SEBHA UNIVERSITY JOURNAL OF PURE & APPLIED SCIENCES VOL 24 NO .3 2025
DOI: 10.51984/JOPAS.V24I3.4037

مجلة جامعة سبها للعلوم البحتة والتطبيقية
Sebha University Journal of Pure & Applied Sciences

Journal homepage: www.sebhau.edu.ly/journal/jopas

The Impact of Foreign Trade on Sustainable Development in the Libyan Economy: An Applied Study (1990–2022)

Hosein Elboiashi[a], Abdelhakim Embaya[b]*

[a]Economic Department, Faculty of Economics, University of Zawia, Libya.
[b]Economic Department, School of Administrative and Financial Sciences, Libyan Academy for Postgraduate Studies, Libya.

Keywords
Sustainable Development.
Foreign Trade Volume.
Model ARDL.
Libya.

ABSTRACT

This study critically examines the short- and long-term linkages between foreign trade volume (TVR) and sustainable development (SD) in Libya's unique post-conflict, resource-dependent economy over the period 1990–2022. Utilising autoregressive distributed lag (ARDL) modelling, it assesses TVR's impact on Hickel's Sustainable Development Index (SDI) a holistic metric that goes beyond GDP by integrating crucial environmental and human well-being indicators. The results reveal a positive long-term cointegration between TVR and the SDI, primarily driven by associated growth in GDP and GDP per capita. However, this relationship remains fragile, as persistent inflation and high unemployment significantly undermine sustainability gains. Libya's structural overreliance on hydrocarbons and chronic macroeconomic instability are identified as the core impediments to balanced progress. The study recommends a strategic pivot towards diversifying exports, stabilising macroeconomic conditions, and implementing fair labour policies to better align trade growth with the Sustainable Development Goals (SDGs). Prioritising inflation control and fostering inclusive employment are paramount to enhancing Libya's SDI resilience.

تأثير التجارة الخارجية على التنمية المستدامة في الاقتصاد الليبي: دراسة تطبيقية (1990-2022)

حسين البوعيشي[a] و عبدالحكيم امبيه [b]*

[a] قسم الاقتصاد، كلية الاقتصاد، جامعة الزاوية، ليبيا.
[b] قسم الاقتصاد، مدرسة العلوم الإدارية والمالية، الاكاديمية الليبية للدراسات العليا، ليبيا.

الكلمات المفتاحية
التنمية المستدامة.
حجم التجارة الخارجية.
نموذج ARDL.
ليبيا.

الملخص

هذه الدراسة تفحص بشكل دقيق الروابط قصيرة وطويلة الأجل بين حجم التجارة الخارجية (**TVR**) والتنمية المستدامة (**SD**) في الاقتصاد الليبي - بسمته المعتمدة على الموارد ووضعه ما بعد الصراع - خلال الفترة (1990-2022). باستخدام منهجية الانحدار الذاتي للفجوات الزمنية الموزعة (**ARDL**)، تقيّم الدراسة تأثير حجم التجارة الخارجية (**TVR**) على مؤشر هيكل التنمية المستدامة (**SDI**)، وهو مقياس شمولي يتجاوز الناتج المحلي الإجمالي ليدمج ما بين مؤشرات الرفاه البشري والبيئي. تكشف النتائج عن تكامل مشترك إيجابي طويل الأجل بين حجم التجارة الخارجية ومؤشر هيكل التنمية المستدامة، المدعوم أساساً بالنمو المصاحب للناتج المحلي الإجمالي ونصيب الفرد منه. ومع ذلك، تظل هذه العلاقة هشة، إذ يضعف التضخم المستمر والبطالة المرتفعة مكاسب الاستدامة بشكل كبير. يُحدد الاعتماد الهيكلي المفرط على الهيدروكربونات وعدم الاستقرار الاقتصادي الكلي المزمن باعتبارهما العائقين الجوهريين أمام التقدم المتوازن. لذلك توصي الدراسة بتحول استراتيجي نحو تنويع الصادرات، واستقرار الأوضاع الاقتصادية الكلية، وتنفيذ سياسات عادلة للعمالة لمواءمة نمو التجارة مع أهداف التنمية المستدامة. ويظل إعطاء الأولوية لكبح التضخم وتعزيز دور العمالة أمراً محورياً لتعزيز مؤشرات التنمية المستدامة في الاقتصاد الليبي.

1. Introduction

The pursuit of sustainable development within resource-rich yet politically fragile states presents one of the most profound paradoxes of our time. A nation afloat on a sea of oil can find itself mired in economic instability and social decay a reality starkly embodied by Libya. For decades, the Libyan economy has been almost singularly defined by its hydrocarbon wealth, which accounts for over 90% of export revenues and the vast majority of its GDP. While this natural endowment has historically fuelled short-term economic gains, it has done so at the immense cost of long-term environmental and social resilience. This overreliance exemplifies a classic case of the "resource curse," whereby immense natural wealth, rather than

*Corresponding author.
E-mail addresses: helboiashi@zu.edu.ly, (A. M. Embaya) abdelhakim.embaya@academy.edu.ly.
Article History : Received 17 May 2025 - Received in revised form 17 July 2025 - Accepted 20 July 2025

paving a path to prosperity, cultivates a landscape of institutional weakness, post-conflict fragility, and deep-rooted socio-economic disparities.

The flood of petrodollars transformed Libya into a quintessential rentier state, where unearned income flowing directly into government coffers severed the traditional bonds of accountability between the state and its citizens. Consequently, the very wealth that should have underwritten national progress became a catalyst for political fragmentation particularly after 2011 as competing factions vied for control over oil terminals and revenue streams. This ongoing internal strife has fundamentally obstructed any coherent attempt to achieve the United Nations Sustainable Development Goals (SDGs). The tragic irony is that a nation with the financial capacity for first-world infrastructure and services instead inherits a legacy of institutional decay and a generation of youth excluded from meaningful economic participation. Libya's story is therefore not merely one of economic hardship, but of a development model in which the nation's greatest asset has become its most formidable obstacle to building a stable, equitable, and sustainable future.

1.2. The Research Problem

The academic discourse on the role of foreign trade in fostering sustainable development remains deeply fragmented. On one hand, classical theories champion trade liberalisation as a powerful engine for innovation, technology transfer, and economic diversification. On the other, critics rightly highlight its environmental costs from resource depletion to the emergence of "pollution havens" in countries with weak regulatory enforcement.

However, these conventional frameworks often fail under the weight of Libya's unique complexities. They are ill-equipped to analyse an economy grappling with a toxic cocktail of post-2011 institutional collapse, extreme resource dependence, and systemic corruption. The catastrophic 52.56% collapse in exports and the US$4.8 billion trade deficit recorded in 2020 are not mere statistical anomalies but symptoms of a system trapped in a vicious cycle of oil-driven dependency and economic volatility.

The existing literature has largely overlooked this destructive interplay between conflict, resource monoculture, and institutional decay leaving a critical gap in our understanding of how to forge a sustainable path forward in fragile, post-conflict economies across the MENA region.

This study directly addresses that analytical void by moving beyond theoretical generalities to examine the empirical reality of Libya's economic predicament. It is guided by two interrelated research questions:

1. In the specific context of Libya's resource-addicted and institutionally fragile economy, does an increase in foreign trade volume truly promote or ultimately hinder sustainable development?
2. How do key macroeconomic forces namely economic growth, per capita income, inflation, and unemployment mediate this relationship, either amplifying its benefits or worsening its drawbacks?

1.3. The Research Aim

This research aims to empirically analyse the complex relationship between foreign trade and sustainable development in Libya's resource dependent economy from 1990 to 2022. Its ultimate objective is to provide robust, evidence-based policy recommendations to steer Libya toward a more resilient, equitable, and genuinely sustainable growth trajectory.

1.4. The Research Hypotheses

This study tests the following hypotheses to investigate the relationship between foreign trade and sustainable development in Libya:

- There is a significant, positive long-term relationship between foreign trade volume (TVR) and the Sustainable Development Index (SDI) in Libya, suggesting that trade openness contributes to sustainable development.
- An increase in both real GDP and real GDP per capita (GDPPC) is positively and significantly associated with improvements in Libya's Sustainable Development Index (SDI).
- The positive effect of foreign trade volume on the SDI is significantly constrained by high levels of inflation and unemployment, reflecting the fragile and conditional nature of trade-driven progress in a volatile economy.

1.5. The Research Objective

To achieve this aim and answer the research questions with empirical rigour, this paper conducts an in-depth analysis of the Libyan economy from 1990 to 2022. Central to this methodology is the application of the Autoregressive Distributed Lag (ARDL) model, which is well suited to measuring both short- and long-term impacts of trade on sustainability indicators.

A key methodological decision is the use of Hickel's (2020) Sustainable Development Index (SDI), which surpasses GDP and even the Human Development Index (HDI) by explicitly integrating environmental efficiency and social equity. This paper models the influence of foreign trade volume (TVR) in conjunction with GDP, GDP per capita (GDPPC), inflation (CPI), and unemployment (UNY) to assess how macroeconomic forces mediate the effects of trade on Libya's sustainability outcomes.

1.6. Importance of Research

1.6.1. Contribution to the Economic Literature

This paper offers three major contributions to the academic discourse on foreign trade and sustainability:

1. **Context-specific empirical analysis:** By focusing on Libya a conflict affected, resource dependent nation in the MENA region this study addresses a crucial gap in the literature, which tends to focus on more stable or diversified economies. It provides valuable insights into the sustainability challenges of fragile, oil exporting countries.
2. **Comprehensive sustainability assessment:** The use of the SDI enables a multidimensional evaluation of trade's impact. For example, while Libya's GDP growth averaged 3.2% per year between 2000 and 2010, its SDI score declined by 15% due to rising carbon emissions and inequality (Hickel, 2020). This reveals the inherent tradeoff between economic expansion and social environmental well-being.
3. **Integration of macroeconomic mediators:** By incorporating inflation, unemployment, and GDP per capita into the analysis, the study offers nuanced insights for policymakers. Preliminary results suggest that unemployment exacerbates the negative environmental effects of trade, while moderate inflation is linked to more equitable resource distribution.

1.6.2. Implications for Economic Policies and Significance for Fragile Economies

Libya's experience holds lessons for other economies dependent on natural energy resources seeking to recover after conflict. Aligning trade policies with the Sustainable Development Goals (SDGs) requires institutional reforms to reduce corruption, diversify exports, and apply environmental safeguards. For example, redirecting oil revenues towards renewable energy infrastructure - such as solar power plants in Libya's desert regions - could reduce carbon intensity while creating jobs. Regional partnerships, such as the African Continental Free Trade Area (AfCFTA), provide avenues for green technology transfer and investment in non-oil sectors.

Globally, this study underscores the urgent need to integrate environmental and social justice agendas into foreign trade frameworks. As climate risks escalate, countries must balance economic openness with regulatory mechanisms that prioritize long-term well-being over short-term gains. For Libya, systemic transformation -grounded in human capital development, transparent governance, and sustainable resource management is key to breaking the "resource curse" and achieving inclusive growth.

2. Economic Literature Review

2.1. Foreign Trade and Sustainable Development in Resource-Dependent States

The nexus between foreign trade and sustainable development in resource-rich, post-conflict economies is gaining prominence, particularly for nations like Libya where economic structures remain heavily reliant on hydrocarbons. Classical trade theory emphasizes the role of openness in enhancing productivity, technology transfer, and sectoral diversification (Frankel & Romer, 1999).

In principle, such dynamics offer a viable exit from resource dependence by promoting competitive non-oil sectors, including

agriculture, tourism, and renewable energy. For Libya where hydrocarbon exports contribute approximately 90% of total revenues and 60% of GDP (World Bank, 2024) such diversification is essential to achieving sustainability. Yet, the empirical realities remain constrained by what Auty (1993) and Sachs and Warner (1995) identify as the "resource curse," where resource wealth undermines institutional strength and economic flexibility.

Further complexities arise when endogenous growth theories are considered. According to Lucas (1988) and Romer (1986), long-run economic progress hinges on human capital accumulation and innovation. However, Libya's excessive oil dependence continues to crowd out educational investment and technological development. Currently, only 5% of the national budget is allocated to research and development, despite hydrocarbons financing over 80% of public spending (World Bank, 2024). Comparatively, Nigeria has faced analogous constraints, where oil wealth has impeded agricultural innovation and heightened food insecurity (Adewale, 2021).

A promising counterexample is Norway, where prudent fiscal management, sovereign wealth investment, and environmental stewardship have transformed oil wealth into long-term national resilience. Norway's use of oil revenue to build a 98% renewable energy grid while legislating strict caps on fossil-fuel spending (OECD, 2023) offers critical insights for Libya's reform trajectory. Nonetheless, such a transformation presupposes robust governance and institutional transparency areas where Libya remains challenged.

2.2. Environmental Trade-Offs and the Environmental Kuznets Curve (EKC)

Environmental degradation constitutes a significant externality in oil-dependent economies with expanding trade regimes. The "pollution haven" hypothesis, where countries with weaker regulations attract polluting industries, is evident in Libya's carbon-intensive trade structure (Levinson & Taylor, 2008; Walter & Ugelow, 1979). Oil operations alone contribute approximately 70% of national carbon emissions (UNCTAD, 2024), magnifying the environmental costs of trade-led growth.

The Environmental Kuznets Curve (EKC), proposed by Grossman and Krueger (1994), posits a non-linear relationship between income and environmental degradation. However, critics argue that the EKC oversimplifies institutional and ecological complexities (Stern & van Dijk, 2020; Dinda, 2004). Libya's fragmented environmental regulation and weak enforcement capacity hinder the operationalization of this theoretical model. Moreover, environmental disasters, such as oil spills and air contamination, continue to displace communities and damage biodiversity (UNCTAD, 2024; Elboiashi, 2023).

Mitigating these consequences requires policy alignment with the Sustainable Development Goals (SDGs), particularly through low-carbon trade incentives, carbon pricing, and robust emission controls. Libya's ratification of the Paris Agreement in 2021 indicates a foundational step. However, unlike Morocco which successfully deployed climate finance to build the Noor Solar Power Plant Libya has yet to develop the institutional architecture necessary to harness such investments (World Bank, 2024; UNEP, 2022).

2.3. Institutions as a Mediating Mechanism

Institutions mediate the transformation of trade flows into inclusive and sustainable outcomes. Acemoglu and Robinson (2012) contend that inclusive institutions those that facilitate rule of law, property rights, and equitable access to resources enable long-term development. In contrast, extractive institutions concentrate wealth and power, fostering economic inefficiencies. Libya's governance, characterized by political fragmentation and weak regulatory enforcement, exemplifies the latter condition (World Bank, 2024).

Institutional quality directly influences the trade-sustainability nexus. Elboiashi (2023) demonstrates that institutional weakness exacerbates trade volatility, while Elboiashi and Embaya (2025) empirically confirm that corruption inversely correlates with progress on SDGs in Libya.

Post-conflict transitions such as Rwanda's demonstrate how institutional reforms centred on citizen engagement and judicial independence can bolster national reconstruction (AfDB, 2023). Similarly, Botswana's use of diamond revenues to fund education and healthcare via an independent regulatory body has insulated it from the resource curse, maintaining 5% annual GDP growth since 2000 (IMF, 2023).

2.4. Human Capital and Equity in Trade Distribution

Human capital is integral to sustainable development and economic diversification. In Libya, chronic underinvestment in health and education constrains labor market dynamism, particularly among youth and women. High unemployment (30%) and deteriorating educational quality have impaired Libya's capacity to transition into a knowledge economy (ILO, 2024; UNDP, 2023). The Sustainable Development Index (SDI) reveals that GDP growth in Libya often occurs at the expense of social justice and environmental integrity (Hickel, 2020).

Vocational training and inclusive labour policies are prerequisites for equitable trade outcomes. Tunisia's investment in STEM education illustrates the potential of human capital to drive export diversification and innovation (AfDB, 2023). In Libya, prioritizing health, education, and gender inclusion is critical for transforming trade revenues into long-term development dividends.

2.5. Regional Integration and Strategic Trade Alliances

Libya's geographic position and resource endowment offer strategic advantages for regional trade integration, particularly through the African Continental Free Trade Area (AfCFTA). Despite abundant solar and wind resources, foreign investment remains deterred by political instability and regulatory uncertainty (UNCTAD, 2024). The failure of initiatives like Desertec highlights the fragility of regional trade efforts in unstable political climates (Carafa & Escribano, 2016).

However, regional collaboration can serve as a vehicle for green transition. The Noor Solar Plant in Morocco demonstrates how regional partnerships and transparent governance can mobilize climate finance for renewable energy infrastructure (World Bank, 2024). Libya's ability to replicate such success depends on institutional reforms and dispute resolution mechanisms within trade frameworks.

3. Previous Empirical Studies

A number of empirical studies have examined the relationship between trade openness, sustainability, and institutional quality in fragile and resource-dependent economies.

The following selection offers insights relevant to Libya's economic challenges:

Table 1: relevant to Libya's economic challenges

Author(s)	Year	Country/Region	Methodology	Key Findings
Frankel & Romer	1999	Global	Cross-country regression	Trade openness significantly enhances income levels, but institutional quality mediates long-term gains.
Auty	1993	Global/Resource Economies	Comparative Case Analysis	Resource-rich countries suffer from distorted diversification incentives and weak governance.
Elboiashi	2023	Libya	Quantitative (Time-series)	Political instability exacerbates trade deficits and undermines diversification efforts.
Elboiashi & Embaya	2025	Libya	Panel Data Analysis	Corruption is negatively associated with SDG progress, particularly in clean energy and justice indicators.
Adewale	2021	Nigeria	Sectoral Analysis	Oil wealth has constrained agricultural innovation and worsened food insecurity.
Dallali et al.	2024	North Africa	Panel ARDL	Renewable energy adoption reduces emissions, but requires stable institutions for effectiveness.
Balogun et al.	2024	ECOWAS	Structural Equation Modelling	Trade openness and human capital significantly contribute to SDG achievement; poverty remains a barrier.
Toktaş et al.	2023	Multi-country	Cross-sectional regression	Trade in environmental goods improves carbon neutrality, but effects vary by governance quality.
Carafa & Escribano	2016	North Africa	Policy Case Study	The Desertec project failed due to governance fragility and investor risk aversion in Libya and neighbors.
Hickel	2020	Global	Composite SDI Metrics	High-income growth does not always equate to sustainability; ecological efficiency is critical.

These studies underscore the multifaceted nature of foreign trade's impact on sustainability, emphasizing the centrality of institutions, social inclusion, and environmental responsibility in shaping developmental outcomes.

4. Methodology and Procedures

4.1. Data and Time Period

This study analyses annual data from 1990 to 2022 to assess Libya's economic transformations, including phases of economic liberalisation, sanctions relief in the early 2000s, the post-2011 conflict period, and subsequent recovery phases. While this period captures the evolving role of foreign trade during Libya's structural transitions, it presents several challenges:

- The 33-year time span limits the robustness of time series results, although ARDL models help mitigate small sample bias;
- Post-2011 volatility complicates trend interpretation;
- Limited availability of SDI data (Hickel, 2020) reduces coverage.

Future research should expand the timeframe and adopt alternative methodological tools to improve analytical precision, especially in fragile contexts. Addressing these limitations would enhance policy design for post-conflict reconstruction and socio-economic resilience in Libya.

4.2. Addressing The Problem of Endogeneity

To address potential reverse causality between foreign trade and sustainability variables, this study integrates SDI indicators with lagged values of Trade Volume (TRV), thereby linking current outcomes to past trade dynamics and reducing simultaneity bias. Key control variables GDP growth, GDP per capita, inflation (CPI), and unemployment (UNY) are included to isolate macroeconomic influences on sustainable development.

While these adjustments reduce omitted variable bias, residual endogeneity risks remain. Therefore, future research should consider using instrumental variables (e.g., exogenous shocks to global demand) or auxiliary models to further strengthen causal inference. Such methodological rigour is essential for developing evidence-based policies that foster economic resilience and inclusive recovery in post-conflict Libya.

5. Model Selection and Characterization

Choosing the appropriate econometric methodology is essential for estimating Libya's sustainable development function. This study compares three potential approaches: Ordinary Least Squares (OLS), the Johansen Error Correction Model (ECM), and the Autoregressive Distributed Lag (ARDL) model. Unit root testing was performed to ensure the time series' stationarity, a prerequisite for valid long-run analysis.

5.1. Unit Root Testing and Joint Integration Analysis

The Augmented Dickey Fuller (ADF) test was used to assess the stationarity of the study's variables (Table 1). The results indicate that economic growth (GDP) and GDP per capita (GDPPC) are stationary at level [I(0)], while the Sustainable Development Index (SDI), Foreign Trade Volume (TRV), Unemployment (UNY), and Inflation (CPI) are stationary at first difference [I(1)].

This mixed order of integration [I(0) and I(1)] rules out the use of OLS or the Johansen cointegration technique, both of which require all variables to be integrated of the same order (Engle & Granger, 1987; Johansen, 1995). Therefore, the ARDL model is chosen for its flexibility in handling variables of mixed integration orders.

Table 2: Unit Root Results for ADF Test

Variable	Level I(0)	First Difference I(1)
SDI	-0.9903 (Non-sig.)	-7.2522***
TRV	-0.3100 (Non-sig.)	-5.9929***
GDP	-3.9506***	-8.8015***
GDPPS	-3.7269***	-5.9789***
UNY	-0.6784 (Non-sig.)	-9.0250***
CPI	1.1992 (Non-sig.)	-3.3876**

Significant level: ***p<0.01, **p<0.05, *p<0.10.
Lag length selected via Schwarz Information Criterion (SIC).

5.2. Justifications for Using the ARDL Model

The bounds-testing approach of the ARDL model is suitable for this analysis because of its flexibility in accommodating variables with different integration ranks [$I(0)$ and $I(1)$], and its durability in cases of small samples (Pesaran et al., 2001). Unlike the Johansen methodology, the ARDL model does not require pre-testing of co-integration ranks and allows for simultaneous estimation of short- and long-term dynamics. This corresponds to the results of Pesaran et al. (2001), which demonstrated the efficacy of the ARDL model in addressing pseudo-regression risks in non-static data.

5.3. Model Characterization and Boundary Testing

Accordingly, the Autoregressive Distributed Lag (ARDL) model can be formulated for the sustainable development function to make it suitable for cointegration testing. This is done within an Unrestricted Error Correction Model (UECM) framework. Assuming a relationship between the Sustainable Development Index (SDI) as the dependent variable and a vector of independent variables (X_t), the model takes the following form:

$$\Delta LSDI_t = a_0 + \sum_{j=1}^{\rho} \beta_j \Delta LSDI_{t-j} + \sum_{j=0}^{q} \gamma_j \Delta LX_{t-j} + \pi_1 LSDI_{t-1} + \pi_k LX_{t-1} + \varepsilon_t \quad \ldots\ldots(1)$$

Where:

- $LSDI_t$ is the logarithm of the Sustainable Development Index (the dependent variable).
- LX_t is a vector containing the logarithms of the independent variables. For this study, the vector X_t includes: Foreign Trade Volume (*TVR*), Gross Domestic Product (*GDP*), GDP per capita (*GDPPs*), Consumer Price Index (*CPI*), and Unemployment (*UNY*).
- The coefficients on the differenced variables (β_j and the vector γ_j) represent the short-run parameters.
- The coefficients on the lagged level variables (π_1 and the vector π_k) represent the long-run parameters.

Furthermore:

- Δ denotes the first difference operator.
- L indicates the logarithmic form. The logarithmic transformation is applied to the variables to mitigate several statistical issues, such as heteroskedasticity, and to linearize exponential trends. Most importantly, it allows the coefficients to be interpreted as elasticities (growth rates). Taking the first difference of a log-transformed variable provides an approximation of its growth rate.
- p and q denote the optimal lag lengths. It is not required for all variables to have the same lag length.
- K denote the number of independent variables.
- ε_t represents the random error term, assumed to have a zero mean, constant variance, and no serial correlation.

When estimating this model, the error correction term ECT_{t-1} and the speed of adjustment coefficient λ can be derived from its parameters (π_1, π_k). Also, $\lambda \equiv \pi_1$ (must be statistically significant and negative for cointegration).

- ECT_{t-1} is estimated as:

$$ECT_{t-1} = LSDI_{t-1} - (\theta_2 LTVR_{t-1} + \cdots + \theta_k LUNY_{t-1})$$

Where: $\theta_k = -\pi_k/\pi_1$

Appendix (1) shows the name of the variables used in the model, their symbols, and the sources of their data.

A F-bounds test for co-integration was applied (Pesaran et al., 2001), comparing critical values with F statistics to ascertain the existence of long-term integrative relationships. This approach balances theoretical rigor with practicality, making it ideal for development economics research. By estimating the coefficients within this model, the effects of foreign trade volume (TRV) on the Sustainable Development Index of the Libyan economy (SDI; Hickel, 2020) are assessed, with the controlled effects of growth in GDP, GDP per capita (GDPPS), inflation, and unemployment. The findings contribute to guiding the alignment of foreign trade policies with environmental, social and economic objectives of sustainable development. These procedures can provide evidence for cross-country comparative studies, similar to OECD analyses (Smith & Jones, 2020), for future research.

Table (2) presents the results of the F-bounds test for co-integration within the framework of the *ARDL* model, using the critical values he proposed (Pesaran et al., 2001). The calculated F statistic of 7.145 exceeds the critical values of the upper limit at all significance levels (10%, 5%, 2.5%, and 1%), as shown in Table (2).

Table 3: F-Bounds Test results for ARDL Model (1990-2022)

F-BOUNDS TEST		
F-STATISTIC	**7.145**	
CRITICAL VALUES	*I*(0)	*I*(1)
10%	2.08	3.00
5%	2.39	3.38
2.5%	2.70	3.73
1%	3.06	4.15
No. COFFECENT (k)	5	

Notes: Critical values are sourced from Pesaran et al. (2001).

This provides strong evidence for rejecting the null hypothesis that there is no co-integration, asserting that there is a long-term equilibrium relationship between sustainable development and independent variables in the model. The optimal slowdown structure for the *ARDL* model, selected using the Schwartz Criterion (sic), is [ARDL (1, 1, 1, 1, 1, 1)]. This structure ensures minimal loss of information about variables while addressing possible subjective correlation.

6. Findings and Discussion

6.1. Short Term Estimates: Dynamic Effects Analysis

Table (3) presents the short-term ARDL model estimates for the Sustainable Development Index (SDI) in Libya. The adjusted coefficient of determination (R^2) reached 0.51, indicating a moderate explanatory power of the model. Several coefficients were statistically significant at the 1% level ($p < 0.01$). The error correction term (CointEq(−1) = −0.74; $p < 0.01$) was negative and statistically significant, confirming an annual adjustment speed of 74% towards long-run equilibrium.

6.1.1. Foreign Trade Volume (TRV):

The results indicate that a 1% increase in foreign trade volume promotes sustainable development by 29%, supporting theories of trade-driven diversification and technology transfer (Dollar & Kraay, 2018). However, Libya's overdependence on hydrocarbons constituting 94% of exports poses risks of Dutch Disease effects (Auty, 2001). Policy recommendations include supporting non-oil exports (e.g. agriculture, manufacturing, tourism, and renewable energy) and simplifying customs procedures to lower trade barriers.

6.1.2. Economic Growth (GDP):

A 1% increase in GDP boosts SDI by 48%, underscoring the role of economic growth in financing human capital and infrastructure (Acemoglu & Robinson, 2012). However, Libya's oil-dependent growth model has intensified macroeconomic volatility and inequality (UNDP, 2023). Policymakers should prioritise support for small and medium-sized enterprises (SMEs), particularly in tourism and renewable energy, by expanding access to credit and vocational training to foster inclusive growth.

6.1.3. GDP Per Capita (GDPPC):

A 1% increase in GDP per capita strengthens SDI by 32%, aligning with Sen's (1999) capability approach. However, this relationship is undermined by wealth inequality and post conflict instability. Redistributive fiscal policies such as progressive taxation and increased investment in marginalised regions are crucial to ensuring that economic gains translate into broader human development.

6.1.4. Inflation and Unemployment:

A 1% increase in inflation reduces SDI by 17%, while unemployment reduces SDI by 23%. These findings highlight how macroeconomic instability erodes both purchasing power and social cohesion (Blanchard, 2016). Strengthening the independence of the Central Bank of Libya (CBL) is critical to maintaining price stability and fiscal discipline. Simultaneously, job creation should be prioritised through public private partnerships and targeted vocational training programmes.

Table 4: Short-Term Results of the Sustainable Development Function (1990–2022)

Variable	Coefficient	Std. Error	T-statistic	Prob.
D(LTRV)	0.29044	0.07412	3.9185	0.0020***
D(LGDPS)	0.47909	0.14682	3.2629	0.0068***
D(LGDPPS)	0.31543	0.10632	2.9667	0.0076***
D(LUNY)	-0.22617	0.06172	-3.6642	0.0032***
D(LCPI)	-0.17052	0.03734	-4.5658	0.0006***
CointEq(-1)	-0.74122	0.14996	-4.9426	0.0001***

Selected Model: ARDL(1, 1, 1, 1, 1, 1)

Significant level: (*) Significant at the 10%; (**) Significant at the 5% and (***) Significant at the 1%.

6.2. Long-Term Estimates: Assessing Sustainable Impacts

Table (4) presents the long-term ARDL estimates for the Sustainable Development Index (SDI) in Libya. Key findings highlight trade-offs between macroeconomic variables and sustainability outcomes, emphasizing human-centered policy priorities.

Foreign Trade Volume (TRV): A 1% increase in foreign trade volume increases the SDI by 27%. Although foreign trade encourages foreign direct investment (FDI) and enhances competitiveness, Libya's heavy dependence on hydrocarbons poses risks of environmental damage and economic imbalance (Grossman & Helpman, 2015), and Libya's dependence on hydrocarbons (94% of exports) threatens environmental degradation and Dutch Disease (UNEP, 2022). Diversification towards renewable energy, tourism and sustainable agriculture - via tax incentives and special economic zones - is crucial to economic sustainability.

Economic Growth (GDP): A 1% GDP increase raises the SDI by 77%, in line with the role of growth in financing SDGs-compliant infrastructure (Acemoglu & Robinson, 2012). However, oil-driven volatility undermines long-term investments. The establishment of a sovereign wealth fund to channel oil revenues towards education and health care can sustain development (IMF, 2024).

GDP Per Capita: A 1% increase in GDP strengthens the SDI by 35%, reflecting the role of income in capacity enhancement (Sen, 1999). Addressing structural inequalities - through scholarships, vocational training, and micro and medium-sized enterprise financing - can empower marginalized groups and reduce regional disparities.

Unemployment: A 1% increase lowers the SDI by 82%, underscoring the social and political costs of unemployment (ILO, 2024). Prioritizing labour-intensive sectors (agriculture, tourism, industry, renewable energies) and anti-corruption reforms (Elboiashi & Embaya, 2025) are vital for inclusive job creation.

Inflation: A rise of 1% reduces the SDI by 49%, highlighting the erosion of purchasing power due to price instability (Friedman, 1977). Strengthening the independence of the Central Bank of Libya (CBL) and fiscal discipline - through effective monetary and fiscal policies and the operationalization of good governance principles - can mitigate inflationary pressures.

Table 5: Long-Term Results of the Sustainable Development Function (1990–2022)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTRV	0.27313	0.07926	3.44570	0.0029***
LGDPS	0.77387	0.15236	5.07926	0.0001***
LGDPPS	0.35094	0.11162	3.14394	0.0051***
LUNY	-0.82496	0.21622	-3.81527	0.0013***
LCPI	-0.49380	0.04180	-11.8123	0.0000***
C	-1.10162	0.22441	-4.90894	0.0004***

Significant level: ***p<0.01, **p<0.05, *p<0.10; where is: (*) Significant at the 10%; (**) Significant at the 5% and (***) Significant at the 1%

6.3. Diagnostic Tests

Diagnostic tests confirm the validity of the ARDL model: no autocorrelation ($F = 0.520$, $p = 0.483$), naturally distributed residues (Jarque-Bera = 0.654, $p = 0.721$), and homoscedasticity ($F = 0.551$, $p = 0.464$). Despite potential concerns about profiling (Ramsey reset $F = 6.846$, $p = 0.035$), the results strongly emphasize sustainable foreign trade policies and stability.

Table 6. Diagnostic Tests for ARDL Model (1990–2022)

Test	Statistic	Prob.
Normality Test (Jarque-Bera)	0.654425	0.7209
Serial Correlation LM Test (Breusch-Godfrey):		
F-Statistic	0.520462	0.4834
Obs*R-squared	1.077844	0.2992
Heteroscedasticity Test (ARCH):		
F-Statistic	0.550861	0.4639
Obs*R-squared	0.577874	0.4471
Ramsey RESET Test:		
F-Statistic	6.846339	0.0346
Likelihood Ratio	21.82754	0.0000

The combined result from the CUSUM test provide strong evidence for the structural stability of the estimated ARDL model as shown in the figure (1)at the Appendix. This stability is a critical finding, as it validates the reliability of the estimated short-run and long-run

coefficients presented in the study. It implies that the relationships captured by the model are consistent and dependable across the entire sample period. Therefore, the conclusions drawn from the model and any policy recommendations derived from its results can be considered robust and not merely artifacts of a specific sub-period.

7. Challenges in the Libyan Economy

Political fragmentation in post-2011 Libya and entrenched dependence on hydrocarbons hindered economic diversification, exacerbating inflation (averaging 12.6% since 2020) and unemployment rates exceeding 30% (World Bank, 2024). Supply chain disruptions, exacerbated by institutional instability and conflict, further deepen structural vulnerabilities. While short-term foreign trade gains from oil exports provide temporary financial relief, they fail to address systemic inequalities, such as unequal access to education and health care. Sustainable development in this context requires institutional reforms to stabilize governance, diversify business partnerships, and prioritize equitable resource allocation.

Hickel 's Sustainable Development Index (SDI) (2020) underscores the urgency of balancing growth with environmental limits, as Libya's carbon intensity per unit GDP remains 40% higher than the global average (UNCTAD, 2024). Accordingly, human-centered policies should redirect the focus from volatile hydrocarbon revenues to overall well-being, including youth vocational training and investments in renewable energy to mitigate climate risk.

8. Comparison with Regional and Global Studies

8.1. Comparison with Ecowas Countries:

Libya's foreign trade and sustainability dynamics differ from ECOWAS countries such as Nigeria and Ghana, where the volume of foreign trade lacks a direct link to sustainable development due to weak institutional frameworks and lack of industrialization (Balogun et al., 2024). For example, Nigeria's oil-dependent economy reflects the vulnerability of the Libyan economy to global price shocks, however, Nigeria's non-oil sectors contribute 70% of GDP, compared to 10% in Libya (AfDB, 2023). Libya's findings suggest that strategic trade integration - coupled with structural reforms such as anti-corruption measures and green industrial policies - could open the door to economic diversification. However, similar to ECOWAS countries, Libya is struggling to translate foreign trade gains into equitable development, as marginalized groups remain excluded from economic opportunities.

8.2. Lessons from OECD Countries:

Foreign trade in OECD nations drives economic growth but risks elevating carbon emissions and resource depletion without robust environmental policies (Ivanovski & Hailemariam, 2021). Germany's renewable energy transition reduced emissions by 42% post-2000 alongside trade expansion, illustrating effective decoupling (Wang & Khan, 2024). Sustainable strategies, including prioritizing renewable energy and regulating non-environmental imports (Dallali et al., 2024; Toktaş et al., 2023), are critical for balancing economic and ecological goals in developing economies like Libya. The key lessons including:

Institutional capacity: OECD countries benefit from strong governance to enforce environmental regulations, such as the Swedish carbon tax, which has reduced emissions by 26% since 1995 (World Bank, 2024). Libya's fragmented institutions lack similar enforcement mechanisms.

Sustainable practices: Investing in environmentally friendly technologies, such as Denmark's wind energy sector (which now accounts for 50% of electricity generation), can align foreign trade with environmental goals (OECD, 2021).

For Libya, adopting OECD-inspired strategies - such as linking trade agreements to emissions reduction targets and diversifying towards solar exports - requires stable governance and strengthened public-private partnerships. These actions can mitigate the "resource curse" while advancing SDGs-compliant development.

9. Limitations and Future Research

This study acknowledges that there are certain limitations that provide scope for further exploration and research. Relying on secondary data sources, such as World Bank and the International Labour Organization (ILO), poses potential measurement biases. In addition, the linear assumptions of the Autoregressive Distributed Lag (ARDL) model may simplify overly complex economic dynamics, as Stern (2004) has highlighted. Key variables, including political stability and innovation, were not included, which could affect outcomes. Furthermore, the composition of foreign trade, as noted in UNCTAD (2023) reports, remains unexplored, warranting future investigations using non-linear frameworks and more detailed analyses.

For economic policymakers, prioritizing the adoption of renewable energy-such as solar tax incentives and green foreign direct investment (e.g., TotalEnergies Initiatives, 2024) is critical. Equitable strategies are needed to align growth in the Libyan economy driven by foreign trade with global borders, as emphasized by Hickel (2020). Cross-country comparisons, particularly those involving OECD countries (Smith & Jones, 2020), can provide valuable insights to contextualize challenges and identify best practices. Future research should focus on addressing these gaps to enhance understanding to achieve the SDGs and develop actionable recommendations for sustainable development in Libya.

10. Conclusion

This study has provided an in-depth analysis of the complex relationship between foreign trade and sustainable development in Libya over the period 1990 to 2022, highlighting both opportunities and challenges within this dynamic. The findings confirm that foreign trade plays a pivotal role in promoting long-term sustainability within the Libyan economy. However, the state's heavy dependence on hydrocarbon exports continues to pose significant risks delivering short term gains at the expense of long-term economic resilience. This duality reinforces the urgent need for strategic interventions that balance immediate economic benefits with the pursuit of sustainable and inclusive growth.

From a development standpoint, key macroeconomic indicators such as economic growth (GDP) and GDP per capita emerged as primary drivers of progress during the study period (Grossman & Helpman, 2015). These indicators have contributed positively to human development by improving living standards and expanding employment opportunities. Conversely, inflation and high unemployment remain critical barriers to development, consistent with Friedman's (1977) assertions regarding their destabilising effects on economic systems. Addressing these challenges is essential for fostering inclusive and equitable development across Libyan society.

To achieve long-term sustainability, Libya must adopt a multifaceted approach centered on trade diversification, green investment, institutional reform, and anti-corruption strategies. Diversifying foreign trade is particularly crucial, given the vulnerabilities tied to over-reliance on hydrocarbons. Expanding the export base to include non-oil sectors such as agriculture, tourism, renewable energy, manufacturing, and services can insulate the economy from volatile oil markets and promote more balanced development. Green investments, particularly in solar and wind energy, offer promising pathways not only to mitigate environmental degradation but also to generate employment and promote socio-economic inclusion.

Institutional coordination is another critical pillar. Effective collaboration between government agencies, the private sector, and international partners is vital to addressing Libya's structural deficiencies and enhancing competitiveness. Stronger institutions ensure more efficient resource allocation, improved public service delivery, and a more conducive environment for entrepreneurship and innovation. In parallel, robust anti-corruption reforms are indispensable for restoring public trust and ensuring transparency. Corruption distorts economic incentives, diverts resources from productive uses, and exacerbates inequality. A clear, enforceable anti-corruption framework is therefore vital for just and sustainable development.

Furthermore, the study underscores the importance of aligning trade led growth with a human centred development paradigm. As emphasised by Hickel (2020), economic policy must be designed within environmental limits to preserve intergenerational equity. For Libya, this means embedding environmental concerns within trade

policy and integrating economic, social, and ecological goals into a cohesive development strategy. Comparative experiences from OECD countries and emerging economies can offer valuable insights into balancing trade expansion with sustainability imperatives.

In conclusion, Libya's path to sustainable development will depend on its ability to address current economic and institutional constraints while capitalising on emerging opportunities. By prioritising trade diversification, investing in green technologies, strengthening institutions, and combating corruption, Libya can transform foreign trade into a driver of inclusive wellbeing and long-term prosperity.

Future research should explore innovative frameworks to overcome Libya's structural vulnerabilities and empirically assess the impact of proposed policy interventions across diverse economic conditions. Ultimately, a comprehensive, evidence-based approach will ensure that Libya's economic trajectory aligns with both domestic aspirations and global sustainable development goals.

11. References:

[1]- Acemoglu, D., & Robinson, J. A. (2012). Why nations fail: The origins of power, prosperity, and poverty. Crown Business.

[2]- African Development Bank (FDB). (2023). African economic outlook. Retrieved January 10, 2025, from https://www.afdb.org/en/documents/african-economic-outlook-2023.

[3]- Auty, R. M. (1993). Sustaining development in mineral economies: The resource curse thesis. Routledge.

[4]- Auty, R. M. (2001). Resource abundance and economic development. In N. J. Smelser & P. B. Baltes (Eds.), International encyclopedia of the social & behavioral sciences (pp. 13145–13149). Elsevier.

[5]- Balogun, M., Tella, S., Adelowokan, O., Ogede, J., & Adegboyega, S. (2024). Achieving sustainable development in ECOWAS countries: The impact of trade openness, poverty and human capital. Future Business Journal, 10(1). https://doi.org/10.1186/s43093-024-00367-9

[6]- Barbier, E. B. (2016). Sustainability and development. Annual Review of Resource Economics, 8, 261–280. https://doi.org/10.1146/annurev-resource-100815-095227

[7]- Becker, G. S. (1993). Human capital: A theoretical and empirical analysis, with special reference to education (3rd ed.). University of Chicago Press.

[8]- Blanchard, O. (2016). Macroeconomics (7th ed.). Pearson Education.

[9]- Carafa, L., & Escribano, G. (2016). Renewable energy in the MENA: Why did the Desertec approach fail? In Routledge handbooks online (pp. 66–78). https://doi.org/10.4324/9781315723617-5

[10]- Copeland, B. R., & Taylor, M. S. (2004). Trade, growth, and the environment. Journal of Economic Literature, 42(1), 7–71.

[11]- Dallali, M., Hamdi, H., & Ben-Salha, O. (2024). Renewable energy and emissions reduction: Evidence from North Africa. Energy Policy, 195, 112456.

[12]- Dinda, S. (2004). Environmental Kuznets curve hypothesis: A survey. Ecological Economics, 49(4), 431–455. https://doi.org/10.1016/j.ecolecon.2004.02.011

[13]- Dollar, D., & Kraay, A. (2018a). Growth is good for the poor. In A. B. Atkinson & F. Bourguignon (Eds.), Handbook of income distribution (Vol. 2, pp. 539–625). Elsevier. https://doi.org/10.1016/B978-0-444-59428-0.00012-3

[14]- Dollar, D., & Kraay, A. (2018b). Trade, growth, and poverty (World Bank Policy Research Working Paper No. 8495). World Bank. https://doi.org/10.1596/1813-9450-8495

[15]- Elboiashi, H. (2023). The impact of political stability and violence on the Libyan trade balance. Economic Studies Journal, 6(2), 163–178. Retrieved January 10, 2025, from https://journal.su.edu.ly/index.php/esj/article/view/1214

[16]- Elboiashi, H. A., & Embaya, A. M. (2025). Economic corruption and its impact on achieving the sustainable development goals (SDGs) in Libya. International Journal of Financial, Administrative and Economic Sciences, 4(2), 248–266. https://doi.org/10.59992/IJFAES.2025.v4n2p9

[17]- Engle, R. F., & Granger, C. W. J. (1987). Co-integration and error correction: Representation, estimation, and testing. Econometric, 55(2), 251–276. https://doi.org/10.2307/1913236

[18]- Frankel, J. A., & Romer, D. (1999). Does trade cause growth? American Economic Review, 89(3), 379–399.

[19]- Friedman, M. (1977). Inflation and unemployment: The new dimension of politics. Institute of Economic Affairs.

[20]- Grossman, G. M., & Helpman, E. (2015). Global markets and domestic politics. Princeton University Press.

[21]- Grossman, G. M., & Krueger, A. B. (1994). Environmental impacts of a North American Free Trade Agreement. In P. M. Garber (Ed.), The Mexico-U.S. Free Trade Agreement (pp. 13–56).

[22]- Hickel, J. (2020a). Growth fetishism and ecological overshoot. Development and Change, 51(2), 295–316. https://doi.org/10.1111/dech.12535

[23]- Hickel, J. (2020b). Less is more: How degrowth will save the world. Penguin Books.

[24]- Hickel, J. (2020c). The Sustainable Development Index: Measuring the ecological efficiency of human development. Ecological Economics, 167, 106331. https://doi.org/10.1016/j.ecolecon.2019.05.011

[25]- International Labour Organization (ILO). (2024). Global employment trends for youth 2024. Retrieved January 29, 2025, from https://www.ilo.org/publications/major-publications/global-employment-trends-youth-2024

[26]- International Monetary Fund (IMF). Middle East and Central Asia Department. (2024). Libya: 2024 Article IV consultation—Press release; Staff report; and statement by the Executive Director for Libya (IMF Staff Country Reports No. (2024/206). https://doi.org/10.5089/9798400281075.002

[27]- Ivanovski, K., & Hailemariam, A. (2021). Trade openness and environmental degradation: A global analysis. Ecological Economics, 180, 106891.

[28]- Johansen, S. (1995). Likelihood-based inference in cointegrated vector autoregressive models. Oxford University Press.

[29]- Kuznets, S. (1955). Economic growth and income inequality. American Economic Review, 45(1), 1–28.

[30]- Levinson, A., & Taylor, M. S. (2008). Unmasking the pollution haven effect. International Economic Review, 49(1), 223–254. https://doi.org/10.1111/j.1468-2354.2008.00478.x

[31]- Lucas, R. E., Jr. (1988). On the mechanics of economic development. Journal of Monetary Economics, 22(1), 3–42.

[32]- Organisation for Economic Co-operation and Development (OECD). (2021). OECD work on trade and the environment: A retrospective, 2008–2020. Retrieved December 16, 2024, from https://www.oecd.org/trade/topics/trade-and-the-environment/

[33]- Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289–326. https://doi.org/10.1002/jae.616

[34]- Romer, P. M. (1986). Increasing returns and long-run growth. Journal of Political Economy, 94(5), 1002–1037.

[35]- Sachs, J. D., & Warner, A. M. (1995). Natural resource abundance and economic growth (NBER Working Paper No. 5398). National Bureau of Economic Research.

[36]- Sen, A. (1999). Development as freedom. Oxford University

Press.

[37]- Smith, J., & Jones, L. (2020). Cross-country comparisons of health expenditures using ARDL models. Journal of Health Economics, 72, 102387. https://doi.org/10.1016/j.jhealeco.2020.102387

[38]- Stern, D. I. (2004). The rise and fall of the environmental Kuznets curve. World Development, 32(8), 1419–1439. https://doi.org/10.1016/j.worlddev.2004.03.004

[39]- Stern, N., & van Dijk, J. (2020). How climate change challenges the EKC (NBER Working Paper No. 27679). National Bureau of Economic Research.

[40]- Toktaş, Y., Alola, A. A., & Adebayo, T. S. (2023). Environmental goods trade and carbon neutrality: A cross-country study. Sustainable Development, 31(4), 2130–2145.

[41]- TotalEnergies. (2024). VPSHR 2023 annual report. Retrieved February 10, 2025, from https://totalenergies.com/

[42]- United Nations Conference on Trade and Development (UNCTD). (2023). World investment report 2023. Retrieved December 10, 2024, from https://unctad.org/

[43]- United Nations Conference on Trade and Development (UNCTD). (2024). Trade and development report 2024. Retrieved March 1, 2025, from https://unctad.org/tdr2024

[44]- United Nations Development Programme (UNDP). (2023). Libya's human development summary 2023–2024. Retrieved March 1, 2025, from https://www.undp.org/

[45]- United Nations Environment Programme (UNEP). (2022). United Nations Strategic Framework for Libya (2019–2022). Retrieved March 1, 2025, from https://www.undp.org/

[46]- Walter, I., & Ugelow, J. L. (1979). Environmental policies in developing countries. Ambio, 8(2–3), 102–109.

[47]- Wang, Q., & Khan, M. K. (2024). Germany's energy transition: Lessons for global decarbonization. Renewable Energy, 221, 119752.

[48]- World Bank (WB). (2024). Libya overview: Development news, research, data. Retrieved January 11, 2025, from https://www.worldbank.org/

12. Appendix:

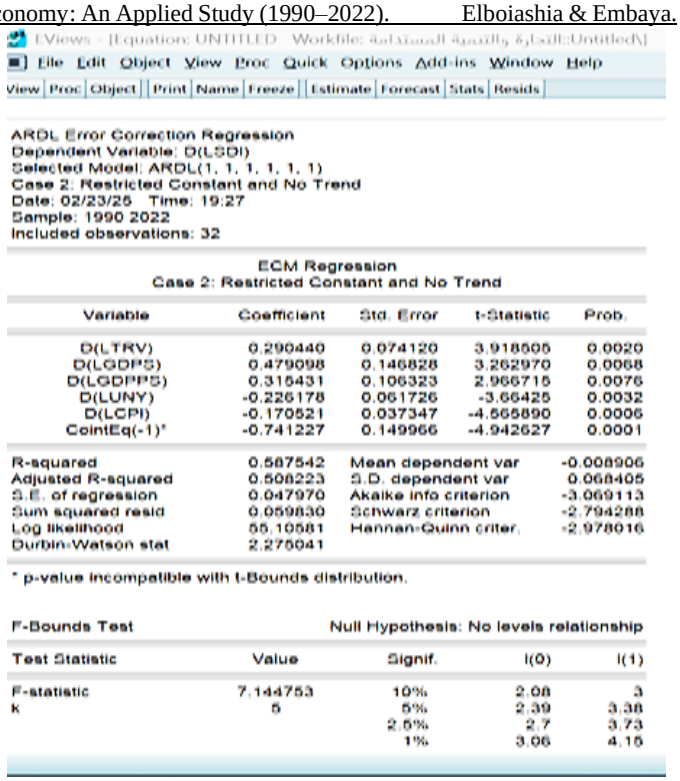
12.1. Appendix 1: Variables Used, Code for Each Variables, and Data Sources

Table 7: Variables Used, Code for Each Variables, and Data Sources

Variable Name	Proxy	Data Source
Sustainable Development Index	SDI	The Sustainable Development Index by Hickel (2020).
Foreign Trade Volume	TRV	World Bank, World Development Indicators (WDI), Jan, 2025.
GDP (Constant 2015 US$)	GDPS	World Bank, World Development Indicators (WDI), Jan, 2025.
GDP per Capita (Constant 2015 US$)	GDPPS	World Bank, World Development Indicators (WDI), Jan, 2025.
Unemployment, Youth Total (% of Total Labor Force Ages 15-24) (Modeled Ilo Estimate)	UNY	World Bank, World Development Indicators (WDI), Jan, 2025.
Cosumer Price Index (2010=100)	CPI	World Bank, World Development Indicators (WDI), Jan, 2025.
Imports of Goods And Services (Current US$)	IMP	World Bank, World Development Indicators (WDI), Jan, 2025.
Exports of Goods and Services (Current US$)	EXP	World Bank, World Development Indicators (WDI), Jan, 2025.

12.2. Annex 2: Short- and Long-Term SDI Function Outcomes

Short-Term



Long-Term

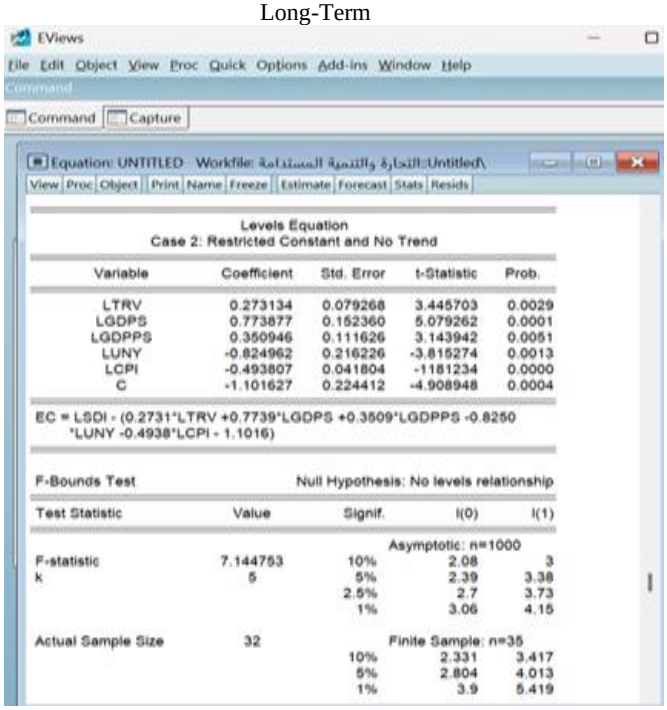


Figure 1: Cumulative sum (CUSUM) test for stability.