
lnForeigndirectinvestmentneto	.0355911	.0745386	0.48	0.643	-.1304912	.2016733
lngovernmentexpenditurecurr~U	1.776399	.6681325	2.66	0.024	.2877067	3.265091
Inflationconsumerpricesannu	.009251	.0236476	0.39	0.704	-.0434391	.0619411
TradeofGDP	-.0036663	.0240372	-0.15	0.882	-.0572244	.0498919
NaturalgasrentsofGDP	.1329979	.1577538	0.84	0.419	-.2184995	.4844953
_IYear_2014	-.3558525	.8270119	-0.43	0.676	-2.19855	1.486845
_IYear_2015	-.0999742	.9131961	-0.11	0.915	-2.134702	1.934754
_IYear_2019	-.77802	.9973864	-0.78	0.453	-3.000335	1.444295
_IYear_2020	-4.440045	1.378113	-3.22	0.009	-7.510672	-1.369418
_cons	-35.80171	12.45429	-2.87	0.017	-63.55161	-8.051817
sigma_u	6.8550759					
sigma_e	1.0719561					
rho	.97613082	(fraction of variance due to u_i)				

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F test that all u_i=0: F(2, 10) = 18.37                     Prob > F = 0.0004
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Figure 8 displays the findings of fixed effect model analyses comparing the independent and dependent variables (GDP growth). The real interest rate (p-value of 0.01), and the oil rents (p-value of 0.007), both demonstrate a significant correlation with economic growth indicators. The pandemic period results for this variable in 2020 are likewise less than 5%. GDP growth is specifically harmed by total trade (-0.0036). Moreover, the recession of 2014–2015 and the pandemic 2019–2020 period show that all variables negatively affect on GDP growth.

4. 1 Coefficient Interpretation

Oil rents: The coefficient, currently at 0.4259238, indicates that there is a 0.426-unit growth in GDP for every incremental increase in oil rent. Real interest rate: a rise in Real Interest rate of one unit is correlated with a rise in GDP growth of 0.1354 units. A one-unit increase in the Lnreal effective exchange rate is linked to a 0.186-unit increase in Gross Domestic Product, according to parameter of 0.1857 for lnRealeffectiveexchangerateU.

LnForeign direct investment: Given the large p-value (0.643) and the lack of statistical significance, it appears that there is no reliable interrelation among adjustments in this variable and changes in GDP. A significant increase in GDP growth of 1.7764 units is correlated with a one-unit increase in the log government expenditure (lngovernmentexpenditurecurrU). Consumer prices and inflation (p-value = 0.704): This variable also doesn't seem to be statistically significant. Similarly, total trade (p-value = 0.882) does not appear to be statistically significant. Natural gas rents: Reflecting a level of 0.419, this variable also outlines lack of statistically significance. In short, there appears to be no statistically significant evidence of correlation between the log of financial direct investment, inflation, openness (total trade), and natural gas rent in Kazakhstan, Uzbekistan, and Azerbaijan and annual GDP growth. The comparatively high p-values for these variables imply that there is no consistent correlation between changes in these variables and changes in economic growth. In summary, it can be stated the important variables—oil rent, real interest rate, real effective exchange rate, and government spending—are likely to influence changes in annual GDP growth.

5. Conclusion

This study looks at how energy prices affect the economies of Kazakhstan, Uzbekistan, and Azerbaijan. The study's selection of these three countries is based on data availability, with the study relying mainly on data obtained from the World Bank's World Development Indicators from 2013 to 2021, and statistics that shows about energy consumption of these countries. Economic growth is examined using four intermediary variables: real interest rate, exchange rate, government expenditure and investment, and energy rents. Fixed effect model analysis is used to estimate the empirical models, which include lagged independent variables as instruments.

The primary factors influencing economic growth in the countries under consideration, as per the estimated growth equation, include the economic growth of the past year, interest rates, government spending, exchange rates, investment, inflation, and openness. Furthermore, the analysis verifies that in Kazakhstan, Uzbekistan, and Azerbaijan, the log of financial direct investment, inflation, openness (total trade), and natural gas rent appear not to have statistically significant predictors of annual GDP growth. Although the prices of oil and gas are positively impacted by oil rent, real interest rates, the log of the real effective exchange rate, and government spending, these factors have beneficial effect to the GDP of these nations. The estimated findings reveal the oil cost has a variable result on economic expansion.

Since the rise in energy cost affects economic growth in a variety of ways, the study strongly advises implementing the necessary policies to minimize fluctuations in oil prices while supporting the utilization of country-specific renewable energy sources.

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