

Resource wealth and human capital: Examining the impact of oil price shocks on higher education spending in Algeria

Binafou FASSA¹, Rafika ZIDAT²

¹University of Bejaia (Algeria), Laboratory of Economic and Development. e-mail: binafou.fassa@univ-bejaia.dz

²University of Bejaia (Algeria), Laboratory of Economic and Development. e-mail: rafika.zidat@univ-bejaia.dz

Received: 10/01/2026

Accepted: 21/04/2026

Published: 30/04/2026

Abstract:

This study examines the relationship between international oil price volatility and public expenditure on higher education in Algeria. Although oil wealth is commonly viewed as a driver of economic development, empirical research often underscores the “resource curse” phenomenon, wherein dependence on commodity exports impedes long-term growth. Drawing on the Dutch Disease framework of resource dependence, this research analyzes how fluctuations in hydrocarbon revenues shape government allocations to the education sector, a fundamental component of human capital formation. Using annual time-series data, the study applies an Autoregressive Distributed Lag (ARDL) cointegration approach to assess both short- and long-run dynamics between oil price shocks and educational spending. The results aim to identify the extent to which Algeria’s higher education funding is vulnerable to global energy market cycles, thereby offering evidence-based policy recommendations to insulate human capital investment from oil revenue instability.

Keywords: Oil Price Volatility; Public higher education expenditure; Resource curse hypothesis; ARDL Bounds Testing Approach; Human capital investment.

JEL Classification codes : Q32, I22, C22

1. INTRODUCTION

At first glance, oil appears to be a precious resource that drives economic development in countries that have it, compared to those that do not. However, since the end of the 20th century, numerous empirical studies seem to show the opposite. Indeed, several authors have observed that the significant revenues generated by oil or international increases in oil prices are a curse for the beneficiary countries. This stems from a development strategy focused on the large-scale exploitation and export of hydrocarbons (Matsuyama, 1992) ;(Corden & Neary, 1982). The basic theoretical analysis is known as the Dutch disease, developed in the 1960s following major discoveries of natural gas and oil in the Netherlands. It is a theory "*focused on assessing the effects of massive exports of natural resources such as hydrocarbons on the growth of the various sectors that make up the economy*" (Arzelier, 1998). A second analysis focusing purely on behavior also highlights the curse of natural resources. According to this approach, a country's wealth in natural resources and confidence in its medium- or long-term sustainability can be a factor that hinders economic diversification, innovation, and entrepreneurship because of oil revenues (Gacem, 2007). However, these analyses are not unanimously accepted, as other authors claim the opposite on the basis of empirical studies (James, 2017; Smith, 2015). It is argued that an increase in oil revenues and therefore a positive fluctuation in oil prices leads to an increase in public spending (Buchanan & Wagner, 1978). The latter are expenditures made by the state, local authorities, administrations, and related bodies for the implementation of government social policy, particularly in the areas of education, training, health, and infrastructure. They are the main instrument of public action (Joumard et al., 2003).

In this study, we focus specifically on assessing the influence of tax revenues generated by hydrocarbons on investment in higher education, which is considered essential for modern economic growth. In addition to the appreciation of the exchange rate, the fiscal dimension of the Dutch disease also entails volatility in public spending. Thus, the state may be inclined to massively increase public spending on higher education during positive oil price shocks, and conversely, to sharply tighten the budget constraint during negative oil price shocks. Consequently, this expansion/contraction cycle undermines the quality of the higher education system and various long-term planning efforts.

In recent years, oil-exporting countries have experienced major changes in their public finances due to fluctuations in oil prices. According to data from the German Petroleum and Energy Industry Association (MWV) on Statista¹, the average annual OPEC crude oil price rose from \$23 per barrel in 2001 to \$107 in 2011 and remained relatively stable at around \$100 until 2014. It then fell sharply by more than 50% in

¹<https://www.statista.com/statistics/262858/change-in-opec-crude-oil-prices-since-1960/>

2015 due to intense geopolitical and economic turmoil around the world. The price of oil then settled at an annual average of around \$50 until 2020, before beginning a spectacular rise in the context of the war in Ukraine, reaching \$102 per barrel in 2022.

Algeria, a major oil producer ranked 16th in the world with 1.4% of global production and 2nd in Africa behind Nigeria in 2022², has experienced significant fluctuations in its oil revenues during all these periods of substantial oil price variations. Given that the education sector is the spearhead of human capital, it seems appropriate to analyze the impact of oil revenues induced by oil price fluctuations on public spending on higher education, which is often used as an indicator of the quality of education. Lucas (1988) emphasizes the importance of public investment in human capital to support the productive sector in order to ensure inclusive, sustained, and sustainable economic growth.

Historically, Algerian higher education has undergone profound quantitative growth since independence. As highlighted in the 2020 report on Algerian Higher Education in the Era of University Governance (ESAGOV)³, immediately following its independence in 1963, Algeria had approximately 2,500 students. The number of students per 100,000 inhabitants increased from 144 in 1971 to 3,300 in 2010, representing approximately 1.2 million students. Nearly 1.34 million students were recorded in 2015. This growth has required significant public funding and substantial infrastructure development. According to data from the Ministry of Higher Education and Scientific Research, the Algerian university network comprises approximately 106 higher education institutions distributed across 48 wilayas (regional divisions), covering the entire national territory. This network comprises 50 universities, 13 university centers, 20 national graduate schools, 10 higher schools, 11 teacher training colleges, and 2 annexes. Given the significant mobilization of public investment in the higher education sector, this study should allow us to highlight, in the case of a rentier state like Algeria, the relationship between international fluctuations in oil prices and public spending on higher education.

This raises the following question: do fluctuations in oil revenues due to changes in oil prices have an impact on public spending on higher education?

Based on this question, the objective of our work is to study the impact of international oil price fluctuations on public spending on higher education in Algeria. Our study differs from those that simply analyze the effect of variations in public revenues on overall public spending (Torres et al., 2012; Al Jabri et al., 2022; Chedrawi, 2017), thereby facilitating the orientation of public policies.

To achieve our objective, we formulate the following research hypotheses:

² <https://www.lexpressquotidien.dz/2023/08/30/lalgerie-second-producteur-de-petrole-en-afrique-en-2022/>

³ <https://www.uni-med.net/wp-content/uploads/2020/04/ESAGOV-rapport-WP11.pdf>

- H1: Fluctuations in oil prices have a positive impact on public spending on higher education.
- H2: Public spending on higher education is heavily dependent on oil revenues, which implies confirmation of the Dutch disease hypothesis for the Algerian case.

To confirm or refute our research hypotheses, the methodology used consists of econometric modeling based on the autoregressive distributed lag (ARDL) approach to the relationship between public spending on higher education and oil prices. We have therefore organized our work as follows: the first section reviews the theoretical and empirical literature to support the robustness of our study, followed by a second section dedicated to econometric modeling. The last two sections concern the discussion of the results and the conclusion, respectively.

2. Literature review

Very little scientific work has been done on the influence of oil price fluctuations on public spending on higher education and vocational training. Gregory (1976; Corden & Neary, 1982) were the first major authors to analyze the relationship between natural resources such as hydrocarbons and economic growth. They drew on the experience of the Netherlands, where the discovery and exploitation of large natural gas reserves in the 1960s had negative consequences for the economy, including a decline in manufacturing and rising inflation.

The rise in massive gas exports caused the domestic currency to appreciate, thereby increasing wage levels faster than productivity in the non-gas sector of the economy. This had a negative impact on the competitiveness of other export products and sectors. The authors called this situation the "*Dutch disease*" theory.

Other authors have highlighted this impact at the political and institutional level. According to, the effects include the deterioration of good governance, reflected in weak property rights, rising corruption, and unequal distribution of wealth. Following this theory, several authors have also analyzed the effects of natural resources on other macroeconomic indicators, particularly public spending.

Using a panel of data at the US state level, (James, 2017) conducted a study on the relationship between natural resources and public spending on education from 1970 to 2008. He concluded that public spending on education in resource-rich states far exceeds that in resource-poor states. His analysis reveals that relative teacher salaries, public school enrollment rates, and teacher-student ratios tend to evolve procyclical in line with periods of expansion and slowdown in resource exploitation.

Contrary to James (2017), (Gylfason, 2001) highlights an unconditional negative relationship between dependence on natural resources and education spending in a

study of a cross-sectional sample of countries. In particular, he states that: "*Nations that believe their natural resources are their most important asset may inadvertently—and perhaps even deliberately—neglect the development of their human resources, devoting inadequate attention and expenditure to education. Their natural wealth may blind them to the need to educate their children.*" The study by (Brunnschweiler & Bulte, 2008) also finds a negative relationship between natural resources and public spending on education.

Smith (2015) uses fixed-effects panel data to assess the impact of major natural resource discoveries since 1950 on GDP per capita and other economic and social indicators. He conducts his study on countries that were not previously resource-rich and finds a positive effect on GDP per capita after extraction that persists in the long term. He also finds positive effects on education levels, a reduction in infant mortality, and negative effects on democratic institutions. However, he does not consider the effect of discoveries on public spending on education. His study contradicts much of the literature on the natural resource curse.

Sun et al (2018) conduct an empirical panel analysis of Chinese provinces on the relationships between natural resource dependence, public education investment, and human capital accumulation. The authors explain why the blessing of abundant natural resources often turns into a curse in many countries and regions, focusing on the crowding-out effect of natural resources on human capital. The results show that natural resource dependence is significantly and negatively correlated with human capital accumulation. After introducing an interaction term between natural resource dependence and public education investment, the authors highlight the possibility of investing in public education to reduce the crowding-out effect of natural resource dependence on human capital.

Using a cross-section of data at the US state level, Papyrakis & Gerlagh (2007) similarly document a negative relationship between resource dependency and education spending. In particular, they find that spending on educational services as a share of state GDP in 1986 is negatively correlated with the level of state resource dependency in the same year.

3. Data and methodology

3.1 Data

Based on existing literature, our study is a series of regressions with public spending on higher education as the dependent variable and including all of the following independent variables: oil prices (OP), gross domestic product (GDP), and institutional quality (IQ). The study covers the period 1970-2022. The rationale for the choice of these variables is explained below.

Education is the main contributor to the accumulation of human capital. The latter facilitates technological innovation and thus provides the population with the capacity to promote development (Lucas, 1988). In this study, the choice of public spending on higher education as our explanatory variable has several advantages. First, according to Friedman (1996), the average level of education and culture, as well as the quantity and quality of human resources, improve, leading to a rise in living standards. These effects of higher education are called environmental effects or externalities in technical terms. This is one of the reasons why state support and the use of public funds are necessary. Secondly, public spending on higher education is directly controlled by the Algerian government, and therefore an analysis of the link between dependence on natural resources and higher education can contribute to the development of public policy. Data on public spending is expressed in real value and comes from the Ministry of Finance (MF).⁴

Over the past three decades, oil-exporting countries have experienced major changes in their public finances due to significant fluctuations in oil prices. Sun et al., (2018) argues that industrial development implies a high demand for technical progress and human capital. Since higher education is considered to be the spearhead of technical progress and human capital accumulation, we believe it is appropriate to assess the relationship between oil price fluctuations and public spending on higher education. The oil price data was collected from the Statista website. This is the average annual oil price from the Organization of the Petroleum Exporting Countries (OPEC), and the data comes from the International Energy Agency via the German oil and energy industry association (MWV).

As for the choice of control variables, we follow the work of (Philippot, 2008; Seghir, 2017; Souidi et al., 2018). These studies emphasize that in the presence of natural rent, poor institutional quality reflects a lack of transparency in budgetary procedures and strong executive involvement. Data on institutional quality are taken from the Economic Freedom of the World website. This is an economic indicator created by the Fraser Institute, which seeks to measure the degree of economic freedom in different countries around the world. It is calculated by the authors based on the following indicators: size of government, property rights, monetary stability, and market regulation. We then calculated a composite index. Based on Economic Freedom, the indicators are calculated on a scale of 1 to 10, with a figure close to 1 indicating poor institutional quality and close to 10 indicating good institutional quality. Gross domestic product is a variable that facilitates the monitoring of economic capacity and fiscal space. It is a variable that is valued in the literature in the form of GDP per capita (Erdoğan et al., 2020), GDP growth rate (Arzelier, 1998) or gross national product (Souidi et al., 2018). This makes it possible to isolate the specific effect of oil revenues

⁴ <https://www.mf.gov.dz/index.php/fr/textes-officiels/lois-de-finances/101-lois-de-finances>

from the overall tax base and economic activity. GDP data was expressed in real value and were collected from the World Development Indicators website.

3.2 Methodology

In order to assess the impact of oil price fluctuations on public spending on higher education, we follow a three-step methodology: the first step consists of analyzing the descriptive statistics of the series and determining their integration orders using the Dickey Fuller unit root test. The latter clarifies the choice of model and helps to avoid biased regression. The Dickey-Fuller unit root test highlights whether a time series is stationary or non-stationary by determining whether it follows a deterministic or stochastic trend. These tests are based on three models, and when the null hypothesis ($H_0: \phi = 1$) is accepted in one of the three models, the process is non-stationary. In this test, errors are assumed to be a white noise, which is not often the case, hence the introduction of another test called the augmented Dickey-Fuller (ADF) test, which takes into account the presence of autocorrelation in the series.

The second step involves estimating the long-term relationship between the variables. To do this, we use the cointegration test developed by, also known as the "bound cointegration test." In the latter, Fisher values are compared with the critical values of the lower and upper bounds simulated by Pesaran and al., (2001). The lower bounds concern integrated variables of order 0 and the upper bounds concern integrated variables of order 1. Thus, if the calculated F is greater than the upper bound, then the hypothesis of the existence of a cointegration relationship is accepted. If the calculated F is less than the lower bound, then the non-existence of a cointegration relationship between the variables is accepted. However, when the calculated F is within the bounds, no conclusion can be drawn.

Once the hypothesis of the existence of a long-term relationship is accepted, we can proceed to estimate the ARDL model. The advantage of this econometric model is that it allows us to capture the short-term and long-term effects of our various explanatory variables on public spending. The functional form of our model is as follows:

$$PSHE = f(OP, GDP, QI)$$

We transform it into a staggered lag autoregressive model as follows:

$$\begin{aligned} LPSHE_T = & \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta LPSHE_{t-1} + \sum_{i=1}^p \alpha_{2i} \Delta OP_{t-1} + \sum_{i=1}^p \alpha_{3i} \Delta GDP_{t-1} \\ & + \sum_{i=1}^p \alpha_{4i} \Delta LQI_{t-1} + \beta_1 LPSHE_t + \beta_2 OP_t + \beta_3 LGDP_t + \beta_4 LQI_t \\ & + \varepsilon_t \end{aligned}$$

With

$LPSHE_t, LOP_t, LGDP_t, LQI_t$ Respectively, the logarithm of public spending on higher education, oil prices, gross domestic product, and the quality of institutions;

α_0 : the constant;

$\alpha_{1i} \dots \alpha_{4i}$: the short-term effects;

$\beta_1 \dots \beta_4$: the long-term effects;

ε_t : estimation residuals;

Δ : the shift operator.

Finally, the last step is dedicated to validating the model. This involves testing for normality, heteroscedasticity, and autocorrelation of estimation errors, as well as testing the stability of the model. These various diagnostics enable us to validate our model as a whole.

4. Results and discussion

4.1 Preliminary analysis

Table 1. Descriptive statistics s of the series

Variables	PSHE	OP	GDP	QI
Mean	1.13E+09	37.41170	1.01E+11	4.188544
Median	5.76E+08	27.60000	8.48E+10	4.119572
Maximum	3.57E+09	109.4500	1.80E+11	5.099694
Minimum	22401996	1.210000	3.04E+10	3.074246
Std. Dev.	1.11E+09	30.38295	4.45E+10	0.527627
Skewness	0.941306	1.054843	0.380376	-0.053706
Kurtosis	2.290176	3.037940	1.928598	2.277540
Jarque-Bera	8.939513	9.831975	3.813011	1.178113
Probability	0.011450	0.007328	0.148599	0.554851
Sum	5.97E+10	1982.820	5.33E+12	221.9928
Sum Sq. Dev.	6.41E+19	48002.43	1.03E+23	14.47630
Observations	53	53	53	53

Produced by us based on the results of Eviews 13 software

The descriptive statistics table above provides general information on the mean, maximum value, minimum value, and standard deviation of our series. We can see that the means of public spending on higher education, oil prices, foreign exchange reserves, and institutional quality are 1.13E +09; 37.41; 4.23E+10; and 4.58, respectively. The maximum and minimum values can be useful for identifying possible data entry errors and also for getting an idea of the dispersion of the data.

Resource wealth and human capital: Examining the impact of oil price shocks on higher education spending in Algeria

It is clear that the oil price variable is the most volatile, with a standard deviation of 30.38, reflecting the constant fluctuations in oil prices on the world market. Furthermore, the Jarque-Bera statistic indicates that public spending on higher education and oil prices is not normally distributed (probability less than 0.05). To overcome this problem in the rest of the study, we transformed the variables into logarithms. This makes the amplitude of the series constant and eliminates the heteroscedasticity of the estimation residuals.

Table 2. Correlation matrix

	LPSHE	LOP	LGDP	LQI
LPSHE	1.000000	0.928770	0.966272	-0.561123
LOP	0.928770	1.000000	0.874106	-0.548419
LGDP	0.966272	0.874106	1.000000	-0.448044
LQI	-0.561123	-0.548419	-0.448044	1.000000

Produced by us based on the results of Eviews 13 software

Table 3. Variance Inflation Factors (VIF)

Variables	Coefficient	Uncentered	Centered
	Variance	VIF	VIF
C	10.56699	10995.50	NA
LOP	0.004513	53.84797	4.873670
LGDP	0.018460	12231.47	4.263774
LQI	0.085542	182.0300	1.438692

Produced by us based on the results of Eviews 13 software

The data in the table above shows a strong correlation (0.92) between oil prices and public spending on higher education (James, 2017). This result means that oil prices and public spending on higher education vary in the same direction. Oil prices directly dictate the public financing capacity for higher education in Algeria. The two variables evolve in a highly synchronized manner. There is also a significant correlation between all the explanatory variables, reflecting multicollinearity. The strongest correlation in the matrix (0.966) is between LPSHE and LGDP. This coefficient, close to **1**, indicates an almost perfect positive relationship. Economically, this suggests that the size of the Algerian economy is the main driver of university investment. The more national wealth grows, the more resources the state allocates to education. LGDP and LOP (0.874): There is a strong correlation between oil prices and GDP. This is logical for an oil-exporting country such as Algeria, where GDP is structurally linked to oil revenues (Souidi et al., 2018).

Given the presence of multicollinearity, we performed a diagnostic analysis of our model coefficients using the Variance Inflation Factor (VIF). This factor measures the degree of multicollinearity between our variables. As shown in the last column of Table 3, all our values are between 1 and 5, indicating a moderate correlation.

Table 4. Unit root tests

Variables	ADF at level at the 5% threshold		ADF in 1 st difference at the 5% threshold		Integration order
	T_{ADF}	Prob.	T_{ADF}	Prob.	
LDPES	-3.39*	0.01	-	-	I(0)
LPP	-2,86*	0.055	-6.52	0.00	I(1)
LGDP	-4.60**	0.002	-	-	I(0)
LQI	-2.07*	0.25	-6.54	0.00	I(1)

Notes: * indicates a significant constant at the 5% level and ** indicates a significant trend at the 5% level.

Variables	PP at level at the 5% threshold		PP in 1 st difference at the 5% threshold		Integration order
	T_{ADF}	Prob.	T_{ADF}	Prob.	
LDPES	-2.80*	0.06	-5.43	0.00	I(1)
LPP	-2,91*	0.05	-6.50	0.00	I(1)
LGDP	-2.21*	0.20	-8.76	0.00	I(1)
LQI	-2.29*	0.17	-6.58	0.00	I(1)

Note: * indicates a significant constant at the 5% level.

Variables	KPSS at level		KPSS in 1 st difference		Integration order
	Valeurs critiques à 5%	LM-Stat	Valeurs critiques à 5%	LM-Stat	
LDPES	0.463*	0.860	0.463	0.293	I(1)
LGDP	0.146**	0.101	-	-	I(0)

Notes: * indicates a significant constant at the 5% level and ** indicates a significant trend at the 5% level.

Produced by us based on the results of Eviews 13 software

After adding the Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests, the tables above provide information on the unit root test results. We observe that the variable LPSHE is non-stationary and integrated of order 1 according to PP and KPSS, unlike the ADF test. As for the variables LOP and LQI, they are both integrated of order 1 according to the ADF and PP tests. However, the variable LGDP is stationary in levels, exhibiting a trend according to the ADF and KPSS tests. Based on the results provided by the three unit root tests, we have some integrated variables of order zero and others of order one. As mentioned above, the ARDL model is appropriate for both integrated variables of order zero and/or integrated variables of order one. Furthermore, this model is better suited to small sample sizes (Pesaran &

Smith, 1995) and allows us to capture the short- and long-term effects of the various explanatory variables on public spending on higher education. In the following sections, we proceed with the cointegration test and the estimation of the long- and short-term models.

4.2 Estimation of the ARDL Model

Table 5. Cointegration test

F-statistic = 8.89	Bornes	
Seuils	Inférieures	Supérieures
10%	3.55	4.23
5%	4.18	4.95
1%	5.67	6.57

Produced by us based on the results of Eviews 13 software

We can see that Fisher's statistic (F-statistic = 8.89) is greater than the upper bound at the 10%, 5%, and 1% thresholds. There is therefore a cointegration relationship between the selected variables. The estimate of this long-term relationship is given in the following table.

Table 6. Long-term relationship

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOP	0.282391	0.118366	2.385754	0.0210
LGDP	2.766820	0.920629	3.005358	0.0042
LQI	-0.858447	0.526842	-1.629420	0.1098
@TREND	-0.030819	0.023052	-1.336952	0.1875

Produced by us based on the results of Eviews 13 software

We estimated our ARDL model with a trend in mind because our LPSHE variable is stationary with a significant trend. The long-term model estimation results in the table above show that all our variables are statistically significant at the 5% level (probabilities less than 0.05) except for the LQI variable and the trend. Economically, a 1% increase in oil prices leads to a 0.28% increase in public spending on higher education in the long term. This result indicates a dependence of public spending on higher education on oil revenues. A rise in crude oil prices increases government revenue, which allows for greater funding of public sectors, including higher education. Furthermore, this dependence exposes higher education funding to budgetary instability in the event of an oil price shock. This budgetary dependence generally leads to underdevelopment of the manufacturing and service sectors in developing countries like Algeria. This may potentially confirm the Dutch disease hypothesis for the Algerian case (Corden & Neary, 1982; Gregory & Gregory, 1976).

We observe that a 1% increase in GDP generates a 2.76% increase in public spending on higher education. This result demonstrates the effort made by the Algerian

authorities to develop human capital, as the state invests more than proportionally in a high level of human capital to support economic growth. This result confirms the hypothesis of Sun et al. (2018) regarding the use of revenues generated by oil rents to promote human capital development. Institutional quality has a negative but not statistically significant relationship at the 5% level with public spending on higher education. Thus, when institutional quality improves by 1%, public spending appears to decrease by 0.85%. This result seems surprising, but we emphasize that it is statistically insignificant and could potentially be explained by a reduction in waste and corruption in the management of public funds, allowing for similar or better results with lower gross expenditures. As for the trend, it is negative and not significant. This lack of significance demonstrates that public spending on higher education does not automatically adjust over time in response to wealth shocks.

Table 7. Short-term relationship

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LPSHE(-1)*	-0.427417	0.076241	-5.606105	0.0000
LOP**	0.120699	0.051348	2.350618	0.0231
LGDP**	1.182585	0.497656	2.376308	0.0217
LQI**	-0.366915	0.219222	-1.673714	0.1010
@TREND	-0.013172	0.010609	-1.241595	0.2207
C	-20.65861	11.41707	-1.809449	0.0769
R-squared	0.491630	Akaike info criterion		-1.010050
S.E. of regression	0.138339	Schwarz criterion		-0.784906
Sum squared resid	0.880335	Durbin-Watson stat		1.922662
F-statistic	8.897059			
Prob(F-statistic)	0.000006			
* p-values are incompatible with t-bounds distribution.				
** Zero-lag variable.				

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ*	-0.427417	0.061466	-6.953674	0.0000
C	-20.65861	2.984318	-6.922389	0.0000
* p-values are incompatible with t-Bounds distribution.				

Produced by us based on the results of Eviews 13 software

In the table above, the adjustment coefficient, or equilibrium restoring force, which is the main object of analysis in the short-term model, is negative and statistically significant. This guarantees the existence of an error correction mechanism and forces of convergence towards long-term equilibrium. Thus, the adjustment coefficient (-0.427) indicates a rather moderate rate of convergence towards long-term equilibrium. This reflects the fact that short term deviations from the long-term equilibrium in oil price variations are corrected at a rate of 42.7% per year through the return effect.

Resource wealth and human capital: Examining the impact of oil price shocks on higher education spending in Algeria

The coefficient associated with the variation in oil prices is positive and significant at the 5% threshold, and we observe that this result has a positive impact. A 1% positive variation in oil prices in the short-term leads to a 0.12% increase in public spending on higher education. It should be noted that the impact is weaker than in the long term, suggesting that while the budget reacts quickly to oil revenues, it takes time for the entire revenue to be structurally reallocated to higher education institutions. As for gross domestic product and institutional quality, they are statistically significant in the short term. A 1% increase in GDP translates into a 1.18% increase in higher education spending in the short term. As with oil, the short-term response is more moderate than in the long term (2.76). This shows that public spending is more rigid in the short term and cannot double instantly even if the economy grows strongly over a year. A 1% improvement in institutional quality leads to a 0.36% decrease in public spending in the short term. This negative sign in the short term confirms our long-term hypothesis: institutional reforms (more transparency, less corruption) immediately lead to a rationalization of spending. Budgetary waste is eliminated, which reduces gross expenditure without necessarily reducing service quality (Madni, 2019). We also note that the trend and the constant are negative and statistically no significant. The constant represents the variation in public spending on higher education when the other explanatory variables are at unity.

Table 8. Model validation test

Test	Null hypotheses (H_0)	$T_{statistic}$	Probabilities
Breusch-Godfrey	No autocorrelation	0,49	0,61
ARCH	Homoscedastic	0,37	0,54
Ramsey	Well specified	1,69	0,09
Jarque-Bera	Normally distributed	1,98	0,36

Produced by us based on the results of Eviews 13 software

We have probabilities greater than 0.05, a result that leads us to accept the null hypothesis. The residuals are therefore homoscedastic, normally distributed, and no-autocorrelated. According to the Ramsey test, the model is well specified.

Fig. 1. CUSUM stability test

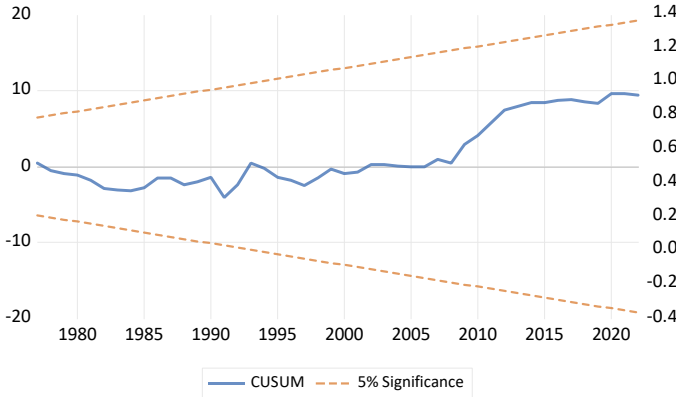
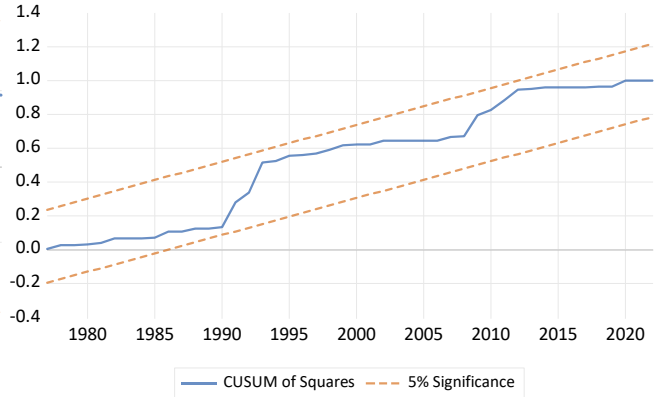


Fig. 2. CUSUM of Squares stability test



Produced by us based on the results of Eviews 13 software

The CUSUM and the CUSUM of Squares tests are performed on the residuals of the estimated model and demonstrates the stability of the model. Thus, we can see the graphical representations that the curves are between the two lines of critical values at the 5% threshold. We can therefore conclude that the parameters are stable and that this is the true relationship between public spending on higher education and oil prices. The chosen model passes the various tests successfully, allowing us to validate it.

Table 9. Chow Breakpoint Test

	F-stat	Prob.
1986	1.73	0.15
2002	2.24	0.07
2015	1.11	0.36
2016	0.90	0.46
2019	0.57	0.68

Produced by us based on the results of Eviews 13 software

To confirm the stability of the ARDL model parameters, we supplemented the graphical analysis of CUSUM and CUSUM of squares with a Chow structural break test for key historical dates (1986, 2002, 2015, 2016, and 2019). The results recorded in Table [X] indicate that for all tested dates, the probability associated with the F-statistic is greater than the threshold of 5%. Therefore, we cannot reject the null hypothesis of coefficient stability. This result corroborates the CUSUM and CUSUM of squares tests, where the residual curves lie within the confidence corridor at 5%. This convergence of tests confirms the absence of structural breaks and validates the reliability of the model's long-term estimates.

5. Conclusion

The objective of this study was to examine the impact of oil price fluctuations on public spending on higher education in Algeria for the period from 1970 to 2022. To do this, we used the ARDL model, given the integration order of our variables and the small size of our sample. After conducting the cointegration test using the, it was found that there is a long-term relationship between the dependent variable and the independent variables. Following the estimation of the ARDL model, the estimation results of the long-term model show that all our variables are statistically significant at the 5% threshold (probabilities below 0.05) except LQI and the trend. Economically, a 1% increase in oil prices leads to a 0.28% increase in public spending on higher education, while a 1% increase in gross domestic product and institutional quality leads to a 2.76% increase and a 0.85% decrease, respectively. The results validate the hypothesis that higher education spending in Algeria is mainly driven by economic growth (LGDP) and oil shocks (LOP). However, the role of institutions (LQI) seems to act as a regulator of spending, suggesting that better institutional quality could lead to a rationalization of the budgets allocated to this sector. As for the results of the error correction model, the recall force (COINTEQ) has a negative coefficient of -0.42 and is significantly different from zero at the 5% threshold, confirming the existence of an error correction mechanism. This means that 42.7% of the equilibrium error committed in period $t-1$ will be adjusted for period t . In the short-term model, all our variables are statistically significant in period $t-1$ and, with the exception of oil prices, the other variables have a negative impact on public spending on higher education. We therefore confirm our initial hypotheses, namely the positive impact of oil prices on public spending on higher education and the strong dependence of the latter on oil revenues. Our results allow us to confirm the Dutch disease hypothesis for the Algerian case. The positive impact of oil prices on public spending on higher education can be explained by the underdeveloped nature of the manufacturing and service sectors, which contribute very little to the financing of higher education through non-oil revenues. The development of the industrial and service sectors is an alternative to dependence on financial resources generated by hydrocarbons. Thus, the financing of human capital formation does not remain solely dependent on oil resources, which are frequently subject to fluctuations due to fluctuations in oil prices.

The limitations of the study are among others: the problems of Annual Data Constraints. Using annual data from 1970 to 2022 captures long-term trends but may smooth over intra-year volatility. Oil prices fluctuate daily; using an annual average might mask the immediate "shock" effects that quarterly data would reveal. More, In Algeria, the massive "youth bulge" creates a structural demand for higher education that persists regardless of oil prices or GDP. Our model does not account for the student population growth rate. The absence also of the youth unemployment rate is a limitation,

as higher education spending is often a tool for social stabilization in resource-rich countries. Although 52 observations are sufficient for ARDL, the inclusion of multiple lags and variables reduces the degrees of freedom, which can slightly affect the power of the statistical tests.

Based on our findings, the following strategic pivots are recommended:

- **Revitalizing Sovereign Wealth Funds:** Algeria should strengthen the revenue regulatory fund. Instead of using it merely to fill budget deficits, a specific "Human Capital Sub-Fund" should be created. This would ensure that during oil price slumps, higher education spending remains constant, avoiding the pro-cyclicality shown in your results.
- **Multi-Year Budgetary Frameworks:** Move away from annual budgeting toward 3-to-5-year envelopes. This protects long-term university projects (research labs, infrastructure) from the short-term volatility of the oil price.
- **From Rent-Seeking to Knowledge-Based:** Since LGDP has the strongest impact, Algeria must transition from an oil-led GDP to a knowledge-led GDP. Universities should not just be "cost centers" funded by oil but "growth engines" that produce patents and startups, contributing to non-oil GDP.
- **Fiscal Reform:** To reduce the 0.92 correlation between LPSHE and LOP, the state must broaden its tax base. Increasing tax revenue from non-oil sectors would provide a more stable, "organic" source of funding for universities.

Bibliographic references:

1. Journal articles:

- Al Jabri, S., Raghavan, M., & Vespignani, J. (2022). Oil prices and fiscal policy in an oil-exporter country : Empirical evidence from Oman. *Energy Economics*, 111, 106103. <https://doi.org/10.1016/j.eneco.2022.106103>
- Arzelier, M.-P. (1998). Dépenses publiques, ressources naturelles et croissance sectorielle. Une comparaison Afrique-Asie. *Revue économique*, 49(1), 119-137. <https://doi.org/10.2307/3502496>
- Auty, R. (2002). *Sustaining Development in Mineral Economies* (0 éd.). Routledge. <https://doi.org/10.4324/9780203422595>
- Brunnschweiler, C. N., & Bulte, E. H. (2008). The resource curse revisited and revised : A tale of paradoxes and red herrings. *Journal of Environmental Economics and Management*, 55(3), 248-264. <https://doi.org/10.1016/j.jeem.2007.08.004>
- Buchanan, J. M., & Wagner, R. E. (1978). Dialogues concerning fiscal religion. *Journal of Monetary Economics*, 4(3), 627-636. [https://doi.org/10.1016/0304-3932\(78\)90056-9](https://doi.org/10.1016/0304-3932(78)90056-9)
- Chedrawi, C. (2017). *LA VOLATILITÉ DU PRIX DU PÉTROLE ET SES CONSÉQUENCES SUR LES PAYS EXPORTATEURS*.
- Corden, W. M., & Neary, J. P. (1982). Booming Sector and De-Industrialisation in a Small Open Economy. *The Economic Journal*, 92(368), 825. <https://doi.org/10.2307/2232670>
- Engle, R. F., & Granger, C. W. J. (1987). Co-Integration and Error Correction : Representation, Estimation, and Testing. *Econometrica*, 55(2), 251-276. <https://doi.org/10.2307/1913236>
- Erdoğan, S., Yıldırım, D. Ç., & Gedikli, A. (2020). RELATIONSHIP BETWEEN OIL REVENUES AND EDUCATION IN GULF COOPERATION COUNCIL COUNTRIES. *International Journal of Energy Economics and Policy*, 10(1), 193-201. <https://doi.org/10.32479/ijeep.8653>
- Friedman, M. (1996). *Capitalism and freedom*. Akadémiai Kiadó.
- Gacem, B. (2007). La rente pétrolière en Afrique : Bénédiction ou malédiction ? *Finance & Bien Commun*, 28-29(3), 114. <https://doi.org/10.3917/fbc.028.0114>
- Gregory, R. G., & Gregory, R. G. (1976). *SOME IMPLICATIONS OF THE GROWTH OF THE MINERAL SECTOR*. <https://doi.org/10.22004/AG.ECON.22682>
- Gylfason, T. (2001). Natural resources, education, and economic development. *European Economic Review*, 45(4-6), 847-859. [https://doi.org/10.1016/S0014-2921\(01\)00127-1](https://doi.org/10.1016/S0014-2921(01)00127-1)
- James, A. (2017). Natural resources and education outcomes in the United States. *Resource and Energy Economics*, 49, 150-164. <https://doi.org/10.1016/j.reseneeco.2017.04.004>
- Journard, I., Kongsrud, P. M., Nam, Y.-S., & Price, R. (2003). Améliorer le rapport coût-efficacité des dépenses publiques : L'expérience des pays de l'OCDE. *Revue économique de l'OCDE*, 37(2), 125-184.
- Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22(1), 3-42. [https://doi.org/10.1016/0304-3932\(88\)90168-7](https://doi.org/10.1016/0304-3932(88)90168-7)
- Madni, G. R. (2019). Probing Institutional Quality Through Ethnic Diversity, Income Inequality and Public Spending. *Social Indicators Research*, 142(2), 581-595.
- Matsuyama, K. (1992). Agricultural productivity, comparative advantage, and economic growth. *Journal of Economic Theory*, 58(2), 317-334. [https://doi.org/10.1016/0022-0531\(92\)90057-O](https://doi.org/10.1016/0022-0531(92)90057-O)

- Papayrakis, E., & Gerlagh, R. (2007). Resource abundance and economic growth in the United States. *European Economic Review*, 51(4), 1011-1039.
<https://doi.org/10.1016/j.eurocorev.2006.04.001>
- Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association*, 94(446), 621-634. <https://doi.org/10.2307/2670182>
- Pesaran, M. H., & Smith, R. (1995). Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, 68(1), 79-113.
[https://doi.org/10.1016/0304-4076\(94\)01644-F](https://doi.org/10.1016/0304-4076(94)01644-F)
- Pesaran, H., Smith, R., & Shin, Y. (2001). Bound Testing Approaches to the Analysis of Level Relationship. *Journal of Applied Econometrics*, 16, 289-326.
<https://doi.org/10.1002/jae.616>
- Philippot, L.-M. (2008). Rente naturelle et composition des dépenses publiques. *Reflets et perspectives de la vie économique*, XLVII(4), 49-63.
<https://doi.org/10.3917/rpve.474.0049>
- Seghir, M. (2017). De l'instabilité macro-économique à la malédiction des ressources naturelles: *Mondes en développement*, n° 179(3), 31-44.
<https://doi.org/10.3917/med.179.0031>
- Smith, B. (2015). The resource curse exorcised : Evidence from a panel of countries. *Journal of Development Economics*, 116, 57-73. <https://doi.org/10.1016/j.jdeveco.2015.04.001>
- Souidi, R., Belkacem, D. K., & SAMI, L. (2018). Natural Resources, Quality of Institutions and Public Spending : The Algerian Case. *Topics in Middle Eastern and North African Economies*, 20(1). <https://ecommons.luc.edu/meea/265>
- Sun, H.-P., Sun, W.-F., Geng, Y., & Kong, Y.-S. (2018). Natural resource dependence, public education investment, and human capital accumulation. *Petroleum Science*, 15(3), 657-665. <https://doi.org/10.1007/s12182-018-0235-0>
- Torres, N., Afonso, Ó., & Soares, I. (2012). Oil Abundance and Economic Growth—A Panel Data Analysis. *The Energy Journal*, 33(2), 119-148.
<https://doi.org/10.5547/01956574.33.2.6>

2. Internet Websites:

- Statista (2022), Change in OPEC crude oil prices since 1960.
web site: <https://www.statista.com/statistics/262858/change-in-opec-crude-oil-prices-since-1960/> (consulted on 02/11/2025)
- Khaled Remouche (2023), Algeria, second largest oil producer in Africa in 2022
web site: <https://www.lexpressquotidien.dz/2023/08/30/lalgerie-second-producteur-de-petrole-en-afrique-en-2022/> (consulted on 17/12/2025)
- Sylvie Monsinjon and al., (2020), Algerian Higher Education in the Era of University Governance (ESAGOV)
web site: <https://www.uni-med.net/wp-content/uploads/2020/04/ESAGOV-rapport-WP11.pdf> (consulted on 05/04/2026)
- web site: <https://www.mf.gov.dz/index.php/fr/textes-officiels/lois-de-finances/101-lois-de-finances> (consulted on 15/07/2025)