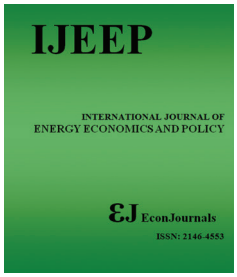

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Analysis of the Effect of Oil and Energy Production on Health and Education Expenditures in Kazakhstan with Autoregressive Distributed Lag Method

Zhazira Taibek[1], Indira Kozhamkulova[1], Almas Kuralbayev[2], Bagdat K. Spanova[3], Kundyz Myrzabekkyzy[4]*

[1]M. Auezov South Kazakhstan University, Shymkent, Kazakhstan, [2]Branch of the Academy of Public Administration under the President of the Republic of Kazakhstan Turkestan, Kazakhstan, [3]Karaganda University of Kazpotrebsoyuz, Karaganda, Kazakhstan, [4]Khoja Akhmet Yassawi International Kazakh-Turkish University, Turkestan, Kazakhstan. *Email: kundyz.myrzabekkyzy@ayu.edu.kz

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ABSTRACT

This study analyzes the impact of Kazakhstan's oil and energy production between 2000 and 2020 on government expenditures on health and education. Kazakhstan's total crude oil and natural gas production, gas fuel production and distribution, domestic general government health expenditures (% of GDP), out-of-pocket health expenditures (% of total health expenditures), and government expenditures on education (% of GDP) are included. ARDL analysis showed that oil and natural gas production has an impact on government expenditures on health and education. Moreover, the boundary value proved that this effect exists in both the short and long terms. ARDL analysis also showed that oil and natural gas production has a short-term effect on out-of-pocket health expenditures, but not in the long term. These findings can be interpreted as there are scientific grounds to expect that the impact of energy production on government investments in education and health will continue in the future.

Keywords: Kazakhstan, Oil, Energy, Education, Health, ARDL
JEL Classifications: C13, C20, C22

1. INTRODUCTION

After the disintegration of the Soviet Union, the former Soviet republics went through a transitional period. During this period, they integrated with the global markets to strengthen their economies and raise the welfare of their citizens. As in other countries, this transition period had been painful in Kazakhstan. However, Kazakhstan has made significant progress in terms of economic growth since 2000. The natural resources of Kazakhstan and the structural reforms implemented by the government provided the basis for this rapid development. Among the major structural reforms, we can count the price liberalization movement in 1992, the introduction of the national currency in November 1993, the recognition of private property rights in the new Constitution adopted in January 1993, and the National Privatization Program in 1993 (Aldıbekova, 2018). Kazakhstan holds about 3% of the world's total oil reserves, about 1.1% of natural gas reserves, and about 3.3% of coal reserves. Thanks to the natural resources policies, Kazakhstan had become one of the fastest-growing countries in the world after gaining independence (Mudarissov and Lee, 2014; Xiong, et al., 2015; Myrzabekkyzy et al., 2022; Bolganbayev, et al., 2022). This rapid change, transformation, and growth have placed the Kazakhstan economy in second place after Russia in terms of economic size among the former Soviet republics (Mukhtarov, et al., 2020). But this rapid growth also made Kazakhstan sensitive to fluctuations in world markets, especially the volatility in oil prices (Kelesbayev et al., 2022).

The economic development of an energy-producing country is directly proportional to the effective allocation of its income from

energy exports. Energy exports constitute a significant part of their budget revenues. Therefore, an increase in this income directly increases the quality of life (health, education, transportation, shelter, entertainment, food, etc.) of their people (Alesina and Rodrik, 1994; Bulut et al., 2014). Education and health, which are important components of the economic development and human capital of a country, are also important indicators of the welfare and development of a society (Kızıl and Ceylan, 2018). This inspired this study to analyze the impact of Kazakhstan's oil and energy production revenues on health and education expenditures between 2000 and 2020. Kazakhstan's total crude oil and natural gas production, gas fuel production and distribution, domestic general government health expenditures (% of GDP), out-of-pocket health expenditures (% of total health expenditures), and government expenditures on education (% of GDP) are included. Data were obtained from the National Statistical Bureau of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan and the World Bank.

2. LITERATURE REVIEW

After the disintegration of the USSR, Kazakhstan gained an important position among the developing countries due to its natural resources and its integration with the global economy through structural reforms. Hence the abundance of studies on different dimensions of Kazakhstan's economy. Many studies used cointegration and ARDL models. Since it is impossible to exhaust this extensive literature within the confines of this study, we will only mention the important ones for this study.

Ayoub (2019) conducted a study on the link between government revenues, money supply, and gross domestic product in China, and used the ARDL model, time series, and secondary data from China's national statistics office (1990-2018). He took Gross Domestic Product as the dependent variable and money supply and government revenue as the independent variables. His findings showed that the independent variable has a positive significant effect on GDP.

Ajide et al. (2017) used the ARDL model in their study on the impact of the banking crisis on the entry of foreign firms into Nigeria. Their results proved that the banking crisis had a negative effect in the short run and a positive effect in the long run. Their analysis also showed that during the Nigerian banking crisis, new firm entries increased due to liquidity problems experienced by the formal financial sector.

Lawal et al. (2017) analyzed the data from 1981 to 2015 using the ARDL model in their study on Capital Flight and Economic Growth in Nigeria. Their research variables were current account balance, capital flight, foreign direct investments, foreign exchange reserve, inflation rate, foreign debt, and real gross domestic product. Their results proved that capital flight harms Nigeria's economic growth.

Aytaç and Akdoğan (2020), in their study on the effect of industrial production on health expenditures in Turkey, examined the long-term relationships between industrial production and economic growth and health expenditures in Turkey between 1975 and 2018 using boundary testing. They also used the ARDL model. Their research concluded that there is a long-term relationship between health expenditures and industrial production and GDP. It has also been proven that there is no significant relationship between industrial production, GDP, and health expenditures in the short term and that the changes in industrial production and GDP affect health expenditures positively in the long term.

Bulut et al. (2014) used cointegration and error correction methods in their studies on the effect of oil revenues on the living standards in oil-exporting ex-USSR countries (Russia, Kazakhstan, and Azerbaijan). They found that oil revenues increased the standard of living in all three countries, and that dependence on oil revenues changed the structure of their economies, which in turn led to employment-based income inequality in different sectors.

Suleymanov et al. (2017) comparatively analyzed the shares of social expenditures in the national budgets of Russia, Kazakhstan, and Azerbaijan between 1992 and 2015. The results showed that basic social expenditures such as education, health, and defense increased as oil revenues increased. However, social spending also declined during times of low oil prices.

Aldıbekova (2018) analyzed the effect of oil prices on the economy of Kazakhstan using the data between 1993 and 2016 and focused especially on the structure of the global oil market, the general status of the Kazakh economy, and the effect of oil price fluctuations. They showed that the fluctuations in the oil markets disrupted the national economy since it is the main income for the country, and recommended long-term investments in different sectors to reduce the share of oil in Kazakhstan's total exports.

Kızıl and Ceylan (2018) examined the effect of health expenditures on economic growth in Turkey. They examined the effects of health expenditures and the population over 65 years old on economic growth in Turkey from 1979 to 2015 using the ARDL model and FMOLS, DOLS, and CCR estimation methods. They used the endogenous growth model to associate human capital accumulation with health expenditures. They determined a positive and statistically significant relationship between health expenditures per capita and economic growth.

Erdoğan et al. (2020) used data between 2001 and 2017 in their studies on the relationship between oil revenues and education in the members of the Gulf Cooperation Council, namely Kuwait, Qatar, Bahrain, and Oman. The total number of students enrolled in post-secondary education and general programs and the number of students enrolled in general and private high school education institutions are taken as the indication of education. ARDL model and group mean DOLS tests were used. They determined a long-term negative relationship between oil revenues and education level in these countries and concluded that these countries do not have a strong awareness of the importance of education and do not allocate sufficient resources to develop human capital.

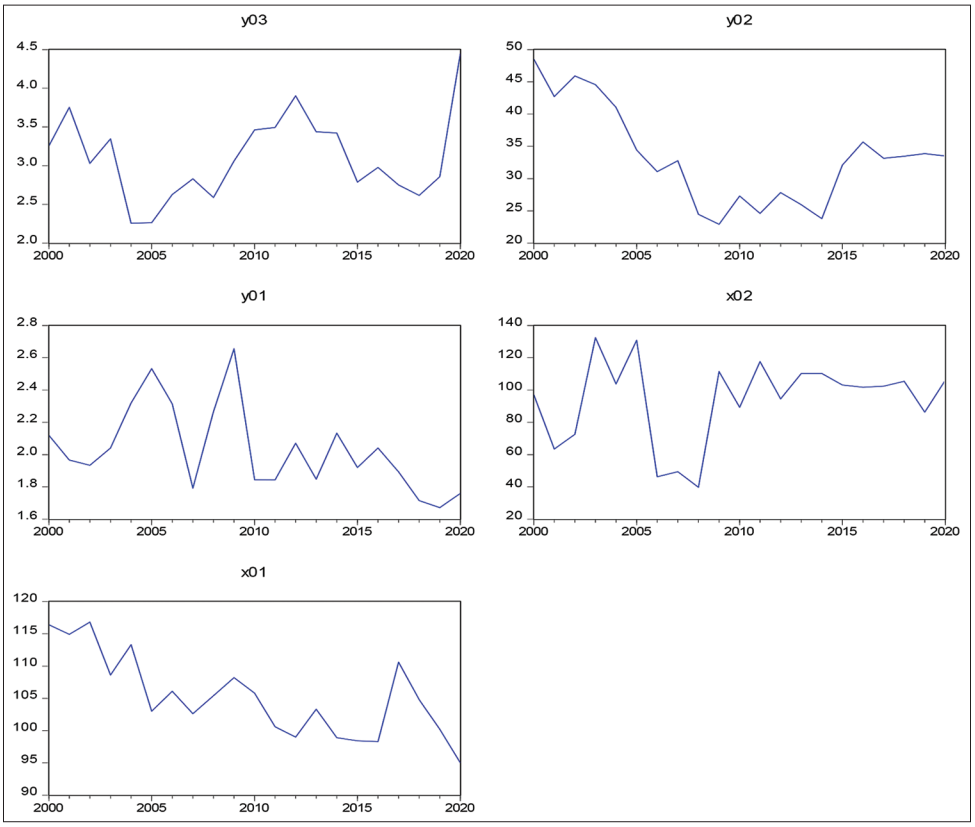
3. METHOD AND DATA

This study analyzed the impact of oil and energy production on health and education expenditures in Kazakhstan. The

Table 1: Research variables and data sources

Variable code	Name	Source
X01	Production of crude oil and natural gas	https://stat.gov.kz/official/industry/63/statistic/8
X02	Production and distribution of gas fuel	https://stat.gov.kz/official/industry/63/statistic/8
Y01	Domestic general government health expenditure (% of GDP)	https://data.worldbank.org/indicator/SH.XPD.GHED.GD.ZS?locations=KZ
Y02	Out-of-pocket expenditure (% of current health expenditure)	https://data.worldbank.org/indicator/SH.XPD.OOPC.CH.ZS?locations=KZ
Y03	Government expenditure on education, total (% of GDP)	https://data.worldbank.org/indicator/SE.XPD.TOTL.GD.ZS?locations=KZ

Graph 1: Line chart of research variables



independent variables include crude oil and natural gas production (X01), fuel gas production and distribution (X02), government health expenditures (% of GDP) (Y01), out-of-pocket health expenditures (% of total health expenditures) (Y02) and government spending on education (% of GDP) (Y03). The years 2000-2020 (21 years) were chosen as the research period. Research variable codes and data sources are given in Table 1.

The effects of oil and energy production on health and education expenditures are analyzed using ARDL and the boundary value approach. This method was developed by Pesaran et al. (2001). The strength of the method is that it does not seek the same level of stationarity as other causality or cointegration methods (such as Engle-Granger and Johansen cointegration). In the ARDL method, it is sufficient for the data to be stationary at the level or first difference.

ARDL model was established for the effect of independent variables on each dependent variable.

Model 1:

$$\Delta y01 = \sum_{i=1}^{p} \alpha_i \Delta y01_{t-i} + \sum_{i=1}^{p} \beta_{1i} \Delta x01_{t-i} + \sum_{i=1}^{p} \beta_{2i} \Delta x02_{t-i} + \delta y01_{i-1} + \theta_1 x01_{t-1} + \theta_2 x02_{t-1} + \varepsilon_t \quad (1)$$

Model 2:

$$\Delta y02 = \sum_{i=1}^{p} \alpha_i \Delta y02_{t-i} + \sum_{i=1}^{p} \beta_{1i} \Delta x01_{t-i} + \sum_{i=1}^{p} \beta_{2i} \Delta x02_{t-i} + \delta y02_{i-1} + \theta_1 x01_{t-1} + \theta_2 x02_{t-1} + \varepsilon_t \quad (2)$$

Model 3:

$$\Delta y03 = \sum_{i=1}^{p} \alpha_i \Delta y03_{t-i} + \sum_{i=1}^{p} \beta_{1i} \Delta x01_{t-i} + \sum_{i=1}^{p} \beta_{2i} \Delta x02_{t-i} + \delta y03_{i-1} + \theta_1 x01_{t-1} + \theta_2 x02_{t-1} + \varepsilon_t \quad (3)$$

Stationarity in time series is analyzed using various unit root tests. The Enhanced Dickey-Fuller (ADF Augmented Dickey-

Fuller) test is used. The following equation gives the test statistic:

$$\Delta Y_t = \beta_0 + \beta_1 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \quad (4)$$

In the ADF test, if the null hypothesis is rejected, the series is deemed stationary at the relevant level (Sevüktekin and Nargeleçekenler, 2007).

4. ANALYSIS AND RESULTS

Explanatory statistics of the research variables are given in Table 2 and their changes over time are given in Graph 1. Explanatory statistics show that all variables comply with the normal distribution according to the Jarque-Bera test.

ADF unit root test results regarding the stationarity of the variables are given in Table 3. The findings show that the X02 variable is stationary at the level and the X01, Y01, Y02, and Y03 variables are stationary at the first difference. Thus, for ARDL analysis, it was seen that the condition of being stationary at the level or first difference was met.

The findings of the analysis of the effect of oil and natural gas production on government expenditures on health (Y01) with the ARDL (4, 4, 4) model are given in Table 4. The findings show that the 1 and 2 periods lagged values of the Y01 variable, the value of the X01 variable 2 periods ago, and the values of the X02 variable at level, 2 periods and three periods ago are effective on the level value of the Y01 variable. LM and ARCH tests showed that there was no autocorrelation and varying variance problem in the lagged model. The results of the boundary test and cointegration test, which is the last stage of the analysis, are given in Table 5. The adjusted R-square value of the model was 92.2%. As seen in Graph 2, this shows that the predictive power of the model is high for Y01.

The findings obtained from the analysis of the effect of oil and natural gas production on out-of-pocket expenditures (Y01) with the ARDL (1, 4, 4) model are given in Table 6. The findings show that the 1-period lagged value of the Y02 variable and the 1-period-lagged value of the X02 variable is effective on the level value of the Y02 variable. LM and ARCH tests showed that there was no autocorrelation and varying variance problem in the lagged model. The results of the boundary test and cointegration test, which is the last stage of the analysis, are given in Table 5. The adjusted R-square value of the model was 91.7%. As seen in Graph 3, this shows that the predictive power of the model is high for Y02.

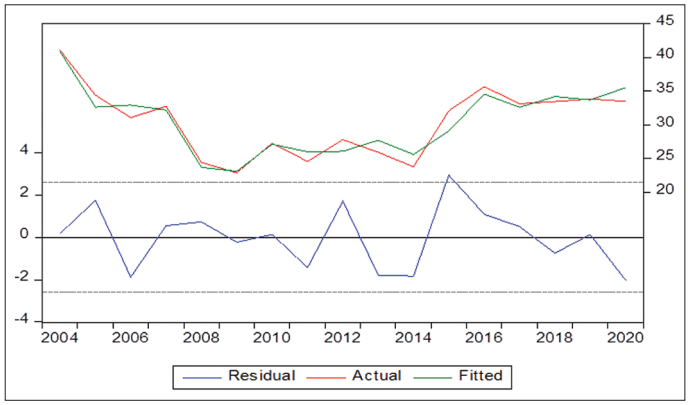
The findings obtained from the analysis of the effect of oil and natural gas production on government education expenditures (Y03) with the ARDL (4, 2, 3) model are given in Table 7. Findings showed

Table 2: Descriptive statistics of research variables

Statistics	Y03	Y02	Y01	X02	X01
Mean	3.103	33.313	2.032	94.005	105.248
Median	3.03	33.144	1.966	102.4	104.8
Maximum	4.446	48.511	2.656	132.4	116.8
Minimum	2.256	22.913	1.671	39.7	95
Standard Deviation	0.546	7.585	0.264	26.006	6.357
Skewness	0.542	0.481	0.81	0.749	0.413
Kurtosis	3.02	2.263	2.939	2.709	2.158
Jarque-Bera	1.03	1.284	2.301	2.038	1.217
Probability	0.598	0.526	0.316	0.361	0.544
Observations	21	21	21	21	21

Graph 2: Observed, estimated, and residual value charts of model 1 developed for the government health expenditures

Graph 3: Observed, estimated, and residual value charts of model 1 developed for the out-of-pocket health expenditures by citizens



Graph 4: Observed, estimated, and residual value charts of model 3 developed for the education expenditures by state

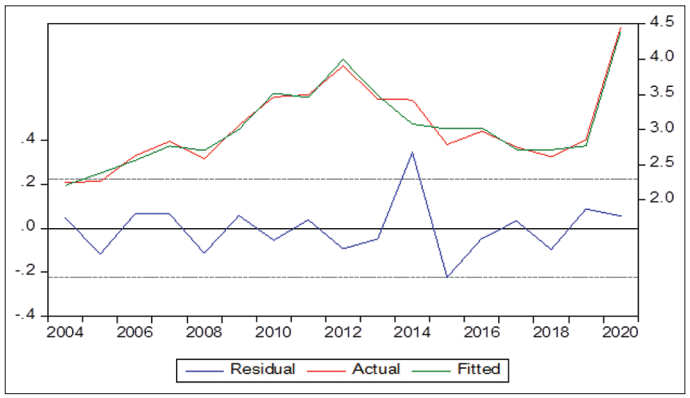


Table 3: Augmented dickey-fuller test findings regarding stationarity of research variables

Variables and critical values	Level		First diference		Conclusion
	t- Statistics	P-value	t- statistics	P-value	
X01	−2.135	0.234	−3.948	0.009	I (1)
X02	−3.783	0.012	−4.339	0.004	I (0)
Y01	−2.908	0.062	−5.984	0.000	I (1)
Y02	−2.213	0.208	−4.513	0.002	I (1)
Y03	−1.979	0.293	−3.961	0.008	I (1)
Test critical values:					
1% level	−3.809		−3.887		
5% level	−3.021		−3.052		
10% level	−2.65		−2.667		

Table 4: ARDL analysis findings for model 1

Variable	Coefficient	Standard Error	t-Statistic (Prob.)
Y01(−1)	1.464	0.19	7.696 (0.017)
Y01(−2)	1.655	0.3	5.514 (0.031)
Y01(−3)	0.655	0.146	4.471 (0.047)
Y01(−4)	0.54	0.172	3.137 (0.088)
X02	0.041	0.005	8.318 (0.014)
X02(−1)	−0.006	0.002	−2.752 (0.111)
X02(−2)	−0.013	0.002	−7.5 (0.017)
X02(−3)	0.03	0.004	7.336 (0.018)
X02(−4)	0.009	0.002	4.303 (0.05)
X01	−0.006	0.009	−0.665 (0.575)
X01(−1)	−0.013	0.007	−2.027 (0.18)
X01(−2)	0.098	0.015	6.455 (0.023)
X01(−3)	0.012	0.007	1.772 (0.218)
X01(−4)	−0.021	0.011	−1.924 (0.194)
C	−19.993	2.809	−7.117 (0.019)
R-squared	0.99		
Adjusted R-squared	0.922		
F-statistic (Prob.)	14.589 (0.066)		
Durbin-Watson stat	3.106		
LM (Prob.)	10.515 (0.19)		
ARCH (Prob.)	3.087 (0.101)		

Table 5: Boundary test results

Test Statistic (F - Statistic)	Value	k
Model I	27.231	2
Model II	4.894	2
Model III	18.704	2
Critical value bounds		
Significance level	I (0)	I (1)
10%	2.915	3.695
5%	3.538	4.428
1%	5.155	6.265

that the 2-period lagged value of Y02, level, 2, and 3-period lagged values of X01, level and 1 period lagged values of X02 are effective on the level value of Y03. LM and ARCH tests showed that there was no autocorrelation and varying variance problem in the lagged model. The results of the boundary test and cointegration test, which is the last stage of the analysis, are given in Table 5. The adjusted R-square value of the model was 95.4%. As seen in Graph 4, this shows that the predictive power of the model is high for Y02.

Boundary test findings for the three models developed in the study are given in Table 5. The F value calculated for Model I and Model III is above the limit value. This result shows that there is cointegration between the variables. Therefore, long-term relationship analysis should also be done for these two models. The F value calculated for Model II is lower than the limit value. Accordingly, it was decided that there was no cointegration in the variables in this model.

Table 6: ARDL analysis findings for model 2

Variable	Coefficient	Standard Error	t-Statistic (Prob.)
Y02(−1)	0.653	0.244	2.677 (0.044)
X02	−0.123	0.058	−2.121 (0.087)
X02(−1)	0.161	0.046	3.499 (0.017)
X02(−2)	−0.005	0.035	−0.14 (0.894)
X02(−3)	−0.078	0.067	−1.165 (0.296)
X02(−4)	0.067	0.037	1.836 (0.126)
X01	−0.119	0.332	−0.359 (0.735)
X01(−1)	0.03	0.204	0.146 (0.89)
X01(−2)	−0.303	0.278	−1.089 (0.326)
X01(−3)	0.401	0.223	1.798 (0.132)
X01(−4)	−0.463	0.241	−1.924 (0.112)
C	55.498	59.098	0.939 (0.391)
R-squared	0.917		
Adjusted R-squared	0.734		
F-statistic (Prob.)	5.023 (0.044)		
Durbin-Watson stat	2.386		
LM (Prob.)	0.572 (0.492)		
ARCH (Prob.)	0.549 (0.471)		

Table 7: ARDL analysis findings for model 3

Variable	Coefficient	Standard Error	t-Statistic (Prob.)
Y03(−1)	0.415	0.183	2.26 (0.073)
Y03(−2)	−0.743	0.262	−2.839 (0.036)
Y03(−3)	−0.205	0.38	−0.539 (0.613)
Y03(−4)	−0.615	0.309	−1.992 (0.103)
X02	0.01	0.003	2.905 (0.034)
X02(−1)	0.012	0.004	2.806 (0.038)
X02(−2)	−0.004	0.004	−0.991 (0.367)
X01	−0.08	0.019	−4.177 (0.009)
X01(−1)	−0.033	0.027	−1.204 (0.283)
X01(−2)	−0.066	0.023	−2.815 (0.037)
X01(−3)	0.047	0.014	3.348 (0.02)
C	18.457	2.359	7.825 (0.001)
R-squared	0.954		
Adjusted R-squared	0.854		
F-statistic (Prob.)	9.487 (0.011)		
Durbin-Watson stat	2.935		
LM (Prob.)	2.152 (0.216)		
ARCH (Prob.)	0.669 (0.427)		

The cointegration analysis findings for the effect of the X01 and X02 variables on the Y01 variable are given in Table 8. The findings show that the long-term effect of both variables on Y01 is statistically significant. In addition, in terms of short-term effects, both the past values of the Y01 and the past values of the X01 and X02 are effective on Y01.

The error correction coefficient is statistically significant at 3.314 and that shows that a one-unit deviation in the variables in the short term will reach equilibrium again in 1/3.314 = 0.30 years, which is approximately 4 months.

The cointegration analysis findings regarding the effect of the X01 and X02 variables on the Y02 variable are given in Table 9. The findings show that the long-term effect of both variables on Y02 is statistically significant. In addition, in terms of short-term effects, both the past values of the Y02 variable and the past values of the X01 and X02 variables are effective on Y02.

The error correction coefficient is statistically significant at −2,147 and that shows that a one-unit deviation in the variables in the short term will reach equilibrium again in ½,147 = 0,47 years, which is approximately 6 months.

Table 8: Short - and long - term ımpact estimates for model 1

Variable	Coefficient	Standard Error	t-Statistic (Prob.)
Short-run regression			
D (Y01(−1))	−2.85	0.167	−17.105 (0.003)
D (Y01(−2))	−1.195	0.086	−13.936 (0.005)
D (Y01(−3))	−0.54	0.069	−7.779 (0.016)
D (X02)	0.041	0.002	18.677 (0.003)
D (X02(−1))	−0.025	0.002	−13.884 (0.005)
D (X02(−2))	−0.038	0.002	−16.844 (0.004)
D (X02(−3))	−0.009	0.001	−9.947 (0.01)
D (X01)	−0.006	0.003	−1.627 (0.245)
D (X01(−1))	−0.09	0.005	−17.064 (0.003)
D (X01(−2))	0.009	0.004	2.049 (0.177)
D (X01(−3))	0.021	0.004	4.669 (0.043)
CointEq(−1)	3.314	0.201	16.502 (0.004)
Long run regression			
X02	−0.018	0.001	−13.59 (0.005)
X01	−0.021	0.004	−4.985 (0.038)
C	6.033	0.553	10.901 (0.008)

Table 9: Short - and long -term ımpact estimates for model 3

Variable	Coefficient	Standard error	t-Statistic (Prob.)
Short-run regression			
D (Y03(−1))	1.562	0.173	9.009 (0)
D (Y03(−2))	0.819	0.173	4.734 (0.005)
D (Y03(−3))	0.615	0.216	2.85 (0.036)
D (X02)	0.01	0.002	4.163 (0.009)
D (X02(−1))	0.004	0.002	1.611 (0.168)
D (X01)	−0.08	0.012	−6.677 (0.001)
D (X01(−1))	0.018	0.014	1.341 (0.238)
D (X01(−2))	−0.047	0.011	−4.382 (0.007)
CointEq(−1)	−2.147	0.196	−10.941 (0)
Long run regression			
X02	0.008	0.002	4.056 (0.01)
X01	−0.061	0.011	−5.781 (0.002)
C	8.596	1.194	7.198 (0.001)

5. CONCLUSION AND RECOMMENDATIONS

Oil, natural gas, and energy production have a significant impact on the economic development of a country. Naturally, this is expected to have an impact on health and education expenditures, which are an indicator of citizens' quality of life. Therefore, in this study, we analyzed the impact of oil and natural gas production on health and education expenditures. The ARDL analysis showed that oil and natural gas production has an impact on government spending or investments in health and education. In addition, boundary test analysis showed that this effect is present both in the short term and in the long term. The ARDL method showed that although oil and natural gas production has a short-term effect on out-of-pocket health expenditures, it has no effect in the long term. This can be interpreted as a scientific expectation that the impact of energy production on government investments in education and health will continue in the future. Another finding is that the structure of the long-term relationship between education and health investments and energy and oil production balances in a very short time.

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