Assessing Algerian government support for sustainable development goals: A study from 2000 to 2022

Fouzi Tahar Abderzag [1, *], Abderrezek Hamza [2], Mohamed Amin Chakroun [3]

[1]College of Sciences and Arts Al-Namas, University of Bisha, Bisha, Saudi Arabia
[2]Department of Economics, College of Economic, Commercial, and Management Sciences, University Mohamed El Bachir El Ibrahimi of Bordj Bou Arreridj, Bordj Bou Arreridj, Algeria
[3]Department of Business Administration, College of Science and Arts Al-Namas, University of Bisha, Bisha, Saudi Arabia

A R T I C L E   I N F O

A B S T R A C T

The Algerian government has integrated the seventeen sustainable development goals (SDGs) into its development strategy beyond 2030, focusing on social policies like healthcare and education while investing in environmental enhancements and clean energy initiatives. This study evaluates the impact of government policies on achieving the SDGs in Algeria from 2000 to 2022. Utilizing the ARDL model, the research demonstrates that government support has a positive long-term effect on sustainable development indicators, with a coefficient of 1.14. Importantly, the model analysis did not identify any statistical anomalies. This assessment highlights the significant role of government support in advancing SDGs in Algeria and underscores the importance of continued policy commitment to drive progress in key areas such as healthcare, education, environmental sustainability, and clean energy.

1. Introduction

The significant drop in oil prices has severely impacted the revenues of the Algerian government (Chelghoum et al., 2023). The significant drop in oil prices since mid-2014 has had a profound impact on the revenues of the Algerian government, deeply affecting the country's economic stability (Chekouri et al., 2021). Algeria, heavily reliant on oil for its revenue, saw a dramatic fall in earnings as oil prices dropped from the $80-110 per barrel range in 2011-2013 to $40-60 per barrel during most of 2015-2017. This decline led to a reduction in state revenues from $74 billion in 2007 to $24 billion in 2017. In response to these financial pressures, the Algerian government has had to draw on its foreign exchange reserves and implement cost-cutting measures. For instance, following the onset of the COVID-19 pandemic in March 2020, which coincided with another significant drop in oil prices, the government was compelled to cut budgeted expenditures by 50% and reduce investments in the energy sector. These economic challenges have underscored the vulnerability of Algeria's economy to fluctuations in global oil prices and highlighted the need for economic diversification and reform. The government has recognized these issues and is exploring various strategies to stabilize and diversify its economic base, including revisiting regulations to attract foreign investments and improve the business climate. Overall, the sharp fluctuations in oil prices have exposed structural weaknesses in Algeria's economic model, necessitating urgent reforms to ensure long-term sustainability and reduce dependency on hydrocarbon revenues. This financial challenge highlights the urgent need to rethink the government's subsidy programs. Traditionally, these subsidies are important for upholding Algeria's social commitments by helping to meet the basic needs of its citizens. However, these programs have not been very effective in supporting the poorest people, and they are costly. They also lead to problems in the economy and the environment (Benameur et al., 2020).

Interestingly, examples from other countries show that with thoughtful planning and clear communication, reforms in subsidy programs can actually strengthen social protection systems. Such reforms help in achieving more inclusive and long-term economic growth without compromising on social welfare (Vidican Auktor and Loewe, 2022).

In this paper, we explore the main types of subsidies in Algeria and assess their role in achieving the Sustainable Development Goals (SDGs) between 2000 and 2022. This period is chosen because it corresponds with an increase in oil revenues, which led to more government subsidies. It is also a time for good data to be available on Algeria's progress in meeting all 17 SDGs. This study aims to provide a detailed look at how subsidy policies intersect with sustainable development in Algeria and to discuss how policy changes could potentially lead to greater economic and social benefits.

2. Literature review

Determining what constitutes a subsidy is critical to any analysis of the implications of government subsidies for sustainable development (DESA, 2001), but there is considerable debate over what precisely defines a subsidy. For example, a subsidy can be defined as any government assistance that (i) allows consumers to purchase goods and services at prices lower than they would in a perfectly competitive private sector or (ii) raises producers' incomes beyond what they would earn without this intervention (Schwartz and Clements, 1999). Modern subsidies cover a wide range of government policies and can be in the form of cash grants, tax breaks, loans at below-market interest rates, loan guarantees, capital injections, guaranteed excessive rates of profit, below-cost or free inputs (e.g., land and energy), and the purchase of goods from producers at inflated prices. This diversity of possible policy options feeds the confusion about exactly what constitutes a subsidy (Rickard, 2018).

There are sound economic rationales for offering some subsidies. For example, by encouraging research and development (R&D), governments seek, among other things, to stimulate the industries of the future and breathe new life into established industries (Ford and Suyker, 1990). To reduce carbon emissions and the need for nonrenewable energy, policies that support environmentally friendly alternatives like electric vehicles (EVs) have been implemented in many countries, and subsidies to incentivize their uptake can improve social welfare (Li et al., 2018). In addition, supportive policies can shape production and consumption patterns, potentially having significant effects on poverty, food security, nutrition, land-use practices, biodiversity, and other sustainability concerns like climate change (Bellmann, 2019). Numerous governments have taken steps to lessen the economic effects of the COVID-19 pandemic by using various policy measures. Besides typical fiscal and monetary actions, governments in developed countries also extensively used credit guarantee programs and, to a lesser degree, direct lending, equity investments, and broad loan forbearance and payment delay programs. They provided support to businesses of all sizes, particularly small and medium-sized enterprises (SMEs), through these new credit programs (Hong and Lucas, 2023).

In recent decades, developing countries have markedly expanded the use of government subsidies linked to social support policies. These subsidies, including both direct payments and indirect aid like tax breaks, along with related policy measures, have gained significant attention in academic research recently (Wenqi et al., 2022).

Assassi and Soullier (2024) evaluated the impact of a contractual arrangement with a subsidized sales price implemented by a tomato cannery in Algeria. The study concluded that the arrangement increased profits by securing outlets and sales prices. The success of the Algerian intervention lies in generating a price premium and in combining public financial capacity and private governance of the contractual scheme. The research reveals that in Algeria, the active participation of the State in both organizational and financial aspects has proven to be advantageous. The substantial state subsidies, in comparison to the remuneration provided to farmers and the expenses associated with contract management, have played a pivotal role in prompting every Algerian tomato cannery to embrace and extend their engagement in contract farming.

Merouani et al. (2023) provided a detailed description of Algeria's social protection system, illustrating a complex array of state and non-state, as well as formal and informal services and organizations. They highlighted the significant role of non-state actors, including religious endowments, local civil society organizations (CSOs), diaspora networks, and village associations known as djemaa or tajmaat, particularly in Kabylia. Remarkably, there are over 108,000 associations, with about 45 percent formally registered with the Ministry of Interior and Local Authorities, which emphasizes the depth and variety within Algeria's social protection framework. Merouani et al. (2023) recommended that social protection strategies should primarily be based on a thorough assessment of risk and vulnerability to ensure the suitability and relevance of policies to the Algerian context and the risks its population faces. Therefore, there is an essential need for ongoing data collection to monitor and evaluate social protection programs and initiatives.

Matallah and Benlahcene (2021) sought to assess the dual facets of government subsidies on income inequality in Algeria during the period 1996-2016. Firstly, it aims to examine the impact of government subsidies, and secondly, to explore the influence of corruption control in enhancing the efficacy of these subsidies in narrowing the income gap. The results affirm the effectiveness of government subsidies in mitigating income inequality in Algeria. Additionally, the findings highlight the substantial negative influence of corruption control on income inequality. The synergistic effect of government subsidies and corruption control emerges as crucial in the concerted effort to diminish income inequality in Algeria.

Wenqi et al. (2022) delved into the influence of government subsidies (Sub) on Corporate Social

Responsibility (CSR), taking into account the quantity and diversity of subsidies as well as the industry type within a competitive business environment. The paper establishes theoretical connections by constructing an oligopolistic market model of private enterprises grounded in the structure-conduct-performance (SCP) paradigm of industrial organization theory. Additionally, our study empirically examines this relationship using a dataset comprising 100 listed companies in Pakistan from 2011 to 2019, employing robust standard error methodologies and a fixed effects IV estimator. The findings reveal a significant positive impact of government subsidies in encouraging private enterprises to actively engage in fulfilling their social responsibilities. Moreover, product market competition serves as an intermediary factor, validating the theoretical proposition. This effect remains consistent across all stages of the enterprise's life cycle. Consumer subsidies are prevalent across the Middle East and North Africa (MENA) Region. Energy subsidies are implemented in all countries within the region, and most nations also provide food subsidies for certain items. These subsidies play a crucial role for households, constituting a significant portion of their expenditures, and they also contribute substantially to government spending or foregone revenues. Notably, consumer subsidies in the MENA Region are more extensive than in other parts of the world, and they are more heterogeneous in many respects (Araar and Verme, 2017). Nevertheless, the impact on poverty and inequality has been unsatisfactory, particularly because a substantial portion of the expenditure, averaging 6% of GDP, has taken the form of subsidies, as opposed to direct social transfers, which account for only 0.7% of GDP on average. (Vidican Auktor and Loewe, 2022). Table 1 presents a comparison between three MENA countries, Algeria, Saudi Arabia, and Egypt, regarding their support policies over decades. Algeria and Saudi Arabia heavily rely on revenues from their oil exports, while Egypt depends less on such resource rents.

Table 1: Comparison of government subsidies share of GDP in ALG, KSA, and EGY for 2010-2022

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Algeria	10.3	14.8	12.2	9.5	9.3	11	10.5	8.4	8.7	8.8	9.8	9.4	8.8
Egypt	6.21	9	9.7	11.2	11.4	8.2	7.4	8.00	7.42	5.4	3.6	3.8	3.9
KSA	1.7	2.3	5.9	3.2	3.9	3.2	2	2.22	2.74	4.28	4.5	4.30	3.8

Table 1 illustrates differences among the three countries in terms of the share of government support in GDP during the period from 2010 to 2022. The average government support as a percentage of GDP is 10.11% for Algeria, 7.32% for Egypt, and 2.91% for Saudi Arabia. The government cash support embedded in the general budget, including food and ration items, electricity, petroleum products, housing programs, and allocations for government institutions, witnessed a significant decrease in Egypt during the period 2018-2022, where cash support constitutes a significant portion of total public expenditures compared to the two other countries, the volume of cash support has declined. It decreased from approximately 29% of total public expenditures in 2013 to around 17% in 2016. In contrast, despite governmental efforts to reform the subsidy policies in Algeria and Saudi Arabia, the share of support as a percentage of GDP decreased at slower rates during the same period. This can be attributed to measures taken in response to the COVID-19 pandemic, as well as social pressures, particularly in Algeria, following the political events in the country.

2.1. Subsidies in Algeria

Algeria relies on petroleum revenues to finance its developmental model, making it vulnerable to fluctuations in oil prices, so its economic growth and achievement of the SDGs are closely linked to hydrocarbon exports. For example, during the 2000–2014 period, a rise in oil prices enabled Algeria to allocate approximately 30$ billion to various forms of support (Fayçal and Ali, 2016).

Social policy in Algeria, which is also known as the social subsidy policy or the social transfer system, is based on direct and indirect state subsidies for a range of basic goods and services or for specific sectors. Some of these subsidies are universal in that they cover all Algerians regardless of their income (e.g., basic commodity subsidies), while other types of subsidies, such as those for housing, are directed at specific groups, with them varying based on household and individual income.

2.1.1. Housing support

The combination of a rapidly growing population, urban migration despite many government efforts to stem the rural exodus, the regulation of land use in territories (Bounoua et al., 2023), and a decline in cohabitation has resulted in a growing demand for housing that has not been matched by an increase in supply. To address this issue, the government has developed a number of programs to provide affordable housing. Explicit housing subsidies are channeled through the National Housing Fund (Fonds National du Logement), and these support access to public housing, both in terms of rental housing and housing for purchase. Implicit housing subsidies take the form of the government supplying land at essentially no cost for public housing programs (Jewell and Souissi, 2016).

2.1.2. Energy subsidies

Domestic energy pricing policies can serve multiple objectives that may often conflict with each other, making it very difficult to evaluate the overall

effectiveness of such subsidy programs. These objectives may include improving social welfare, fostering economic development, and serving political considerations (Fattouh and El-Katiri, 2012). Many studies have concluded that price subsidies for natural gas, electricity, and the fuel deliver a much more diverse range of benefits to the rich compared to the poor (Matallah et al., 2023).

Algeria's energy subsidies support fuel, electricity, and natural gas, with all their prices being lower than the market value due to executive decrees that determine prices and profit margins at the production, sale, and distribution of various energy products. Such pricing management takes place under the price stabilization mechanism or the regulation of profit margins for some widely consumed basic products.

2.1.3. Household subsidies for widely consumed commodities

A basket of basic commodities benefits from a state subsidy program. Like many countries, Algeria

offers support for widely consumed staples in order to stabilize prices in domestic markets, such as supporting farmers financially through direct assistance and seeking to diversify economic activity in rural areas and so-called shadow areas. "It also provides relief for the price of imported products or production inputs—such as sugar, oil, milk, and cereals—by financing the difference between the international market price of these products and the actual sale price to both consumers and producers. This supportive policy helps protect the purchasing power of the most disadvantaged social classes and fixed-income earners (Rafaa and Djenidi, 2023).

The above areas are the most important target sectors for subsidies in Algeria. Fig. 1 illustrates Algeria's support policy structure.

2.1.4. Evolution of the Algerian government's subsidies during the 2000–2022 period

Table 2 shows how the value of Algeria's total support packages has evolved over the study period.
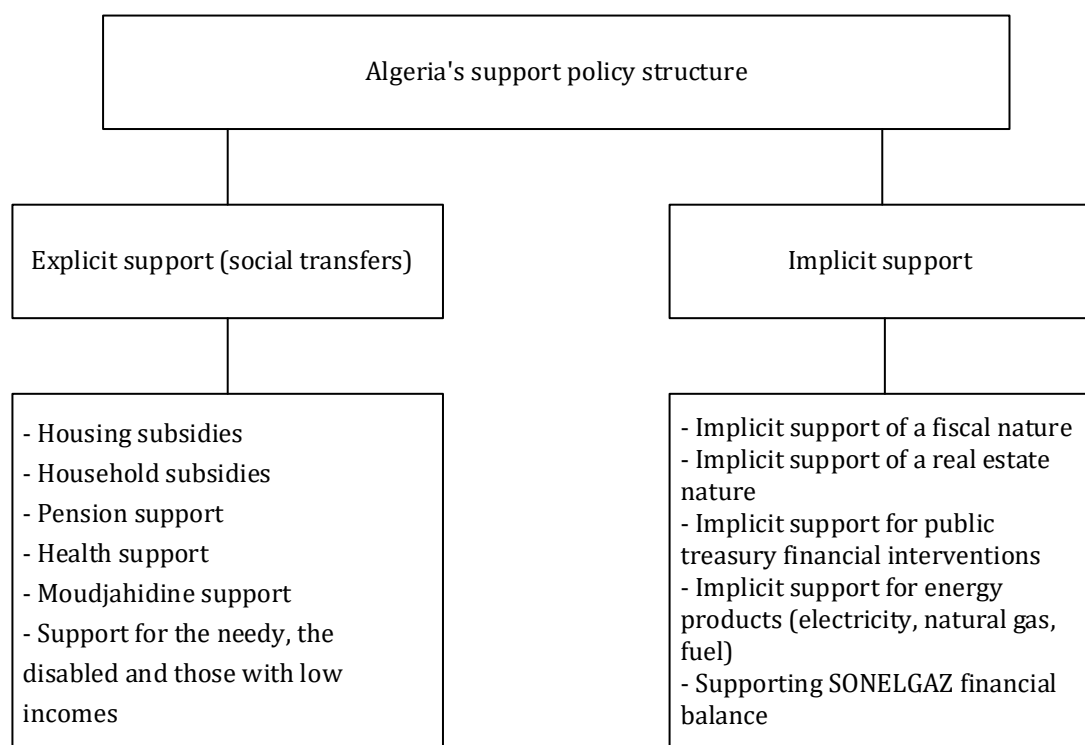

Fig. 1: Algeria's support policy structure (Rafaa and Djenidi, 2023)

Table 2: The value of Algerian government subsidies and its share of GDP for 2000–2022

Year	Government subsidies (10^6/DZD)	% of GDP	Year	Government subsidies (10^6/DZD)	% of GDP
2000	344,480	8.4	2011	2,065,074	14.8
2001	426,795	9.9	2012	1,868,500	12.2
2002	474,563	10.9	2013	1,574,361	9.5
2003	433,065	8.4	2014	1,609,123	9.3
2004	437,429	7.2	2015	1,830,314	11
2005	435,498	5.8	2016	1,841,570	10.5
2006	584,800	7	2017	1,630,771	8.4
2007	676,805	7.2	2018	1,763,817	8.7
2008	1,164,067	10.6	2019	1,820,767	8.8
2009	1,107,855	10.9	2020	1,847,516	9.8
2010	1,239,260	10.3	2021	1,927,499	9.4
			2022	1,942,100	8.8

Table 2 shows the trend for greater government support in Algeria, with it rising from 344,480 to 1,942,100 million DZD in just over two decades, which is a five-fold increase. This rise can be partly explained by higher basic food prices, especially in 2011, as well as higher oil prices in the second decade, which in turn gave the government scope to increase its support, especially for housing programs.

2.2. Overview of the integration of SDGs in Algeria

The United Nations' SDGs are the successors of the Millennium Development Goals (MDGs), which were agreed by world leaders in 2000 to be fulfilled by 2015. The goals are directed at a number of basic indicators for global well-being, such as education, health, and equality. The 17 SDGs are specified by 169 individual targets, with the common understanding being that these global goals need to be treated as being interconnected and interdependent rather than being handled separately or even confined in silos (Pedersen et al., 2023).

Algeria ranked top at the Arab and African levels for 2022 in terms of achieving the SDGs, according to the SDGs indicators report for that year, and it ranks 64th globally (Sachs et al., 2022). The indicators are illustrated in Fig. 2.

Algeria's progress in achieving its SDG targets since 2015 has been notable. Despite the challenges of the COVID-19 health crisis, reforms in economic, social, and environmental fields, which lie at the heart of the Government Action Plan 2021–2024, have continued at a sustained pace with the objective of accelerating economic diversification, energy transitioning, job creation (particularly for young people), improvements in public services, and enhancements in the resilience of institutions and the population in the face of climate change and various other crises. The plan strongly emphasizes the socioeconomic inclusion of populations in regions that lag behind in terms of development. It recognizes that implementing these reforms requires changes in governance methods to realize a more inclusive society with a more modern and efficient administration (UNSDG, 2022).

2.3. Progress in achieving the SDGs over the study period

Algeria's commitment to the SDGs is particularly evident through its performance in achieving them, as measured by the annual global rankings. Algeria's scores are given in Table 3.
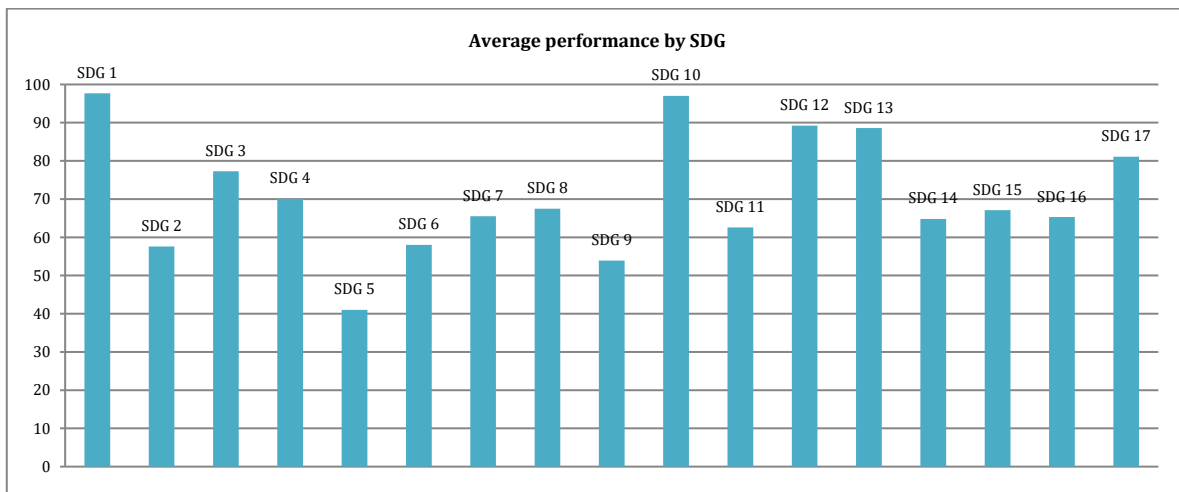

Fig. 2: Partial indicators for Algeria's performance in achieving the SDGs

Table 3: Algeria's overall progress in achieving all 17 SDGs

Year	Overall score	Year	Overall score
2000	65.34	2011	69.41
2001	66.12	2012	71.18
2002	66.02	2013	71.22
2003	66.57	2014	71.81
2004	67.24	2015	72.16
2005	67.74	2016	71.88
2006	68.35	2017	72.01
2007	68.25	2018	71.69
2008	68.32	2019	70.77
2009	68.82	2020	71.27
2010	68.98	2021	70.96
		2022	70.83

Algeria has made significant development progress, enabling it to maintain its place among countries with a high human development index, such that it is ranked first in the Maghreb and third in Africa. Indeed, Algeria is one of the few countries that have reduced monetary poverty by 75% over the 1995–2011 period. The Global Sustainable Development Network Report 2022 (SDN), as shown in Table 3, gives Algeria a score of 70.83 out of 100 for its progress in achieving the 17 SDGs, placing it at the top for the Middle East and North Africa region.

3. Methodology

3.1. The autoregressive distributed lag (ARDL) model

The ARDL has become commonly used in recent times. This model was proposed and discussed by Pesaran et al. (1999, 2001), and it integrates the

autoregressive model and the distributed lag model into a single model. In this approach, time series are functions of their own lags, the current independent variable values, and the lags of those variables that lag for one or more periods. The ARDL model has several advantages (Zafar, 2020):

- The Bounds test approach is simple, unlike other multi-variable cointegration tests (Engle and Granger, 1987; Johansen, 1988; Johansen and Juselius, 1990) because this test allows an assessment of the cointegration relationship through OLS once the lag order of the model has been identified.
- It can be applied regardless of whether the variables under consideration are integrated from rank zero I (0), from rank one true I (1), or from the same rank.
- The results of its application are good when the sample size (i.e., the number of views) is small. This contrasts with most traditional cointegration tests, which often require a large sample size to ensure accurate results.
- It helps simultaneously examine the short-run and long-run effects of the independent variables on the dependent variable (Peng et al., 2022).

3.2. This study's model

This research considered two variables, namely the SDGs score as the dependent variable and the value of government subsidies as the independent variable. The data covered a period from 2000 to 2022. Based on economic theory and previous studies, the study model was formulated as follows:

$$SDGS_t = f(SUB_t)$$

where, SDGS is the SDGs score, SUB is the value of government subsidies, and t is the time index.

Thus, the model took the following form:

$$\Delta SDGS_t = \alpha + \beta_1 SDGS_{t-1} + \beta_2 SUB_{t-1}$$
$$+ \sum_{i=1}^{q1} \vartheta_{1i} \Delta SDGS_{t-i}$$
$$+ \sum_{i=1}^{q2} \vartheta_{2i} \Delta SUB_{t-,} + \varepsilon_t$$

where, β_i represents the long-term form, ϑ_{2i}. ϑ_{1i} represents the short-term form, α is a constant term, and ε_t is the random error bounds.

3.3. The stationarity of the variables

Confirming the stationarity of the data is the first step in any time series study (Shahid et al., 2024) because if the time series data is not stationary, it will be impossible to obtain accurate and logical results, with them instead being spurious and misleading. The process for detecting the presence of a unit root in time series data often begins with a first-order autoregressive model AR(1), which takes the following form:

$$\Delta X_t = \varphi X_{t-1} + \varepsilon_t$$

The augmented Dickey-Fuller (ADF) test is the most common method for testing for unit roots (Shresthaa and Bhatta, 2018), and this requires estimating the following model:

$$\Delta X_t = \alpha + \varphi \cdot X_{t-1} + \beta \cdot t + \varepsilon_t$$

This tests the null hypothesis that there is the presence of a unit root. Table 4 shows the results of this test for the study variables:

Table 4: Augmented Dickey-Fuller test results for the research variables

The series		The level			The first difference			The rank
		None	Intercept	Trend and intercept	None	Intercept	Trend and intercept	
$SDGS_t$		2.0942	-2.1162	-0.4824	-3.7579	-4.1701	-4.7403	I(1)
SUB_t		-0.3813	-2.3961	-2.3032	-4.7948	-4.6704	-4.5440	I(1)
The critical tabulated values	1%	-2.6742	-3.7695	-4.4407	-2.6797	-3.7880	-4.4678	
	5%	-1.9572	-3.0048	-3.6328	-1.9580	-3.0123	-3.6449	
	10%	-1.6081	-2.6422	-3.2546	-1.6078	-2.6461	-3.2614	

From Table 4, we can see that the results of the Dickey-Fuller test for the study variables indicate that $SDGS_t$ and SUB_t contain a unit root at their original level, but they become static at first difference.

3.4. Configuring the model

3.4.1. Determining the optimal lag periods for the variables used in estimating the ARDL model

In order to determine the optimal number of lag periods, we used the Akaike standard, such that lag periods that give the lowest value for this standard are selected. Fig. 3 shows the 12 best models in terms of the lowest values for the Akaike standard, with the best of these being the ARDL (1.3) model.

3.4.2. Bounds testing approach

After establishing the stationarity of the series, the ARDL bounds test approach was applied to test for the existence of cointegration between the variables in their long-run relationship (Khanal et al., 2022). The F-statistic was calculated to test the null hypothesis that all forms of the lagged independent variable are equal to zero at one time period:

$$H_0: \beta_2 = 0$$

This null hypothesis indicates the absence of a long-term equilibrium relationship between the variables (i.e., the absence of cointegration among the variables), as opposed to the alternative hypothesis that states that at least one form of the lagged variables is not equal to zero:

$H_1: \beta_2 \neq 0$

In other words, this indicates the presence of a long-term equilibrium relationship (i.e., the presence of cointegration among the variables).

In order to test for the presence of a long-term equilibrium relationship between government subsidies and the SGDs score in Algeria, the F-statistic was calculated through the bounds test, and the results are given in Table 5.
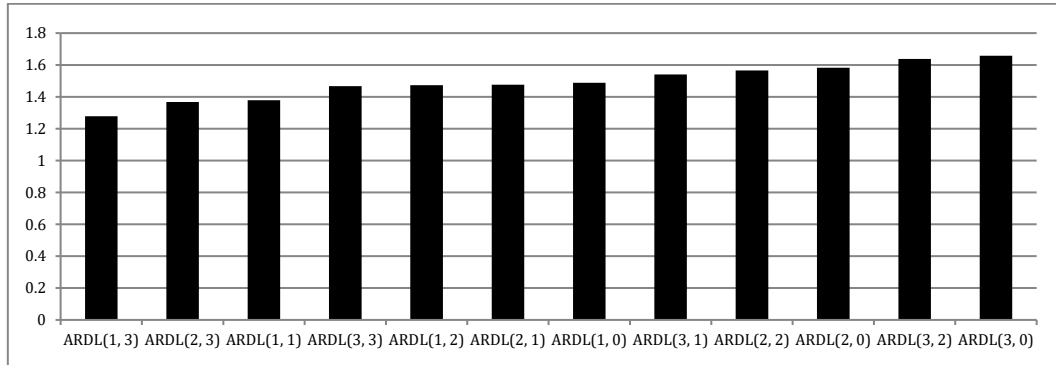

Fig. 3: Top 12 ARDL models according to the Akaike information criterion

Table 5: Bounds test results

F-bounds test		Null hypothesis: No levels relationship		
Test statistic	Value	Significance	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	8.151646	10%	3.02	3.51
k	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58
Actual sample size	20		Finite Sample: n=30	
		10%	3.303	3.797
		5%	4.09	4.663
		1%	6.027	6.76

According to Table 5, the calculated F-statistic was 8.151, which is greater than the value of the upper bound (6.76) at a 1% significance level. This means that the alternative hypothesis ($H_1: \beta_2 \neq 0$) could be accepted. In other words, there is a long-term equilibrium relationship between government subsidies and the SDGs score, so there is a common or simultaneous cointegration relationship.

3.4.3. Estimating the forms of the model for both the long and short terms, as well as the error correction form

After confirming the presence of a long-term equilibrium relationship between government support and the SGDs score for Algeria, we estimated

the forms of the ARDL model for both the long and short terms, along with the error correction form. This estimation included the lagged time series variables that were included in the model alongside the error correction term, and the results of this are given in Table 6.

The error correction equation ECM could be inferred as follows:

$$CointEq = SDGS_t - (1.1451 \cdot MTR_t + 60.044)$$

In the results of the error correction model estimation given in Table 7, we can see a significant level of agreement in terms of the significance levels and directions between the forms estimates for the short term and long term.

Table 6: The form estimates for the long term in the ARDL model

Levels equation; Case 2: Restricted constant and no trend				
Variable	Coefficient	Std. error	t-statistic	Probability
SUB	1.145102	0.348953	3.281532	0.0055
C	60.04441	3.232036	18.57789	0.0000
EC = SDGS - (1.1451*SUB + 60.0444)				

Table 7: The results of the error correction model estimation for the ARDL model

ECM regression; Case 2: Restricted constant and no trend				
Variable	Coefficient	Std. error	t-statistic	Prob.
D(SUB)	0.030448	0.051343	0.593037	0.5626
D(SUB(-1))	-0.069990	0.053018	-1.320124	0.2080
D(SUB(-2))	-0.128812	0.051946	-2.479743	0.0265
CointEq(-1)	-0.203961	0.038580	-5.286634	0.0001
R-squared	0.595292	Mean dependent var		0.240500
Adjusted R-squared	0.519409	S.D. dependent var		0.547929
S.E. of regression	0.379850	Akaike info criterion		1.078774
Sum squared resid	2.308573	Schwarz criterion		1.277921
Log-likelihood	-6.787744	Hannan-Quinn criterion		1.117650
Durbin-Watson stat	2.851249			

4. Results and discussion

4.1. Economic insights

A: Evaluating the forms estimates of the model for both the long and short terms: Based on the estimation results of the ARDL model, as shown in Tables 5 and 6, we can conclude the following. The coefficient SUBt indicates that government support has a significant positive effect on the SDGs score in Algeria in the long term. This means that for every unit change in government subsidies, there is a corresponding change in the SDGs score in the same direction with a magnitude of 1.14 units. In contrast, the form value in the short term for both the current and previous periods is 0.030 and -0.06, respectively. This implies that government support has a positive effect in the same year, with an increase of one unit resulting in an improvement of 0.030 units in the SDGs score for that year, although this is followed by a decrease of 0.06 units in the subsequent year. B: Evaluating the estimates of the unrestricted error correction model (ARDL-ECM): Through the error correction model, we found that the estimated forms align closely with the long-term forms. We expected the error correction term (COINTEQ(-1)), which represents the speed of adjustment from the short term to the long term, to be negative and statistically significant in order to provide evidence of a long-term equilibrium relationship between the studied variables. The results of estimating the error correction model did indeed indicate that the coefficient is statistically significant with a negative sign (-0.203), meaning that each deviation in the short term is corrected by 20.30% in the long term within one year, so a 100% correction takes approximately 4.92 years. Furthermore, the estimates for the short-term forms revealed that most of the estimated forms are statistically significant.

4.2. Statistical implications

Based on statistical standards, the estimated ARDL (1.3) model was found to be generally statistically acceptable. Most of its estimated forms have statistical significance based on the Student t-test at a significance level of $\alpha = 5\%$, while the value for the corrected determination coefficient of $\bar{R}^2 = 0.9485$ indicates that the model has a high degree of interpretative capacity. Finally, the Fisher statistic of 71.104, as shown in Table 8, indicates the overall significance of the estimated model.

4.3. Econometric insights

A: Model adequacy tests: After estimating the forms of the ARDL model for both the long and short terms and after evaluating it economically and statistically, we performed diagnostic checking tests. The results of this are shown in Table 9.

Thus, the results of the model adequacy tests were as follows:

- The BGLM statistic indicates there is no problem with autocorrelation in the errors.
- The results of the ARCH test indicate that there is no problem with variability instability, with a probability value of 0.46 at a significance level of 5%, thus confirming the absence of any problem with variability instability.
- The Jarque–Bera (JB) statistic indicates that the residuals follow a normal distribution, with the p-value of 0.94 being greater than the 5% significance level.
- The RESET test statistic indicates the adequacy of the functional form of the estimated model because the p-value equals 0.629, which is greater than the 5% significance level.

B: Tests for the structural stability of the model's forms: To verify that the estimated model was free from structural changes over time, we used the cumulative sum of residuals test (CUSUM) and the cumulative sum of squares of residuals test (CUSUMSQ).

From the graphical representation in Fig. 4, it is clear that both the CUSUM and CUSUMSQ statistics for this model fall within the critical bounds at a 5% significance level. This suggests that there is stability and consistency in the model's estimates between the long-term and short-term results, indicating that the estimated forms for the unrestricted error correction model (UECM) remain structurally stable throughout the study period.

Table 8: Statistical indicators and measures for the estimated ARDL model

R-squared	0.962113	Mean dependent var	69.97300
Adjusted R-squared	0.948582	S.D. dependent var	1.790813
S.E. of regression	0.406076	Akaike info criterion	1.278774
Sum squared residuals	2.308573	Schwarz criterion	1.577494
Log likelihood	-6.787744	Hannan-Quinn criterion	1.337088
F-statistic	71.10410	Durbin-Watson stat	2.851249
Prob(F-statistic)	0.000000		

Table 9: Results of the diagnostic checking tests

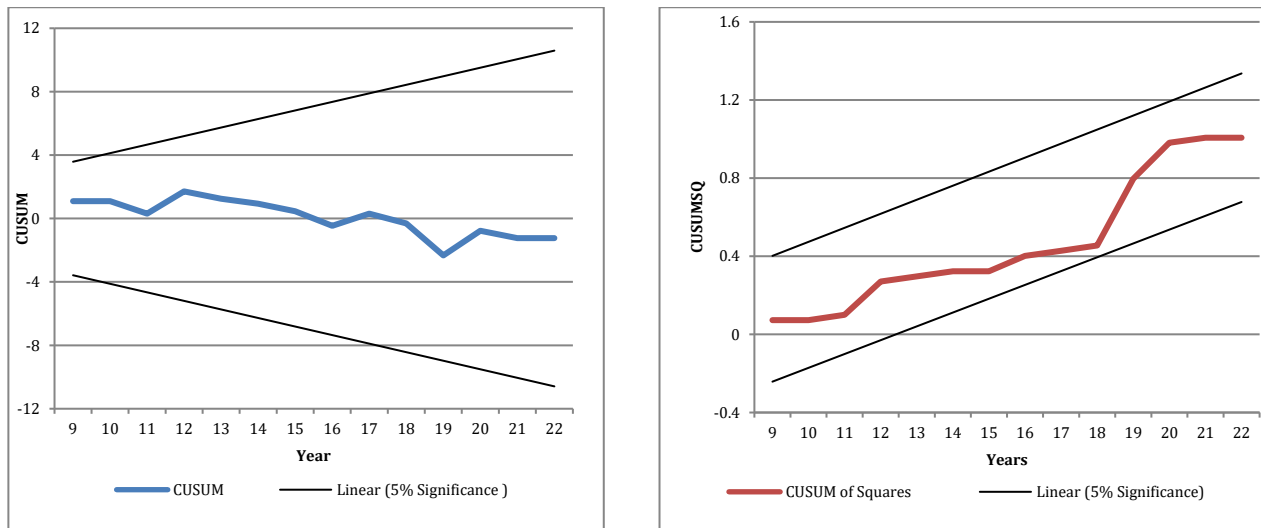| RESET	Jarque Bera	ARCH	BGLM
F − statistic = 0.480	J. B = 0.119	F − statistic = 0.799	F − statistic = 2.489
Prob. F(2.12) = 0.629	Probability = 0.941	Prob. F(2.15) = 0.467	Prob. F(2.12) = 0.124

Fig. 4: The results of the structural stability tests for the model's forms

5. Conclusion

This econometric study has demonstrated that government subsidies have a positive long-term effect on achieving the SDGs. This implies that further progress is dependent to some degree on subsidies, so given its fiscal situation, Algeria should systematically reduce most of its generalized subsidies and instead establish a cash-transfer program that specifically focuses on assisting low-income households. Indeed, targeted cash transfers would more efficiently safeguard poorer citizens while being less expensive than subsidies. This would then allow the government to invest more in projects related to aspects like infrastructure, education, and health, which could, in turn, boost economic growth while also helping sustainable development efforts.

To drive sustainable development efforts and mitigate the negative impacts of subsidy policies on the sustainability of state resources, policymakers in Algeria should consider the following steps:

- Implementing a subsidy reform strategy necessitates thorough preparation, effective execution, and consistent follow-through. This strategy is expected to demand a significant investment of time and effort, and policymakers should not underestimate the resources and political capital required for its successful implementation.
- The introduction of price increases in a subsidy reform strategy should be carefully phased to be appropriate. Rapid hikes in energy prices can provoke a negative public reaction, as evidenced by the failure of Mauritania's attempt to reform energy subsidies in 2008. On the other hand, a gradual removal of subsidies may lead to only partial and incomplete reforms if not executed at an optimal pace.
- Policymakers in Algeria have the opportunity to spearhead a thorough and independent study that encompasses the most effective strategies for implementing energy subsidy reforms and the potential impact of expanding cash transfers. This comprehensive study should incorporate key elements such as behavioral change, stakeholder mapping, political economy analysis, and strategic communication.
- In a country grappling with both the challenges of natural resource dependence and a warming climate, the rationalization of energy demand emerges as an essential initial measure toward adopting a more sustainable approach to address these predicaments.

As mentioned above, our econometric study has demonstrated a long-term positive correlation between government subsidies in Algeria and the achievement of SDGs. This necessitates a gradual reform of subsidy policies instead of outright elimination to avoid the negative impact on the sustainable developmental trajectory. This is the path that MENA countries, being among the most significant subsidizers globally, should follow.

Despite concerns about implementation challenges, countries in the Middle East and North Africa (MENA) region stand to gain from gradually reforming spending on subsidies. This approach can contribute to rebalancing their economies, fostering growth and employment, and supporting a more sustainable and efficient trajectory for economic development.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

Araar A and Verme P (2017). A comparative analysis of subsidies and subsidy reforms in the Middle East and North Africa region. In: Verme P and Araar A (Eds.), The quest for subsidy reforms in the Middle East and North Africa region: A microsimulation approach to policy making: 33-60. Volume

42, Springer, Cham, Switzerland. https://doi.org/10.1007/978-3-319-52926-4_2

Assassi S and Soullier G (2024). Do state-subsidized contractual arrangements improve farmers' income? Empirical evidence from Algeria. Canadian Journal of Development Studies, 45(1): 62-86. https://doi.org/10.1080/02255189.2023.2212895

Bellmann C (2019). Subsidies and sustainable agriculture: Mapping the policy landscape. Chatham House, London, UK.

Benameur AG, Belarbi Y, and Toumache R (2020). The macroeconomic effects of oil prices fluctuations in Algeria: A SVAR approach. Les Cahiers du Cread, 36(3), 59-82.

Bounoua L, Bachir N, Souidi H, Bahi H, Lagmiri S, Khebiza MY, and Thome K (2023). Sustainable development in Algeria's urban areas: Population growth and land consumption. Urban Science, 7(1): 29. https://doi.org/10.3390/urbansci7010029

Chekouri SM, Sahed A, and Chibi A (2021). Oil price and exchange rate nexus in Algeria: Evidence from nonlinear asymmetric and frequency domain approach. International Journal of Energy Sector Management, 15(5): 949-968. https://doi.org/10.1108/IJESM-08-2020-0018

Chelghoum A, Boumimez F, and Alsamara M (2023). Asymmetric effects of oil price shocks on the demand for money in Algeria. The Quarterly Review of Economics and Finance, 89: 1-11. https://doi.org/10.1016/j.qref.2023.02.009

DESA (2001). Energy subsidy reform and sustainable development: Challenges for policymakers. In the 9th Session of the United Nations Commission on Sustainable Development, Department of Economic and Social Affairs, New York, USA.

Engle RF and Granger CW (1987). Co-integration and error correction: Representation, estimation, and testing. Econometrica: Journal of the Econometric Society, 55(2): 251-276. https://doi.org/10.2307/1913236

Fattouh B and El-Katiri L (2012). Energy subsidies in the Arab world. United Nations Development Programme, New York, USA. https://doi.org/10.26889/9781907555350

Fayçal M and Ali HM (2016). Economic growth and government subventions for agriculture sector in Algeria: An ARDL model. Arab Economic and Business Journal, 11(2): 105-114. https://doi.org/10.1016/j.aebj.2016.10.001

Ford R and Suyker W (1990). Industrial subsidies in the OECD economies. OECD Economics Department Working Papers, Organisation for Economic Co-operation and Development, Paris, France.

Hong MGH and Lucas D (2023). Evaluating the costs of government credit support programs during COVID-19: International evidence. International Monetary Fund, Washington, USA. https://doi.org/10.5089/9798400231971.001

Jewell A and Souissi M (2016). Algeria: Selected issues. IMF Country Report No. 16/128, International Monetary Fund, Washington, USA. https://doi.org/10.5089/9781484358351.002

Johansen S (1988). Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control, 12(2-3): 231-254. https://doi.org/10.1016/0165-1889(88)90041-3

Johansen S and Juselius K (1990). Maximum likelihood estimation and inference on cointegration-With applications to the demand for money. Oxford Bulletin of Economics and Statistics, 52(2): 169-210. https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x

Khanal A, Rahman MM, Khanam R, and Velayutham E (2022). Does tourism contribute towards zero-carbon in Australia? Evidence from ARDL modelling approach. Energy Strategy Reviews, 43: 100907. https://doi.org/10.1016/j.esr.2022.100907

Li B, Chen W, Xu C, and Hou P (2018). Impacts of government subsidies for environmental-friendly products in a dual-channel supply chain. Journal of Cleaner Production, 171: 1558-1576. https://doi.org/10.1016/j.jclepro.2017.10.056

Matallah S and Benlahcene L (2021). Public service delivery dilemma and economic growth challenges in the MENA region. Theoretical and Applied Economics, 28(4): 31-50.

Matallah S, Boudaoud S, Matallah A, and Ferhaoui M (2023). The role of fossil fuel subsidies in preventing a jump-start on the transition to renewable energy: Empirical evidence from Algeria. Resources Policy, 86: 104276. https://doi.org/10.1016/j.resourpol.2023.104276

Merouani W, Messekher H, Hamaizia A, and Belkacem MA (2023). Reforming Algeria's social protection system. Chatham House, London, UK. https://doi.org/10.55317/9781784135751

Pedersen AB, Hickmann T, Renn O, Eckert N, Jax K, Lepenies R, Liu HY, Lyytimäki J, Reis S, and Rusch G (2023). SDGs at the halfway point: How the 17 global goals address risks and wicked problems. Ambio, 52(4): 679-682. https://doi.org/10.1007/s13280-023-01837-0 **PMid:36820962 PMCid:PMC9948769**

Peng B, Chang BH, Yang L, and Zhu C (2022). Exchange rate and energy demand in G7 countries: Fresh insights from Quantile ARDL model. Energy Strategy Reviews, 44: 100986. https://doi.org/10.1016/j.esr.2022.100986

Pesaran MH, Shin Y, and Smith RJ (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3): 289-326. https://doi.org/10.1002/jae.616

Pesaran MH, Shin Y, and Smith RP (1999). Pooled mean group estimation of dynamic heterogeneous panels. Journal of the American Statistical Association, 94(446): 621-634. https://doi.org/10.1080/01621459.1999.10474156

Rafaa M and Djenidi M (2023). The impact of the government support on economic growth in Algeria econometric study between 2010-2021. Journal of Economic Growth and Entrepreneurship, 6(1): 96-117.

Rickard SJ (2018). Spending to win: Political institutions, economic geography, and government subsidies. Cambridge University Press, Cambridge, UK. https://doi.org/10.1017/9781108381475

Sachs JD, Kroll C, Lafortune G, Fuller G, and Woelm F (2022). Sustainable development report 2022. Cambridge University Press, Cambridge, UK. https://doi.org/10.1017/9781009210058

Schwartz G and Clements B (1999). Government subsidies. Journal of Economic Surveys, 13(2): 119-148. https://doi.org/10.1111/1467-6419.00079

Shahid R, Shahid H, Shijie L, and Jian G (2024). Developing nexus between economic opening-up, environmental regulations, rent of natural resources, green innovation, and environmental upgrading of China-Empirical analysis using ARDL bound-testing approach. Innovation and Green Development, 3(1): 100088. https://doi.org/10.1016/j.igd.2023.100088

Shrestha MB and Bhatta GR (2018). Selecting appropriate methodological framework for time series data analysis. The Journal of Finance and Data Science, 4(2): 71-89. https://doi.org/10.1016/j.jfds.2017.11.001

UNSDG (2022). Cadre de coopération des nations unies pour le développement durable de l'Algérie 2023-2027. United Nations Sustainable Development Group, Algeirs, Algeria.

Vidican Auktor G and Loewe M (2022). Subsidy reform and the transformation of social contracts: The cases of Egypt, Iran and Morocco. Social Sciences, 11(2): 85. https://doi.org/10.3390/socsci11020085

Wenqi D, Khurshid A, Rauf A, and Calin AC (2022). Government subsidies' influence on corporate social responsibility of

private firms in a competitive environment. Journal of Innovation and Knowledge, 7(2): 100189. https://doi.org/10.1016/j.jik.2022.100189

Zafar KM (2020). ARDL–Analysis of the relationship among exports, FDI, current account deficit and economic growth in Pakistan. Iranian Economic Review, 24(2): 393-414.