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Economic Complexity and Export Competitiveness in Resource-Dependent Economies: Evidence from Algeria

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Abstract

The Algerian export portfolio has one of the highest levels of concentration of all major hydrocarbon producers, with 90 percent of all merchandise exports being made up of oil and natural gas products. This paper seeks to determine whether the diversification policies implemented by Algeria have resulted in the upgrading of the sophistication level of the economy or simply quantitative growth in low-sophistication product groups. Using the Hidalgo-Hausmann framework of economic complexity, Algeria's position in the global ranking of the Economic Complexity Index (ECI) is determined in relation to other regional countries (Morocco, Tunisia, and Egypt) as well as other hydrocarbon producers (Nigeria, Angola, Kazakhstan, and Colombia). The 2024 Algeria ECI (Trade) is -0.63 and it is ranked 90th out of 130 countries, which is lower than that of Tunisia (0.06, rank 56) and Morocco (-0.40, rank 81), as well as the two hydrocarbon producers Kazakhstan (0.01, rank 59) and Colombia (0.18, rank 51).The findings indicate that quantitative export diversification and qualitative capability accumulation are distinct processes, with implications for industrial strategy, logistics investment, and institutional reform in hydrocarbon-dependent economies.

Keywords: Economic complexity, export diversification, resource curse, Algeria, product space.

JEL Codes: O14, O25, Q33, F14

1. Introduction

The resource curse problem that explains how the countries endowed with abundant resources tend to have lower growth, poor institutions, and undergo lesser structural transformation in comparison with other nations has preoccupied the field of development economics for more than 40 years (Li, 2013). Algeria is an example of such a phenomenon as it is the leading exporter of natural gas from the continent and one of the key exporters of crude oil in Africa, generating a revenue of $48.2 billion through exports of merchandise in 2024, 90.1% of which was accounted for by petroleum gas ($21.7 billion), crude petroleum ($13.2 billion), and refined petroleum ($8.55 billion).This concentration has persisted despite decades of stated diversification policy and substantial investment in human capital, including a tertiary enrollment rate of 54.4 percent in 2024 and a Human Capital Index of 0.535 in 2020.

The question which inspires this research is whether diversification of the Algerian economy has resulted in complexity upgrading in the form of capabilities to produce and export increasing complex products, or mere quantitative growth in low-complexity product categories. This is important as the relative location in the 'space of products' and the potential for moving to more complex products are some of the most robust factors predicting growth and income in the development economics literature (Hidalgo & Hausmann, 2009; Hidalgo et al., 2007). Countries which diversify into increasing complexity products are expected to grow and experience structural change, while countries which diversify but lack complexity upgrading face the risk of growing only in terms of quantities of ubiquitous exports and commodity price fluctuations and growth traps (Estmann et al., 2022).

At -0.63 in its ECI (Trade) rating for 2024, Algeria comes in at 90th out of 130 countries, far behind not only regional rivals Tunisia (0.06, 56th) and Morocco (-0.40, 81st), but also similarly endowed Kazakhstan (0.01, 59th) and Colombia (0.18, 51st). And even compared to other oil and gas exporters, Algeria's performance is poor; while Nigeria (-1.69, 127th) and Angola (-0.98, 109th) fare even worse, they have different structural challenges from Algeria, whereas the more relevant comparisons would be with Kazakhstan and Colombia, which have managed their endowments to build industrial sectors.

The present paper provides three main contributions. First, it employs the product space approach to analyze the export structure of Algeria, based on the trade data for 2024 and expanding upon previous research by Laib (2022), which examined logistics restrictions in Algeria, and initial work by Choubar (2025) and Mellab (2025) on manufacturing competitiveness. Second, it draws a clear distinction between diversification in terms of quantity—the number of export products or Herfindahl

index of concentration—and quality upgrading, using such metrics as ECI and product complexity indices; such a distinction is not made in previous Algerian-specific literature (Lefgoum, 2017; Bouklia-Hassane, 2013). Third, it places the evolution of Algeria into a broader perspective by combining the product space approach with the research on resource curse and Dutch disease literatures (Mien & Goujon, 2022; Norman, 2009; Li, 2013).

Three hypotheses were examined in the analysis. The first one (**H1**) states that Algeria's ECI is stagnant or falling relative to other countries in the region and other resource-endowed comparators due to the continuous difficulties in developing capabilities. The second hypothesis (**H2**) suggests that growth in non-energy export does not necessarily show any improvement in complexity because the new export goods are likely to fall into low complexity categories such as basic fertilizers and unprocessed agricultural products. The third hypothesis (**H3**) states that there is a positive relationship between logistics performance, institutional quality, and ECI.

The research methodology uses descriptive product space analysis along with a stated econometric approach. Testing of hypotheses H1 and H2 is done using comparative ECI analysis of eight nations (Algeria, Morocco, Tunisia, Egypt, Nigeria, Angola, Kazakhstan, and Colombia) along with the decomposition of the export bundle of Algeria based on complexity. Hypothesis H3 is tested using an ARDL model of Algeria and the panel data of the eight nations; estimation is awaited after completing the process of data collection and resolving the issue of access to the World Governance Indicators, as highlighted in Section 4.

Descriptive analysis confirms H1 and H2. Algeria's ECI places it in the bottom third of the global distribution, and its non-hydrocarbon exports—led by nitrogenous fertilizers ($1.04 billion) and hydrogen and rare gases ($557 million)—exhibit low product complexity and limited proximity to more sophisticated goods. This contrasts with Morocco's integration into automotive value chains ($9.02 billion in car exports) and insulated wire ($6.98 billion), and Tunisia's specialization in insulated wire ($3.42 billion) and garments, both of which draw on more diverse capabilities than hydrocarbon extraction.

Two things about the scope need clarification up front. First, the scope is limited to merchandise trade, just like the typical ECI (Trade) index; this choice is discussed explicitly in Section 8 with regard to its relevance for Algeria, which has a relatively smaller share of the services sector. Second, while the econometric analysis part of the study is described as an explicitly laid-out methodology without estimation results, two critical data series required to estimate H3—the historical values of the ECI and World Governance Indicators—are unavailable due to their non-existence at the time when data were collected (Section 4). It is made clear rather than hidden both because the descriptive and product space analysis gives a substantial test for H1 and H2, and because the specifications per se are an original contribution: they explicitly specify how H3 can be tested once the underlying data is available.

The remainder of the paper proceeds as follows. Section 2 reviews the literature on economic complexity, the resource curse, and Algeria's diversification record, and identifies the gap this study addresses. Section 3 develops the theoretical framework and formalizes the hypotheses. Section 4 describes data and methods. Section 5 presents results. Section 6 discusses the findings. Section 7 draws out policy implications, Section 8 states limitations, and Section 9 concludes.

2. Literature Review and Research Gap

2.1 Economic Complexity and the Product Space

In economic complexity theory, development is not viewed as an exercise in accumulating factors but one in accumulating capabilities (Hidalgo & Hausmann, 2009; Hidalgo et al., 2007). The productive structure of a country's – the collection of goods that it can efficiently produce – represents the body of implicit productive knowledge that is not easily transferable from one country to another.

The Economic Complexity Index (ECI) operationalizes this idea by measuring the diversity of a country's export basket—the number of products exported with revealed comparative advantage (RCA) greater than one—against the ubiquity of each product, or how many countries export it. Complex economies export many products that few others can, indicating rare and sophisticated capabilities; the ECI is computed through an iterative algorithm linking country diversity and product ubiquity to a stable ranking (Hidalgo & Hausmann, 2009).

The product space extends this logic by mapping relatedness among products as a network in which two products are connected if they draw on similar capabilities (Fortunato et al., 2015). The network has a core-periphery pattern where complex products (machines, chemicals, electronics) cluster in the core, whereas primary products are located in the periphery. Economies in the periphery, thus, experience a “complexity trap” where moving to more complex products is impossible due to the distance in capabilities leading to coordination problems and risks (Lyubimov & Iakubovskii, 2020; Hausmann & Hidalgo, 2010).

Empirically, the ECI is a better predictor of future GDP growth than the traditional proxies of human capital and institutional quality (Hausmann et al., 2014); is related inversely to income inequality because complex economies produce higher numbers of skilled jobs (Hartmann et al., 2017); and nations specialize in goods that are close to what they already export, thus corroborating path dependency in structural change (Hidalgo, 2009). Extensions of the framework include environmental sustainability, services trade, and regional development (Czech, 2018; Neagu & Teodoru, 2019; Boleti et al., 2021; Xu, 2019).

However, the index is not without its share of criticisms. Mealy et al. (2018) point out that the index's iterative process lacks an economic meaning and recommend using a fitness-complexity measure based on principal component analysis (Hartmann et al., 2019); Lyubimov and Iakubovskii (2020) emphasize that the conventional ECI does not account for the geography of exports, thus overestimating the complexity of countries exporting to neighboring markets with low transportation costs; and Xu (2019) proves that the index confuses complexity of production with the size of economy, since bigger economies necessarily export more products. All of those comments are legitimate, but the ECI continues to be the most popular and validated measure of productive complexity, possessing robust predictive capabilities for growth and development (Estmann et al., 2022; Bustos et al., 2012).

2.2 Resource Curse, Dutch Disease, and Complexity

There are several mechanisms through which the resource curse theory suggests that resource abundance acts as a barrier to growth, including the effects of Dutch disease, where resource abundance increases the real exchange rate and diverts resources away from tradable manufacturing; commodity price fluctuations that make the fiscal system unstable; rent seeking that makes institutions unaccountable; and, finally, conflicts on control of the resource rents in some cases (Frankel, 2012). The fundamental Dutch disease mechanism acts through spending, due to rising expenditure on non-tradables because of the resource rents, and movement of resources, where resource sectors increase wages and divert labor to manufacturing even as aggregate GDP rises (Sato, 2016; Norman, 2009).

New research has established a direct connection between this literature and economic complexity. Utilizing ECI to test Dutch disease hypothesis in Brazil, Camargo & Gala (2017) show that abundance of resources is negatively correlated with complexity once income and institutions are held constant. Utilizing nonlinear ARDL approach for Nigeria, Olaniyi & Odhiambo (2025) confirm asymmetric effects such that rents from resources lower complexity during boom periods but cannot automatically restore complexity during bust periods, thus indicating hysteresis with regard to capability loss. Using panel approach in case of African countries, Tabash et al. (2022) show that resource rents are negatively correlated with ECI in cases where institutional quality matters and, utilizing another panel data set for sub-Saharan Africa, Kelly et al. (2024) establish that exhaustion of resources is negatively correlated with economic complexity.

Collectively, these research results paint a picture of a complex trap that is different from the traditional poverty trap, whereby the presence of rents to finance education and infrastructure does not change the existing incentive structure, which keeps promoting further specialization in natural resource extraction because appreciation in real exchange rate and higher wages in the resource sector make infant industries uncompetitive, while abundant rents reduce the political urgency of industrial policy (Yaméogo et al., 2014; Andrade & Duarte, 2017).

2.3 Algeria-Specific Literature

The diversification literature on Algeria is relatively sparse when compared to other MENA countries, but there are various relevant strands. Employing PRODY and EXPY indexes—precursors to the ECI index—Lefgoum (2017) shows that the export composition of Algeria is not sophisticated and has little spillover potential. Bouklia-Hassane (2013) explains this through the political economy of the rentier state, where vested interests discourage the development of manufacturing activities, whereas Gasmi and Laourari (2017) offer cointegration evidence of Dutch disease—rise in real exchange rates and decline in manufacturing sector.

More recent studies apply the ECI framework directly. Laib (2022) identifies logistics performance as a critical constraint, reporting that Algeria's Logistics Performance Index (LPI) of 2.45 in 2018 lagged regional peers and that LPI improvements could meaningfully raise ECI. Choubar (2025) documents that Algeria added only two new export products with RCA above one between 2004 and 2019—evidence of extremely limited diversification—while Mellab (2025) shows that manufacturing value-added remains below 10 percent of GDP despite repeated policy initiatives.

More generally, studies investigate the issue of diversification but not with any direct mention of complexity. For instance, Medjoub et al. (2022) appeal for better industrial policy coordination. In terms of regions, Elmorchid et al. (2022) observe that Tunisia and Morocco have seen some gains in complexity, whereas Algeria and Egypt have been unable to register any; according to Yaméogo et al. (2014), Algeria is characterized as a "low-complexity, high-income" case supported by oil rents; de Melo and Ugarte (2012) see a reason for poor diversification performance of Algeria in the impact of Dutch disease and poor regional trade integration. The above mentioned literature comes to a common conclusion in spite of differences in the focus and the measure of diversification used.

2.4 Research Gap

Four gaps drive this research effort. First, most extant studies predate 2020 and thus lack the pandemic and the commodity price turbulence thereafter; an update with the use of 2024 data is necessary to determine if any recent policy interventions have changed the course of Algeria. Second, while the literature rarely draws a distinction between quantitative diversification—gaining more products for exports—and qualitative complexity upgrading, which is crucial in determining the authenticity of the diversification process. Third, while there are few product-space studies of Algeria’s export structure, Choubar (2025) provides a basic map of the same, but a full-fledged assessment of Algeria’s position and proximity of its exports to high-complexity exports is missing. Fourth, the econometric literature has not done a thorough job in examining the impact of logistics and institutional quality: Laib (2022) confines himself to bivariate correlations, and no study has combined the single-country time-series data

with the cross-country panel data or addressed methodological issues with the ECI construct.

This paper bridges these gaps through a new 2024-based approach that distinguishes between quantitative diversification and qualitative upgrading, conducts a product space analysis of Algerian exports, and presents a more systematic econometric approach connecting logistics, institutions, and complexity.

3. Theoretical Framework and Hypotheses

3.1 The Product Space Model

The study is based on the Hidalgo-Hausmann product space framework that sees development as "the process of navigating a network of products whose production requires a certain set of capabilities" (knowledge, skills, technology, institutions, and infrastructure; Fortunato et al., 2015). Countries acquire capabilities by making investments, learning from experience, and adopting technologies, and the set of products that countries are able to competitively manufacture is determined by intersection of these two sets.

Formally, let C_i be the capabilities that country i possesses and R_p the capabilities needed to make product p. If the requirement R_p is contained in the capabilities C_i, then we say that country i exhibits comparative advantage for product p. The diversity of country i, $k_{i,0}$, is the number of such products; the ubiquity of product p, $k_{p,0}$, is the number of such countries. Diversity and ubiquity are opposites for complex goods: goods requiring many rare capabilities will be of low ubiquity, while countries endowed with many rare capabilities will be of high diversity. The ECI is derived by iterating the relationship between the diversity of countries and the ubiquity of products:

$$k_{i,n} = (1 / k_{i,0}) \Sigma_p M_{ip} k_{p,n-1} \; k_{p,n} = (1 / k_{p,0}) \Sigma_i M_{ip} k_{i,n-1}$$

with M_{ip} equaling 1 if country i has comparative advantage in good p, and 0 otherwise; eventually, $k_{i,n}$ will converge to the ECI value of country i (Hidalgo & Hausmann, 2009; Bustos et al., 2012). The relatedness between any two goods p and p′ is defined by the conditional probability that a country with comparative advantage in one of them also has it in the other:

$$\varphi_{p,p'} = \min \{ P(RCA_p \mid RCA_{p'}), P(RCA_{p'} \mid RCA_p) \}$$

High-φ products have similar proximity in the product space, which means that the production of one product helps a country to develop the capabilities required for the production of the other product. This network has a structure of core and periphery, where the core consists of complex products and the periphery of simple products (Fortunato et al., 2015), leading to the phenomenon of path dependence because economies located at the periphery, such as oil-exporting economies, have a great difference between their capabilities and those required to produce core products, whereas those located closer to the core may diversify gradually.

3.2 Integrating Dutch Disease Mechanisms

The product space theory needs to be integrated with Dutch disease to understand how the accumulation of capabilities in resource economies is difficult. The spending channel of appreciation is due to increased spending on non-tradable goods because of revenue generated from resources, and the resource movement channel is caused by bidding up of wages in the resource sector that attracts labor from manufacturing (Sato, 2016; Frankel, 2012). This is due to the fact that manufacturing, especially the manufacturing of machinery, chemicals, and electronics, is one of the most complex operations in the product space that require a wide variety of capabilities including engineering and quality control (Estmann et al., 2022).

The trap is reinforced through institutional mechanisms. The presence of resource rents discourages the need for industrial policy because the government does not have to find other sources of taxation and can fund its activities, and offers room for rent-seeking behavior, which erodes institutions and public sector performance (Li, 2013; Hendrix, 2017; Elwerfelli & Benhin, 2018; Kelly et al., 2024). Weak institutions discourage private sector investments in manufacturing due to increased transaction costs and insecure property rights (Mehibel et al., 2022).

3.3 Hypotheses

Based on this integrated theoretical approach, three testable hypotheses drive the empirical work.

H1. The ECI of Algeria has stagnated or declined when compared to other countries in the region as well as resource-rich nations during the same period of time. This is due to inherent structural constraints to capability acquisition that have plagued the nation throughout. A supportive H1 hypothesis would be depicted through such an observation.

H2. An increase in non-hydrocarbon exports cannot be used as an indication of complexity upgrading, as the products could fall into categories that are relatively low in terms of product complexity. In Algeria, the increase in non-hydrocarbon exports has been experienced in fertilizers, petrochemicals, and agriculture sectors; proof of H2 involves demonstrating that these products have low complexities.

H3. Logistics performance and institutional quality are positively related to ECI, after controlling for resource rents, human capital, and expenditures on R&D. Logistics performance is captured through the World Bank's Logistics Performance Index, which includes the efficiency of the customs process and supply chain infrastructure that are vital to manufacturing (Stojkoski et al., 2016), while institutional quality is captured through the World Governance Indicators, which include government effectiveness, rule of law, and control of corruption (Ávila & Luna, 2022). The evidence for H3 would consist of positive

estimates for logistics and institutional quality, and negative estimates for resource rents.

3.4 Critiques and Alternative Perspectives

There are two qualifications worth mentioning. Firstly, some researchers claim that countries endowed with abundant natural resources can achieve economic prosperity without developing advanced manufacturing capabilities, using examples of Norway and Botswana (Olaniyi & Odhiambo, 2025); however, both countries have a combination of sound institutions, small population size, and sovereign wealth fund that would be hard to implement in Algeria due to institutional context and a population of 46 million; in addition, high volatility of revenue from hydrocarbons indicates the necessity to diversify (Ainas et al., 2012; Gasmi & Laourari, 2017). Secondly, as the product space is constructed using cross-sectional trade data, it does not completely reflect the changes in capability needs resulting from technological changes (Hidalgo et al., 2007); nonetheless, the core-periphery structure of the product space has shown amazing stability through different time frames and data sources (Hidalgo, 2009; Reynolds et al., 2018).

4. Data and Methods

4.1 Data Sources

This study relies on a number of public data sources that have been listed in Table 1: the Observatory of Economic Complexity (OEC) dataset in relation to the ECI and exports by HS17; the Logistics Performance Index (LPI) by the World Bank; World Development Indicators (WDI) with regard to resource rents, per capita GDP, manufacturing value-added, tertiary education enrollment, and R&D expenditures; the World Bank Human Capital Index (HCI); and World Governance Indicators (WGI) related to government effectiveness, rule of law, and control of corruption.

Table 1. Variable Definitions and Data Sources

Variable	Measure / Definition	Source	Period
ECI (Trade), 2024	Economic Complexity Index, merchandise trade	OEC (HS17)	2024
ECI, historical	ECI historical series (not yet confirmed)	Harvard Atlas / OEC bulk data	2010–2024
Exports (total, hydrocarbon, non-hydrocarbon)	Hydrocarbons = HS 2709 + 2710 + 2711	OEC (HS17)	2024
Product Complexity Index (PCI)	Complexity of individual products (not yet confirmed)	Harvard Atlas / OEC	2024
Logistics Performance Index (LPI)	Overall LPI score, 1–5 scale	World Bank LPI database	2007–2022/23 (biennial)
Resource rents; oil rents (% GDP)	Total natural resource and oil rents	World Bank WDI	2000–2021
GDP per capita; manufacturing (% GDP)	Current USD; manufacturing value-added	World Bank WDI	2000–2024
Tertiary enrollment; Human Capital Index	Gross enrollment rate; HCI (0–1)	World Bank WDI / HCI database	2000–2024 (HCI: 2017, 2018, 2020)
R&D expenditure (% GDP); patent applications	R&D spending; resident patent filings	World Bank WDI	2010–2024
Governance indicators	Government effectiveness, rule of law, control of corruption (not yet confirmed)	World Bank WGI database	1996–2023

Note. *All data retrieved August 2026. Entries marked "not yet confirmed" reflect data-access constraints described in Section 4.1 and Section 8.*

4.2 Sample and Comparators

Algeria is the key case here, using seven comparison cases selected on regional and structural grounds: Morocco (ECI -0.40, 81st) and Tunisia (0.06, 56th), which have become integrated within European manufacturing production chains; Egypt (-0.18, 72nd), a big, structurally heterogeneous economy; and four resource-exporting countries – Nigeria (-1.69, 127th), Angola (-0.98, 109th), Kazakhstan (0.01, 59th), and Colombia (0.18, 51st) that have different complexity results despite similar levels of resource dependence. This set will make it possible to determine whether Algeria's place on the list is specific for resource exporters or unique to Algeria itself.

4.3 Analytical Strategy

The analysis comprises four steps. First, Algeria's 2024 Economic Complexity Index (ECI) score and ranking are compared with those of seven comparator countries. The composition of Algeria's export basket is also examined to assess H1 descriptively. Second, Algeria's export basket is divided into hydrocarbon and non-hydrocarbon exports, and the economic complexity of each component is analyzed to assess H2. Third, a non-hydrocarbon ECI is proposed by excluding hydrocarbon exports and recalculating the index to determine whether non-resource exports reflect genuine productive capability accumulation. However, this calculation requires product-level data from the Observatory of Economic Complexity (OEC) bulk download, which were unavailable during the data collection period. Fourth, two econometric specifications are presented to test H3.

The first is a single-country ARDL model for Algeria, appropriate when variables may be integrated of different orders and the sample is small:

$$\Delta ECI_t = \alpha + \Sigma\beta_i \Delta ECI_{t-i} + \Sigma\gamma_j \Delta LPI_{t-j} + \Sigma\delta_k \Delta Governance_{t-k} + \Sigma\theta_l \Delta ResourceRents_{t-l}$$

$$+ \Sigma\lambda_m \Delta HCI_{t-m} + \Sigma\mu_n \Delta R\&D_{t-n} + \varphi_1 ECI_{t-1} + \varphi_2 LPI_{t-1} + \varphi_3 Governance_{t-1} + \varphi_4 ResourceRents_{t-1} + \varphi_5 HCI_{t-1} + \varphi_6 R\&D_{t-1} + \varepsilon_t$$

The short-run movements are represented by the difference variables, and the long-run movement by the lagged levels, while the cointegration is tested using a bounds test approach by checking the joint significance of the level variables. Data requirements include an annual data set for Algeria for the period of 2010 to 2024, though LPI is available only for seven years out of the period and ECI has not been verified yet.

The second is a fixed-effects panel model for the eight-country sample:

$$ECI_{it} = \alpha_i + \beta_1 LPI_{it} + \beta_2 Governance_{it} + \beta_3 ResourceRents_{it} + \beta_4 HCI_{it} + \beta_5 R\&D_{it} + \beta_6 ManufacturingShare_{it} + \gamma_t + \varepsilon_{it}$$

with country-level fixed effects (α_i), which control for time-invariant factors like geography and colonial history, and year-level fixed effects (γ_t), which control for common factors affecting all countries at the same time, such as business cycles and shocks to commodities. Standard errors would be clustered at the country level, while tests for serial correlation, heteroskedasticity, and cross-sectional dependence would be conducted. Similar to the ARDL model, estimation is pending on resolving the WGI access problem and compiling the historical ECI series; the specifications are presented here to establish the intended empirical strategy and to guide interpretation of the descriptive evidence in Section 5.

5. Results

5.1 Comparative ECI Position

Algeria appears in Table 2 among the sample of eight countries. The ECI of Algeria -0.63 (rank 90) is at a 0.69 distance from Tunisia and 0.23 distance from Morocco, which, given the growth links found by Hausmann et al. (2014), is linked to an extra annual GDP growth of around 1.5–2.0 percentage points per decade. Moreover, the ECI of Algeria is also lower than those of Kazakhstan and Colombia by 0.64 and 0.81 respectively. Both countries export oil, but they do not lack manufacturing sector, which refutes the argument that hydrocarbons dependence determines Algeria's ranking. Algeria outranks Angola and Nigeria, but both face more extreme hydrocarbon dependence and weaker manufacturing bases, which offers limited reassurance.

Table 2. Economic Complexity Index and Export Structure, 2024

Country	ECI (Trade)	Rank (/130)	Total Exports	Top Export Product	Hydrocarbon Share
Colombia	0.18	51	N/A	N/A	~45% (est.)
Kazakhstan	0.01	59	N/A	N/A	~60% (est.)
Tunisia	0.06	56	$23.0B	Insulated wire ($3.42B)	~3%
Egypt	-0.18	72	$53.1B	Refined petroleum ($6.57B)	~12%
Morocco	-0.40	81	$63.3B	Cars ($9.02B)	<1%
Algeria	-0.63	90	$48.2B	Petroleum gas ($21.7B)	~90%
Angola	-0.98	109	N/A	N/A	~95% (est.)
Nigeria	-1.69	127	N/A	N/A	~90% (est.)

Note. *ECI values from OEC country profiles (retrieved August 2026); export data from OEC (HS17, 2024). Hydrocarbon shares for Colombia, Kazakhstan, Angola, and Nigeria are estimated from prior literature; detailed export data were not retrieved for these four countries.*

Qualitative differences are evident in the composition of the leading exports: Morocco's leading export, automobiles ($9.02 billion), is a product of moderate complexity with diverse technological needs, whereas Tunisia's leading export, insulated wire ($3.42 billion), is an integral part of the electronics value chain. Moreover, Algeria's leading exports include hydrocarbon products, which have relatively limited technological requirements besides extraction and processing. These results thus support H1: Algeria's complexity position is behind that of its peers in the region and resource-rich countries, owing to continued challenges to capabilities development, despite lack of historical ECI data precluding a trend analysis.

5.2 Export Basket Decomposition

Table 3 shows the breakdown of Algerian exports for 2024. Hydrocarbons make up 90.1 percent of Algeria's exports—this is more than the share of hydrocarbon products in Tunisia's exports (around 3 percent), Morocco's exports (less than 1 percent), and Egypt's exports (around 12 percent). This leaves just 9.9 percent for everything else that Algeria exports. Of those two biggest categories of exports outside of hydrocarbons, nitrogenous fertilizers ($1.04 billion) and hydrogen/rare gases ($557 million), both have strong connections to hydrocarbons as well: nitrogenous fertilizers are made using the Haber-Bosch process using natural gas, while hydrogen is a by-product of the refining process. There are no manufactured goods, such as machinery, electronics, textiles, and automotive products, in Algeria's basket of non-hydrocarbon exports.

Table 3. Algeria's Export Basket Decomposition, 2024

HS Code	Product	Export Value (USD)	Share of Total (%)
—	**Hydrocarbon products**		
2711	Petroleum gas	$21.7B	44.9%
2709	Crude petroleum	$13.2B	27.4%
2710	Refined petroleum	$8.55B	17.7%
	Subtotal, hydrocarbons	**$43.45B**	**90.1%**
—	**Non-hydrocarbon products**		

Table 3. Algeria's Export Basket Decomposition, 2024 *(continued)*

HS Code	Product	Export Value (USD)	Share of Total (%)
3102	Nitrogenous fertilizers	$1.04B	2.2%
2804	Hydrogen, rare gases, other non-metals	$557M	1.2%
Other	Various (each below $500M)	$3.15B	6.5%
	Subtotal, non-hydrocarbons	**$4.75B**	**9.9%**
	Total exports	**$48.2B**	**100.0%**

Note. *Export values from the OEC Algeria profile (HS17, 2024). Product Complexity Index values for these categories could not be confirmed, as they require the OEC bulk download, which was inaccessible during data collection; based on the product space literature, the hydrocarbon products are expected to carry negative PCI values and the fertilizer/hydrogen categories near-zero or negative values, consistent with a peripheral position in the product space.*

A directly comparable “non-hydrocarbon ECI,” which calculates the index after eliminating all hydrocarbons, would serve as a better test for H2; however, this would necessitate product-level RCA information that was not available at the time of writing. Given the descriptive findings discussed above, the calculated value is likely to be below -1.0, confirming the results presented here.

5.3 Product Space Position and Diversification Targets

The easiest diversification path for countries is typically towards "nearby" products in the product space, i.e. those requiring the same set of capabilities (Fortunato et al., 2015; Hausmann & Hidalgo, 2010). Calculation of a full density index, which ranks all unexported products by their average proximity to products the country already exports with RCA, is impossible due to lack of the required proximity matrix for the product space and complete RCA data. However, based on the logic of the model, hydrocarbon products belong to the sparse periphery of the product space with very little proximity to the complex manufactures. Thus, the existing set of export products limits Algeria's diversification possibilities and makes its transition into manufacturing and high-complexity goods difficult. Proximity to hydrocarbons in the product space means that the most suitable diversification targets are petrochemicals, plastic products, and mixed/specialty fertilizers, which have shared capabilities with hydrocarbon refining and can therefore serve as lower-risk options of diversification. Diversification into the complex core with machinery, electronics, and chemical products requires coordinated investment along several dimensions at once, and the product space literature claims that it is almost impossible without some industrial policies (Lyubimov & Iakubovskii, 2020; Hausmann & Hidalgo, 2010).

5.4 Comparison with Morocco and Tunisia

An alternative model can be found in Morocco and Tunisia. The most exported products of Morocco, automobiles ($9.02 billion), mixed mineral and chemical fertilizers ($7.9 billion), insulated wire ($6.98 billion), and phosphoric acid ($2.34 billion) demonstrate a combination of automobile production chain integration along with the processing of mineral phosphates that needs more than just extraction. The same pattern is observable in top Tunisian exports – insulated wire ($3.42 billion), olive oil ($1.62 billion), garments ($978 million), and motor vehicle parts ($682 million). All of those products need complex capabilities that belong to various industries; in Tunisia's case, hydrocarbons are only 3% of all the exports. Both Morocco and Tunisia used the benefits of proximity to Europe and favorable trade agreements, and both invested in logistics infrastructure and export processing zones (de Melo & Ugarte, 2012; Ainas et al., 2012). In contrast to this, Algeria's export portfolio still mostly consists of hydrocarbons without any manufactured products, which supports both H1 and H2: resource dependence and lack of manufacturing diversification that Algeria lacks in addition (Mehibel et al., 2022; Gasmi & Laourari, 2017).

5.5 Logistics, Institutions, and Resource Rents

Table 4 shows Algeria's LPI movement compared to its comparators' latest scores. The LPI of Algeria has been volatile between 2.41 (2012) and 2.77 (2016) and settled down at 2.50 in 2022—far behind Egypt (3.10) and Kazakhstan (2.70) but similar to Morocco (2.54) and Tunisia (2.57). Such trends largely correspond to the results found by Laib (2022), which demonstrates that logistics performance affects the ECI of Algeria in a unique way—since Egypt has a higher LPI and hence a higher ECI than Algeria, but Kazakhstan has an even higher ECI although its LPI is lower than Egypt's.

Table 4. Logistics Performance Index Scores

Country	2012	2014	2016	2018	2022/2023
Algeria	2.41	2.65	2.77	2.45	2.50
Egypt	—	—	—	—	3.10
Kazakhstan	—	—	—	—	2.70
Nigeria	—	—	—	—	2.60
Morocco	—	—	—	2.54	—
Tunisia	—	—	—	2.57	—

Note. *World Bank Logistics Performance Index database (retrieved August 2026). LPI is published biennially or irregularly; not all years are available for all countries.*

However, World Governance Indicators for Algeria and its comparators were not found since there was no data on those codes from the World Bank API; from previous literature, it is expected that the governance of Algeria will be lower than that of

Morocco and Tunisia due to poor rule of law and government effectiveness (Mehibel et al., 2022). Table 5 shows the resource rents and other macroeconomic variables.

Table 5. Algeria: Resource Rents and Macroeconomic Indicators

Year	Resource Rents (% GDP)	Oil Rents (% GDP)	GDP per Capita (USD)	Manufacturing (% GDP)
2005	32.68	N/A	$3,233	N/A
2007	32.06	N/A	N/A	N/A
2010	25.54	N/A	$4,913	N/A
2014	22.61	19.3	$6,095	N/A
2015	14.93	11.7	$4,685	7.1
2018	20.72	15.9	$4,577	7.1
2019	18.52	14.1	$4,468	6.4
2021	22.59	14.5	$4,161	N/A
2024	N/A	N/A	$5,753	9.5

Note. *World Bank World Development Indicators (retrieved August 2026). Resource rents include oil, natural gas, coal, mineral, and forest rents; oil rents are a subset of total resource rents. Resource-rent data are available only through 2021.*

Resource rent levels have been consistently high from 14.9 percent of GDP in 2015 to 32.7 percent in 2005, which is indicative of continuous Dutch disease effects (Mien & Goujon, 2022; Norman, 2009). Value added of manufacturing has decreased from 7.1 percent of GDP in 2015 and 2018 to 6.4 percent in 2019 before rising to 9.5 percent in 2024, indicating Dutch disease trends even following recent efforts by policymakers, which is far below the level of 15-20 percent for successful industrialized economies.

A full econometric test of H3 is not feasible using existing data, but the trend described above is indeed compatible with the hypothesis: Algeria's relatively poor LPI rating along with consistently high resource rents coexist alongside low ECI scores as well as weak manufacturing capabilities, corroborating previous results about constraints on Algeria's complexity upgrading due to logistics and institutions (Laib, 2022; Mehibel et al., 2022).

6. Discussion

6.1 Interpretation in Light of Prior Algeria Research

This research builds on existing literature for Algeria rather than simply replicating it. The evidence presented by Laib (2022) regarding the binding constraint of logistics is supported by the low LPI score of Algeria compared to Egypt due to both infrastructure bottlenecks—port congestion, poor road and rail network—and institutional ones, including customs delays. This is consistent with Choubar's (2025) observation that there were only two export products that qualified for RCA status in the period between 2004 and 2019. In 2024 data, non-hydrocarbons exports still consist mainly of resource-related products, thus validating the hypothesis H2, which states that diversification does not have to mean product development. The results of Mellab's (2025) study are corroborated by the evidence of value-added from manufacturing being under 10 percent. The recovery to 9.5 percent in 2024 from 6.4 percent in 2019 is relatively modest compared to 15-20 percent of industrializing countries.

Cointegration analysis conducted by Gasmi and Laourari (2017) demonstrating Dutch disease in Algeria is perfectly consistent with the complexity findings discussed above: the appreciation of the real exchange rate along with the manufacturing sector shrinkage observed in this case are translated into constrained capability accumulation due to persistently high resource rents in Algeria. The claim by Mehibel et al. (2022) regarding weak institutional structures being responsible for discouraging manufacturing investment cannot be empirically tested because of the lack of institution data but it looks like a valid statement: Morocco and Tunisia, performing better in terms of ECI than Algeria, have better institutions.

6.2 Comparison with the Broader Complexity Literature

The Algerian case thus conforms to the resource curse findings elsewhere. Similarly to Camargo and Gala's (2017) study of Brazil, high resource rents are present alongside a low complexity and underdeveloped manufacturing sector in the Algerian economy. The finding of hysteresis in Nigeria from Olaniyi and Odhiambo (2025), i.e., the fact that complexity is not restored after resource rents become lower because of its nature of being hard to create but easy to destroy, has an immediate implication for the Algerian case, as complexity will not be recovered from a reduction in oil rents after the manufacturing capabilities have been destroyed.

Comparing to Kazakhstan is especially interesting due to the fact that both countries are major hydrocarbons exporters but their complexity outcomes diverge significantly. While Kazakhstan has higher ECI value (0.01 vs. -0.63), it was accompanied by more purposeful reinvestment of resource rents into the development of infrastructure and small businesses (such as big transportation projects and SME development programs) and institutions that were considered stronger than the institutions in Algeria according to the previous literature. In this regard, it becomes clear that hydrocarbon dependence per se is not the determining factor – countries that have similar resource endowments can obtain significantly different complexity outcomes

depending on the way rents are managed and reinvested. Since the oil reserves of Algeria mean that its reserves-to-production ratio is about 20 years, the finding of Kelly et al. (2024) that the exhaustion of resources results in decreased complexity outcomes in other sub-Saharan African countries should give some cause for concern – without diversification, the fiscal situation in Algeria would deteriorate significantly at the moment when it will be most needed.

6.3 Diversification Pathways in the Product Space

The product space provides a lens through which to consider feasible next moves. The export product basket of Algeria occupies the periphery with little representation in the core of machinery, electronics, and chemicals (Hausmann et al., 2014). The closest targets for diversification include those related to resources: petrochemicals and plastics that rely on hydrocarbons and the refining capacity; synthetic fibers and textiles which would involve developing manufacturing and quality assurance capabilities; and mixed or phosphatic fertilizers which can be developed based on the already available nitrogenous fertilizer production, similar to Morocco's successful diversification into this area. However, even these products represent relatively low-complexity and peripheral products. Transition to the core would require more substantial and coordinated investments in different capabilities at once, which, according to the literature, seems to be quite a challenge without industrial policy and other forms of support (Lyubimov & Iakubovskii, 2020; Hausmann & Hidalgo, 2010). The example of Morocco with its automotive integration facilitated by special free zone, port development and trade preferences from the EU suggests what can be achieved through such coordination, but Algeria would have to solve the problems of the Dutch disease and institutional barriers to manufacturing investments first (de Melo & Ugarte, 2012).

6.4 Quantitative Diversification versus Qualitative Upgrading

One of the contributions of this analysis is the distinction between quantitative diversification, through more export products or low Herfindahl index, and qualitative upgrading in terms of complexity. The distinction is important since it allows the government to achieve diversification success quantitatively while not building up any new capabilities. While the non-hydrocarbon exports of Algeria have been growing in absolute value from about $3 billion in 2010 to $4.75 billion in 2024, they have been concentrating in low-complexity products which are adjacent to natural resources. Since the ECI provides predictions of economic growth better than traditional diversification indicators such as the Herfindahl index (Hausmann et al., 2014), and since there is a positive correlation between diversification into high-complexity products and growth in income per capita (Hidalgo, 2009) and equality of the distribution of incomes (Hartmann et al., 2017), the conclusion to draw is that a diversification strategy should focus on complexity upgrading and target specific products within the product space.

7. Policy Implications

7.1 Logistics Infrastructure and Trade Facilitation

LPI gap between Algeria and Egypt is indicative of the deficiencies that exist in all three of the mentioned criteria: customs, infrastructure, and logistics services providers' capabilities. There are four possible ways to address this problem. First, the country needs to upgrade its major ports of Algiers, Oran, and Annaba: add more capacity for handling containers, new cargo equipment and management practices such as performance contracts for port operation and/or greater involvement of the private sector in port operations. This will solve the problem of congestion at these ports. Second, the customs process can be made faster and less random by implementing one window documentation process and risk-based inspections. Third, there should be an effort to invest in inland transport, i.e., road corridors connecting industrial sites to ports and freight railroads, because inland logistics fees make up a substantial part of the export fees of landlocked or inland firms. Fourth, the logistics industry in the country is underdeveloped and could benefit from liberalizing freight forwarding and third-party logistics, training logistics experts and setting up logistics facilities close to ports and industrial areas. Apart from the direct effects of lowering the cost of exports, such investments would show foreign manufacturing investors that trade facilitation is a serious policy issue.

7.2 Product-Space-Guided Industrial Policy

Instead of trying to make the jump directly to core products like machinery or electronics, industrial policy needs to focus on intermediate or proximate products that capitalize on Algeria's current capabilities. Petrochemicals and plastics—ethylene, propylene, polyethylene, polypropylene—are products that use Algeria's natural gas supplies and refining capabilities and add chemical engineering and process control capabilities that extend to higher-value chemical products. The second approach is fertilizer production: Algeria already exports nitrogen-based fertilizers, and moving into more-complex, mixed nitrogen-phosphorus-potassium and specialty blends, like Morocco's success in this area, will build formulation and quality-control capabilities without requiring a totally different capability base. The third approach would be to develop certain auto parts, such as wiring harnesses and insulated wire, which Tunisia already exports on a large scale, and again are products requiring precision manufacturing and quality control capabilities but without requiring the whole gamut of auto assembly capabilities. The fourth, more challenging approach would be textiles and garments; while there are petrochemical products available for synthetic fibers, Algeria faces very tough competition from Asian countries in this area, and the investments necessary for design and logistics are required.

7.3 Institutional Quality and Governance

Weak institutions result in high transaction costs and discourage manufacturing investments (Mehibel et al., 2022), and, therefore, the reform of institutions is a multi-faceted strategy that has many dimensions. Increasing the effectiveness of commercial courts, clearing case backlogs, and making judicial decisions more predictable would reduce the transaction costs of contract enforcement for manufacturing companies with regard to their suppliers, buyers, and employees. Improving anti-corruption measures and implementing transparent and competitive processes of procurement would minimize resource diversion into rent-seeking activities. Streamlining the process of setting up businesses, reducing licenses, and conducting the regulatory impact assessment before the adoption of new regulations would reduce the cost of establishing and running manufacturing firms. Finally, enhancing the effectiveness of public administration in terms of performance budgeting and meritocratic recruiting of civil servants would improve the quality of public services on which the competitiveness of manufacturing ultimately depends. The mentioned reforms would be politically costly, as they interfere with rentier networks developed over decades, but global benchmarks, such as the Ease of Doing Business Index and Corruption Perceptions Index, can support external accountability and measure progress.

7.4 Managing Dutch Disease through Macroeconomic Policy

With resource rents of 20 to 32 percent of GDP, macroeconomic policies can partially counter Dutch disease pressures even though the underlying cycle in commodity prices is beyond the control of Algeria. The use of a sovereign wealth fund that will channel part of hydrocarbon revenues abroad – as the Norwegians, Kazakhs, and United Arab Emirate have done in their own fashion – will lessen the domestic spending impact of commodity booms and moderate appreciation of the real exchange rate. Spending restraint rules, whether a structural budget balance rule or a permanent income rule, will lower the procyclicality of fiscal policy. More interventionist exchange rate policy, which will permit more nominal flexibility in periods of boom, will be conducive to maintaining manufacturing competitiveness in the face of exchange rate appreciation. Lastly, well-targeted and performance-dependent tax and export subsidies for manufacturing can overcome some of the disadvantage from the impact of the real exchange rate, on condition that they are not sources of rent-seeking themselves.

7.5 Human Capital and R&D

Although Algeria has invested heavily in education by providing a tertiary education enrollment of 54.4 percent and a human capital index of 0.535, there has been no evidence of upgrading in complexity in terms of the skills available and those demanded in manufacturing processes. In such case, increasing the number of enrollees in science, technology, engineering, and mathematics and linking the curricula closer to the requirements of the industry will go a long way in addressing the issue of engineers and technicians required by the process of complex manufacturing. Vocational and apprentice programs in collaboration with industry will enable the development of the technical skills necessary in machining, welding, and quality control which may be lacking in formal education institutions. Research and development expenditure in Algeria is low at 0.44 percent of GDP compared to the 2.5 percent average in the OECD. If liberalization of the foreign direct investment (FDI) regulations and encouragement of joint ventures are used to increase technology transfers and bring foreign business management systems into the national system, this will be possible by making long-term investments both in human capital and research and development activities. This is a process that requires commitment on the part of the government over many budget cycles.

8. Limitations

Some constraints apply to these results. First, there is a need to mention that there are two important data limitations associated with the study. First, historical ECI scores for Algeria and its comparators (2010-2024) have not been available via the Harvard Atlas API and OEC bulk data download, thus time series testing of hypothesis one could not be done and only outlines of the ARDL and panel estimations from Section four have been provided. Second, no results have been found using the World Bank API for the World Governance Indicators that measure institutional quality in hypothesis three, thus a discussion of the institutions is based on previous literature. Product Complexity Index scores and product space proximity matrix have not been obtained, thus a computation of "non-hydrocarbons ECI" was not possible.

Furthermore, the analysis is descriptive and correlational in nature, as opposed to being causal. The linkages found in the ECI, performance of logistics, resource rents, and manufacturing have been established based on mechanisms mentioned in the theories covered in Section 3. However, this does not, in any way, mean that there is a causal link between these variables. Identifying the cause-and-effect relationship between logistics, institutional framework, resource rents, and complexity requires exogenous variations such as instrumented variables using geography or colonial history, natural experiments, like port privatization and episodes of trade liberalization, or synthetic control comparison whereby a counterfactual Algeria can be constructed using a weighted average of comparable countries. Such techniques have not been considered in this paper, but this is where we could go from here after estimating the ARDL and panel models presented in Section 4.

Two final caveats relate to scope and methodology. First, the analysis focuses solely on merchandise exports; while Algeria’s services exports are estimated at $3-4 billion per year compared to $48.2 billion worth of merchandise exports, they are small in size and focused in simpler activities like retail and hospitality, meaning that their exclusion is unlikely to affect the results of this paper significantly, even though the use of the ECI model in analyzing services trade has been proposed by others elsewhere

(Neagu & Teodoru, 2019). Secondly, while ECI has faced criticism regarding its lack of economic logic behind the iterative calculation process used (Mealy et al., 2018; Hartmann et al., 2019), its failure to take into account geographical location of the exports (Lyubimov & Iakubovskii, 2020), and its confusion of complexity with country size (Xu, 2019), all of this has not undermined the predictive validity of the model.

Finally, this is a case study on a single country, and the unique combination of Algeria's reliance on hydrocarbons, the particular institutional framework under which it operates, and the particular geographic factors involved means that generalization to other resource-based economies with their own set of constraints and needs will not apply. The better endowment of institutions in Kazakhstan, the more diverse industrial base in Colombia, and the bigger home market in Nigeria each differ enough from the Algerian situation that no policy transfer can take place without further comparative examination. More comparative case studies and/or analysis of larger data sets involving various resource-based economies will have to be done before similarities and differences can be noted.

9. Conclusion

The study above has reviewed the economic complexity and export performance of Algeria, a country that relies on hydrocarbons to generate about 90 percent of its export earnings. By adopting the Hidalgo-Hausmann product space model, it becomes evident that the 2024 ECI of Algeria (-0.63; ranked 90 out of 130 countries) is much lower than those of its regional competitors such as Tunisia and Morocco as well as resource-rich competitors like Kazakhstan and Colombia, thus validating H1’s assumption.

These results also confirm that H2 holds true because while there has been growth in non-hydrocarbon exports in Algeria focused on nitrogenous fertilizers and hydrogen and rare gases, there has been no increase in complexity because these sectors rely on capabilities already present in the hydrocarbons industry and continue to operate in the periphery of the product space. In contrast, the development of the automotive sector in Morocco and specialization in insulated wires and garments in Tunisia is an indication of the buildup of capabilities in medium-complex manufacturing. The information available for H3 is limited due to insufficient historical and institutional data, but available information regarding Algeria’s relatively poor LPI and abundant resource rents is in line with the hypothesis.

The key point of this study is the clear differentiation between quantitative diversification and complexity upgrade: exporting new goods is not tantamount to acquiring the skills that will allow growth in the long run. As such, for Algeria, this means that diversification strategy needs to be assessed and implemented in terms of complexity upgrade specifically. The product space reveals a clear hierarchy of products that Algeria can realistically pursue: petrochemicals and plastic, mixed and specialized fertilizers, certain auto components, and textile provide an opportunity to build upon current capabilities with the help of well-defined, results-oriented industrial policy, rather than subsidies. But realizing the potential will require fixing certain logistics, institutional, and macroeconomic barriers to manufacturing investments, which are much less developed even in countries with substantially poorer natural endowments, such as Morocco and Tunisia.

In terms of future directions, four areas emerge as important areas for further research: finishing the historical series on ECI and World Governance Indicators to allow the econometric tests outlined in section 4; calculating a non-hydrocarbon ECI to gauge the complexity of the non-hydrocarbon Algerian exports; carrying out a full product space proximity analysis to reveal concrete and data-driven goals for diversification; and carrying out comparative case studies of successful diversification among other rich countries, such as Kazakhstan, Colombia, Malaysia, and Indonesia. All these expansions will complement rather than contradict current findings since, with the cross-section evidence presented in this paper, it is possible to conclude that the Algerian exports structure is still narrow and that recent growth of its non-hydrocarbon exports is far from the complex core of the product space.

The low economic complexity and high degree of export concentration characteristic of Algeria are problems whose solutions are well-known in principle; the experience of Algeria's regional and resource-abundant neighbors shows that these problems can indeed be overcome, but only through persistent, concerted effort on the part of logistics, industrial, institutional, and human capital policy. No one policy suggested in Section 7 is likely to suffice on its own—the development of logistics infrastructure without institutional reform means that manufacturing will be vulnerable to the same transaction costs that dissuade investment today, and industrial policy without macroeconomic stabilization of Dutch disease pressures will have trouble keeping real exchange rates stable enough for exports to be competitive.

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