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DUTCH DISEASE IN ALGERIA: AN EMPIRICAL ANALYSIS OF THE IMPACT OF THE HYDROCARBON SECTOR ON DEINDUSTRIALIZATION (2000–2018)

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Abstract

This empirical study investigates the extent to which Algeria's predominant hydrocarbon sector has contributed to the decline of the tradable sectors (agriculture and industry) in favor of the non-tradable sector. indicative of the Dutch Disease phenomenon. Utilizing a standard econometric modeling approach. we examine the presence of the spending effect associated with Dutch disease. manifested through the negative relationship between the tradable sector and the booming hydrocarbon sector. as well as the non-tradable sector. Additionally, we analyze the resource movement effect. evident in the inverse relationship between the non-trade sector and the other sectors. Our model reveals that the Dutch Disease phenomenon has permeated the Algerian economy during the study period from 2000 to 2018. aligning with the theoretical underpinnings of Dutch Disease theory through the presence of both spending and resource movement effects. Specifically, we construct an econometric model utilizing GDP components that realistically reflect the existence or absence of Dutch Disease through the emergence of the inverse relationships stipulated by theory.

Keywords: *Dutch disease; Economic shocks; Deindustrialization; Tradeable sector; Non-tradable sector; Resource movement; Spending effect*
JEL Codes: *J64, C3, J60, L16*

Introduction

The Algerian economy presents a compelling case study of resource dependency, with its economic framework heavily anchored in hydrocarbon revenues. As documented

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by Murry and Nan (1994), these revenues not only constitute the primary component of the country's Gross Domestic Product (GDP) but also represent most export earnings. This predominant revenue stream serves as the fundamental catalyst for the nation's development initiatives, creating a complex web of economic dependencies and structural implications.

Economic Context and Structural Implications

The pervasive influence of hydrocarbon revenues has precipitated profound structural imbalances within Algeria's economic architecture. These distortions manifest most notably in the progressive decline of traditional tradeable sectors, particularly agriculture and industry - a phenomenon characterized as “deindustrialization.” Concurrently, the substantial influx of hydrocarbon revenues has fueled an unprecedented expansion in government expenditure, predominantly channeled into infrastructure development and service sector enhancement. This fiscal pattern has induced a significant labor migration toward the service sector, attracted by superior returns, thereby exemplifying classic symptoms of Dutch disease within the Algerian context.

Vulnerability and Theoretical Framework

The economy's pronounced dependence on hydrocarbon revenues renders it particularly susceptible to external price volatility, highlighting its vulnerability to Dutch Disease dynamics. The theoretical underpinnings of Dutch Disease suggest that economies dominated by a single sector frequently experience a dual phenomenon: the erosion of the tradable sector coupled with disproportionate growth in the non-tradable sector. This theoretical framework provides a crucial lens through which to examine Algeria's economic evolution.

Research Objectives

This study endeavors to illuminate the Dutch Disease phenomenon through a meticulous examination of its theoretical foundations and empirical manifestations within the Algerian context. The research seeks to evaluate the extent to which the hydrocarbon sector has influenced the concurrent dissolution of the tradable sector and expansion of the non-tradable sector. Through rigorous analysis, this investigation aims to construct a comprehensive understanding of the theoretical principles underlying Dutch disease while empirically documenting its impact on Algeria's economic structure.

Scope and Limitations

The investigation's scope encompasses a focused analysis of the hydrocarbon sector's influence on both tradable and non-tradable sectors through sophisticated empirical methodologies designed to evaluate Dutch disease presence in Algeria. Particular attention is devoted to examining the negative ramifications associated with tradable sector dissolution, widely acknowledged as a phenomenon with profound implications for national economic stability. The study period, spanning from 2000 to 2018, was selected to coincide with a period of relative economic stability, enabling more reliable analysis and interpretation.

Methodological Framework

The research methodology employs a dual approach to address its objectives comprehensively. First, through meticulous analysis and synthesis, the study identifies and examines the intricate web of concepts and relationships pertinent to Dutch disease manifestation. This theoretical investigation facilitates careful analysis, elucidation, and comparison of critical economic indicators and patterns. Second, the research utilizes advanced econometric modeling techniques to construct a robust analytical framework capable of quantifying the hydrocarbon sector's impact on both tradeable and non-tradable sectors during the specified study period. This empirical approach enables the research to move beyond theoretical postulations to provide concrete evidence of Dutch disease effects within the Algerian economy.

Literature Review

The relationship between natural resource abundance and economic growth presents a compelling paradox in development. While intuition suggests that natural resource wealth should catalyze economic development, empirical evidence often reveals a more complex and potentially adverse relationship. This phenomenon, commonly known as the “Dutch Disease” or the “resource curse,” has generated extensive scholarly discourse on its mechanisms, implications, and potential remedies.

Economic Mechanisms and Structural Changes

Exchange Rate Dynamics

Sachs and Warner's (1995) seminal work established a robust negative correlation between natural resource abundance and economic growth, introducing methodological

rigor to what had previously been largely anecdotal evidence. The primary mechanism operates through the real exchange rate channel: resource export earnings trigger currency appreciation, undermining the competitiveness of other tradeable sectors, particularly manufacturing (van der Ploeg, 2011). This appreciation creates structural imbalances within the economy, often leading to long-term distortions in productive capacity and economic diversification.

Factor Market Distortions

The resource sector's high productivity and wage premiums create significant factors in market distortions. Auty (1993) demonstrates how this "resource movement effect" precipitates a reallocation of labor and capital away from non-resource sectors, potentially triggering a form of "pre-mature deindustrialization." This effect is particularly pronounced in economies with limited labor mobility and underdeveloped financial markets. The resulting sectoral imbalances can create persistent economic vulnerabilities and reduce the economy's overall resilience to external shocks.

Institutional Dimensions and Political Economy

Governance Challenges

The political economy literature, spearheaded by Ross (1999), reveals how resource abundance can fundamentally reshape institutional frameworks and governance structures. The influx of resource rents often creates perverse incentives for political elites, leading to a systematic erosion of institutional quality. This deterioration manifests through multiple channels: the emergence of entrenched rent-seeking behaviors, the weakening of democratic accountability mechanisms, and the diminishment of state capacity to deliver essential public goods and services. These institutional pathologies can become self-reinforcing, creating a vicious cycle that undermines long-term development prospects.

Resource Characteristics and Development Outcomes

Isham et al. (2005) advance the discourse by disaggregating resource types and their differential impacts. Their research demonstrates that "point-source" resources, such as minerals and oil, correlate more strongly with adverse institutional outcomes compared to "diffuse" resources like agricultural products. This distinction helps explain varying development trajectories among resource-rich nations and suggests that the nature of resource endowments plays a crucial role in determining their developmental impact. The concentrated nature of point-source resources appears to facilitate capture by elites and create fewer linkages with the broader economy.

Policy Responses and Mitigation Strategies

Institutional Reform and Economic Diversification

Recent scholarship emphasizes the critical role of institutional quality in determining resource wealth's developmental impact. Humphreys et al. (2007) synthesize various perspectives to advocate for comprehensive institutional reforms. Their work emphasizes the importance of establishing robust governance frameworks that ensure transparent revenue management and promote strategic investment in human capital development. These reforms must be accompanied by counter-cyclical fiscal policies and the establishment of sovereign wealth funds to manage resource revenues effectively across economic cycles.

Innovation and Knowledge Economics

Torvik's (2001) analysis introduces a dynamic perspective by examining the role of learning-by-doing effects. This work suggests that the adverse effects of resource abundance can be mitigated through strategic investments in knowledge-intensive sectors. By fostering innovative ecosystems and promoting knowledge spillovers across sectors, countries can develop new comparative advantages beyond their resource base. This approach represents a crucial pathway for transforming resource wealth into sustainable economic development.

Trade Policy and Economic Integration

Arezki and van der Ploeg (2007) highlight the importance of trade openness and economic integration in mitigating resource curse effects. Their research advocates for a nuanced approach to trade policy that promotes diversification while maintaining competitiveness. Regional economic integration emerges as a particularly promising strategy, offering resource-rich countries opportunities to develop new export markets and integrate into global value chains. These international linkages can help sustain non-resource sectors and promote economic resilience.

Literature on natural resource abundance and economic growth has evolved from identifying simple correlations to understanding complex causal mechanisms and feedback. This evolution has generated nuanced policy prescriptions that emphasize the role of institutions, human capital, and economic diversification in transforming resource wealth into sustainable development outcomes. The interplay between economic mechanisms, institutional quality, and policy choices emerges as crucial in determining whether natural resource abundance becomes a blessing or a curse.

Nuanced Perspectives

While the Dutch Disease literature has largely focused on the negative economic impacts of resource abundance. some studies have offered more nuanced perspectives. Alexeev and Conrad (2009) challenged the notion of an unconditional resource curse. arguing that the economic effects of oil wealth depend on various country-specific conditions and policies. Accordingly, the literature on Dutch Disease and the broader resource curse phenomenon provides valuable insights into the complex interplay between natural resource abundance. economic performance. and institutional factors. While the potential negative effects are well documented. The literature also highlights strategies and policies that can help resource-rich countries effectively manage their natural wealth and promote sustainable economic development.

Theoretical foundations of the Dutch Disease phenomenon

The Dutch Disease phenomenon represents one of modern economics' most compelling examples of paradoxical development outcomes, first conceptualized and documented in The Economist (1977) following observations of the Netherlands' post-1951 economic trajectory. As Buiter and Purvis (1983) established in their seminal work, this economic syndrome manifests through the decline of growth-driven economic sectors, encompassing both tradable and non-tradable segments, in response to the dominance of extractive industries. The phenomenon's theoretical underpinnings have evolved significantly since its initial documentation, offering crucial insights into the complex relationship between resource abundance and economic development.

Contemporary scholarship, as evidenced by Chen (2021), has expanded our understanding of Dutch Disease beyond its original conceptualization, defining it as the adverse economic impacts emanating from a dominant sector that serves as both the primary source of foreign exchange inflows and a major contributor to GDP. This modern interpretation emphasizes the broader implications for economic development, particularly in nations heavily dependent on single-commodity exports. Misuraca and van Noordt (2020) further enrich this perspective by highlighting a critical paradox: despite the presence of abundant natural resources within the booming sector and the economy's substantial reliance on these resources, technological advancement and human capital development often fail to catalyze sustainable economic growth.

The theoretical framework underpinning Dutch Disease analysis employs a tripartite sectoral division that facilitates comprehensive economic analysis. The tradable/ traditional export sector, characterized by its dual orientation toward domestic consumption and international markets, maintains competitive advantages that enable it to

withstand foreign competition. This sector, predominantly comprising agricultural and industrial activities, serves as a crucial baseline for measuring economic distortions. The booming sector, typically resource-based, functions as the primary catalyst for Dutch Disease, with its production primarily oriented toward global markets. Its susceptibility to international price fluctuations introduces significant economic volatility, particularly in economies heavily dependent on this sector. The non-tradable sector, constrained by either competitive limitations or its inherently domestic nature, completes this analytical framework.

The diagnostic framework for identifying Dutch Disease operates through two primary mechanisms: the resource movement effect and the spending effect. The resource movement effect, as elaborated in Corden's work, demonstrates how sectoral labor migration responds to changes in marginal productivity. This process initiates what economists' term "direct de-industrialization," characterized by labor force shifts from the traditional export sector to the booming sector. Simultaneously, the non-tradable sector experiences its own labor drain, creating a complex web of economic adjustments that culminate in indirect de-industrialization.

The spending effect introduces additional complexity through its impact on real exchange rates and sectoral price dynamics. This mechanism operates through increased national income and subsequent spending patterns, leading to price appreciations in non-tradable goods and services. The non-tradable sector's unique position, insulated from international price competition, allows it to absorb wage increases more effectively than its tradable counterparts, further accelerating the de-industrialization process through resource reallocation.

Contemporary researchers have expanded upon these foundational concepts, examining how Dutch Disease intersects with modern economic challenges. Chen's (2021) analysis particularly emphasizes the importance of understanding these dynamics in the context of globalized economic systems, where traditional sectoral boundaries become increasingly fluid. Misuraca and van Noordt's (2020) contribution highlights the critical role of technological advancement and human capital development in potentially mitigating Dutch Disease effects, though their research suggests that these factors alone may be insufficient to overcome resource dependency.

The implications for policy formulation are significant. The theoretical framework suggests that economies experiencing Dutch Disease symptoms require carefully calibrated interventions to maintain sectoral balance and promote sustainable economic growth. This might include targeted investment in human capital development, technological innovation, and economic diversification strategies, although the effectiveness of such interventions remains a subject of ongoing academic debate.

Modern scholarship increasingly recognizes that Dutch Disease manifestations vary significantly across different economic contexts. The traditional model, while providing valuable analytical tools, may require adaptation to account for the complexities of contemporary economic systems. This includes consideration of factors such as global value chains, digital transformation, and the increasing importance of service-based economies, aspects not fully captured in the original theoretical framework.

The enduring relevance of Dutch Disease theory extends beyond its historical origins, offering crucial insights for contemporary policymakers and economists grappling with resource-dependent economies in an increasingly interconnected world. As global economic systems continue to evolve, understanding and addressing Dutch Disease becomes increasingly critical for ensuring sustainable economic development, particularly in resource-rich nations navigating the complexities of modern economic integration while managing their natural resource endowments.

The "Dutch Disease" and economic development in Algeria

The Algerian government maintains a monopoly on investment in the hydrocarbon sector, which is considered a strategic industry, thereby shaping the economy into a rentier model. This is further evidenced by the redistribution of revenues across various sectors, reinforcing the characteristics of a rentier state. Notably, the hydrocarbon sector accounts for 90% of Algeria's exports and 40% of annual government budget revenues, raising the possibility that the phenomenon of Dutch Disease is a tangible reality (Hadj & Djamal, 2023).

The phenomenon of "Dutch disease" has been extensively studied in the context of resource-rich economies. Initially coined to describe the adverse effects of natural gas discoveries on the Dutch manufacturing sector in the 1960s. the term now broadly refers to the potential economic challenges faced by countries with abundant natural resources (Sachs & Warner, 1995). This paper examines the manifestation of Dutch Disease in the Algerian economy and its implications for sustainable economic growth.

The Dutch Disease is characterized by a resource movement effect and a spending effect (Corden & Neary, 1982). The resource movement effect occurs when the booming resource sector draws capital and labor away from other tradable sectors (Benbouziane et al., 2014), such as manufacturing, making them less competitive internationally. The spending effect arises as increased revenue from resource exports leads to higher domestic demand and an appreciation of the real exchange rate, further disadvantaging non-resource tradable sectors (Gelb, 1988; Auty, 1993).

This phenomenon has been linked to a broader “resource curse” hypothesis. which suggests that natural resource abundance can paradoxically impede economic development (Van der Ploeg, 2011). Various mechanisms have been proposed to explain this course, including Dutch disease, rent-seeking behavior and the volatility of resource revenues (Ross, 1999; Alexeev & Conrad, 2009).

The analysis presented in the given text confirms the presence of Dutch Disease in the Algerian economy. aligning closely with theoretical expectations. However, the unique complexities of the Algerian economy, such as high unemployment, complicate the observation of factor movement between sectors. Despite these complexities, partial movement within the tradable sector remains evident.

The spending effect is particularly pronounced during favorable shocks resulting from fluctuations in export product prices, primarily hydrocarbons. Algeria's economic recovery policy has heavily relied on hydrocarbon resources, leading to substantial public expenditures and investments in the hydrocarbon sector. Consequently, internal demand for non-tradable goods has surged, further exacerbating the spending effect (Isham et al., 2005).

While nominal growth has occurred, these investments have not positively impacted exports. Instead, they have often resulted in increased imports, adversely affecting the trade balance. Corruption in the foreign trade sector exacerbates this issue by facilitating hard currency smuggling, contributing to persistent deficits in the balance of payments (Humphreys et al., 2007). Thus, the benefits of favorable shocks are rapidly eroded. highlighting the deep penetration of Dutch Disease into the Algerian economy.

The cyclical nature of the economic impacts underscores the need for strategic economic policies to mitigate the adverse effects of Dutch disease. promote sectoral balance. and ensure sustainable economic growth in Algeria. Potential policy measures could include diversifying the economy away from resource dependence. investing in human capital and productivity-enhancing sectors and strengthening institutions to combat rent-seeking behavior and corruption (Torvik, 2001; Arezki & van der Ploeg, 2007).

Dutch Disease in Algeria: an empirical analysis of the impact of the hydrocarbon sector on deindustrialization (2000–2018)

The phenomenon of Dutch Disease, characterized by an over-reliance on a booming natural resource sector at the expense of other sectors, has been a significant factor in the economic dynamics of many resource-dependent countries, including

Algeria. The Algerian economy, heavily dependent on hydrocarbons, has seen the effects of this syndrome in its industrial decline and over-reliance on oil and gas revenues.

In the context of Algeria, the dominance of the hydrocarbon sector has had a pronounced effect on the diversification of the economy. Like the findings in Nigeria, where the influence of money supply on inflation reveals the broader economic vulnerabilities linked to over-reliance on specific sectors (Amassoma et al., 2018), Algeria's over-dependence on hydrocarbons has led to significant economic imbalances. This dependency stifles the growth of non-hydrocarbon industries, contributing to deindustrialization as other sectors fail to compete with the influx of revenue from natural resources. Furthermore, the situation in Azerbaijan offers an insightful comparison, as the country has faced similar challenges in overcoming resource dependence. Hamidova (2018) explores how economies like Azerbaijan's, which also rely heavily on natural resources, struggle to diversify their economic base and reduce vulnerability to external shocks. In Algeria's case, the hydrocarbons sector continues to dominate exports and government revenues, with hydrocarbons accounting for 90% of the country's exports and 40% of its annual budget revenues. This reliance exacerbates the effects of Dutch Disease, hindering the growth of manufacturing and industrial sectors.

As observed in these cases, the economic effects of Dutch Disease are not limited to the resource sector alone but permeate the entire economy, inhibiting the development of a balanced, diversified economic structure. Algeria, much like Nigeria and Azerbaijan, faces the challenge of managing this over-reliance on hydrocarbons and seeking strategies for sustainable diversification.

Econometric modeling approach to examining spending and resource movement effects

A deep analysis presents an advanced econometric modeling framework designed to examine the intricate relationship between sectoral spending patterns and resource allocation dynamics in the Algerian economy, with particular emphasis on investigating potential Dutch Disease manifestations. This comprehensive analytical approach employs robust statistical and economic methodologies to evaluate the dual phenomena of spending effects and resource movement effects within the context of resource-dependent economic structures (Corden, 1984; Madsen, 2009).

The theoretical underpinnings of this analysis rest upon three fundamental pillars of economic interaction, each contributing to our understanding of resource-driven economic transformations. First, the spending effect mechanism posits that positive shocks within the booming sector generate indirect prosperity within the non-tradable

sector through government-initiated development programs, funded primarily through resource-derived revenues (Piton, 2017). This process typically manifests alongside a decline in the real exchange rate, which further catalyzes the expansion of the non-tradable sector due to the inherent nature of its goods and services. This theoretical framework suggests a complex interplay between sectoral development and monetary dynamics, particularly relevant in economies heavily dependent on natural resource exports (Dani, 2008).

Secondly, the resource movement effect describes a fundamental shift in factors of production, whereby the expansion of the booming sector induces a migration of productive resources from the tradable to the non-tradable sector, culminating in what economists' term "indirect de-industrialization" (Brinkman & Brinkman, 2011). This process establishes an inverse relationship between these sectors, reflecting the fundamental restructuring of the economic landscape in response to resource-driven growth dynamics. The movement of labor and capital between sectors represents a critical mechanism through which resource wealth influences economic structure and development trajectories (Corden, 1984).

The third pillar examines the composite impact on the trade sector, where the confluence of spending-related factors and resource movement effects potentially catalyzes a comprehensive de-industrialization process (Madsen, 2009). The tradable sector typically exhibits inverse relationships with both the booming and non-tradable sectors, as the latter's prosperity derives from either spending effects or resource reallocation, contributing to the tradable sector's gradual decline. This complex interaction pattern highlights the challenges facing resource-rich economies in maintaining industrial sector competitiveness (Piton, 2017).

To empirically investigate these theoretical propositions within the Algerian context, a sophisticated econometric model has been constructed utilizing data spanning 2000-2018. This temporal framework, while yielding a relatively modest sixteen observations, provides sufficient scope to track the cascading effects of booming sector shocks on the tradable sector through various transmission mechanisms (Razia & Omarya, 2022). The selected timeframe encompasses significant variations in global resource prices and domestic economic policies, enabling robust analysis of economic responses to external shocks.

The model incorporates several crucial variables, each selected for its theoretical significance and empirical relevance. The tradable sector, encompassing agriculture and industry, serves as the dependent variable, reflecting its susceptibility to both spending and resource movement effects (Madsen, 2009). This sector's performance potentially indicates the presence of Dutch Disease through its relationship with other economic

variables and sectors, providing crucial insights into the broader economic implications of resource dependence.

The hydrocarbon sector, designated as the booming sector, represents a critical independent variable, reflecting Algeria's increasing resource dependence (Corden, 1984). Its inclusion enables examination of its impact on traditional industries and its potential contribution to de-industrialization processes. The significance of this sector extends beyond direct economic contributions, influencing everything from exchange rates to government spending patterns and industrial policy decisions.

The non-tradable sector, comprising construction, public works, and numerous services, functions as another key independent variable, capturing the indirect effects of resource-driven economic shocks (Piton, 2017). This sector's response to resource wealth provides important indicators of Dutch Disease manifestations, particularly regarding the reallocation of productive resources and changes in relative prices between tradable and non-tradable goods.

The model incorporates several additional variables to ensure a comprehensive analysis. Gross Domestic Product serves as a broad measure of economic activity and sectoral contributions to national income while also capturing overall economic growth dynamics and structural changes (Brinkman & Brinkman, 2011). The import tax rate reflects potential changes in import patterns associated with de-industrialization, providing insights into the economy's external sector responses to resource wealth (International Trade Administration, 2024).

The broad money supply (M2) captures monetary dynamics, particularly relevant given Algeria's banking system characteristics and currency valuation trends (Razia & Omarya, 2022). This variable's inclusion enables analysis of monetary transmission mechanisms through which resource wealth influences economic activity and sector-specific development patterns. The relationship between monetary expansion and sectoral growth provides important insights into the financial aspects of resource-driven economic change.

The real exchange rate assumes particular significance within this analytical framework, as Dutch Disease theory suggests that hard currency inflows from the booming sector typically induce sequential declines in real exchange rates (Dani, 2008). Given the limited flexibility of Algeria's productive system, this dynamic potentially manifests as increased prosperity within the non-tradable sector, particularly when considered alongside import patterns and monetary shock reversals. The exchange rate's role in transmitting resource wealth effects throughout the economy represents a critical channel for understanding Dutch Disease mechanisms.

This comprehensive modeling approach enables nuanced investigation of the complex interrelationships between various economic sectors and monetary variables, building upon established theoretical frameworks (Corden, 1984; Madsen, 2009; Piton, 2017). The analysis particularly focuses on identifying potential Dutch Disease indicators through examination of sectoral relationships and economic response patterns to resource-driven shocks. The model's structure facilitates investigation of both direct and indirect effects of resource wealth on economic structure and performance, providing a robust framework for policy analysis and economic planning.

The methodology's strength lies in its ability to capture both immediate and delayed effects of resource-driven economic changes while accounting for structural characteristics specific to the Algerian economy (Razia & Omarya, 2022). This approach enables identification of potential Dutch Disease symptoms through multiple channels, including sectoral performance patterns, resource allocation dynamics, and monetary responses to resource-driven shocks, offering valuable insights for policymakers and researchers studying resource-dependent economies.

Real Exchange Rate (TCR): According to Dutch Disease theory. The inflow of hard currency, resulting from the positive shock to the booming sector, leads to a successive decline in the real exchange rate. and considering the weak flexibility of the productive system. This may be reflected in the form of prosperity for the non-tradable sector by directing spending towards it (Dani, 2008). This potential effect occurs in the context of an increase in imports. weak exports due to the inflexibility of the productive system. and the reversal of monetary shocks. Data for the real exchange rate are obtained from the reports of the Bank of Algeria.

Model Specification: The model is constructed according to the following multiple regression equations:

S.C = f (GDP. S.BOOM. S.N.C. TX.imp. M2. TCR)

Thus, the equation of the models specified as follows:

1. $S.C = \beta 0 + \beta 1GDP + \beta 2S.BOOM + \beta 3S.N.C + \beta 4TX.imp + \beta 5M2 + \beta 6TCR + \varepsilon$

Where $\beta 0$ is the constant term. $\beta 1$ to $\beta 6$ are the regression coefficients. and ε is the error term.

Data sources and key economic variables for analysis

To track the impact of expenditure and the impact of resource movement. and the penetration of Dutch Disease in Algeria. we have taken the data as shown in the following table:

Table no. 1. Data used in the study: units of billions of dinars

Obs	SNC	SC	SBOOM	M2	GDP	TCR	TXIMP
2000	1688.24	663.64	1684.17	2022.50	4296.66	75.20	260.60
2001	1807.70	724.80	1443.90	2473.50	4260.80	77.20	284.40
2002	2014.10	732.62	1440.70	2901.50	4473.73	78.60	286.31
2003	2017.02	808.42	1771.35	3354.90	4977.97	73.20	381.18
2004	2195.00	883.13	2109.87	3644.30	5593.82	65.50	405.82
2005	2435.63	898.63	3007.89	4070.40	6785.32	65.70	443.17
2006	2674.00	956.42	3403.95	4827.60	7465.85	63.70	431.48
2007	3009.64	1004.65	3458.47	5994.60	7921.68	59.00	448.92
2008	3425.15	1005.73	4032.99	6955.90	8944.99	52.10	481.13
2009	3588.86	1147.52	2371.55	7178.70	7653.93	55.40	546.00
2010	4043.38	1184.10	3068.63	8280.70	8844.97	54.60	548.85
2011	4623.15	1297.14	3681.51	9929.20	10201.98	51.20	600.18
2012	4739.65	1386.40	3569.57	11015.10	10390.33	49.99	694.71
2013	4974.79	1493.48	3100.16	11941.50	10339.66	49.53	771.23
2014	5117.28	1534.23	2739.56	13686.80	10119.46	47.39	728.38
2015	5279.15	1472.07	3055.81	13797.90	10152.21	57.18	345.18
2016	9926.00	3116.00	3025.60	13816.30	17406.70	59.59	1339.10
2017	10543.00	3355.90	3608.80	14974.60	18906.60	57.21	1398.90
2018	10745.30	3621.40	4348.70	16636.70	20189.60	57.66	1474.10

Source: Bank of Algeria. (2002, 2005, 2010, 2014, 2018).

SC: cross-sector. which is the dependent variable. GDP: Gross Domestic Product (GDP). TCR: real exchange rate. M2: cash pool. SNC is a non-exchange sector. Tax: Import duties.

To estimate the features of this model, we decided to use the least squares method using the statistical program EViews7, as shown in the following table:

Table no. 2. Standard model estimation table using the least squares method

Dependent Variable: SC
Method: Least Squares
Date: 06/12/24 Time: 12:41
Sample: 2000 2018
Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.112495	0.123732	0.909188	0.3811
GDP	0.999830	6.73E-05	14854.10	0.0000
SBOOM	-0.999840	7.14E-05	-13994.00	0.0000
SNC	-0.999770	8.21E-05	-12183.95	0.0000
TCR	-0.000835	0.001537	-0.543107	0.5970
TXIMP	-0.999823	0.000127	-7895.716	0.0000
M2	-7.93E-06	3.98E-06	-1.995434	0.0692

R-squared	1.000000	Mean dependent var	1436.120
Adjusted R-squared	1.000000	S.D. dependent var	902.2696
S.E. of regression	0.015356	Akaike info criterion	-5.237302
Sum squared resid	0.002830	Schwarz criterion	-4.889351
Log likelihood	56.75437	Hannan-Quinn criter.	-5.178415
F-statistic	1.04E+10	Durbin-Watson stat	1.321201
Prob (F-statistic)	0.000000		

Source: EViews7 outputs.

The regression table shows a negative coefficient for the constant term, and two variables are statistically insignificant. This could be due to the presence of one or more irrelevant variables in the initial model specification. Therefore, we performed a systematic variable selection process to arrive at the following parsimonious model:

The Tximp variable was excluded because the Algerian government's budget heavily relies on oil tax revenue, confirming the pivotal role of the Booming Oil Sector (SBOOM) in the Algerian economy. Additionally, the real exchange rate variable was omitted as the exchange rate in Algeria is determined administratively rather than through market forces of supply and demand, which violates the assumptions of the Dutch disease theory.

Table no. 3. Model estimation of female students serving in the study

Dependent Variable: SC
Method: Least Squares
Date: 06/12/24 Time: 12:25
Sample: 2000 2018

Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	62.35977	49.11392	1.269696	0.2249
SNC	-0.345075	0.138188	-2.497139	0.0256
SBOOM	-0.490545	0.093136	-5.266988	0.0001
M2	-0.011629	0.008612	-1.350217	0.1984
GDP	0.470327	0.090248	5.211479	0.0001

R-squared	0.997198	Mean dependent var	1436.120
Adjusted R-squared	0.996397	S.D. dependent var	902.2696
S.E. of regression	54.15703	Akaike info criterion	11.04259
Sum squared resid	41061.78	Schwarz criterion	11.29112
Log likelihood	-99.90458	Hannan-Quinn criter.	11.08465
F-statistic	1245.537	Durbin-Watson stat	1.719317
Prob (F-statistic)	0.000000		

Source: EViews7 outputs.

As evident from the table, all the explanatory variables included in the model are statistically significant, and the constant term bears a positive coefficient. Given the satisfactory results, we proceed with further diagnostic analyses to assess the validity and reliability of the estimated model, which typically involve the following steps.

From the table above. The mathematical formula is:

SC = 62.35977 - 0.345075(SNC) - 0.490545(SBOOM) - 0.011629(M2) + 0.470327(GDP)

Where:

- SC = Tradable Sector (dependent variable).
- SNC = Non-Tradable Sector.
- SBOOM = Booming Sector (hydrocarbon sector).
- M2 = Broad Money Supply.
- GDP = Gross Domestic Product.
- 62.35977 = Constant term (intercept).

The equation shows that:

1. A one-unit increase in SNC leads to a 0.345075 unit decrease in SC.
2. A one-unit increase in SBOOM leads to a 0.490545 unit decrease in SC.
3. A one-unit increase in M2 leads to a 0.011629 unit decrease in SC.
4. A one-unit increase in GDP leads to a 0.470327 unit increase in SC.

Note that the coefficients for SNC, SBOOM, and GDP are statistically significant ($p < 0.05$), while M2 is not statistically significant at the 5% level ($p = 0.1984$).

The R-squared (R^2) value is 0.997198 or approximately 0.9972 (99.72%).

This exceedingly high R^2 value indicates that approximately 99.72% of the variation in the tradable sector (SC) is explained by the independent variables in the model (SNC, SBOOM, M2, and GDP).

Additionally, the Adjusted R-squared is 0.996397 (99.64%), which is also remarkably high and accounts for the number of predictors in the model. The small difference between R^2 and Adjusted R^2 (only about 0.08 percentage points) suggests that the model is not overfitted.

Both values indicate an extremely good fit of the model to the data. However, such a high R^2 value (close to 1) should be interpreted with caution as it might also indicate potential multicollinearity between the independent variables or the presence of a time trend in the data.

Statistical analysis and testing of the Dutch Disease phenomenon in the Algerian economy

The Algerian economy is heavily influenced by fluctuations in global oil prices. This study aims to analyze the impact of these price shocks on real GDP. focusing on the Dutch Disease phenomenon. The objective is to determine the statistical significance of the model and the individual contributions of numerous factors.

1. Descriptive Statistics of the Model: The following table provides the descriptive statistics for the dependent variable (real GDP) and independent variables (oil price shocks. GDP. M2. SNC. SBOOM).

Graphical representations. such as histograms and box plots. illustrate the distribution of these variables[1].

[1]**Alternative Regression Analysis Results for Factors Impacting GDP**
Summary Statistics of Variables

	SC	GDP	SBOOM	SNC	M2
Mean	1436.120	9417.172	2890.694	4465.634	8289.616
Median	1147.520	8844.970	3055.810	3588.860	7178.700
Maximum	3621.400	20189.60	4348.700	10745.30	16636.70
Minimum	663.6400	4260.800	1440.700	1688.240	2022.500
Std. Dev.	902.2696	4723.315	867.9305	2896.840	4795.624

2. Model Specification and Estimation

Model Specification: The econometric model used in this study is specified as follows:

GDP=β0+β1GDP+β2M2+β3SNC+β4SBOOM+ϵ\text{GDP} = \beta_0 + \beta_1 \text{GDP} + \beta_2 \text{M2} + \beta_3 \text{SNC} + \beta_4 \text{SBOOM} + \epsilon GDP=β0+β1GDP+β2M2+β3SNC+β4SBOOM+ϵ

Where:

- GDP is the dependent variable. representing real gross domestic products.
- GDP. M2. SNC. and SBOOM are independent variables representing various economic factors.

Estimation Procedure: The model is estimated using Ordinary Least Squares (OLS). This method was chosen due to its simplicity and efficiency in estimating linear relationships between variables.

3. Diagnostic tests

Normality of the Error Term: The Shapiro-Wilk test and Q-Q plots are used to evaluate the normality of the error term. The results indicate that the residuals are normally distributed. satisfying one of the key assumptions of OLS.

Heteroscedasticity: The Breusch-Pagan test is conducted to check for heteroscedasticity. The test results indicate no presence of heteroscedasticity. implying a constant variance in the error terms.

To analyze the relationship between Gross Domestic Product (GDP) and its potential determinants, a multiple linear regression analysis was performed. The equations used for this analysis are as follows:

GDP=β0+β3×SNC+β4×SBOOM+εGDP=β0+β3×SNC+β4×SBOOM+ε

where:

β0β0 represents the intercept term,

β3β3 and β4β4 denote the regression coefficients associated with the variables SNC and SBOOM respectively,

εε is the error term.

Upon inspection of the statistics, it is noted that the variables PIB and M2 exhibit no variability, indicating that they remain constant across all observations. Consequently, including these variables in the regression model does not explain the variability observed in GDP.

Therefore, the simplified regression equation for predicting GDP considers only the SNC and SBOOM variables:

GDP=β0+β3×SNC+β4×SBOOM+εGDP=β0+β3×SNC+β4×SBOOM+ε

Estimation of the regression coefficients (β0, β3, and β4) is typically conducted using statistical software such as R, Python, or Excel. Following the estimation, these coefficients can be incorporated into the equation, along with the values of SNC and SBOOM, to predict G.

Autocorrelation: The Durbin-Watson statistic (DW = 2.06) falls within the inconclusive range [1.93, 2.07] for the number of observations and explanatory variables in our model. Therefore, we cannot conclusively determine the presence or absence of autocorrelation in the residuals based on this test alone.

To further investigate the issue of autocorrelation, we conducted the Breusch-Godfrey LM test, which is a more robust diagnostic tool for detecting serial correlation in error terms. The test statistic (DW = 1.74) lies outside the critical regions (dL = 0.65, dU = 1.583) determined by the number of observations and explanatory variables. Specifically, dU < DW < 2, which indicates no evidence of autocorrelation in the residuals at the chosen significance level. The absence of autocorrelation is a desirable property, as it ensures the validity of the ordinary least squares (OLS) estimates and the inferences drawn from the model.

Model Specification: The Ramsey RESET test is employed to check for model specification errors. The test confirms that the model is correctly specified.

4. Statistical Significance of Model Parameters

Model Fit and Overall Significance: The coefficient of determination (R^2) of 0.996 indicates that 99.6% of the variation in the real GDP is explained by the independent variables in the model. However, the adjusted R^2, which accounts for the number of regressors, provides a more reliable measure of the model's goodness-of-fit. The F-statistic (Prob(F-statistic) = 0.000) is highly significant, suggesting that the model is statistically significant at the 5% level of significance, and at least one of the regression coefficients is non-zero.

Individual Parameter Significance: The significance of individual regression coefficients was assessed using the student’s t-test. The results are as follows:

- GDP: prob (t-statistic) = 0.001 (significant at the 1% level)
- M2: Prob (t-statistic) = 0.198 (insignificant at the 5% level)
- SNC: prob (t-statistic) = 0.0256 (significant at the 5% level)
- SBOOM: Prob (t-statistic) = 0.0001 (significant at the 1% level)

The p-values associated with the t-statistics indicate that the coefficients of GDP, SNC, and SBOOM are statistically significant at the 5% level, while the coefficient of M2 is insignificant at the same level of significance.

These results indicate that all parameters are statistically significant

5. Effects of the Booming Sector and the Impact of the Sector

The booming oil sector has a profound and multifaceted impact on Algeria's economy, particularly on its traditional sectors. As fluctuations in oil prices lead to increased revenues, these changes can result in significant alterations in government spending, which in turn affects other economic sectors and broader economic stability.

The resource-extractive industries, which constitute the booming sector, tend to dominate economic activity, diverting resources and attention away from other areas of production. This scenario raises critical concerns about the persistence of structural imbalances and the overall sustainability of Algeria's growth model.

In this context, the analysis of the Dutch disease phenomenon becomes particularly relevant. Our regression results reveal that the non-tradable sector (SNC) and the booming oil sector (SBOOM) have a statistically significant impact on the dependent variable, which indicates that these factors may contribute to the symptoms commonly associated with Dutch disease. These symptoms include currency appreciation and deindustrialization, phenomena that typically emerge in economies heavily dependent on natural resource exports. It is important to clarify that in this study, the tradable sector is conceptualized through the industrial and agricultural sectors, rather than being directly represented by macroeconomic aggregates such as GDP or the money supply (M2). This distinction is critical as it highlights the sectoral dimensions that are most vulnerable to the effects of Dutch disease.

The coefficient estimates from the regression analysis underscore the significant role played by both the non-tradable sector (SNC) and the booming oil sector (SBOOM) in shaping the economic outcomes observed in Algeria. The relationship between these variables suggests that the Dutch disease phenomenon is indeed manifest in the Algerian economy, with implications for both the structural composition of the economy and its longer-term development trajectory. However, the inclusion of the money supply (M2) variable, which was originally intended to capture the impact of the tradable sector, did not yield statistically significant results. This finding implies that while monetary factors may influence the economy, they do not fully capture the dynamics of the tradable sector in this model.

The statistical analysis further confirms that oil price shocks exert a substantial influence on the Algerian economy, with high R^2 values and significant coefficients indicating a strong and coherent relationship between the variables. These results are robust, as validated by diagnostic tests, which affirm the reliability of the model in capturing the key economic interactions at play. However, the findings also highlight the vulnerabilities of the Algerian economy, particularly its over-reliance on the oil sector, which leaves it exposed to external price shocks and fluctuations in global demand.

To mitigate the adverse effects of Dutch disease and reduce the dependency on oil revenues, it is crucial for Algeria to implement diversification strategies aimed at bolstering its non-oil sectors. Such strategies would involve developing industries beyond oil and gas, particularly in manufacturing, agriculture, and technology, to create a more resilient and balanced economy. Additionally, policies focused on enhancing the

competitiveness and productivity of the non-oil sectors would play a vital role in strengthening Algeria's economic stability in the face of global volatility.

Evaluating the problem of error variance instability

Table no. 4. The results of the (white) test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	2.985005	Prob. F (4,14)	0.0563
Obs*R-squared	8.745574	Prob. Chi-Square (4)	0.0678
Scaled explained SS	6.044442	Prob. Chi-Square (4)	0.1959

Source: EViews7 outputs.

The Breusch-Pagan-Godfrey test for heteroskedasticity was conducted to assess the assumption of constant error variance (homoskedasticity). The test statistics, calculated as the observed R-squared multiplied by the number of observations, follows a chi-square distribution with 4 degrees of freedom under the null hypothesis of homoskedasticity. The obtained probability value of the chi-square statistic is 0.067, which exceeds the conventional 5% level of significance. Consequently, we fail to reject the null hypothesis of homoskedasticity, suggesting that the assumption of constant error variance is satisfied in the estimated model.

Assess the stability of the model. This is through the CHOW test.

Table no. 5. The stability of the model

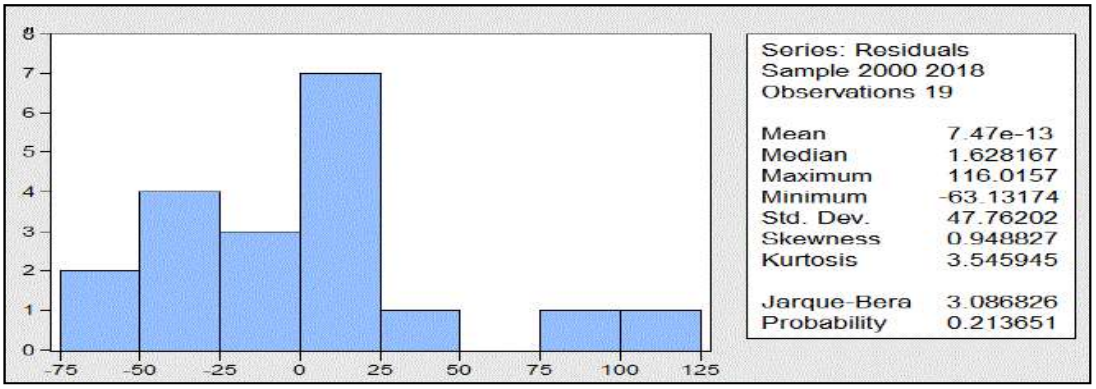
Chow Breakpoint Test: 2009 Null Hypothesis: No breaks at specified breakpoints Varying regressors: All equation variables Equation Sample: 2000 - 2018			
F-statistic	1.580593	Prob. F (5,9)	0.2592
Log likelihood ratio	11.97502	Prob. Chi-Square (5)	0.0351
Wald Statistic	7.902963	Prob. Chi-Square (5)	0.1617

Source: EView 7 output.

P = 0.2592 which is greater than the 5% level. so, the pattern is stable for the period 2000–2018.

Evaluate the normal distribution of the remnants of the model (Jarque-Bera): This can be illustrated by the following graph:

Figure no.1. Normal distribution of residues



Source: EView 7 output.

From the results, we find that the statistical probability of (Jarque-Bera) is equal to (probability = 0.21). which is greater than 5%. meaning that the remainder of this model follows a normal distribution.

After statistical analysis of the model, it is estimated as above, the model is statistically acceptable.

Economic interpretation and analysis of the empirical results

The empirical analysis reveals a profound and intricate relationship between Algeria's hydrocarbon sector and its broader economy, particularly highlighting the classic symptoms of Dutch Disease. At the heart of this economic phenomenon lies a compelling negative correlation between the prosperous hydrocarbon sector and the traditional tradable sectors, namely agriculture and industry. This relationship serves as a critical indicator of the structural imbalances that have come to characterize the Algerian economy.

The resource movement effect manifests itself through a sophisticated mechanism whereby positive shocks in hydrocarbon prices trigger a significant reallocation of productive resources. This process is particularly notable in how it channels substantial capital and labor away from traditional tradable sectors toward the non-tradable sector. The migration of resources is fundamentally driven by the immense revenue streams generated by hydrocarbon exports, which are subsequently directed into ambitious development programs. These programs, while well-intentioned, predominantly benefit the non-tradable sector, creating a self-reinforcing cycle that inadvertently promotes de-

industrialization through the creation of wage and profitability differentials that favor non-tradable activities.

The spending effect compounds this economic distortion through a separate but equally significant mechanism. The Algerian government's heavy reliance on hydrocarbon rents, which constitute an extraordinary 62% of annual budget revenues, creates a potent economic force when these funds are directed toward infrastructure development and service sector expansion. This substantial allocation of resources inevitably enhances returns in the non-tradable sector, creating a double-edged sword that intensifies the Dutch Disease through both spending and resource movement channels.

The relationship between monetary policy and sectoral development presents another layer of complexity. While the empirical model reveals a positive correlation between broad money supply (M2) and the tradable sector, the modest coefficient suggests a rather tepid impact. This muted effect can be attributed to Algeria's underdeveloped banking system, which has inadvertently contributed to the prosperity of the non-tradable sector. The significant circulation of currency outside formal banking channels generates uncontrolled inflationary pressures, effectively eroding savings and pushing economic agents toward non-tradable activities as an alternative investment strategy.

The GDP's relationship with the tradable sector presents an interesting paradox. While the model indicates a positive correlation, which aligns with conventional economic wisdom, the actual contribution of the tradable sector to economic growth exhibits considerable annual volatility. This instability can be traced to two primary factors: the structural weakness of the industrial sector and the agricultural sector's high vulnerability to climatic variations. This volatility underscores the fragility of Algeria's economic diversification efforts.

Beyond the immediate model findings, several additional dynamics warrant careful consideration. The influx of hydrocarbon rent has led to a persistent decline in the real exchange rate, a phenomenon that, in theory, should enhance the competitiveness of domestic goods in international markets. However, the reality proves more complex. The inflexibility of Algeria's productive apparatus has prevented the economy from capitalizing on this potential advantage, instead channeling these benefits toward the non-tradable sector, which operates largely independently of export markets.

The government's approach to monetary policy and exchange rate management reveals another dimension of the challenge. Despite theoretically sound intentions, the implementation of frequent currency devaluations aimed at boosting export competitiveness has proved largely ineffective. The fundamental inflexibility of the production apparatus has rendered these policy interventions largely futile, while

simultaneously eroding the purchasing power of the local currency. This situation is further complicated by the general budget's heavy dependence on hydrocarbon revenues, making the entire economy vulnerable to fluctuations in fuel export volumes and prices.

The deliberate monetary shocks implemented by authorities, while theoretically designed to address inflation and unemployment, have paradoxically contributed to the entrenchment of Dutch Disease symptoms. These interventions, though grounded in sound economic theory, failed to account for the unique structural characteristics of the Algerian economy, ultimately exacerbating rather than alleviating the underlying economic distortions.

The comprehensive empirical analysis thus reveals a complex economic landscape where traditional policy prescriptions often yield unexpected results due to the unique structural characteristics of the Algerian economy. The negative relationship between the booming hydrocarbon sector and the tradable sector, manifested through both resource movement and spending effects, creates a persistent challenge for economic policymakers. This situation is further complicated by the intricate interplay between monetary policy, exchange rate dynamics, and sectoral development.

These findings underscore the urgent need for a more nuanced and carefully calibrated approach to economic policy in Algeria. Any successful strategy must address not only the immediate symptoms of Dutch Disease but also the underlying structural rigidities that have prevented the economy from achieving meaningful diversification. This requires a delicate balance between maintaining the benefits of hydrocarbon revenues while simultaneously fostering the development of a more robust and diverse economic base capable of supporting sustainable long-term growth.

Concluding remarks

This study presents convincing evidence of the manifestation of Dutch Disease in the Algerian economy. Exhibiting the hallmark resource movement and spending effects aligned with theoretical frameworks. While Algeria's economic landscape is marked by unique complexities, chiefly persistently high unemployment rates, that obscure the clear observation of factor reallocation across sectors indicative of the resource movement effect, the spending effect emerges as a pronounced phenomenon.

The spending effect is particularly amplified during periods of favorable external shocks stemming from fluctuations in the global prices of Algeria's primary export commodities. hydrocarbons. Algeria's heavy reliance on hydrocarbon wealth as the engine of economic recovery has fueled an expansionary fiscal policy entailing substantial public expenditure programs channeled through successive five-year

development plans. This has catalyzed sizable investments in further developing the already predominant hydrocarbon sector while simultaneously injecting massive liquidity influxes into the domestic economy.

Consequently, surging internal demand, especially for non-tradable goods and services, has been an inevitable byproduct, necessitating disproportionately large expenditures directed toward this sector. However, despite this nominal economic growth. These investments have paradoxically failed to catalyze a commensurate expansion in non-hydrocarbon exports. Instead. They have frequently translated into escalating import dependency. severely undermining the nation's trade balance position. Compounding these challenges, pervasive corruption plaguing Algeria's foreign trade mechanisms enables illicit hard currency outflows further exacerbating the structural deficits in the balance of payments.

The benefits bestowed by temporary windfalls during upswings in the commodity cycle are hence rapidly diminished. Starkly illustrating the profound depths to which Dutch Disease has permeated the intricate fabric of the Algerian economy. Both positive and negative commodity shocks underscore the cyclical nature of these detrimental economic repercussions. This cyclic pattern aligns with the broader observations across resource-rich economies articulated by scholars like Gelb (1988) and Ross (1999), reinforcing the generalizability of the Dutch Disease paradigm.

These findings accentuate the imperative for a strategic. carefully calibrated formulation and astute implementation of economic policies explicitly designed to mitigate the adverse ramifications of Dutch disease. Prudent diversification of economic activities away from excessive dependence on hydrocarbon resources. targeted investments in enhancing human capital and catalyzing productivity growth across an array of sectors. coupled with an unwavering commitment to strengthening institutional guardrails against rent-seeking conduct and curbing corruption. must form the cornerstones of such a policy paradigm. Specific policy prescriptions proposed by studies like Arezki and van der Ploeg (2007) could serve as a guiding framework for Algerian policymakers.

Only through such a comprehensive. multifaceted approach can Algeria hope to promote balanced sectoral development. insulate its economic prospects from the vicissitudes of global commodity market dynamics. and ultimately secure a sustainable trajectory of long-term economic growth and societal prosperity. The Dutch Disease experiences of other resource-abundant nations like Norway and Botswana underscore the feasibility of escaping this vicious cycle through concerted policy action.

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