Beyond Oil: Do Algerian Non-Hydrocarbon Exports Contribute to Economic Growth? New Empirical Evidence Using the Augmented ARDL Bounds Testing Approach

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Abstract:

This study investigates the impact of non-hydrocarbon exports on economic growth in Algeria from 1984 to 2023. Utilizing the Augmented Autoregressive Distributed Lag (AARDL) Bounds Test. The results establish a long-term equilibrium relationship between per capita GDP and key economic variables, including hydrocarbon exports, non-hydrocarbon exports, private investment, and the real exchange rate. A positive and significant relationship was found between non-hydrocarbon exports and economic growth in both the short and long run. This finding holds true despite the continued dominance of hydrocarbon exports as the primary driver of economic growth. Furthermore, the study underscores the critical role of private investment and the real exchange rate in fostering economic growth. Private investment contributes to production expansion and value creation, while the real exchange rate enhances the competitiveness of Algerian exports in global markets. Accordingly, the study recommends adopting more sustainable economic policies, such as strengthening institutional frameworks, improving logistics infrastructure, and providing incentives for export-oriented sectors.

Keywords: Hydrocarbon exports; non-hydrocarbon exports; economic growth; AARDL model; Algeria.

Jel Classification Codes : F43 ; F14 ; C32 ; O55

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1-Introduction:

Economic growth is a crucial objective for various countries. This goal has garnered significant interest, particularly for developing countries seeking to enhance social welfare indicators. Amidst the chronic challenges confronting these nations, such as poverty, inequality, and infrastructural deficits, the necessity of bolstering growth rates is a strategic avenue for financing sustainable development programs (Sachs, 2015). Prominent studies indicate that sustainable economic growth directly contributes to the creation of new employment opportunities, the augmentation of individual incomes, the funding of essential services like education and healthcare, as well as the reduction of reliance on external aid (Barro, 1991) .

In the pursuit of stable and sustainable growth, export expansion emerges as a key driving force, providing the necessary foreign exchange inflows required for financing development programs and market expansion, attracting investment, and stimulating technological innovation—factors that collectively enhance the capacity of developing countries to achieve their development goals. Consequently, considerable attention within the economic literature has been devoted to analyzing the relationship between export performance and growth rates.

Although the role of exports in economic growth has been extensively addressed in the field of international trade and economic growth, it remains highly relevant for economists and policymakers in formulating effective growth strategies. Empirical studies have extensively investigated the impact of exports on the economic growth of developing countries from various perspectives (e.g., Michaely, 1977; Feder, 1983; Chow, 1987; Millia et al., 2021). Most studies have predominantly concluded that export performance exerts a positive influence on economic growth. According to (Parvin & Tang, 2014), exports augment foreign exchange earnings and generate more employment opportunities in the domestic market.

Neoclassical economic literature considers export performance to be a fundamental driver of economic growth, operating through several key channels (Ram, 1987) , including: (a) promoting specialization and leveraging comparative advantages, which contributes to higher production efficiency; (b) achieving economies of scale by expanding market reach; (c) optimizing the use of available productive capacities and resources; and (d) accelerating innovation and technological advancement. Due to the positive impact of exports on growth, (Xu, 1996) posited that economists and policymakers prefer export promotion strategies to stimulate economic growth and development. Meanwhile, neo-Marxist approaches adopt a contrasting perspective, considering that trade exchange between developing countries and their advanced industrial counterparts—particularly exports flowing from the former to the latter—may constitute a primary mechanism for depleting the resources of poor countries and perpetuating their economic dependency. While this topic is not novel, it remains a subject of intense debate, as the relationship between exports and economic growth continues to be ambiguous.

However, in countries exporting natural resources, particularly hydrocarbon-dependent economies, the impact of exports on growth may differ significantly. These economies face substantial risks stemming from price volatility and the repercussions of the "natural resource

curse" (Ross, 2015), (Sachs & Warner, 2001). Additionally, concerns regarding the depletion of non-renewable resources and the adverse environmental impacts associated with hydrocarbon

extraction activities pose a fundamental threat to the long-term stability and sustainability of economic growth in these nations (Venables, 2016). This overreliance underscores the urgent need to diversify the economic structure by developing new sectors and strengthening non-oil exports. Such measures are critical to ensuring sustainable economic growth, reducing vulnerability to external shocks, and achieving inclusive development (Gelb, 2012).

In recent years, economic diversification has gained increasing affection, especially following successive economic crises that have prompted resource-dependent countries to explore new revenue streams by leveraging their full economic potential within comprehensive national policies encompassing all productive sectors.

In this context, Algeria, like other resource-dependent developing countries, has long relied heavily on energy export (oil and gas) revenues. For decades, the country's economic performance has been closely tied to the fluctuations in hydrocarbon revenues, with economic and financial policies centered primarily around this sector.

Oil and gas exports still account for approximately 98% of total exports, while the national budget largely depends on petroleum tax revenues. This excessive reliance on hydrocarbon revenues has made the Algerian economy highly vulnerable to economic crises triggered by energy price volatility, as evidenced by the oil shocks of 1986 and 2014, which had long-term repercussions that were difficult to mitigate. In light of these challenges, the need for economic diversification and improved economic performance through the full exploitation of all productive sectors and income sources has become increasingly imperative.

In this regard, non-hydrocarbon exports emerge as a key mechanism capable of stimulating economic growth in Algeria and reducing overdependence on hydrocarbon exports, which are inherently unstable due to their sensitivity to global energy price fluctuations. According to official statistics from the Bank of Algeria, non-hydrocarbon exports have shown significant growth in recent years after remaining relatively low for decades under the dominance of energy exports. For instance, the value of non-hydrocarbon exports reached approximately $5.98 billion in 2022 and around $5 billion in 2023, compared to less than $2 billion in previous years. These figures highlight the Algerian government's considerable efforts to promote and diversify national exports, reducing reliance on the volatility of hydrocarbon revenues, which still constitute a substantial portion of total exports.

This study holds significant importance for policymakers in Algeria, as it will provide precise empirical evidence to inform their decisions regarding export diversification strategies. The results of this study will either provide strong support for intensifying policies and efforts aimed at promoting, supporting, and developing non-hydrocarbon exports through establishing export incentives, reducing bureaucratic obstacles, and improving logistical infrastructure; or necessitate a reevaluation of current strategies and conducting a comprehensive review of accompanying trade and economic policies, with a focus on enhancing competitiveness, improving export-supporting infrastructure, diversifying foreign markets, and seeking more effective growth driver.

Despite growing interest in diversifying Algeria's export base, studies comprehensively examining the impact of non-hydrocarbon exports on economic growth remain limited in number and quality of empirical evidence. Available findings are characterized by contradiction and methodological ambiguity, limiting their ability to guide effective economic policies. Additionally, the literature lacks the application of modern cointegration models such as the extended ARDL bounds test, which is distinguished by its ability to identify the existence of a long-term relationship. This collectively indicates a genuine knowledge vacuum that needs to be filled, thus highlighting a clear research gap requiring a modern empirical study that provides robust empirical evidence on whether Algeria's non-oil exports contribute tangibly to supporting economic growth. Based on the foregoing, this study seeks to answer the following research question:

Do non-hydrocarbon exports contribute to stimulating economic growth in Algeria?

The remainder of the paper is structured as follows: Section 2 reviews the most relevant studies on the relationship between non-hydrocarbon export diversification and economic growth, particularly in resource-dependent economies. Section 3 analyzes the development of Algeria's foreign trade sector, with a focus on the dynamics of exports, imports, and the growth of non-hydrocarbon exports. Section 4 presents the econometric model employed in the study and outlines the methodology used for its estimation, based on the Augmented Autoregressive Distributed Lag (AARDL) cointegration approach. Section 5 discusses the empirical findings and provides an in-depth analysis of the results. Finally, Section 6 presents the conclusion.

2. Previous Studies:

Several previous studies have examined the relationship between non-hydrocarbon export diversification and economic growth, particularly in rentier economies primarily relying on oil and gas exports. These studies have focused on assessing the impact of economic diversification in reducing dependency on unstable income sources and enhancing economic stability, utilizing various analytical methodologies. The following section provides a structured review of the most relevant previous studies.

The Gulf Cooperation Council (GCC) countries have increasingly focused on diversifying their exports beyond oil and gas as part of broader economic strategies to reduce dependence on oil revenues and promote sustainable growth. Numerous studies have analyzed the effectiveness of these policies and assessed the impact of economic diversification on growth, providing varying evaluations based on each country's experience.

In this context, (Coury & Dave, 2010) conducted an empirical assessment of economic diversification in the GCC countries from 1980 to 2005, analyzing the roles of oil revenues, government policies, and foreign labor inflows in achieving diversification. The study found that lagged oil revenues were the primary factor influencing economic diversification in later periods, highlighting the continued reliance of these economies on oil income despite efforts to diversify revenue sources. Moreover, the study revealed that government spending had a significantly negative impact on diversification, suggesting that public expenditure was not effectively utilized to strengthen non-oil sectors but rather reinforced dependence on oil rents.

Similarly, (Waheed & al, 2020) analyzed the effects of non-oil exports and tourism revenues on economic growth in Saudi Arabia using quarterly data from 1980 to 2017. The study employed

various cointegration techniques, including the ARDL Bounds Test, Johansen's Test, and the Gregory-Hansen Cointegration Approach. The findings demonstrated that non-oil exports and tourism revenues significantly influenced economic growth, indicating that these sectors could be viable alternatives to oil revenues. The study further suggested that the tourism sector,

particularly under Saudi Vision 2030, has the potential to emerge as a robust non-oil revenue source, thereby reducing reliance on oil exports.

Nevertheless, the sustainability of these positive effects remains uncertain. (Dekkiche & al, 2023) found that non-oil exports contributed positively to economic growth in the short run, but had a negative and statistically insignificant impact in the long run. This outcome was attributed to excessive dependence on oil, which limits the long-term viability of non-oil sectors.

Similarly, (Khayat, 2024) investigated the impact of non-oil exports on economic growth in Saudi Arabia over the period 2000–2022 using the Johansen-Juselius Cointegration approach (1990) within a VECM framework. The study concluded that non-oil exports exerted a significant positive influence on long-term economic growth, whereas oil exports had a significantly negative impact, thereby reinforcing the imperative for a more comprehensive and effective diversification strategy.

Also, (Duhu, 2021) analyzed the impact of export diversification on Nigeria's economic growth between 1980 and 2017 using the Autoregressive Distributed Lag (ARDL) bounds testing approach. The results indicated that while export diversification had a positive effect, it was not statistically significant in both the short and long run. This finding suggests that diversification alone may be insufficient to drive economic growth unless supported by complementary policies that ensure the sustained contribution of non-oil sectors to the economy.

To further explore the relationship between non-oil exports, diversification, and economic growth, (Dahiru, 2023) examined the asymmetric impact of non-oil exports on economic diversification over the period 1985–2021, employing the Nonlinear ARDL (NARDL) model. The results revealed that both agricultural and mining exports exerted a positive and statistically significant impact on diversification, suggesting that investment in these sectors could help reduce Nigeria's dependence on oil as the primary revenue source. Additionally, the Wald test results indicated an asymmetric response of non-oil exports in the long run, where the positive impact of increasing exports outweighed the negative effects of declining exports. This underscores the importance of implementing stabilization policies to mitigate fluctuations in non-oil export performance.

Taking a more detailed look at the structure of economic diversification in Nigeria, (Busayo & al 2023) analyzed the impact of export diversification on economic growth from 1983 to 2020 using the NARDL model. This study distinguished between horizontal diversification (broadening the economic base) and vertical diversification (expanding industrial exports). The findings revealed that horizontal diversification contributes to long-term growth, while vertical diversification significantly enhances economic growth in both the short and long run. These results highlight the importance of targeting investments toward industrial sectors, as manufacturing-based diversification proves more effective in fostering sustained economic growth than merely increasing the variety of exported raw materials.

In this context, Algeria could derive valuable insights from Nigeria's experience with export diversification, particularly in light of the empirical evidence demonstrating the impact of non-oil exports on Nigeria's economic growth. This raises important questions regarding the extent to which Algeria can adapt such experiences to its own economic structure, and whether similar

diversification strategies could produce comparable outcomes given Algeria's unique economic characteristics and institutional landscape.

(Trinh & Thuy, 2021) analyzed data from 44 emerging economies between 1995 and 2015 to examine the nonlinear relationship between export diversification and economic growth using threshold regression models. The study found that the positive effects of economic diversification only materialize after surpassing a certain threshold, indicating that countries with a high level of export diversification achieve higher growth rates than those that rely on a narrow range of export products.

A separate study investigating the role of export subsidies in supporting economic diversification (Huseyn & al, 2024)analyzed the impact of export subsidies on non-oil export growth in Azerbaijan. It examined how these subsidies affected exporters' revenues. The results indicated that export subsidies were ineffective in fostering non-oil export growth or diversifying exported products, nor did they contribute to developing distribution channels. On the contrary, the study found that production support measures were more effective in achieving economic diversification and boosting growth, suggesting that stimulating domestic production could be more beneficial than providing direct financial support for exports.

Regarding the impact of export diversification on income distribution and economic growth, (Benli & Gültekin, 2025) examined the relationship between export diversification and economic performance at the provincial level in Turkey over the period 2004 to 2018, utilizing panel data models. The study concluded that higher levels of export diversification—as measured by the Gini coefficient (GINI) and the Herfindahl-Hirschman Index (HHI)—were associated with a decline in per capita income, reflecting structural shifts linked to economic redistribution. Furthermore, the Theil index parameters were found to be statistically insignificant, indicating that different indicators of diversification may capture distinct dimensions and produce varying empirical results. These findings suggest that economic diversification may have uneven effects on income distribution, whereby certain social groups or regions may disproportionately benefit, thereby underscoring the need for government intervention to ensure an equitable distribution of the gains from diversification.

In the European context, (Zélity, 2025) examined the interaction between export diversification and macroeconomic shocks in five European countries. The results showed that greater export diversification amplifies the impact of economic shocks on the balance of payments, production costs, and domestic productivity. This suggests that countries with more diversified exports are more affected by global market fluctuations, mainly operational and production costs. However, the study also revealed that export diversification reduces the impact of economic shocks on trade costs, foreign population size, and fixed income costs, indicating that diversification can serve as a stabilizing tool for national economies in response to global economic fluctuations.

Algeria has long pursued the objective of reducing its dependence on the hydrocarbon sector and promoting export diversification. However, empirical studies indicate that structural constraints continue to impede the realization of this goal. The existing literature suggests that export diversification has yet to exert a significant influence on economic growth, reflecting

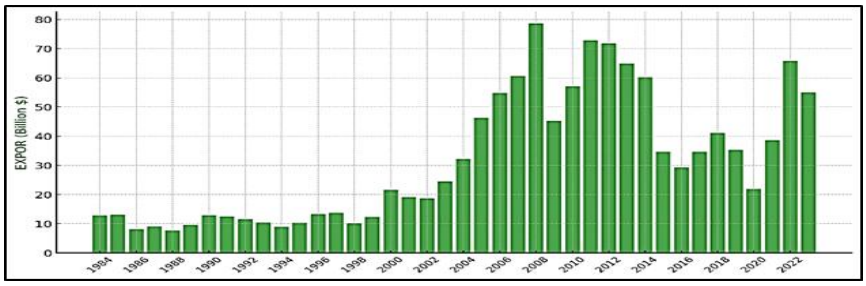
the continued dominance of the oil and gas sector within the national production structure (El-Ayati & al, 2018), (Benazza, 2019), (Belhanafi & Mokhtari, 2019), (Belhia & Mahcene, 2019), (Belhadi & al, 2021), (Maliki & al, 2021), (Ayad, 2021) . These studies reveal that Algeria continues to face fundamental structural challenges in achieving effective economic diversification.

3. Analysis of the Evolution of Algeria's Foreign Trade Sector (1984–2023):

3.1 Analysis of the Evolution of Algerian Exports (1984–2023):

Algerian exports have experienced significant fluctuations since 1984. Initially, total exports were valued at $12.8 billion in 1984 but dropped to approximately $8.07 billion in 1986 following the oil shock, severely impacting Algeria's export revenues due to the collapse of global oil prices. However, exports recovered in 1990, reaching $12.9 billion, only to experience another sharp decline in 1994, falling to $8.89 billion, as illustrated in the following figure (Unit: Billion USD):

Figure 1: Evolution of Total Algerian Exports (1984–2023)



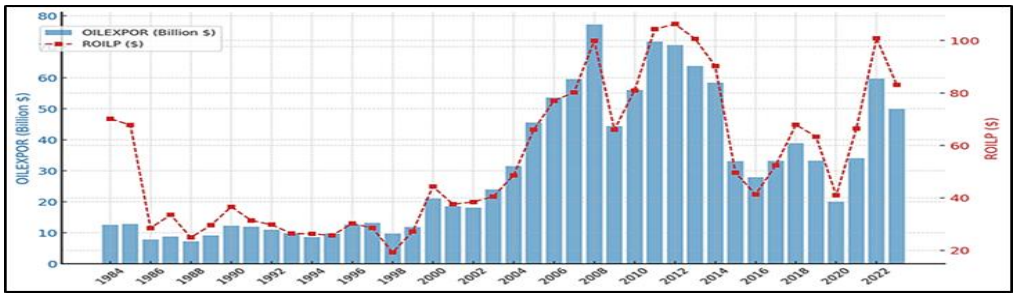
Source: Bank of Algeria Data

At the beginning of the new millennium, Algerian exports surged significantly, doubling in value. In 2000, exports reached $21.6 billion, but they experienced slight declines in subsequent years due to global oil price fluctuations, which dropped to $28 per barrel in 2003. However, exports rose significantly in 2006, reaching $54.7 billion, before peaking at $78.6 billion in 2008 due to the sharp rise in global oil prices, which stood at $61 per barrel in 2006 and $94 per barrel in 2008.

However, the 2008 financial crisis profoundly impacted global oil and gas demand. Oil prices dropped to $61 per barrel, leading to a significant decline in Algerian exports, which fell to $45.2 billion in 2009.

In the following years, exports rebounded, reaching $72.9 billion in 2011. However, with the collapse of global oil prices, which fell from $90 per barrel in 2014 to $49 per barrel in 2015, and further to $41 per barrel in 2016, Algerian exports plummeted, declining to $34.6 billion in 2015 and $29.3 billion in 2016, as depicted in the following figure (Unit: Billion USD):

Figure 2: Evolution of Algeria's Hydrocarbon Exports and Real Oil Prices (1984–2023)



Source: Bank of Algeria Data & Organization of the Petroleum Exporting Countries (OPEC)

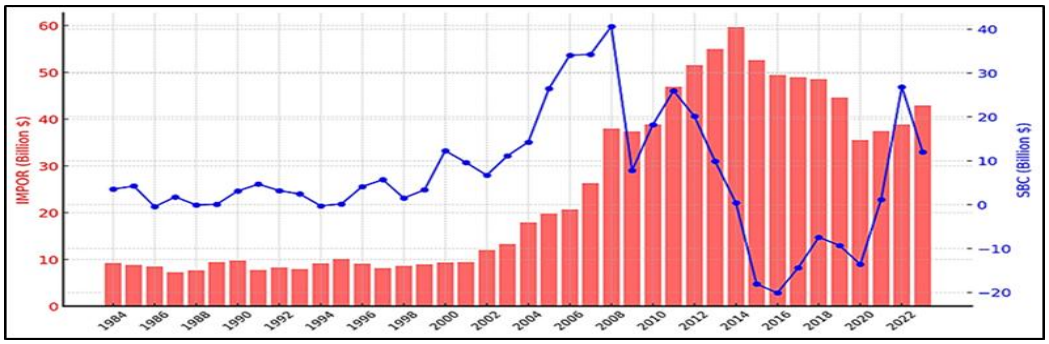
Oil prices rebounded to $70 per barrel in 2018, leading to a recovery in Algerian exports, which reached $41.1 billion that year. However, the economic repercussions of the COVID-19 pandemic in 2019 triggered a global decline in energy demand due to the strict public health measures

implemented by major economies. As a result, oil prices dropped to $41 per barrel in 2020, causing a sharp contraction in Algerian exports, which fell to $21.9 billion—a decline that had a substantial adverse impact on the national economy.

Subsequently, the Russia-Ukraine war contributed to a surge in global oil prices, which rose to $100 per barrel in 2022 and stabilized at around $83 per barrel in 2023. This price increase led to a significant rise in Algerian exports, which climbed to $65.7 billion in 2022 and approximately $55 billion in 2023, reflecting the continued dependence of Algeria's export performance on fluctuations in global energy markets.

3.2 Analysis of the Evolution of Algerian Imports:

Figure 3: Evolution of Algerian Imports and Trade Balance (1984–2023) Unit: Billion USD



Source: Bank of Algeria Data

Algerian imports have experienced significant fluctuations since 1984, as illustrated in Figure 3. The total value of imports declined from approximately $9.24 billion in 1984 to $7.27 billion in 1987, primarily due to the sharp reduction in foreign exchange revenues from hydrocarbon exports following the 1986 oil shock. However, imports rebounded slightly in 1990, reaching $9.77 billion, before stabilizing at around $8 billion annually throughout the 1990s.

Algeria's economic reform strategies, implemented in 1994 and 1995, introduced gradual trade liberalization policies, which had a notable impact on increasing import volumes. At the

beginning of the new millennium, imports rose significantly, reaching $12 billion in 2002, and continued to increase to $20.7 billion in 2006.

This upward trend was driven by higher state revenues from hydrocarbon exports, the launch of major national development programs, and a large-scale public spending strategy. As a result, Algerian imports surged dramatically, reaching $38 billion in 2008. The trend continued, with imports increasing to $46.9 billion in 2011, and eventually peaking at $59.7 billion in 2014, marking the highest level recorded during the period under review. Yet, following the collapse in oil prices in 2015 and the resulting decline in foreign currency revenues, Algeria's imports fell sharply, decreasing to $49.4 billion in 2016 and further to $48.6 billion in 2018. This downward trend continued, with imports reaching their lowest level at $35.5 billion in 2020.

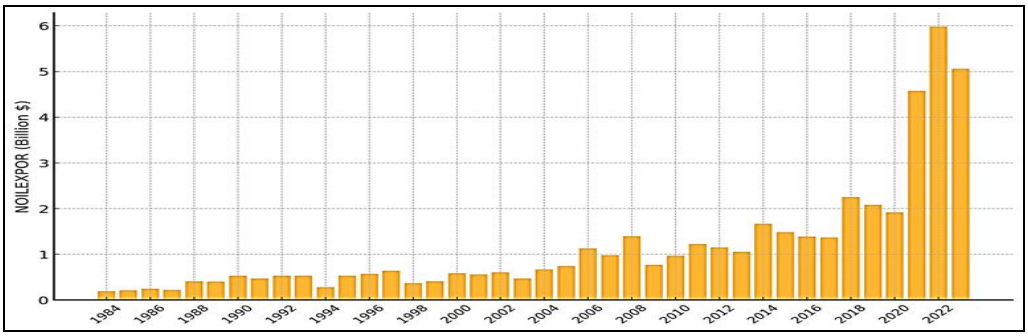
By 2022, imports had stabilized at approximately $38.9 billion and rose modestly to $43 billion in 2023. During this period, the Algerian government adopted a restrictive foreign trade policy, particularly targeting imports. Measures were taken to limit the entry of various goods, while simultaneously promoting local production to satisfy domestic demand. In parallel, regulatory reforms were introduced to reorganize and restructure the foreign trade sector, aiming to enhance

efficiency and reduce dependence on external markets.

3.3 Analysis of the Evolution of Algerian Non-Hydrocarbon Exports

Since the mid-1970s, Algeria has pursued a strategy aimed at diversifying its industrial base and developing alternative economic sectors in order to reduce its reliance on the hydrocarbon sector, whose performance remains highly vulnerable to fluctuations in global energy prices. However, despite the implementation of various economic policies over the past decades, the anticipated objectives have not been fully realized. Figure 4 illustrates the evolution of Algeria's non-hydrocarbon exports between 1984 and 2023 (in billion USD), highlighting the limited progress made in expanding and consolidating the non-hydrocarbon export base over the long term.

Figure 4 : Evolution of Algerian Non-Hydrocarbon Exports (1984–2023)



Source: World Bank Data (WDI) and United Nations Conference on Trade and Development (UNCTAD)

An analysis of the data presented in the figure above shows that Algeria's non-hydrocarbon exports have remained relatively weak for a very long period. Their total value was approximately $190 million in 1984, rising to around $530 million in 1990, and remaining at similar levels throughout the 1990s. With the beginning of the new millennium, Algeria's non-hydrocarbon exports saw a noticeable increase, although their volume remained relatively small compared to the country's vast economic potential. Their value reached approximately $1.13 billion in 2006 and $1.39 billion in subsequent years, yet they remained relatively low despite this growth. In 2018, the value of non-hydrocarbon exports doubled, reaching approximately $2.24 billion, continuing to rise in the following years to about $4.57 billion in 2021, $5.98 billion in 2022, and around $5.059 billion in 2023. This growth in the value of non-hydrocarbon exports can reflect the Algerian government's recent efforts to implement economic diversification policies and reduce excessive dependence on the hydrocarbon sector as the sole source of foreign currency revenue.

Despite recent improvements in Algeria's non-hydrocarbon exports, the national economy continues to face structural challenges that hinder the realization of effective economic diversification. Chief among these are the persistent overdependence on the hydrocarbon sector, the underdeveloped industrial production base, and the limited competitiveness of Algerian products in international markets. Furthermore, the export sector is constrained by logistical deficiencies—notably in transport and storage infrastructure—and by bureaucratic hurdles that delay trade processes and complicate export operations. In addition, the scarcity of financing available to emerging enterprises and prospective exporters poses a significant barrier to the expansion of non-hydrocarbon exports.

To overcome these obstacles, it is imperative to adopt more sustainable and integrated economic policies aimed at stimulating exports and fostering diversification. Improving the business environment through the reduction of administrative burdens and the simplification of customs procedures would provide crucial support to exporters. Simultaneously, enhancing logistical infrastructure—particularly by upgrading port facilities and transportation networks—could significantly reduce export costs. The government may also consider introducing financial and fiscal incentives for enterprises investing in priority non-hydrocarbon sectors such as manufacturing, agriculture, and technology, thereby boosting the global competitiveness of Algerian products.

Moreover, directing investments towards research and development (R&D) is essential to support industrial innovation and raise the quality of export-oriented goods in line with international standards. Strengthening trade partnerships through regional and global agreements would further facilitate the integration of Algerian products into new markets and supply chains.

Ultimately, the success of economic diversification efforts depends on the coherent and consistent implementation of these policies, alongside ongoing evaluation mechanisms to ensure sustained and measurable progress in the transformation of Algeria's economic structure.

4. Econometric Study:

4.1 Data and Methodology:

In this section, we seek to evaluate the impact of non-hydrocarbon exports on economic growth in Algeria by employing an econometric model that incorporates key determinants of economic growth over the period 1984-2023. The model is specified as follows:

$$Growth = f(OIL_{EXP}, NOIL_{EXP}, INV, EXC)$$

$$Growth = \alpha_0 + \alpha_1 OIL_{EXP} + \alpha_2 NOIL_{EXP} + \alpha_3 INV + \alpha_4 EXC + \varepsilon_i \dots (1)$$

- $Growth$: Real GDP per capita is used as an indicator of economic growth.
- OIL_{EXP}: Algerian hydrocarbon exports (in billions of USD).
- $NOIL_{EXP}$: Algerian non-hydrocarbon exports (in billions, USD).
- INV: Gross fixed capital formation as a percentage of GDP (%).
- EXC: The exchange rate of the Algerian dinar against the US dollar.

Regarding the data sources for the variables used in the econometric study, we primarily relied on data from the Bank of Algeria and data from the World Bank (WDI) for the period spanning from 1984 to 2023.

At the beginning of the new millennium, cointegration tests witnessed significant advancements with the emergence of the Bounds Test methodology within the framework of the Autoregressive Distributed Lag (ARDL) model, developed by (Pesaran & Shin, 1995), (Pesaran & Shin, 1998), (Pesaran & al, 2001). This methodology quickly gained particular importance in econometrics in general and time series analysis in particular due to its advantages over other cointegration testing methods. Despite these advantages, the cointegration approach using the Bounds Test developed by (Pesaran & al, 2001) has some limitations. To address these shortcomings, (McNown & al, 2018), (Sam & al, 2019) introduced an enhanced version known as the Augmented ARDL Bounds Test, incorporating additional and more precise tests to detect long-

run equilibrium relationships.

5. Analysis and Discussion of the Econometric Study Results:

5.1 Results of Time Series Stationarity Tests:

As a preliminary step before estimating the model, we will examine the stationarity of the study variables to determine their order of integration. This will be done using the Phillips-Perron (PP) test. By analyzing the results of the table, we note that all the series are integrated of degree I(1). Since no variable is stationary at the second difference I(2), the cointegration relationship can be tested using the Augmented ARDL Bounds Test method.

Table 1: Results of the Unit Root Test using the Phillips-Perron (PP) test

		GROWTH	$NOIL_{EXP}$	OIL_{EXP}	INV	EXC
With Constant	t-Statistic	-0.5221	-0.2524	-0.9923	-1.5486	-2.129
	Prob.	0.8760 n0	0.9228 n0	0.7466 n0	0.4988 n0	0.2348 n0
With Constant & Trend	t-Statistic	-2.2972	-3.3436	-2.0660	-2.3269	-1.3247
	Prob.	0.4255 n0	0.0743 *	0.5479 n0	0.4103 n0	0.8668 n0
Without Constant & Trend	t-Statistic	0.6882	5.7413	0.8308	-0.0956	-2.0636
	Prob.	0.8602 n0	1.000 n0	0.8868 n0	0.6445 n0	0.0389 **
At First Difference						
		d(GROWTH)	$d(NOIL_{EXP})$	$d(OIL_{EXP})$	d(INV)	d(EXC)
With Constant	t-Statistic	-3.7820	-10.055	-5.7932	-5.4217	-4.8303
	Prob.	0.0065 ***	0.0000 ***	0.0000 ***	0.0001 ***	0.0004 ***
With Constant & Trend	t-Statistic	-4.0164	-11.389	-5.6938	-5.3683	-5.2504
	Prob.	0.0165 **	0.0000 ***	0.0002 ***	0.0005 ***	0.0006 ***
Without Constant & Trend	t-Statistic	-3.7541	-7.917	-5.780	-5.5161	-4.3538
	Prob.	0.0004 ***	0.0000 ***	0.0000 ***	0.0000 ***	0.0001 ***

Notes: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant *MacKinnon (1996) one-sided p-values.

Source: Outputs of EViews 13

5.2 Results of the Cointegration Test Using the Augmented ARDL Bounds Test:

To examine the existence of a cointegration relationship between the study variables within the framework of the Unrestricted Error Correction Model (UECM) using the Augmented ARDL Bounds Test, the study model takes the following form:

$$\Delta Growth = \alpha + \gamma_1(NOIL_{EXP_{t-1}}) + \gamma_2(OIL_{EXP_{t-1}}) + \gamma_3(INV_{t-1}) + +\gamma_4(EXC_{t-1}) + \gamma_5(Growth_{t-1}) + \sum_{i=1}^{q} \emptyset_1 \Delta NOIL_{EXP_{t-1}} + \sum_{i=1}^{q} \emptyset_2 \Delta OIL_{EXP_{t-1}} + \sum_{i=1}^{q} \emptyset_3 \Delta INV_{t-1} + \sum_{i=1}^{q} \emptyset_4 \Delta EXC_{t-1} + \sum_{i=1}^{q} \emptyset_5 \Delta Growth_{t-1} + \varepsilon_i$$

Where:

$\gamma_1$term relationship coefficients between the study -: Represent the long γ_5 ، γ_4 ، γ_3 ، γ_2 ، variables.

$\emptyset_1$cients.term period coeffi-: Represent the short $\emptyset_5$ ، $\emptyset_4$ ، $\emptyset_3$ ، $\emptyset_2$ ،

To confirm the existence of a cointegration relationship (long-term equilibrium) using the Augmented ARDL Bounds Test.

The following table presents the results of the cointegration test using the augmented ARDL bounds test approach, following (Sam & al, 2019).

Table 2: Results of the Cointegration Test Using the Augmented ARDL Bounds Test

$Growth = f(OIL_{EXP}, NOIL_{EXP}, INV, EXC)$ Selected Model: ARDL(4, 3, 4, 3, 4)			
Overall F-bounds test	F-Statistic	5.423	
	Overall F-bounds test Critical values for the bounds test: (Narayan, 2005) (k=4) Case 5: Unrestricted Constant and Unrestricted Trend	Lower Bound I(0)	Upper Bound I(1)
	Significance Level 1%	5.604	7.172
	Significance Level 5%	4.036	5.304
	Significance Level 10%	3.374	4.512
T- bounds test on legged dependent variable	T-statistic	-4.546	
	T- bounds test: Critical values for the bounds test: (Pesaran & al, 2001)	Lower Bound I(0)	Upper Bound I(1)
	Significance Level 1%	-3.96	-4.96
	Significance Level 5%	-3.41	-4.36
	Significance Level 10%	-3.13	-4.04
Exogenous F-bounds test on legged independent variable	F-Statistic	5.272	
	Exogenous F-bounds test: Critical values for the bounds test: (Sam & al, 2019) Case 5: Unrestricted Constant and Unrestricted Trend	Lower Bound I(0)	Upper Bound I(1)
	Significance Level 1%	4.02	6.69
	Significance Level 5%	2.71	4.61
	Significance Level 10%	2.16	3.74
Result	Existence of a Cointegration Relationship (Long-term Equilibrium).		

Note: According to the AIC criterion, the following lag values were selected: Selected Model: ARDL(4, 3, 4, 3, 4)

Source: Prepared by researchers based on Eviews 13 outputs.

By analyzing table results for the cointegration test using the augmented bounds testing approach, we observe that the computed Overall F-bounds test statistic is 5.423, which is higher than the critical upper bound value I(1) proposed by (Narayan, 2005) at the 5% significance level for samples ranging from 30 to 80 observations. This result leads to the rejection of H_0 and the acceptance of H_1, confirming the presence of a long-run equilibrium relationship (cointegration) between the model variables. Furthermore, the results of the T-bounds test for the lagged dependent variable support this conclusion, as the T-statistic (-4.546) absolute value is greater than the critical upper bound I(1) at the 5% significance

Level. This implies the rejection of H_0 and acceptance of H_1, indicating the absence of a degenerate case in the lagged dependent variable (Degenerate Case ≠1). Regarding the Exogenous F-bounds test for the lagged independent variables, the computed Exogenous F-bounds test statistic is 5.27, also greater than the critical upper bound I(1) proposed by (Sam & al, 2019) at the 5% significance level. This leads to the rejection of H_0 and acceptance of H_1, confirming the absence of a degenerate case in the lagged independent variables (Degenerate Case ≠2).

These findings indicate the existence of a long-run equilibrium relationship between Algerian migrant remittances and certain economic determinants included in the model.

5.3 Long-Run Equilibrium (Long-Term Parameters):

After confirming a cointegration relationship between economic growth in Algeria (and some of its determinants, we will estimate the long-term relationship within the framework of the AARDL model by obtaining the long-term parameters, as shown in the following table.

Table 3: Estimated Long-Term Parameters of the Model

Dependent Variable : (Growth)			
Explanatory Variables	Model Parameters: Selected Model: ARDL(4, 3, 4, 3, 4)	t-Statistic	Prob
OIL_{EXP}	0.057*	3.918	0.002
$NOIL_{EXP}$	0.068***	1.807	0.095
INV	0.219 **	2.536	0.026
EXC	0.224 *	7.136	0.000
Constant (C)	2.592*	3.049	0.01
TREND	0.0047***	1.803	0.096

Notes: (*)Significant at the 1%; (**)Significant at the 5%; (***) Significant at the 10%

Source: Prepared by the researchers based on Eviews 13 outputs

Based on the analysis of the estimation results in the previous table, a set of key conclusions can be drawn regarding the relationship between economic growth and its main determinants in the Algerian economy:

Oil Exports and Economic Growth: The results reveal a statistically significant and positive relationship between oil exports and economic growth in Algeria. Specifically, a 1% increase in oil exports is associated with a 0.057% rise in the economic growth rate. This relationship is significant

at the 1% level, underscoring the pivotal role of the hydrocarbon sector in driving the national economy. The strength of this dependency can be attributed to the sector's overwhelming contribution to the state budget, primarily through petroleum-related taxation, which finances a substantial portion of public expenditure. Moreover, oil exports account for more than 98% of Algeria's total exports, rendering the economy highly vulnerable to fluctuations in global oil prices. These findings are consistent with previous research, including (Driouche & al, 2020), which emphasize the strong correlation between Algeria's economic performance and international oil price dynamics.

Non-Oil Exports and Economic Growth: The results indicate a positive and statistically significant relationship between non-oil exports and economic growth at the 10% significance level. Specifically, a 1% increase in non-oil exports is associated with a 0.068% rise in economic growth. While this finding is consistent with much of the existing literature, it diverges from the results of (Ayad, 2021), who reported a positive but statistically insignificant relationship between non-oil exports and economic growth in the Algerian context. This positive correlation likely reflects the recent improvement in Algeria's non-oil export performance, which reached $5.98 billion in 2022 and approximately $5 billion in 2023. The increase can be attributed to governmental efforts to diversify the economy and reduce dependence on hydrocarbon revenues as the main source of foreign exchange. Policies such as import restrictions, incentives for domestic production, and broader support for non-hydrocarbon sectors have contributed to this shift, signaling the beginning of structural changes in Algeria's trade and production patterns. However, this approach comes with challenges. One primary concern is the limited competitiveness of Algerian products in international markets. Additionally, import restrictions have contributed to higher inflation, affecting the affordability of certain goods. Moreover, most Algerian economic sectors remain underdeveloped in terms of global competitiveness, which could hinder the long-term sustainability of this progress.

Investment and Economic Growth: The results indicate a positive and statistically significant relationship between private investment (measured by gross fixed capital formation) and economic growth at the 5% level. A 1% increase in investment leads to a 0.219% rise in economic growth.

These findings are consistent with economic growth theories, particularly the endogenous growth theory, which highlights the pivotal role of capital investment in driving sustainable economic development—especially in emerging economies. Increased investment, notably within the private sector, contributes to economic diversification by strengthening productive capacities and expanding non-oil export activities. As a result, the economy becomes less dependent on hydrocarbons as the principal source of foreign exchange, thereby enhancing long-term economic resilience and stability.

Exchange Rate and Economic Growth: The estimates show a positive and statistically significant relationship between the real exchange rate and economic growth at the 1% level. A 1% increase in the exchange rate leads to a 0.22% rise in economic growth. These results suggest that an increase in the exchange rate enhances the competitiveness of Algerian exports in international markets, thereby contributing to higher export revenues and overall economic expansion. Nonetheless, the extent of this positive impact largely depends on the capacity of local producers to capitalize on the improved price competitiveness and successfully penetrate foreign markets.

Overall, the findings underscore the structural constraints of the Algerian economy, including its persistent dependence on hydrocarbons, limited diversification of export sectors, and the critical role of private investment in fostering economic growth. While recent gains in non-oil exports are encouraging, further efforts are required to strengthen the international competitiveness of domestic industries. Moreover, improving the investment

climate remains a key priority to support sustainable, resilient, and autonomous economic growth that is less susceptible to external shocks.

5.4 Short-Term Equilibrium and the Error Correction Model:

Regarding short-term equilibrium, the error correction term UECM (-1) was negative and statistically significant at the 1% level. This confirms the existence of a long-term equilibrium relationship between economic growth in Algeria and its key economic determinants included in the estimated model, as shown in the following table:

Table 4 : Estimated Short-Term Model Parameters for the Study Model

Dependent Variable (ΔGrowth)				
Variables	Parameters	Std error	t-statistic	Prob
$\Delta Growth(-1)$	1.026 *	0.024	6.537	0.00
ΔOIL_{EXP}	0.063 *	0.024	5.341	0.00
$\Delta NOIL_{EXP}$	0.037 *	0.040	3.344	0.00
ΔINV	0.169 *	0.037	4.857	0.00
ΔEXC	0.082 **	0.008	2.764	0.017
$UECM(-1)$	-0.731 *	0.097	-6.012	0.00
R-squared=0.92 , Adjusted R-squared=0.83 , DW=1.752 $F-STATISTIC = 10.27\ (prob = 0.00)$				

Notes: (*)Significant at the 1%; (**)Significant at the 5%; (***) Significant at the 10%

Source: Prepared by researchers based on the outputs of Eviews 13

Based on the results presented in Table 4, the following can be observed:

Regarding the short-term coefficients in the error correction model (ECM), their signs align with those of the long-term coefficients, reinforcing the credibility of the results. The relationship between the economic growth rate ($\Delta Growth$) and its one-period lagged value ($\Delta Growth(-1)$), it is positive and statistically significant at the 1% level.

Similarly, the coefficient of oil exports (ΔOIL_{EXP}) is positive and significant at the 1% level, confirming its vital role in supporting short-term economic growth. As for non-oil exports ($\Delta NOIL_{EXP}$), a key variable in explaining economic growth in Algeria according to the studied model, shows a positive and significant effect at the 1% level. This indicates that non-oil exports positively enhance economic growth in both the short and long term.

Furthermore, the coefficient of private investment (ΔINV) is positive and significant at the 1% level, highlighting the crucial role of capital investment in driving economic expansion.

Similarly, the coefficient of the real exchange rate (ΔEXC) exhibits a positive effect and is significant at the 5% level, reflecting the impact of exchange rate fluctuations on economic activity.

Regarding the error correction term ($UECM-1$), it has a negative sign, with a value of ($UECM-1=-0.731$), and is statistically significant at the 1% level. This indicates a rapid adjustment process towards long-term equilibrium, reflecting the stability of the long-run relationship between economic growth and its key determinants. It also confirms the model's validity in analyzing the dynamic relationship between the studied variables.

5.5 Diagnostic Tests of the Error Correction Model Residuals:

Diagnostic tests were conducted on the estimated Error Correction Model (ECM) residuals, including serial correlation, normality, and heteroskedasticity tests. The results presented in the table below illustrate the model's statistical adequacy:

Table 5 : Residual Diagnostic Tests

Residual Diagnostics		
Normality test	Jarque-bera=0.639	Prob=0.726
Serial correlation LM test	F-Statistic=0.248	Prob.F(2. 10) =0.784
	Obs*R-squared=1.702	Prob. Chi-square (2) =0.427
Hetreroskedasticity Breuch-Pagan-Godfrey	F-Statistic=1.876	Prob.F(23. 12) =0.784
	Obs*R-squared=28.169	Prob. Chi-square (23) =0.209

Source: Prepared by researchers based on the outputs of Eviews 13

- Normality Test: The Jarque-Bera statistic is 0.639, and its associated probability is 0.726, which exceeds the 5% significance level. Thus, there is no evidence to reject the null hypothesis, indicating that the residuals follow a normal distribution.
- Serial Correlation (LM Test): The value of Obs*R-squared is 1.702, with a probability of 0.427, exceeding the 5% significance level. Accordingly, the null hypothesis of no serial correlation in the residuals is accepted, confirming that the model is free from autocorrelation issues.
- Heteroskedasticity (Breusch-Pagan-Godfrey Test): The Obs*R-squared statistic is 28.169, with a p-value of 0.209, which is higher than the 5% significance level. Therefore, the null hypothesis that the residuals are homoscedastic is accepted, indicating no heteroskedasticity problem within the model.

These results reflect the model's statistical validity, as it does not suffer from non-normality, autocorrelation, or heteroskedasticity issues. Hence, the model's estimates and conclusions can be considered highly reliable.

5.6 Model Stability Test (Stability Test):

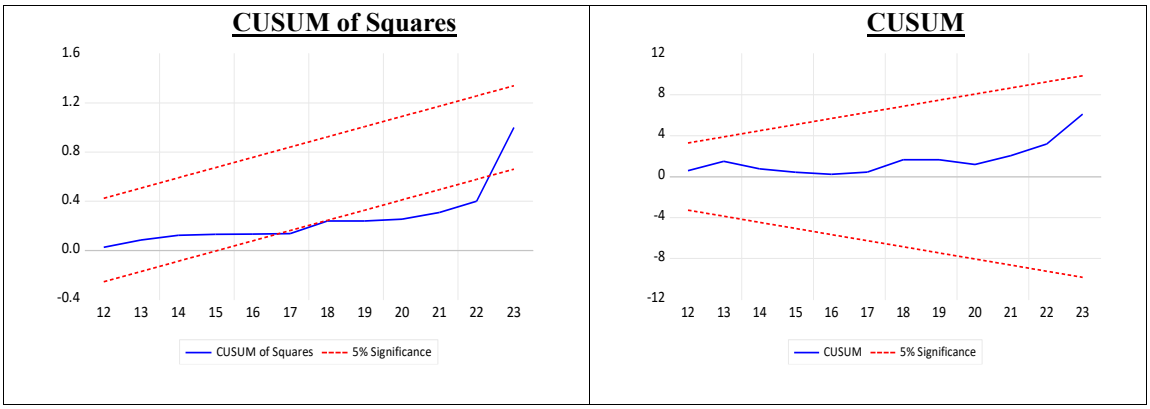
To ensure that the data used in the study's models do not exhibit any structural changes, we employ the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUM of Squares), as illustrated in the following table and figure:

Table 6 : Model Stability Tests (Stability Diagnostics)

Stability Diagnostics		
Ramsey rest test	F-Statistic=2.338	Prob=0.154
	T-Statistic=1.529	Prob=0.154
Recursive estimates	CUSUM test: Stable	
	CUSUM of Squares test: Stable	

Source: Prepared by researchers based on the outputs of Eviews 13

Figure 5 : Model Stability Test



Source: Eviews 13 outputs

The results in Table (6) highlight the key findings of the model stability tests. The Ramsey RESET Test shows no functional form errors in the estimated parameters (F-Statistic = 2.338, Prob = 0.154). Additionally, the CUSUM test indicates clear stability of the estimates at a 5% significance level. In contrast, the CUSUM of Squares test suggests only partial stability; the plot briefly exceeds the critical boundaries in certain years before returning, indicating no prolonged or significant structural changes.

Figure (6) presents a graphical analysis of the model's stability using the CUSUM and CUSUM of Squares tests. The CUSUM plot remains within the critical bounds throughout the study period, indicating parameter stability and the absence of structural breaks. In contrast, the CUSUM of Squares plot occasionally breaches the confidence boundaries; however, these deviations are brief and not sustained, implying limited short-term volatility rather than persistent structural instability. Taken together, these results suggest that the model demonstrates an acceptable degree of stability, with no significant structural changes observed in the underlying data. This reinforces the robustness and reliability of the estimated results.

6. Conclusion:

This study aimed to assess the impact of non-hydrocarbon exports on economic growth in Algeria over the period 1984–2023 using the ARDL bounds testing approach. The econometric analysis yielded several important findings that contribute to the understanding of Algeria's growth dynamics and export structure.

The findings underscore the crucial role of non-hydrocarbon exports in fostering economic growth in Algeria. The econometric analysis, encompassing both short- and long-run dynamics, reveals a positive relationship between non-hydrocarbon exports and economic growth—though the effect remains less pronounced than that of hydrocarbon exports. Despite recent improvements in the performance of non-oil exports, the hydrocarbon sector continues to dominate as the principal source of foreign exchange and a major driver of economic activity. Moreover, the results highlight the significance of private investment and the real exchange rate in enhancing growth. The Error Correction Model (UECM) further confirms the existence of a long-term equilibrium relationship between economic growth and its key determinants, with a high adjustment speed, indicating that deviations from the long-run path are corrected relatively quickly.

On the other hand, diagnostic tests confirm the statistical robustness of the estimated model. The results indicate no evidence of serial correlation, heteroskedasticity, or violations of the normality assumption in the residuals. Furthermore, the CUSUM and CUSUM of Squares tests demonstrate a satisfactory degree of structural stability throughout the study period. Collectively, these diagnostic outcomes provide strong evidence for the reliability of the estimated parameters, thereby reinforcing the model's suitability for informing and guiding economic policy decisions.

This paper examined the role of Algeria's non-hydrocarbon exports in fostering economic growth over the period 1984–2023, with particular attention to the recent surge in export revenues. Utilizing the augmented bounds cointegration approach, the analysis confirmed the existence of a long-run equilibrium relationship between economic growth and its key determinants. The findings indicate that the export sector remains a central engine of growth in Algeria—driven not only by hydrocarbon exports, which continue to form the backbone of the national economy, but also by the growing contribution of non-hydrocarbon exports, which have recently surpassed five billion dollars. These results align with World Bank projections that anticipate further expansion of Algeria's non-hydrocarbon exports, supported by the government's strong commitment to diversifying sources of foreign exchange. Additionally, the study identifies a positive relationship between private investment, the real exchange rate, and economic growth over the study period.

Despite the recent improvements in Algeria's non-hydrocarbon exports, the findings underscore the urgent need for more comprehensive and sustainable economic policies to ensure long-term growth and resilience. Key policy priorities should include:

- Enhancing the institutional environment and streamlining administrative and customs procedures to encourage investors and exporters to enter global markets.
- Supporting economic sectors with export potential, such as agriculture and manufacturing.
- Activating economic diplomacy to boost the international image of domestic products and open new markets.
- Developing logistics infrastructure, including upgrading ports and transportation networks to reduce export costs.
- Establishing free zones and specialized industrial clusters near export hubs.
- Offering full or partial tax exemptions for exporters, particularly during the initial stages of their operations.
- Reducing customs duties on equipment and materials used in export-oriented production.
- Encouraging local production and advancing industrial and agricultural sectors with higher

value-added, ensuring greater competitiveness in external markets.

- Redirecting capital towards research and development and supporting industrial innovation, especially in non-hydrocarbon sectors.
- Expanding and diversifying trade agreements and economic partnerships, thereby increasing market access for Algerian products and reducing vulnerability to external shocks from overdependence on a limited set of trade partners.

Overall, The study concludes that achieving effective economic diversification in Algeria hinges on a strategic interplay between domestic policy reforms and external integration

efforts. Domestically, it is essential to stimulate private investment, enhance the business environment, and develop productive sectors beyond hydrocarbons—particularly those with strong export potential. Externally, aligning trade and diplomatic strategies to facilitate Algeria's deeper integration into international markets is equally critical. Although recent progress in expanding non-hydrocarbon exports is encouraging, the sustainability of this trajectory depends on the continuity of structural reforms and the strategic allocation of resources toward high-potential sectors. Only through such coordinated efforts can Algeria achieve sustainable economic growth and reduce its vulnerability to global oil price fluctuations.

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