



Research Article

Management of the Extractive Sector and Energy Diplomacy: Their Impact on the Economic Development of Cematic Countries – The Case of Cameroon

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Abstract

This article aims to analyze the impact of extractive sector management and energy diplomacy on the economic development of developing countries. It examines the strategic role of extractive resource governance and energy diplomacy in the dynamics of sustainable and inclusive economic growth. In a context where industrialization and development rely heavily on access to energy, the study analyses the link between the management of the extractive sector, energy diplomacy and their contribution to economic growth and sustainable development. Methodologically, the research employs an autoregressive integrated moving-average (ARDL) model applied to two equations, covering the period 2000–2024. The econometric results obtained reveal that the management of the extractive sector, when it incorporates energy diplomacy, has a positive and significant effect on GDP per capita, thereby reflecting inclusive growth in both the short and long term. Furthermore, energy diplomacy also contributes to sustainable development, with an impact that is noticeable in both the short and long term, though more pronounced over the long term, thereby confirming its pivotal role in Cameroon's development strategy. Finally, this research highlights the importance of effective governance of the extractive sector and proactive energy diplomacy in stimulating growth and promoting sustainable development. It also emphasizes the need for Cameroon to strengthen its natural resource management policies and intensify its international energy cooperation in order to transform its extractive potential into a genuine driver of economic prosperity.

Keywords

Management, Extractive Sector, Energy Diplomacy, Economic Growth, Sustainable Development, Governance

1. Introduction

Cameroon, like many African countries, possesses significant natural resources, particularly in the mining, oil and gas sectors, which constitute a potential driver for its economic development. Its extractive sector, one of its economic pillars

(accounting for 6.29% of GDP in 2022), remains dominated by oil and gas [28, 29]. However, the management of the extractive sector and energy diplomacy (as seen in recent crises

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in the Middle East) are crucial issues that can significantly influence the country's development trajectory [18, 22]. In a geopolitical and geostrategic context where Africa is increasingly courted by the world's major powers for its natural resources, Cameroon must navigate with caution to maximize the benefits of its resources whilst preserving its sovereignty and stability.

For example, Russia has successfully used its energy diplomacy to influence relations with European countries, notably by using its gas resources as a bargaining chip. This global geopolitical dynamic offers important lessons for developing countries, particularly Cameroon, which must develop a strategy for managing the extractive sector and energy diplomacy tailored to its specific context in order to promote sustainable and inclusive economic development.

According to the World Bank report [10, 15], extractive resources account for approximately 30% of the country's tax revenue and are a major source of employment for the population. However, this natural wealth is not without its challenges. Poor governance of these resources, often characterized by corruption and a lack of transparency, undermines their potential for sustainable development [11, 12]. Indeed, energy diplomacy is emerging as a key factor in the management of the extractive sector. It is defined as the set of strategies and international relations aimed at securing energy supplies and promoting sustainable partnerships in the energy sector [22]. In a global context where the energy transition towards renewable resources is becoming increasingly urgent, Cameroon, like any other developing country, must adapt its energy diplomacy to attract responsible investment and diversify its energy sources. Energy diplomacy thus appears to be an essential element in the management of this sector to promote sustainable development and achieve development goals.

The interaction between the management of the extractive sector and energy diplomacy has a direct impact on the economy. Effective management can promote the responsible exploitation of resources, minimize socio-environmental conflicts and maximize economic benefits for local communities. At the same time, a proactive energy diplomacy can strengthen the country's institutional capacities and promote high standards of sustainability [38]. However, this synergy requires strong political will and a robust regulatory framework to ensure that the benefits derived from natural resources are shared by the entire population, as energy is a key driver of development. In light of recent events that have highlighted issues of governance and international relations, notably the case of Savannah Energy and Cotco, which, having experienced major difficulties in managing its operations, led to diplomatic tensions between Cameroon and Chad. This situation illustrates how a simple management failure linked to the governance of the extractive sector can have significant consequences for relations between countries. Consequently, diplomatic tensions can also arise from existing geopolitical and geostrategic issues between countries [20] (such as the diplomatic tensions between European countries and Russia, or the

diplomatic tension between Niger and France over the uranium affair).

Thus, the need to learn lessons from these situations is all the more fundamental, as it highlights the risks associated not only with the inefficient management of extractive resources (as in the cases of Savannah Energy and Cotco) but also with diplomatic tensions between countries possessing these strategic energy resources (such as the case of Russia with Europe over gas and oil, etc.). Consequently, errors or problems related to the management of the extractive sector can not only compromise the profitability of projects but also damage interstate relations, which are essential for regional cooperation in the energy sector [39]. This highlights the importance of a strategic approach that integrates both the sound and transparent management of these resources and the establishment of strong and proactive energy diplomacy [19] (as in the case of Russia's dealings with Asian countries regarding the sale of its strategic resources), to enable and facilitate energy trade without diplomatic complications (as seen in the diplomacy between Cameroon and Chad regarding the Savannah and Cotco affairs). In the Cameroonian context, extractive resources play a significant role in the economy. However, little research has attempted to explain the link that may exist between diplomacy, the management of the extractive sector and its impact on economic development. It is therefore crucial to understand how the management of the extractive sector and energy diplomacy can be optimized to promote sustainable and inclusive economic development.

2. Extractive Sector Management and Energy Diplomacy: A Literature Review

Extractive sector management refers to the application of management principles and practices in extractive industries, such as mining, oil and gas production, and the extraction of natural resources, etc. In addition to this definition, extractive sector management involves the management of operations, human resources, risks, the environment, and relations with local communities and stakeholders. This management of the extractive sector, as described by Paul Collier, involves the effective management of extracted natural resources whilst balancing economic, environmental and social considerations to ensure sustainable use.

Diplomacy refers to the art and practice of negotiation between states or groups. According to Henry Kissinger, the former US Secretary of State, diplomacy is essential for maintaining international peace and stability. He emphasizes that diplomacy involves not only formal negotiations, but also an understanding of the cultures and interests of other nations. Other authors, such as Hans Morgenthau, highlight the importance of power relations in diplomacy. Energy diplomacy refers to the use of energy policy as a tool for negotiation and influence on the international stage. According to Daniel

Yergin, author of "The Prize", energy diplomacy has become a key element of international relations, particularly in the context of countries' growing dependence on energy resources. This form of diplomacy may include bilateral agreements on energy supply, strategic partnerships and initiatives to promote renewable energy.

The central issue of this study is to analyze the various factors linking the management of the extractive sector and energy diplomacy that may influence economic development. According to Auty [7], the extractive sector can be both a blessing and a curse for developing countries, depending on how resources are managed. Energy diplomacy, for its part, is crucial for securing a country's energy interests, as highlighted by [24]. Several authors, such as [26, 49], have shown that the transparent and responsible management of extractive resources is essential for promoting sustainable development [37, 48], work has shown that countries which implement effective energy policies and establish robust institutions can benefit from sustainable economic growth and reduce the risks associated with dependence on natural resources. Another fundamental aspect of energy diplomacy is its contribution to market stability. Relations between producer and consumer countries result in cooperation agreements that help mitigate price fluctuations and ensure a favorable climate for trade. [21], emphasise that global energy governance relies heavily on these diplomatic mechanisms, as they reduce uncertainty and promote a more equitable regulation of energy resources.

Energy diplomacy also plays a decisive role in the transition to renewable energy. By encouraging international cooperation, it facilitates the transfer of clean technologies and the implementation of joint projects focused on sustainability [22]. According to [14, 33, 34], this approach fosters the emergence of a more resilient energy system, where fossil fuels are gradually replaced by less polluting renewable sources, thereby contributing to global climate goals. According to [4], the impact of energy diplomacy on economic growth is evident through the facilitation of access to energy sources. These authors demonstrate that energy availability strongly influences economic prosperity, whilst emphasizing that international cooperation is a key factor in strengthening energy security and promoting inclusive development.

More recent research, such as that by [5, 16, 19, 36, 40], has focused on the role of energy diplomacy in economic growth and energy security. [36], highlights the importance of international cooperation in ensuring equitable access to energy resources, whilst [5], demonstrate that energy diplomacy contributes directly to economic growth by facilitating the security of supply. Thus, the literature confirms that energy and energy diplomacy are strategic levers for sustainable economic development. This leads us to formulate the following hypothesis:

H1: Energy diplomacy, manifested through the effective management of the extractive sector, has a positive effect on economic growth.

According to [3, 27], regional energy cooperation can promote economic integration and improve access to energy. In Cameroon, initiatives such as the construction of pipelines (e.g. the Chad–Cameroon pipeline) and energy infrastructure with neighboring countries demonstrate a commitment to strengthening this energy diplomacy [37]. The literature highlights the need to integrate sustainable practices into the management of the extractive sector to minimize environmental impacts [2, 23]. The report by the United Nations Environment program (UNEP, 2023) emphasizes that Cameroon must adopt strategies aimed at reducing greenhouse gas emissions whilst exploiting its resources. Such an approach is essential to ensure sustainable economic development.

According to [1], the quality of governance is a key determinant of economic growth and sustainable development. Transparent and accountable management of extractive resources is therefore essential. Energy diplomacy is crucial for safeguarding a country's energy interests and promoting international cooperation [24, 35]. Proactive energy diplomacy can contribute to energy stability and sustainable development. Consequently, effective management of the extractive sector and proactive energy diplomacy can help achieve this objective. The stakeholder approach holds that a company should not only seek to satisfy its preferred shareholders, but also take into account the interests of all stakeholders involved, such as employees, customers, communities and the state. In light of the above, we formulate the following hypothesis:

H2: Effective management of the extractive sector, accompanied by appropriate energy diplomacy, contributes positively to sustainable development.

3. Methodology

To achieve the objective of this research, which is intended to be interdisciplinary, linking both economics and management, we have adopted a quantitative methodological approach based on the econometric analysis of data from the World Bank for the period from 2000 to 2024. We used the ARDL (Autoregressive Distributed Lag) method to examine the short- and long-term relationships between the variables studied. The statistical data used were sourced from the World Bank website. We used Stata software to carry out the econometric analyses, including unit root tests, cointegration tests and the estimation of the ARDL model. This approach enabled us to empirically assess the impact of energy diplomacy and the management of the extractive sector on economic growth and sustainable development, and to draw conclusions based on robust statistical evidence.

3.1. Basic Concept

The ARDL model allows us to examine the dynamic relationship between a dependent variable and one or more explanatory variables, whilst taking into account the lags of these variables. It is particularly useful for studying long-term and short-

term relationships. The model can be written as follows:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + \beta_n X_{nt} \quad (1)$$

3.2. Characteristics of the ARDL Method

- 1) *Simultaneous estimation*: Long-run and short-run coefficients can be estimated simultaneously, allowing for a comprehensive analysis of the dynamics between the variables.
- 2) *Cointegration test*: The ARDL method includes tests to determine whether there is a cointegration relationship between the variables, implying that they move together in the long run.

3.3. Steps in its Implementation

- 1) Step 1: Identification of variables (selecting the relevant dependent and explanatory variables).
- 2) Step 2: Stationarity tests (check the stationarity of the

time series (ADF, KPSS tests, etc.)).

- 3) Step 3: Selection of lags (determining the optimal number of lags to include in the model).
- 4) Step 4: Estimation of the ARDL model (estimate the model using appropriate estimation methods).
- 5) Step 5: Analysis of results (interpret the coefficients, check the model assumptions and perform diagnostic tests).
- 6) Step 6: Co-integration tests: If necessary, carry out tests to check for the presence of a co-integration relationship (robustness).

It is important for us here to recall our two analytical models before presenting the variables, although these models are also presented below:

The equation for the 'Economic growth (GDPH)' variable: it is expressed by the following equation:

$$GDPH_t = \beta_0 + \beta_1 DIPLOENRG_t + \beta_2 DEPU_t + \beta_3 INFL_t + \beta_4 INVEST_t + \beta_4 GOVERN_t + \mu_t \quad (2)$$

In light of this equation, it should be noted that the economic literature highlights several channels through which economic growth can be measured and influenced. Some authors demonstrate that productive public expenditure, particularly that directed towards education and infrastructure, is a key determinant of productivity growth and thus of economic

growth [47]. For this part, [50] emphasizes the central role of investment in physical and technological capital as a fundamental driver of long-term growth.

As regards the equation for the 'sustainable development measured by ENA' variable, it is expressed by the following equation:

$$ENAt = \alpha_0 + \alpha_1 DIPLOENRG_t + \alpha_2 DEPU_t + \alpha_3 DEPSANTE_t + \alpha_4 GOVENT + \varepsilon_t \quad (3)$$

It should be noted that sustainable development is assessed using a set of economic and social indicators. [46], establish that excessively high levels of public debt undermine the sustainability of growth and hinder long-term development prospects. Conversely, [9], demonstrate that health expenditure constitutes a strategic investment in human capital, enabling increased productivity and strengthening the foundations of balanced development. These findings suggest that economic sustainability depends not only on the prudent management of public finances, but also on the priority given to social spending.

Several authors agree on the central role of governance in achieving sustainable development goals. [49], emphasizes the need for responsible, transparent and sustainability-oriented governance to ensure sound resource management and the reduction of inequalities. [44], takes a similar line, showing that the establishment of robust institutions is essential for implementing effective economic and social policies. Governance thus emerges as a cross-cutting factor linking both economic growth and sustainable development, determining their viability and how they are integrated.

3.4. Data Source

The data used in this research is drawn from World Bank databases, which are secondary data sources, notably the World Development Indicators [11] and the Worldwide Governance Indicators (WGI, 2020), as well as from the International Energy Agency. The first database provided us with variables such as the per capita GDP growth rate and adjusted net savings as a percentage, whilst the volume of energy trade, derived from the second database, serves as a measure of diplomacy in this sector or the favorable international business climate in the energy sector. Indeed, the variables used are determined or selected based on the existing literature on the subject, data availability, and economic theory.

Consequently, Adjusted Net Savings (ANS) is selected in this study as the dependent variable in the second equation. ANS is an indicator of sustainable development because it takes into account the three pillars of SD (economic, social and environmental) in its formulation. This indicator is derived from Genuine Savings (also known as Adjusted Net Savings or Genuine Savings), a weak sustainability indicator developed by the World Bank (WB) to guide the sustainable

development policies of countries reliant on the exploitation of natural resources.

The growth rate of GDP per capita (*GDPH*); the literature on this variable, for its part, takes into account a number of fundamental control variables in its estimates. Thus, we have control variables such as: the inflation rate (*INFL*), investment (*INVEST*), public consumption (*DEPUB*), which are essential and whose influence improves the results. Furthermore, the external debts incurred by a country today constitute a burden for future generations. These debts raise significant issues in terms of sustainable development, in that while borrowing enables the state to finance immediate needs and long-term investments, it must also provide for the repayment of the principal (loans) and debt servicing (interest rates on loans) on the dates agreed with creditors in the future. The repayment period for these government debts usually spans several decades. They therefore constitute a burden (a poor legacy) bequeathed to future generations [17].

Energy diplomacy (β_1 DIPLOENEG); as our variable of interest, this variable facilitates international energy trade, given that our work focuses on the management of the extractive sector; the same variable could have been framed differently if our topic had, for example, concerned foreign policy on energy, in which case the variable on energy diplomacy might have focused on the total amount of foreign investment in the energy sector. Indeed, energy diplomacy can be captured in various ways; foreign investment in the energy sector; this indicates the country's attractiveness to foreign investors in the energy sector.

Health expenditure (*DEPSANT*): the approach adopted by the World Bank in calculating real savings does not take current health expenditure into account. However, the 'health' component of human capital is of paramount importance in endogenous growth [47], just as education is. But from an economic perspective (within the framework of endogenous growth theory), health expenditure is often regarded as an investment and thus helps to improve productivity and non-natural capital... However, it can have two effects on real savings: a positive (+) effect, in that healthcare expenditure is regarded as an investment, which will improve productivity and non-natural capital, thereby ensuring a sustainable economy in the long term. The effect will be negative (-) insofar as increased healthcare expenditure implies a sick population and therefore low productivity, which will not lead to a sustainable economy in the long term.

Furthermore, Governance (*GOVERN*) is captured through its six dimensions, namely: Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. The six dimensions of governance (WGI, 2020) and the scores are assumed to follow a normal distribution and are assessed on a scale ranging from -2.5 to +2.5, with a higher score indicating better governance, i.e. greater efforts towards good governance.

3.5. Model Specification and Estimation

Y_{it} Given that our research uses variables whose data are in the form of time series, it is necessary to ensure their stationarity, hence the need to carry out stationarity tests to determine the degree of integration of the variables. A variable is said to be stationary when its mean and variance fluctuate around a constant amplitude. In other words, a time series is stationary in terms of mean and variance if its mean ($E(Y_t)$) remains invariant or constant over time and its variance does not increase over time ($Var(Y_t) = \sigma$), and the same applies to its covariances ($E(Y_t - c)(-c - c) =$) [30].

Several stationarity tests are described in the literature: the Dickey-Fuller test, the augmented Dickey-Fuller (ADF) test, and the Phillips-Perron test. The latter seeks to determine whether or not there is a unit root in the model's variables (non-stationary series) and does so by estimating the following three models using OLS:

$$\Delta x_t = \rho x_{t-1} + \sum_{j=1}^p \varphi_j x_{t-j} + \varepsilon_t \quad (4)$$

$$\Delta x_t = \alpha + \rho x_{t-1} + \sum_{j=1}^p \varphi_j x_{t-j} + \varepsilon_t \quad (5)$$

$$\Delta x_t = \alpha + \beta t + \rho x_{t-1} + \sum_{j=1}^p \varphi_j x_{t-j} + \varepsilon_t \quad (6)$$

We then test the null hypothesis $\varphi = 0$ (non-stationarity) against the alternative hypothesis $\varphi < 0$ (stationarity) by referring to the values tabulated by Dickey and Fuller (1981). If the variables are integrated of the same order (assuming all are stationary in first differences), the cointegration test is then performed to identify the number of cointegration vectors and eliminate its effect where necessary. Indeed, the Engle and Granger cointegration test is valid only in a bivariate setting, whilst Johansen's test is applicable only in a multivariate setting but for integrated series of the same order. However, there is no reason to assume that several series are generally integrated of the same order. When the series are integrated to different orders, Johansen's approach is no longer tenable. In this scenario, the literature proposes a cointegration test when the variables are integrated only to order 0 or 1, i.e. at level and first difference: this is the cointegration test by [43], known as the 'bounds test for cointegration' [30, 31]. From an econometric perspective, two equations will be estimated as part of this study. The first equation will assess the impact of mining projects on economic growth, drawing primarily on [13, 42], whilst the second equation to be estimated examines the relationship between the impact of mining projects and economic development, drawing on [6].

The econometric form chosen for the first equation is as follows:

$$\text{Economic growth (GDPH)} \\ GDPH_t = \beta_0 + \beta_1 DIPLOENRG_t + \beta_2 DEPUB_t + \beta_3 INFL_t + \beta_4 INVEST_t + \beta_4 GOVERN_t + \mu_t \quad (1, \text{ above})$$

Where β_0 is the constant when all variables are zero, $GDPHt$ denotes the growth rate of GDP per capita; $DIPLOENEGt$: energy diplomacy, which is our dependent variable; $DEPUBt$: public consumption expenditure; $INFLt$: the inflation rate; $INVESTt$: investment; $GOVERNt$: governance; and μ_t : the error term or residual representing the variables not accounted for in the models. To analyze the effect of economic

growth and energy diplomacy, we will use the autoregressive distributed lag (noted ARDL: Autoregressive Distributed Lag) to model the long-term and short-term dynamics of the impact of energy diplomacy on economic growth in Cameroon. In its general (explicit) form, an ARDL is written, drawing on [30], as follows:

$$\gamma_t = a_0 + a_1\gamma_{t-1} + \dots + a_p\gamma_{t-p} + b_0X_t + \dots + b_qX_{t-q} + \omega_t \quad (7)$$

or:

$$\gamma_t = a_0 + \sum_{i=1}^p a_i\gamma_{t-i} + \sum_{j=1}^q b_jX_{t-j} + \omega_t \quad (8)$$

$$\gamma_{t-2} = a_0 + \sum_{i=1}^p a_i\gamma_{t-i} + \sum_{j=1}^q b_jX_{t-j} + \omega_t \quad (9)$$

The error-correcting form of equations (7 or 8), taking into account the variables defined in equation (5) of economic

growth, can be expressed as follows:

$$\Delta GDPHt = a_0 + \sum_{k=1}^p a_1k \Delta GDPHt - k + \sum_{i=1}^q a_2k \Delta DIPLOENERGHt - k + \sum_{i=1}^q a_3k \Delta INFLtk + \sum_{i=1}^q a_4k \Delta DEPUBt - k + \sum_{i=1}^q a_5k \Delta INVESTt - k + \sum_{i=1}^q a_6k \Delta GOVERNt - k + b_1GDPHt - 1 + b_2DIPLOENERGHt - 1 + b_3DEPUBt - 1 + b_4INFLt - 1 + b_5INVESTt - 1 + b_6governnt - 1 + U \quad (10)$$

Furthermore, in order to measure the impact of mineral resource extraction on a sustainable development pathway, we propose to evaluate [25], according to which the rents from a non-renewable natural resource are sustainable only if these rents correspond to the depreciation of the resource's natural capital and are reinvested in other forms of capital. To this end, we adopt the following specification for the second equation of the sustainable development (ENA) model:

$ENAt = \infty 0 + \infty 1DIPLOENRGt + \infty 2DEPUBt + \infty 3DEPSANTEt \propto 4GOVENT + \varepsilon t$ (2, above) where 0 is the

constant when all variables are zero, $ENAt$ is the adjusted net savings, which is our dependent variable here; $diploeneg$: energy diplomacy; $DEPUBt$ the stock of external debt, $DEPSANTEt$, health expenditure, $GOVERNt$ governance, and εt represents the residual or error term and reflects the variables not taken into account in the model. If we also aim here to analyze the short-term and long-term dynamic impacts of the above explanatory variables on adjusted net savings, we obtain the following ARDL representation:

$$\Delta ENAt = a_0 + \sum_{k=1}^p a_1k \Delta ENAt - k + \sum_{i=1}^q a_2k \Delta DIPLOENERGHt - k + \sum_{i=1}^q a_3k \Delta DEPUBt - k + \sum_{i=1}^q a_4k \Delta DEPSANTEt - k + \sum_{i=1}^q a_5k \Delta GOVERNt - k + b_1ENAt - 1 + b_2DIPLOENERGHt - 1 + b_3DETPUBt - 1 + b_4DEPSANTEt - 1 + b_5GOVERNt - 1 + U(10) \quad (11)$$

4. Presentation and Analysis of the Main Results

The methodology of time series estimation requires preliminary tests to be carried out, notably the stationarity test and the cointegration test, to avoid any spurious regression. To fulfil this empirical requirement, we carried out two stationarity tests suited to the model specified in this study: the augmented Dickey-Fuller unit root test (ADF test) and the Perron unit root test.

Table 1. Summary of the results of the ADF and Perron stationarity tests.

variable	First difference		
	ADF	PPERON	Decision
DEPUB 1	-1.155 (-0.6927)	-5.51 (0.0001)	I(1)

variable	First difference		
	ADF	PPERON	Decision
INFL2	-2.054 (0.2635)	-6.595 (0.007)	I(1)
INVEST 1	-4.708 (0.0009)		I(0)
GOVERN1	-0.876 (0.7958)	-5.025 (0.0002)	I(1)
DIPLOENERGE 2	-3.713 (0.0039)		I(0)
DEBT	-0.513 (0.8894)	-3.873 (0.012)	I(1)
GDPH1	-2.926 (0.0424)		I(0)
DEPSANTE	-2.307 0.1698	0.0389	I(1)
ENA 2	-3.713 (0.0825)	-7.88 (0.005)	I(1)

Source: Author, based on WDI data

In order to avoid spurious regression, stationarity and unit root tests were applied using the augmented Dickey-Fuller (ADF) and Perron tests. Having said that, the tests on the series under study lead to the rejection of several integrated variables of different orders (I (0), I (1)), so we can resort to the cointegration test by [43], known as the ‘bounds test for cointegration [31, 32]. The results of this test are reported below: the stationarity hypothesis holds for all series except economic growth (GDPH1), investment (Invest) and energy diplomacy (DIPLOENERG), which are stationary in level; the other series are stationary in first differences, and no series is integrated of order 2 or higher, which is rather crucial for the application of the ARDL model.

Table 2. Results of the cointegration test for the economic growth model.

Test statistic	Value k	Signif	I (0)	I (1)
F-statistic	16.5	10%	2.57	3.46
		2.5%	3.13	4.05
K	3	5%	2.86	3.78
		1%	3.43	4.37

Source: Author, based on WDI data

Table 3. Results of the cointegration test within the sustainable development model.

Test statistic	Value	Signif	I (0)	I (1)
F-statistic	13.5	10%	3.17	4.14
		5%	3.79	4.85
K	3	2.5%	4.41	5.52
		1%	5.15	6.36

Source: Author, based on WDI data

Analysis of the results in Tables 2 and 3 shows that there is a cointegration relationship between the variables in the first

model as well as those in the second model, as the F-statistic for the economic growth model (16.5) and for the sustainable

development model (13.5) are greater than the upper bounds in both cases (3.46 and 4.14). If it is lower, we can say that cointegration does not exist, and if the F-statistic is below both limits, there will be no cointegration [30].

4.1. Results of the Economic Growth Model (Gdph_t)

As a reminder of the first hypothesis of this study, '*Energy diplomacy, manifested through the management of the extractive sector, has a favorable effect on economic growth*'.

Thus, the results of the ARDL model estimation with economic growth as the dependent variable are generally satisfactory. The estimated model is significant and explains over 80% of the variation (adjusted R²). Consequently, the dynamics of economic growth, with a Fischer's F-statistic of this magnitude, reflect the overall significance of the model.

Table 4. ARDL model estimation.

ARDL (3, 4, 4, 4) regression			
Sample 2000–2024	Number of observations	=	20
	R-squared	=	0.9909
	Adjusted R-squared	=	0.808
Log likelihood	Root MSE	=	4.02E+10

Table 5. Coefficients of the economic growth (GDPHT), Management (GOVEN) and Energy Diplomacy (DIPLOENR) model.

D.GDPH	Coeff.	Std. Err.	T	P>t	[95 % Conf.]	
GOUVEN1						
D1.	3.19E+12	1.68E+12	1.9	0.0308	1.45E+13	1.81E+13
LD.	3.16E+12	1.82E+12	1.73	0.0334	2.63E +13	3.00E+13
L2D.	4.59E+12	1.95E+12	2.35	0.0256	2.01E+13	2.03E+13
L3D.	4.54E+12	1.75E+12	2.58	0.0235	2.68E+13	2.78E+13
GDPH						
LD.	0.10398	0.6675941	0.16	0.0502	8.586567	8.678607
L2D.	0.621072	0.6835361	0.91	0.0503	8.064077	9.306221
DIPLOENR						
D1.	333.8882	382.458	0.85	0.05	182,941	6,533.175
LD.	84.35956	354.26	0.26	0.008	3,150.35	3,781.631
L2D.	111.0449	304.5537	0.36	0.0107	3980.767	3758.677
L3D.	270.3223	212.8137	1.16	0.0453	3228.501	2687.856

Source: Extract from the complete table of the economic growth model

The ARDL model estimation results, as illustrated in Table 4 above, show the presence of a positive GDPH coefficient, with a p-value for the first coefficient of 0.0502, followed by energy diplomacy with a p-value for the first coefficient of 0.05, and finally management with a p-value for the first coefficient of 0.0308.

Thus, all have significance thresholds below 5%. We can say that all three move in the same direction. Consequently,

when we increase the volume of trade in the energy sector, GDP also increases; therefore, effective management of this sector has a positive impact on economic growth.

As energy diplomacy is a key component of every country's foreign policy, its effective management increases in tandem with the country's Gross Domestic Product (GDP). Indeed, in the case of Cameroon, the country is currently experiencing rapid economic growth, with GDP having risen significantly

in recent years. This economic growth is largely due to the development of sectors such as agriculture, industry and services, which require an increasing amount of energy to operate. To meet this demand, Cameroon has established an active energy diplomacy, in collaboration with its partners, to secure its energy supplies and support its economic growth.

Cameroon's rising GDP is driving an increasing demand for energy to sustain economic activity, particularly in the industrial, transport and domestic consumption sectors. To meet this demand, Cameroon has established strategic partnerships with energy-producing countries. These partnerships enable Cameroon to secure its energy supplies and diversify its energy sources, including notably oil, gas and hydroelectric power [45]. Furthermore, Cameroon's management of the extractive sector and its energy diplomacy enable the country to benefit from the experience and technologies of foreign countries to develop its own energy resources.

4.2. Results of the Sustainable Development Model Estimation

As a reminder of the second hypothesis of this study, the aim of this analysis is to confirm or refute *H2*: Effective management of the extractive sector, coupled with energy diplomacy, contributes positively to sustainable development. We therefore observe in Table III.5 that the results of the ARDL model estimation for the second equation, with ENA as the dependent variable, are generally satisfactory. The estimated model is significant and shows that the exogenous variables explain 75.8% (adjusted R^2) of sustainable development in Cameroon, with a Fischer's F-statistic that is equally strong, reflecting the overall significance of the coefficients.

Table 6. ARDL model estimation and Coefficients for sustainable development (ENA), Management (GOUVEN), Energy diplomacy (DIPLOENR).

ARDL (4, 3,3) regression Sample: 2000–2024			Number of obs. =20 R-squared =0.8807 Adjusted R-squared =0.758		[95% Confidence Interval]	
D. ENA	Coef.	Std. Err.	T	P>t		
ENA1						
LD.	0.475077	0.1623286	2.93	0.022	0.0912309	0.858923
L2D.	0.2969446	0.156279	1.9	0.039	0.0725966	0.6664858
L3D.	0.8484809	0.1636207	5.19	0.001	0.4615795	1.235382
DIPLOENR						
D1.	333.88824	382.458	0.85	0.05	4182.941	4533.175
LD.	84.35956	354.26	0.26	0.04	3,650.35	3,781.631
L2D.	111.0449	304.5537	-0.36	0.0077	3580.767	3758.677
GOVEN						
D1.	7.791997	3.646609	2.14	0.044	0.8308624	16.41486
LD.	6.539406	3.786841	1.73	0.0128	2.415051	15.49386
L2D.	18.37396	5.904601	3.11	0.017	4.411796	32.33612

Source: extract from the table 'Long-term coefficients of the sustainable development model (ENAt)'

If we continue to focus on our variable of interest, which is energy diplomacy with a p-value of 0.05 for the first coefficient, this moves in the same direction as sustainable development (ENA) with a p-value of 0.022, and also management, which is governance. In this sense, the positive relationship implies that when Cameroon increases the volume of its energy trade with other countries—which is only possible through good relations with them—Cameroon also increases

this variable, which measures sustainable development. Indeed, energy diplomacy is a key component of sustainable development, and its importance is growing steadily alongside the country's efforts to achieve the Sustainable Development Goals (SDGs). Indeed, Cameroon has committed to reducing its greenhouse gas emissions and promoting the use of renewable energy, which requires active energy diplomacy. Consequently, energy diplomacy enables Cameroon to negotiate

agreements with foreign countries for the acquisition of technologies and capital to develop its energy resources.

5. Discussion, Limitations and Prospects

The adoption of energy diplomacy facilitates the transition to a low-carbon economy. Indeed, the country possesses vast renewable energy resources, such as hydroelectricity, solar energy and wind power. However, the development of these resources requires significant investment and partnerships with countries experienced in this field. Energy diplomacy enables Cameroon, for example, to secure these investments and benefit from the experience of other countries to develop its own sustainable energy resources. This is the case with the signing of agreements with foreign companies to develop energy projects such as hydroelectric power stations and wind farms.

Energy diplomacy is also a key tool for attracting investment in sustainable energy infrastructure. By establishing strong relationships with producer countries and investors, Cameroon can secure the capital needed to develop its sustainable energy resources and improve its energy infrastructure. Furthermore, energy diplomacy enables the country to benefit from other nations' technologies and expertise to develop its own sustainable energy resources. This is in line with the views of authors such as [8, 36], who emphasise the importance of international cooperation in ensuring equitable access to energy resources. In this vein, [4], demonstrate that energy diplomacy contributes directly to economic growth by facilitating the security of supply.

At the conclusion of this research on the management of the extractive sector and energy diplomacy, as well as their impact on economic development in Cameroon, we sought to answer the central question: how can these two levers be used to promote sustainable economic development? The analysis conducted as part of this study confirmed both initial hypotheses. On the one hand, it appears that energy diplomacy, when accompanied by rational and strategic management of the extractive sector, has a positive effect on national economic growth. This finding is supported by the results in Tables 4 and 5, which demonstrated that economic growth, management and energy diplomacy evolve in a convergent manner. Secondly, the results from Table 6 confirm that the combination of effective management of the extractive sector and proactive energy diplomacy contributes significantly to the promotion of sustainable development, by integrating economic, social and environmental dimensions.

More specifically, our estimates show that effective management of the extractive sector through energy diplomacy has a positive impact on sustainable development in both the short and long term. In other words, poor management or managerial errors by those in charge of any sector of the energy industry, such as: oil, gas, the electricity grid, and any other form of energy, can lead to war and hinder economic growth (as in the case of the war

in the Persian Gulf) and also prevent energy trade between countries or international partners (the Strait of Hormuz incident involving the US-Israeli-Iranian crisis). Returning to the case of Savannah Energy, between Chad and Cameroon via the companies SNH and COTCO, Savannah had sold 10% of its shares in Cotco to SNH for approximately 26 billion CFA francs (according to the newspaper Ecomatin, 2024). As Cotco is responsible for transporting oil via the Chad-Cameroon pipeline, energy diplomacy could play a crucial role in averting this conflict by conducting transparent negotiations (Ensure that all negotiations and agreements relating to energy resources are transparent and fair for all stakeholders). And also by adhering to conventions and statutes (ensuring that all transactions and agreements comply with established conventions and statutes, such as those of Cotco, to avoid disputes and diplomatic tensions). Consequently, collaborative resource management with partner countries is essential to safeguard the interests of all stakeholders. Furthermore, mediation and arbitration, utilizing mediation and arbitration mechanisms to resolve disputes peacefully, are necessary to enable nations to preserve energy resources and promote inclusive and sustainable development. To this end, we can validate our two initial hypotheses, namely:

H1: Energy diplomacy, manifested through the management of the extractive sector, has a positive impact on GDP and promotes economic growth in the short term.

H2: Effective management of the extractive sector, accompanied by appropriate energy diplomacy, contributes positively to sustainable development in Cameroon.

In terms of implications and prospects, in line with our research findings, the results first and foremost imply that developing countries should prioritize human resources that demonstrate a high degree of diplomatic responsibility and respect for rules of protocol and decorum, ensure that senior officials receive training in diplomacy and even in the management of the extractive sector, to intensify energy diplomacy efforts to secure the country's energy supplies and promote the use of renewable energy, to develop strategies to diversify energy sources and reduce dependence on oil, and to establish energy management institutions to coordinate energy development efforts and ensure a stable and sustainable energy supply chain. Energy diplomacy appears as a key mechanism for fostering collaboration between nations, facilitating technology transfer, and mobilising financial resources for sustainable energies initiatives [41].

Secondly, for international organizations, they enable them to provide funding and technical support to help developing countries such as Cameroon, for example, to develop their energy resources in a sustainable and stable manner, encourage these organizations to provide expertise and technologies to help Cameroon improve its energy infrastructure, promote regional or international cooperation to foster sustainable energy development in Africa, and promote dialogue between energy infrastructure managers in neighboring countries to avoid border conflicts related to the management of extractive resources. Finally, for researchers and academics, to conduct

further research on the topic of extractive management in general, to study success stories of effective management of the extractive sector combined with energy diplomacy in other countries to identify best practices, and to develop simulation models to assess the potential effects of energy diplomacy on the Cameroonian economy and on a sample of developing countries possessing strategic extractive resources.

The first limitation of this study lies in the timeframe of the analysis. Although the research covers a period of around twenty years, this timeframe remains relatively short for accurately gauging the actual impact of extractive sector management and energy diplomacy on sustainable development. Economic, social and, above all, environmental effects often manifest themselves over the long term, sometimes spanning several decades, which makes it difficult to conduct a comprehensive assessment of the results. Added to this is another significant limitation related to the availability and accessibility of data. The most recent information on the extractive sector is sometimes incomplete, fragmented or unpublished for reasons of confidentiality and lack of transparency. This scarcity of current data limits the possibility of conducting an in-depth and up-to-date analysis, forcing researchers to rely on institutional reports or secondary sources, which do not always accurately reflect the reality on the ground.

Abbreviations

ARDL	Autoregressive Distributed Lag
GDP	Gross Domestic Product
WGI	Worldwide Governance Indicators
ENA	Adjusted Net Savings

Author Contributions

Amanwa Garandi Albert: Conceptualization, Formal Analysis, Methodology, Resources, Writing – original draft

Conflicts of Interest

The authors declare no conflicts of interest.

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