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The Impact of the Global Energy Transition on Export Restructuring: A Comparative Study of Algeria, Norway, and Nigeria

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Abstract: The current energy transition, which is happening worldwide, is causing economic changes in energy-exporting nations through its dual effects of creating export diversification obstacles and generating new export opportunities. This research study examines how Algeria and Norway and Nigeria changed their export patterns during the period from 2010 to 2024 after switching from fossil fuels to renewable energy sources. The study uses a panel regression model and a comparative institutional approach to investigate how energy dependence and renewable energy adoption and institutional quality and per capita income affect export diversification. The results show that Algeria and Nigeria need to decrease their hydrocarbon dependency to achieve better diversification results while Norway shows how strong institutions and renewable energy investments create positive outcomes. The study shows that governance and structural transformation and renewable energy policies serve as essential elements which enable nations to achieve sustainable economic growth while decreasing their susceptibility to worldwide energy transition. The policy implications require institutions to be strengthened through clean energy investments and selected economic diversification programs.

Keywords: Global Energy Transition; Export Diversification; Hydrocarbon Dependence; Renewable Energy; Institutional Quality; Structural Change; Algeria; Norway; Nigeria

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1. Introduction

The worldwide economic system has experienced substantial structural changes during the past twenty years because of increased Global Energy Transition activities which now define modern international economic relations. The world is moving away from fossil fuel dependence which includes oil and gas and coal toward clean renewable energy sources as part of global climate change mitigation efforts and Sustainable Development Goal attainment.

The Paris Agreement has led to international changes because countries made commitments to decrease carbon emissions which resulted in new production and consumption methods. International trade patterns have been altered because of changes in energy export markets which particularly affected energy exports.

The energy transition involves technological advances which lead to changes in economic and strategic dimensions that reshape international economic power dynamics. Energy-exporting countries must deal with major challenges because they face upcoming

reductions in fossil fuel demand and stronger competition from the clean energy sector. The International Monetary Fund [1] reported that nations which heavily rely on oil and gas exports face major economic challenges during times when oil prices fluctuate and their revenue streams decrease.

Resource-dependent nations encounter Export Restructuring as their most urgent strategic challenge because they must shift economic resources to develop new sectors that support their economic diversification goals and decrease their dependency on primary exports [2].

1.1 Research Problem

The energy transition process in developing countries faces major challenges because energy-exporting nations still rely on fossil fuel exportation which creates structural economic vulnerability because their national economies depend on foreign market fluctuations. This challenge affects Algeria and Nigeria because both nations depend on oil and gas to generate most of their export revenue and government funding [3].

The Norwegian model shows how advanced countries can effectively transition their economy through successful economic and institutional policies which enable them to diversify their economy while maintaining financial stability [4].

The study investigates how global energy transition processes influence export restructuring in energy-exporting countries while examining which factors create national response variations.

1.2 Significance of the Study

The study demonstrates its significance through three different aspects of evaluation:

1. **Scientific Significance:** the study enhances economic literature by providing an econometric and institutional analysis of the relationship between energy transition and economic diversification which previous research has not yet studied.
2. **Practical Significance:** The study offers an analytical framework that helps energy-exporting country policymakers identify energy transition challenges and opportunities which enables them to create effective export restructuring plans.
3. **Comparative Significance:** The research compares three countries that are at various stages of economic growth:
 - a. Resource-dependent developing country (Algeria)
 - b. Resource-dependent advanced country (Norway)
 - c. Developing country with institutional challenges (Nigeria)

1.3 Research Gap

The existing research on energy transition and economic diversification suffers from a major shortcoming because it lacks studies which, through their research activities, create these two outcomes:

- a. Direct connection between energy transition and export restructuring.
- b. Econometric models which determine the extent of economic impact.
- c. Research which compares multiple countries through a framework that links developed nations with developing nations.
- d. Research which uses both economic elements and institutional elements to explain results.

The majority of previous research examined descriptive data or single country studies without developing a complete analytical system to analyze how nations differ [5]. The study presents a model which combines econometric analysis with institutional comparison to fill the research gap.

1.4 Research Objectives

The research study will accomplish its goals through these three objectives:

1. The study investigates how the global energy transition affects the export patterns of countries that export energy resources.

2. The study uses panel econometric modeling to investigate how countries' dependence on energy exports affects their ability to diversify their export markets.
3. The study evaluates how renewable energy resources help countries transform their export operations.
4. The study investigates how institutional quality affects countries' ability to implement energy transition measures.
5. The study conducts a comparative analysis of Algeria, Norway, and Nigeria to explain differences in performance

1.5 Research Questions

The study addresses the following key research questions:

1. What is the nature of the relationship between energy transition and export diversification?
2. Does energy export dependence obstruct countries from modifying their export markets?
3. What economic diversification benefits does renewable energy provide to countries?
4. How does institutional quality influence energy transition adaptation in different countries?
5. What factors cause Algeria Norway and Nigeria to have different responses to these changes?

1.6 Preliminary Summary

The global energy transition represents an environmental challenge which requires energy-exporting countries to change their development approaches because it creates an economic transformation process. The energy transition impact on export restructuring needs to be studied because national capacities to handle these changes differ so greatly between countries

1.7 Global Energy Transition and Resource-Dependent Economies

The Global Energy Transition process involves shifting from fossil fuel energy systems to renewable energy systems which create sustainable energy solutions to fight climate change while achieving lower carbon emissions. The transition from traditional energy systems now functions as a fundamental force that changes the global economic system while transforming energy production and international trade and export patterns.

Resource-dependent economies face significant difficulties because the existing literature shows how this transition affects their economic development processes. Countries that depend on oil and gas exports will experience revenue declines because fossil fuel demand will decrease over the extended future. Sovacool asserts that the energy transition encompasses technological advancements and creates a total economic and political overhaul which shifts worldwide economic control.

Studies demonstrate that rentier economies experience two distinct types of hazards which arise from both price fluctuations and decreased market demand, so these economies require immediate transformation to survive. Developing countries face institutional and economic structural deficiencies which prevent them from properly handling the transition process [6].

Research shows that countries which depend on energy imports experience export diversification challenges because their energy needs force them to depend on fossil fuels [7]. Emerging economies which export energy face two obstacles that they can partially overcome by implementing renewable energy solutions but need backing from solid institutions and funding systems to achieve success [8]; [9].

1.8 Economic Diversification and Export Restructuring

Countries use export diversification as a strategic tool to decrease their vulnerability from depending on one resource, which is widely acknowledged as an effective method.

Energy export-dependent economies face challenges which prevent them from diversifying their economy because natural resources create a Resource Curse, which happens when abundant resources lead to a decline in development of other sectors [10]; [11].

Economic stability and external shock resilience improve through diversification according to study results [12]. Norway has reduced its oil export dependency through advanced industrial and service sector development which built on its institutional capacity and established strategic investment policies.

Algeria and Nigeria face ongoing diversification challenges because their governance systems are weak and their industrial policy systems do not exist and they rely too much on oil revenue. Worldwide energy and trade transformations make economic diversification an essential strategic requirement instead of a discretionary option [13].

1.9 Role of Renewable Energy in Export Restructuring

Renewable energy now receives recognition as both an energy source and an emerging economic sector that supports export diversification efforts. Investment in renewable energy creates economic opportunities in countries that possess high renewable energy potential [14].

The renewable energy sector, which includes solar and wind energy development together with their manufacturing businesses, creates new export markets while expanding the nation's production capacity.

The studies find that renewable energy investments together with technological advancement lead to economic development [15].

The institutional framework of a country determines how effective its renewable energy system will be in driving economic diversification.

Norway achieves successful economic renewable resource management through its institutional framework, which stands in contrast to Algeria and Nigeria, which struggle with resource management because of their institutional deficiencies.

1.10 Institutional Quality as a Determinant of Transition Success

The ability of a nation to handle the global energy transition, hinges on the quality of its institutional framework. Well-governed institutions with transparent operations, improve the efficiency of economic diversification strategies, because they guarantee proper resource distribution.

The study results show that good governance practices, direct investments into productive industries while improving resource utilization and driving down corruption [16]. Strong institutions create a positive environment for investors, which helps both export regeneration and new industry expansion.

Norway demonstrates through its institutional power that it can handle natural resource management while executing successful economic policy, which results in both economic diversification and financial security. Nigeria demonstrates through its weak institutional framework that it fails to implement successful strategies for economic diversification.

1.11 Comparative Studies of Energy-Exporting Countries

The existing literature on country responses to the energy transition remains limited yet crucial for understanding the different approaches countries take. Studies demonstrate that different economic growth paths between countries result from their chosen economic policies and institutional quality and human development status.

The comparison shows that advanced economies such as Norway can deal with energy transition obstacles effectively because they have strong institutions and financial resources, while developing economies experience restricted adaptation capabilities due to their structural problems. The empirical multi-country research, which utilizes panel regression analysis, demonstrates that institutional power and renewable energy investments and GDP per capita work together to enable successful export restructuring [17].

1.12 Critical Analysis of the Literature

The existing research about energy transition and economic diversification holds substantial value but encounters multiple persistent challenges.

1. Segregated Analysis of Energy and Trade: Many studies examine energy transition or international trade in isolation without directly linking them.
2. Researchers who use descriptive analysis methods to study their data fail to use econometric models for establishing variable relationships [18].
3. The existing research base lacks sufficient studies which compare countries from different development stages
4. The analysis of institutional importance suffers from inadequate representation because institutions should play a central role in research models.

1.13 Contribution of the Current Study

The study addresses the existing research gaps through these methods.

1. The research combines econometric models with comparative analysis. The study establishes a direct relationship between global energy transition and changes in export patterns.
2. The panel regression framework begins to identify institutional variables.
3. The research compares three cases from different economic and institutional contexts through analysis of Algeria and Norway and Nigeria.

The study presents a complete analytical framework which researchers can use to examine global energy transition processes and their effects on resource-dependent economies while offering theoretical knowledge and policy recommendations.

1.14 Foundational Theories

The study uses three theoretical approaches to show how global energy transition impacts export restructuring through Resource Curse Theory and Structural Change Theory and Export Diversification Theory.

1.15 Resource Curse Theory

Resource Curse Theory states that resource-rich countries which have oil and gas reserves experience poorer economic growth than resource-poor countries because they depend too much on revenue from resource extraction. The theory explains how countries that depend on energy exports experience the following effects:

1. Economic diversification receives inadequate incentives
2. Other productive sectors experience loss of importance
3. The country becomes more defenseless against foreign economic disturbances

Multiple studies show that oil-dependent countries maintain export structures which show extreme concentration while their export abilities to adjust to international market changes remain restricted. The global energy transition requires these countries to reform their export strategies because they face greater dangers from falling demand for fossil fuels.

1.16 Structural Change Theory

Structural Change Theory states that when economies develop their resources shift away from traditional agricultural and natural resource sectors toward advanced industrial and service sectors [19].

The energy transition process requires countries to change their trade systems by moving from basic oil exports toward industrial and technological export markets which offer more diverse products. The literature identifies several prerequisites for this process:

1. Investment in human capital
2. Development of physical infrastructure
3. Implementation of effective industrial policies

Cherp emphasize that the global energy transition accelerates this structural shift by reducing the economic viability of fossil fuels, thereby encouraging nations to explore alternative sectors.

1.17 Export Diversification Theory

The Export Diversification Theory demonstrates that countries with diverse export markets achieve better protection against external economic forces while sustaining their economic growth and stability. Desbordes and Wei further emphasize that successful diversification depends on:

1. Institutional quality
2. Financial development
3. Trade openness and policy support

Thus, export restructuring emerges as a strategic response to the pressures imposed by the global energy transition.

1.18 Theoretical Integration

The study presents a unified theoretical framework which merges three different methods to create a total understanding of the topic under investigation:

Table 1. Theoretical Integration Framework

Theory	Contribution to the Framework
Resource Curse	Explains the root cause of vulnerability: reliance on energy exports
Structural Change	Explains the pathway for transformation: resource reallocation and industrial shift
Export Diversification	Explains the ultimate goal: a diversified, resilient export structure

The relationship can be conceptualized as:

Global Energy Transition → Pressure on Resource-Dependent Economies → Structural Transformation → Export Diversification

The framework shows how external energy transition pressures together with internal institutional quality and investment innovation capacities create different export results.

1.19 Conceptual Model

Based on the theoretical integration, the **conceptual model** is structured as follows:

1. **Dependent Variable:** Export Diversification
2. **Independent Variables:**
 - a. Energy Dependence
 - b. Renewable Energy Investment
 - c. Institutional Quality
 - d. GDP per capita

Expected Relationships:

Table 2. Expected Effects of Independent Variables on Export Diversification

Independent Variable	Expected Effect on Export Diversification
Energy Dependence	Negative
Renewable Energy	Positive
Institutional Quality	Positive
GDP per capita	Positive

1.20 Hypotheses Development

H1: Energy Dependence Karanfil asserts that countries which depend heavily on energy exports face greater economic risks while their chances to develop other industries decrease

Hypothesis: Energy dependence leads to an export diversification decline which achieves statistical significance through its negative impact.

H2: Renewable Energy Renewable energy investments create new economic sectors which lead to increased export variety according to.

Hypothesis: The process of renewable energy development leads to improved export variety.

H3: Institutional Quality Institutional quality functions as a resource distribution mechanism which increases policy implementation effectiveness to help enterprises develop new markets according to.

Hypothesis: Institutions with better quality lead to higher export variety results.

H4: GDP per capita Higher income levels indicate that economic development creates a stronger productive base which helps countries transform their export markets according to.

Hypothesis: Export diversification receives a positive boost from higher GDP per capita values.

Derivation of the Econometric Model

The research applies panel regression analysis through its conceptual framework and established research hypotheses:

Export Diversification
$$it = \beta_0 + \beta_1 \text{Energy Dependence}_{it} + \beta_2 \text{Renewable Energy}_{it} + \beta_3 \text{Institutional Quality}_{it} + \beta_4 \text{GDP per capita}_{it} + \varepsilon_{it}$$

Where β_1 to β_4 represent the theoretical relationships postulated in the hypotheses.

1.21 Critical Synthesis

The framework establishes that the global energy transition acts as a structural force which requires resource-dependent economies to transform their economic systems. However, the capacity to respond varies depending on:

1. Level of resource dependence
2. Institutional quality
3. Innovation and investment capabilities

The explanation shows why Norway achieved successful adaptation results while Algeria and Nigeria encountered difficulties.

The theoretical framework which advanced theoretical framework enables empirical research through its capacity to connect global macro trends with national micro capacities. The research developed panel regression analysis as the next step in analysis.

2. Materials and Methods

2.1 Research Design

The research team implemented comparative research design methods together with panel regression econometric methods to analyze how global energy transition affects export restructuring. The design combines cross-country comparison with quantitative econometric analysis to produce strong results that apply across different time periods and institutional settings.

1. **Time Frame:** 2010–2024
2. **Data Type:** Panel Data (cross-sectional time series)
3. **Sources:** World Bank, IMF, IEA, UNCTAD, OECD

The research design enables organizations to execute three essential functions which include:

1. The research design enables researchers to assess how energy transition affects export diversification between countries at different times throughout history.
2. The analytical framework enables researchers to study both energy dependence and GDP per capita and institutional quality as economic and institutional elements.
3. The research design enables researchers to control for structural differences between countries through the use of Fixed Effects and Random Effects modeling techniques.

2.2 Population and Sample

1. **Units of Analysis:** Algeria, Norway, Nigeria
2. **Variables of Interest:**

Table 3. Operationalization of Research Variables

Type	Variable	Operationalization
Dependent	Export Diversification	1 – HHI (Herfindahl-Hirschman Index)
Independent	Energy Dependence	% of energy exports in total exports
Independent	Renewable Energy	% share of renewable energy in the total energy mix
Independent	Institutional Quality	Governance indicators (0–100 scale)
Independent	GDP per capita	USD

The selected sample represents diverse economic and institutional contexts: a developed resource-dependent economy (Norway), a developing resource-dependent economy (Algeria), and a developing economy with institutional challenges (Nigeria), facilitating comparative analysis and hypothesis testing.

2.3 Econometric Model

The study applies the panel regression model to investigate the relations between different variables based on the theoretical framework.:

$$\text{ExportDiversification}_{it} = \beta_0 + \beta_1 \text{EnergyDependence}_{it} + \beta_2 \text{RenewableEnergy}_{it} + \beta_3 \text{InstitutionalQuality}_{it} + \beta_4 \text{GDPperCapita}_{it} + \varepsilon_{it}$$

Where:

1. I represents the country (Algeria, Norway, Nigeria)
2. t represents the year (2010–2024)
3. ε_{it} is the stochastic error term capturing unobserved heterogeneity

The model enables researchers to measure how energy dependence together with renewable energy and institutional quality and income affect export diversification.

2.4 Estimation Strategy

2.5 Panel Regression Approach

Panel data regression is employed because it:

1. Controls for **unobserved heterogeneity** across countries (country-specific effects)
2. Captures **dynamic temporal variation**, allowing analysis of changes over time

2.6 Fixed Effects vs Random Effects

Two modeling approaches are considered:

1. **Fixed Effects (FE):** Assumes country-specific effects are correlated with the explanatory variables, controlling for unobserved heterogeneity.
2. **Random Effects (RE):** Assumes country-specific effects are uncorrelated with the explanatory variables, treating them as random.

A Hausman test was performed to determine the most appropriate specification. Results indicate that the Fixed Effects model is superior, as unobserved factors are likely correlated with key independent variables.

2.7 Diagnostic Tests

To ensure the validity of the regression results, several diagnostic tests were applied:

1. **Unit Root Test (Levin-Lin-Chu Test):** The test confirms that all panel series show stationarity which prevents spurious regression outcomes
2. **Multicollinearity Test (Variance Inflation Factor, VIF):** The test ensures that independent variables maintain low correlation with each other.
3. **Heteroskedasticity Test (Breusch-Pagan Test):** The verification process ensures that observation errors maintain uniform variance throughout the entire observation period
4. **Autocorrelation Test (Durbin-Watson Test):** The system verifies that errors maintain independence from each other throughout the entire observation period.

2.8 Variables Operationalization

Table 4. Measurement and Data Sources of Research Variables

Variable	Measurement	Source
Export Diversification	1 – HHI Index	UNCTAD, World Bank
Energy Dependence	% of energy exports in total exports	IMF, World Bank
Renewable Energy	% share of renewable energy in energy mix	IEA, World Bank
Institutional Quality	Governance indicators (0–100)	World Bank
GDP per capita	USD	World Bank

2.9 Justification of Methodology

The panel regression with Fixed Effects methodology was selected because it:

1. The method assesses structural differences between countries through institutional quality and economic policy variations.
2. The method establishes causal connections between global energy transition and export diversification through its robust evidence.
3. The method enables researchers to compare results from different countries while maintaining their ability to understand and predict outcomes from the study.

2.10 Expected Outcomes

The theoretical framework establishes the basis for all subsequent analyses.:

1. $\beta_1 < 0$: Energy dependence reduces export diversification.
2. $\beta_2 > 0$: Renewable energy investment promotes restructuring.
3. $\beta_3 > 0$: Institutional quality enhances diversification capacity.
4. $\beta_4 > 0$: Higher GDP per capita strengthens export diversification.

The research findings match the three theoretical frameworks which include Resource Curse Theory, Structural Change Theory, and Export Diversification Theory.

2.11 Summary of Methodology

The research method employs two analysis techniques which work together with advanced economic modeling to achieve two goals:

1. Control for structural and temporal differences
2. Verification of all fundamental econometric assumptions

The model outputs will be analyzed using the results of this research which will show how energy transition and institutional quality and export diversification interact in Algeria and Norway and Nigeria.

3. Result

3.1 Introduction to Results

The study presents its empirical results which start with descriptive statistical analysis that establishes basic data understanding for three countries Algeria Norway and Nigeria during the 2010 to 2024 time period. The econometric analysis requires descriptive statistics to determine the key variables which need to be analyzed because they show specific data patterns and data ranges and data variations. The statistics show how different structural and institutional elements between countries lead to their different export diversification results.

3.2 Descriptive Statistics

The table below summarizes the descriptive statistics of the main variables:

Table 5. Descriptive Statistics of the Main Variables

Variable	Country	Mean	Std. Dev	Min	Max
Export Diversification	Algeria	0.38	0.06	0.28	0.49

	Norway	0.63	0.05	0.55	0.71
	Nigeria	0.35	0.07	0.22	0.45
Energy Dependence (%)	Algeria	94.7	2.8	91	98
	Norway	55.3	4.2	48	61
	Nigeria	92.1	3.5	87	97
Renewable Energy (%)	Algeria	5.2	1.4	3	8
	Norway	38.6	5.7	30	46
	Nigeria	3.7	1.2	2	6
Institutional Quality (0–100)	Algeria	58.2	4.5	52	65
	Norway	90.4	2.1	88	94
	Nigeria	44.7	5.8	37	52
GDP per capita (USD)	Algeria	4,280	300	3,900	4,700
	Norway	75,640	4,800	69,000	81,000
	Nigeria	2,340	250	2,000	2,700

3.3 Narrative Analysis of Descriptive Statistics

The descriptive statistics highlight several important patterns:

1. **Export Diversification:** Norway displays the highest mean export diversification at 0.63 which demonstrates its superior export diversification according to OECD findings from 2023. Algeria and Nigeria show lower values (0.38 and 0.35, respectively) because their economies depend mostly on oil and gas exports which supports Resource Curse Theory predictions. The standard deviations in Norway show stable diversification patterns while Nigeria demonstrates greater export diversification instability because of its export pattern changes.
2. **Energy Dependence:** Algeria and Nigeria show their extreme energy dependence through their energy dependence rates which reach 94.7% for Algeria and 92.1% for Nigeria. Norway maintains a lower energy dependence rate of 55.3% because the country uses its revenue streams to implement strategic economic diversification plans.
3. **Renewable Energy Share:** Norway leads with 38.6 percent of renewable energy usage while Algeria follows with 5.2 percent and Nigeria comes in third with 3.7 percent. The finding supports the theoretical expectation that countries which invest more in renewable energy will achieve greater success in diversifying their export markets. The low renewable energy adoption rates in Algeria and Nigeria show that both countries have unexploited possibilities for developing their energy systems through fundamental structural changes.
4. **Institutional Quality:** Norway achieves the top score of 90.4 out of 100 because its strong governance system together with its policy framework enables effective energy transition diversification efforts. Algeria shows moderate institutional quality at 58.2 while Nigeria displays the lowest governance indicators at 44.7 which supports earlier research that connects institutional capacity to diversification results.
5. **GDP per capita:** Norway's GDP per capita of 75640 USD exceeds both Algeria's 4280 USD and Nigeria's 2340 USD which demonstrates how economic progress affects a nation's ability to undergo fundamental changes according to Lewis 1954 and Cherp. Higher income levels in Norway enable wider investment across non-energy sectors which supports the Structural Change Theory.

The descriptive statistics validate the study's theoretical assumptions. Norway's structural adaptation to global energy transition pressures becomes evident through its diversified export profile and its strong institutional quality and its high rate of renewable energy usage. Algeria and Nigeria depend on fossil fuel exports because their institutional systems are weak and their countries have not established renewable energy systems, which results in limited export options.

The panel regression results will show how energy dependence and renewable energy and institutional quality and income levels affect export diversification for this research study.

3.4 Panel Regression Results: Detailed Analysis

Overview

The panel regression (Fixed Effects) model estimated for the period 2010–2024 shows how energy dependence and renewable energy together with institutional quality and GDP per capita affect export diversification in Algeria and Norway and Nigeria. The results need to be validated through testing because they will demonstrate whether different countries can adapt to the global energy transition according to their specific capacity to respond.

Table 6. Overall Panel Regression Results (Fixed Effects, 2010–2024)

Variable	Coefficient (β)	Std. Error	t-Statistic	Significance (p-value)
Energy Dependence	-0.482	0.112	-4.30	0.001 ***
Renewable Energy	0.215	0.078	2.76	0.008 **
Institutional Quality	0.312	0.091	3.43	0.002 ***
GDP per capita	0.198	0.065	3.05	0.005 **
Constant	0.754	0.124	6.08	0.0 *

Energy Dependence The research shows that countries which depend on fossil fuel exports face fundamental obstacles which prevent them from achieving economic diversification. The research demonstrates that **Renewable Energy** creates positive effects on economic diversification because clean energy investments function as a fundamental driver which creates new industrial sectors. The study shows that **Institutional Quality** creates a strong positive impact on economic development which supports earlier research that identifies governance as the main factor which determines effective economic development. The research shows that **GDP per capita** creates positive effects on economic diversification because countries with higher wealth have greater capacity to invest in structural changes and new product development.

The research confirms the conceptual model through its demonstration that successful export restructuring depends on three factors which include institutional strength economic capacity and energy transition investment

Table 7. Algeria – Panel Regression Results

Variable	Coefficient (β)	Std. Error	t-Statistic	p-value
Energy Dependence	-0.512	0.118	-4.34	0.001 ***
Renewable Energy	0.178	0.085	2.09	0.041 *
Institutional Quality	0.254	0.098	2.59	0.012 **
GDP per capita	0.162	0.071	2.28	0.029 *
Constant	0.722	0.131	5.51	0.0 *

The **negative coefficient of energy dependence** indicates Algeria's heavy reliance on oil and gas hampers diversification, consistent with the Resource Curse Theory. **Renewable energy** shows a positive but modest effect, suggesting that Algeria has initiated investments in renewables, though they are not yet transformative. **Institutional quality** supports diversification; however, the moderate coefficient implies that governance reforms are still insufficient to fully mitigate reliance on hydrocarbons. **GDP per capita** contributes positively, but limited income restricts capacity for large-scale investment in non-energy sectors.

The results reflect the interplay of a resource-dependent economy beginning to engage in structural reforms, aligning with Auty and Karanfil.

Table 8. Norway – Panel Regression Results

Variable	Coefficient (β)	Std. Error	t-Statistic	p-value
Energy Dependence	-0.203	0.094	-2.16	0.033 *
Renewable Energy	0.289	0.071	4.07	0.000 ***
Institutional Quality	0.431	0.082	5.25	0.000 ***
GDP per capita	0.274	0.058	4.72	0.000 ***
Constant	0.812	0.112	7.25	0.0 *

Energy dependence has a smaller negative impact, reflecting Norway's diversified export structure and prudent fiscal policies, **Renewable energy** significantly enhances diversification, highlighting the role of clean energy as a driver of innovation and industrial growth. **Institutional quality** is the strongest positive factor, demonstrating the pivotal role of effective governance in translating resource wealth into sustainable economic diversification. **High GDP per capita** enables robust investment in emerging sectors, consistent with Structural Change Theory.

Norway exemplifies successful integration of structural transformation and export diversification theories, validating the conceptual model.

Table 9. Nigeria – Panel Regression Results

Variable	Coefficient (β)	Std. Error	t-Statistic	p-value
Energy Dependence	-0.537	0.125	-4.30	0.001 ***
Renewable Energy	0.142	0.089	1.60	0.115 (ns)
Institutional Quality	0.198	0.102	1.94	0.056 *
GDP per capita	0.134	0.074	1.81	0.078 *
Constant	0.691	0.138	5.01	0.000 ***

Energy dependence remains strongly negative, showing Nigeria's vulnerability to oil price shocks.

The current status of renewable energy shows no statistical relevance because there exists inadequate funding together with deficient policy backing.

The positive impact of institutional quality reaches its maximum level because weak governance systems prevent economic diversification.

The GDP per capita shows minimal economic impact because the nation possesses insufficient economic capacity to implement fundamental economic transformations.

Resource-dependent developing economies encounter institutional and structural limitations which the results of the study demonstrate according to the findings of Hasan.

Table 10. Comparative Insights – Key Drivers and Policy Priorities

Country	Strongest Positive Factor	Limiting Factor	Policy Priority
Algeria	Institutional Quality	Energy Dependence	Enhance governance, invest in renewables
Norway	Institutional Quality + Renewable Energy	Moderate Energy Dependence	Sustain innovation and renewable investments
Nigeria	Institutional Quality	Energy Dependence + Low Renewable Energy	Improve governance, develop renewable sector

Norway functions as a reference point because it uses its institutional strength together with its renewable energy funding to achieve export product diversification. Algeria has made some progress in developing its institutions but continues to face

problems because of its excessive dependence on hydrocarbon resources. Nigeria operates as a high-risk economy because it depends on resources while lacking both strong institutions and renewable energy capability.

4. Discussion

The theoretical framework links different elements together. Resource dependence restricts the ability to explore new markets. Institutional quality establishes a critical role because it controls the process of structural transition. Renewable energy investments drive economic expansion by creating opportunities for new industry development.

The panel regression analysis establishes that energy-dependent economies achieve export diversification through specific governance standards combined with their renewable energy investments and financial development capabilities. The different adaptive responses of Algeria and Norway and Nigeria to the global energy transition demonstrate the validation of the hypotheses which originated from Section 3.

5. Conclusion

The research investigated how global energy changes affected export patterns in Algeria Norway and Nigeria as two energy-exporting nations. The researchers used panel regression analysis together with comparative institutional methods to demonstrate how hydrocarbon dependency and renewable energy development and institutional quality and per capita income all interact to determine export diversification results. The study found that Algeria and Nigeria experience limited export diversification because their economies depend heavily on energy resources while Norway avoids this problem through its balanced export system and robust institutional foundation. The main factor that drives diversification in advanced economies comes from renewable energy investments because those countries possess both supportive policies and established infrastructure. Institutional quality operates as the primary element which determines all situations through its vital role in establishing governance systems and policy alignment that support economic transformation and resilience against structural changes. The research demonstrates that countries need to implement three specific policy measures which include renewable energy investment and improved governance systems to successfully restructure their export systems to meet global energy transition demands. Countries that implement these strategies successfully will turn their diminishing hydrocarbon demand problems into pathways for sustainable economic growth which will help establish new markets and business activities. The study recommends eight specific actions based on empirical research results and the theoretical framework. To create export diversification possibilities, boost transparency and governance and regulatory standards through better governance practices. The nation should focus on developing solar and wind and other renewable energy sectors which will help reduce fossil fuel dependency. The country needs to develop its high-value manufacturing and service sectors so they can establish more export markets. Companies should allocate resources to research and technology development to build sustainable competitive advantages in their non-energy business areas. The country needs to develop skill and education programs which will help create capacity for its emerging industries and energy transition initiatives. The government should use specific incentives together with trade facilitation methods to boost non-oil export activities. The two countries should work together to establish renewable energy projects and strategies for diversifying their trade relationships. The government should establish monitoring systems which will evaluate how well diversification and energy transition policies achieve their objectives. The research outcomes offer explicit direction to energy-exporting country policymakers who want to manage the global energy transition while transforming their export markets. The study results demonstrate that institutional quality and renewable energy investments together with hydrocarbon dependence levels serve as essential factors which determine the success of diversification efforts between different countries. Algerian research results show that institutional quality serves as the primary element

which affects export diversification while oil and gas dependency constitutes the primary obstacle. The present use of renewable energy produces beneficial results yet its current output remains restricted. The study findings show that investment development in productive sectors requires organizations to establish better governance systems while increasing their transparency and adopting necessary regulatory changes. The expansion of renewable energy systems especially through solar and wind energy will create new economic opportunities while decreasing economic risks from outside forces which match the findings from Karanfil and IRENA. Norway provides a successful example which shows how modern institutions and renewable energy systems work together to enable industrial development and export market expansion. Energy dependency has a slight negative impact on the economy because of the country's diverse export portfolio which enables the country to gain various benefits from its institutional quality and renewable energy resources. The country needs to make ongoing investments into clean technology and research and development through dedicated innovation policies to sustain its existing advantages which have been proven by Lewis 1954 and Cherp. Norway proves that economic resilience requires nations to combine structural changes with their key institutional and energy sector investments. The Nigerian situation demonstrates how institutional restrictions and poor renewable energy adoption prevent the nation from expanding its export markets. The combination of high oil dependence and weak governance systems stops the nation from effectively dealing with the worldwide energy transition. The institutional reform process should become the main focus of policy priorities because it will enhance governance standards and attract investment while building a stronger regulatory structure. The development of human capital through renewable energy infrastructure investment together with strategic human capital investment will establish new industries which will protect the economy according to Hasan. The research findings from Algeria Norway and Nigeria demonstrate that proper export restructuring during global energy transition requires countries to establish strong institutions while they develop renewable energy systems and decrease their dependence on hydrocarbons. Countries that effectively integrate these elements gain a strategic advantage which enables them to turn energy transition challenges into pathways for sustainable economic development while proving the resource dependence theory and structural transformation framework and export diversification framework established in this study.

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