Research paper / Оригинальная статья
https://doi.org/10.51176/1997-9967-2024-2-6-19
МРНТИ 06.73.07
JEL: B23, N17, O47

Evaluating Key Drivers of Green Logistics Performance During Economic Growth in African Countries

Ali U. Ahmad[a]*, Jagan Jeevan[a], Siti Marsila M. Ruslan[a]

[a]*Faculty of Maritime Study, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia*

For citation: Ahmad, A. U., Jeevan, J. & Ruslan, S. M. M. (2024). Evaluating Key Drivers of Green Logistics Performance During Economic Growth in African Countries. Economy: strategy and practice 19(2), 6-19, https://doi.org/10.51176/1997-9967-2024-2-6-19

ABSTRACT

This study evaluates the key drivers of green logistics performance and their impact on economic growth in African countries. The study employs a quantitative approach using panel data analysis for African countries from 2007 to 2022. Impulse Response Function and Variance Decomposition methods are utilized to examine the dynamic relationships among variables, including economic growth, Logistics Performance Indicators (LPI), fossil fuel consumption, and greenhouse gas emissions. The findings reveal significant positive relationships between green logistics performance indicators, such as the ability to track and trace consignments, logistics service quality, and trade infrastructure, with economic growth. Conversely, fossil fuel consumption and greenhouse gas emissions exhibit negative associations with economic growth and environmental sustainability. The results underscore the importance of embracing green logistics practices and sustainable development strategies in African economies. By improving logistics infrastructure, enhancing service quality, and reducing environmental impacts, countries can foster economic growth while mitigating adverse effects on the environment. Future research could explore region-specific factors influencing green logistics adoption and examine the role of policies and regulations in promoting sustainable practices. The findings have implications for policymakers, industry stakeholders, and regulatory bodies in developing targeted strategies to align economic progress with environmental responsibility in African nations.

KEYWORDS: Africa, Green Logistics Performance, Economic Growth, Impulse Response Function, Variance Decomposition Function, Sustainable Growth

CONFLICT OF INTEREST: the authors declare that there is no conflict of interest

FINANCIAL SUPPORT: The study was not sponsored (own resources).

Article history:
Received 16 May 2024
Accepted 10 June 2024
Published 30 June 2024

***Corresponding author: Ali U. Ahmad.** – PhD Student, Faculty of Maritime Study, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia, email: aliumarahmd@gmail.com

Оценка ключевых факторов эффективности зеленой логистики в период экономического роста в странах Африки

Ахмад А.У. [a]*, Дживан Д.[a], Руслан С.М.М.[a]

[a] *Университет Малайзии Теренггану, 21030 Куала Нерус, Теренггану, Малайзия*

Для цитирования: Ахмад А.У., Дживан Д., Руслан С.М.М. (2024). Оценка ключевых факторов эффективности зеленой логистики в период экономического роста в странах Африки. Экономика: стратегия и практика, 19(2), 6-19, https://doi.org/10.51176/1997-9967-2024-2-6-19

АННОТАЦИЯ

В данном исследовании была проведена оценка ключевых факторов эффективности зелёной логистики и их влияние на экономический рост в странах Африки. В исследовании был применён количественный подход с использованием анализа панельных данных для стран Африки за период с 2007 по 2022 год. Методы функции импульсного отклика и разложения дисперсии были использованы для изучения динамических взаимосвязей между переменными, включая экономический рост, показатели эффективности логистики, потребление ископаемого топлива и выбросы парниковых газов. Результаты выявили существенные положительные взаимосвязи между показателями эффективности зелёной логистики, такими как способность отслеживать грузы, качество логистических услуг и торговая инфраструктура, и экономическим ростом. Напротив, потребление ископаемого топлива и выбросы парниковых газов демонстрируют отрицательные связи с экономическим ростом и экологической устойчивостью.Результаты подчеркивают важность внедрения методов зелёной логистики и стратегий устойчивого развития в экономиках Африки. Улучшая логистическую инфраструктуру, повышая качество обслуживания и снижая воздействие на окружающую среду, страны могут способствовать экономическому росту, одновременно смягчая неблагоприятное воздействие на окружающую среду. Будущие исследования могут изучить региональные факторы, влияющие на внедрение зелёной логистики, и рассмотреть роль политики и нормативных актов в продвижении устойчивых практик. Результаты исследования имеют важное значение для политиков, заинтересованных сторон в отрасли и регулирующих органов при разработке целевых стратегий по согласованию экономического прогресса с экологической ответственностью в африканских странах.

КЛЮЧЕВЫЕ СЛОВА: Африка, эффективность зеленой логистики, экономический рост, функция импульсного отклика, функция разложения дисперсии, устойчивый рост

КОНФЛИКТ ИНТЕРЕСОВ: авторы заявляют об отсутствии конфликта интересов

ФИНАНСИРОВАНИЕ: исследование не имело спонсорской поддержки (собственные ресурсы).

История статьи:
Получено 16 мая 2024
Принято 10 июня 2024
Опубликовано 30 июня 2024

* **Корреспондирующий автор: Али У.А.** – PhD докторант, факультет морских исследований, Малазийский университет Тренгану, 21030 Куала-Нерус, Тренгану, Малайзия, email: aliumarahmd@gmail.com

1. INTRODUCTION

In the past decades, the rapidly growing global economy has fueled an unprecedented demand for goods and services, intensifying the need for efficient and sustainable logistics systems. The transportation and logistics sector, a crucial component of economic growth, has struggled to balance economic expansion with environmental sustainability. This dilemma is particularly acute in African countries, where economic development is a pressing priority, yet the consequences of unsustainable practices pose severe threats to the region's ecological well-being. According to the United Nations Environment Programme (UNEP), the transportation sector accounts for approximately 25% of global greenhouse gas emissions, with a significant portion attributable to logistics operations (UNEP, 2021). Furthermore, the International Energy Agency (IEA) reports that Africa's energy-related carbon dioxide emissions have increased by nearly 50% since 2000, underscoring the urgency of addressing the environmental impact of logistics activities (IEA, 2022). Previous empirical studies have explored various aspects of green logistics and its relationship with economic growth, but a comprehensive understanding of the key drivers in the African context remains elusive. Rao and Holt (2005) examined the role of green logistics practices in enhancing environmental and economic performance, while Rodrigue et al. (2017) investigated the impact of sustainable transportation strategies on economic development. However, these studies primarily focused on developed economies or specific regions, leaving a gap in understanding African countries' unique challenges and opportunities.

This research aims to evaluate the key drivers of green logistics performance amid economic growth in African countries, utilizing advanced econometric techniques such as impulse response function and variance decomposition. This study aims to contribute to the existing body of knowledge by providing empirical evidence and insights into the intricate interplay between green logistics practices, economic growth, and environmental sustainability in Africa. By identifying the critical factors influencing green logistics performance, the research will inform policymakers, industry stakeholders, and regulatory bodies in their efforts to foster sustainable economic development while mitigating environmental impacts. Additionally, the study's findings serve as a foundation for tailored strategies and interventions to promote the adoption of green logistics practices, thereby aligning economic progress with environmental responsibility in African nations.

2. LITERATURE REVIEW
2.1 THEORETICAL FOUNDATION

This study draws its theoretical foundation from the Natural Resource-Based View (NRBV) theory and Logistics Theory, which provide complementary perspectives on the interplay between environmental sustainability, logistics operations, and economic performance. The NRBV theory, proposed by Hart (1995), offers a strategic framework for understanding how firms can leverage environmental challenges as opportunities for competitive advantage. It posits that organizations can achieve superior financial performance by proactively developing capabilities in pollution prevention, product stewardship, and sustainable development while minimizing their environmental impact. In green logistics, the NRBV theory suggests that embracing sustainable practices, such as energy-efficient transportation modes, minimizing waste, and optimizing supply chain processes, can enhance operational efficiency, reduce costs, and ultimately contribute to economic growth (Markley & Davis, 2007).

Complementing the NRBV theory, Logistics Theory provides a comprehensive understanding of the intricate networks and processes involved in moving and storing goods, services, and related information (Tseng et al., 2005). It emphasizes the importance of efficient and effective logistics management in facilitating economic activities and enabling trade. By integrating environmental considerations into logistics operations, firms can mitigate their ecological footprint, improve operational performance, enhance customer satisfaction, and ultimately drive economic growth (Wu & Dunn, 1995).

By combining the insights from the NRBV theory and Logistics Theory, this study offers a holistic perspective on the crucial role of green logistics in achieving sustainable economic development in African countries. The NRBV theory highlights the strategic value of environmental responsibility, while the Logistics Theory underscores the significance of efficient and effective logistics management for economic prosperity. Together, these theoretical frameworks provide a robust foundation for evaluating the key drivers of green logistics performance and their impact on economic growth in the African context.

2.2 MEASUREMENT OF GREEN LOGISTICS PERFORMANCE

The measurement of green logistics performance is crucial for assessing logistics operations' environmental impact and sustainability. Green logistics is a modern approach that reduces environmental damage and improves the logistical environment and efficient resource utilization (Seroka-Stolka & Ociepa-Kubicka, 2019). This research asserts that understanding green logistics performance should encompass traditional logistics performance principles while incorporating green development concepts. It recognizes the relationship between green and traditional logistics, where green logistics extends traditional logistics principles in the green and low-carbon era context. Traditionally, logistics performance has been measured by the efficiency and effectiveness of the logistics service provided. However, in the current era of environmental consciousness, logistical operations must prioritize natural world preservation and conservation of limited resources. The concept of "green logistics performance" encompasses this aspiration. The Logistics Performance Index (LPI) and the Green Logistics Performance Index (GLPI) are prevalent measures used to evaluate supply chain effectiveness and environmental factors, respectively (Fan et al., 2022). This research takes a holistic approach by merging the logistical and green levels to fill the research gap, aiming to develop a conceptual model examining how green logistics performance affects economic growth, international trade, and environmental quality.

2.3 PREVIOUS STUDIES

The existing empirical literature provides valuable insights into the relationship between green logistics, economic growth, and environmental sustainability. Several studies have examined the impact of environmental logistics performance indicators (ELPI) on economic indicators across different regions and country groups (Khan et al., 2017; Zaman & Shamsuddin, 2017; Yu et al., 2018). These studies consistently highlight the positive influence of green logistics practices on economic growth, foreign direct investment (FDI) inflows, and trade openness. However, they also reveal the negative impact of greenhouse gas (GHG) emissions and fossil fuel consumption associated with logistics operations on environmental sustainability. Moreover, researchers have explored the role of green logistics in promoting renewable energy consumption and mitigating environmental degradation (Khan et al., 2018; Khan, 2019). These studies suggest that adopting renewable energy sources and green practices can alleviate the harmful effects of logistics operations on the environment while fostering economic activities and export opportunities.

More recently, studies have focused on the impact of green logistics performance on international trade and economic growth in specific regional contexts, such as the One Belt and Road Initiative (OBRI) countries (Li et al., 2021) and the Asia-Pacific Economic Cooperation (APEC) nations (Le et al., 2022). These studies provide empirical evidence of the positive effects of green logistics practices on export trade and economic growth while highlighting the importance of environmental sustainability. Notably, Karaman et al. (2020) and Yingfei et al. (2022) have explored the link between green logistics performance and sustainability reporting, as well as the mediating role of firm performance and service quality. These studies offer insights into the potential of green logistics practices to enhance competitive advantage and stakeholder communication. Despite the valuable contributions of existing research, there remains a gap in understanding the key drivers of green logistics performance and their relative importance in shaping economic growth and environmental sustainability in Africa. Most studies have focused on developed economies or specific regional groupings, leaving a need for empirical evidence tailored to African countries' unique challenges and opportunities.

2.4 CONCEPTUAL MODEL

The conceptual framework in Figure 1 analyzes the Natural Resource-Based View (NRBV) theory and Logistics Theory. The NRBV theory suggests firms can gain a competitive advantage by efficiently managing natural resources and aligning with green logistics practices that mitigate environmental impacts like greenhouse gas emissions. Logistics Theory emphasizes optimizing resource allocation and efficient flow of goods and services. The framework incorporates tracking and tracing capabilities, logistics infrastructure, on-time performance, and customs clearance efficiency, supporting efficient operations and minimizing environmental impacts. By integrating green logistics practices, companies can differentiate services, attract environmentally conscious customers, and gain competitive advantage while contributing to environmental sustainability and economic growth.

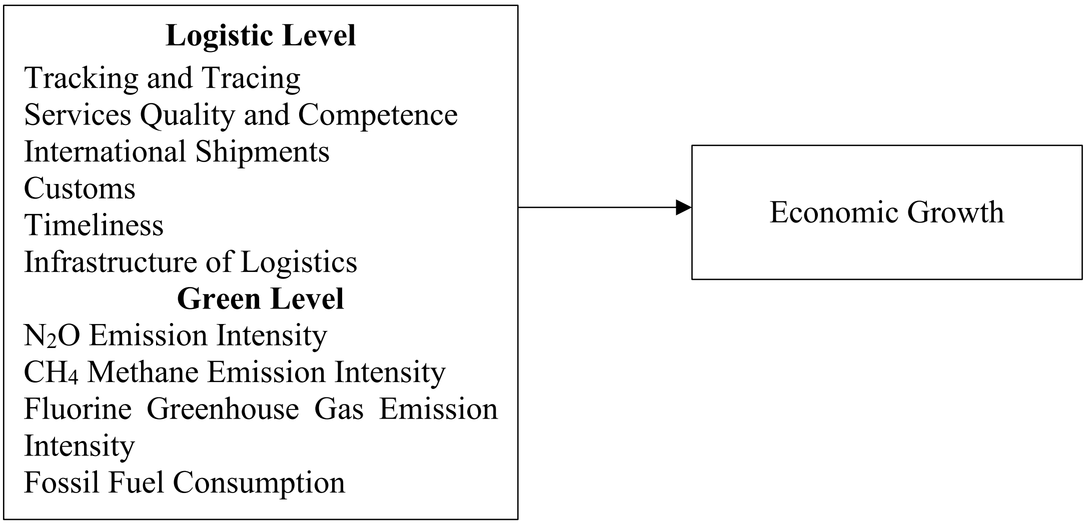

Figure 1. Conceptual Model

3. METHODS
3.1 DATA AND MODEL SPECIFICATION

The study utilizes panel data analysis on African countries from 2007 to 2022, sourced from the World Bank Development Database, to quantitatively evaluate critical drivers of green logistics performance impacting sustainability, economic growth, and trade. The analytical model specification aims to contribute insights into sustainable development and logistics practices in African economies. By adopting a panel data approach, the analytical model in this study can be specified as follows:

$$lnEG_{it} = \rho_1 + \gamma_1 lnLTT_{it} + \gamma_2 lnLCS_{it} + \gamma_3 lnLIS_{it} + \gamma_4 lnLCC_{it} + \gamma_5 lnLT_{it} + \gamma_6 lnLI_{it} + \gamma_7 lnFFC_{it} + \gamma_8 lnNEI_{it} + \gamma_9 lnCHME_{it} + \gamma_{10} lnFGGE_{it} + \mu_{it} \quad (1)$$

Where, In Eq. (1), i denotes the ith country in the panel; t represents time; $p_1$symbolizes the constant; y_1 to y_{10} denote the elasticity coefficients of economic growth ($InEG_{it}$), Ability to Track and Trace Consignments ($InLTT_{it}$), Competence and Quality of Logistics Services ($InLCS_{it}$), Ease of Arranging Competitively Priced Shipments ($InLIS_{it}$), Efficiency of Customs Clearance Process ($InLCC_{it}$), Shipments Reach Consignee Within Scheduled or Expected Time ($InLT_{it}$), Quality of Trade and Transport-Related Infrastructure ($InLI_{it}$), Fossil Fuel Energy Consumption ($InFFC_{it}$), N2O emission intensity ($InNEI_{it}$), CH4 Methane emissions intensity ($InCHME_{it}$), Fluorine Greenhouse Gas Emissions ($InFGGE_{it}$), μ_{it} indicates the error term.

3.2 ECONOMETRIC TECHNIQUES

When analyzing panel data, it is crucial to determine whether the slope coefficients are homogeneous or heterogeneous across cross-sectional units (Granger, 2003). The study employs the F-test and Swamy's (1970) test to examine slope homogeneity, accounting for factors like region-specific characteristics (Breitung, 2005). Additionally, cross-sectional dependence is tested using Pesaran's (2004) CD test and the Breusch-Pagan (1980) LM test, suitable when T > N, to check for potential biases due to trade agreements, spillover effects, and shared borders among cross-sectional units.

The test for cross-sectional dependence (CD) in the error terms is presented as follows:

$$CD = \sqrt{\frac{2G}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \breve{F}_{ij}} \quad (2)$$

Where represents F_{ij} represent the simplest estimate form of the residuals for the pair-wise correlation.

$$\breve{F}_{ij} = \frac{\sum_{q=1}^{Q} \mu_{ij}\mu_{ij}}{\left(\sum_{q=1}^{Q} \mu_{iq}^2\right)^{1/2} \left(\sum_{q=1}^{Q} \mu_{jq}^2\right)^{1/2}} \quad (3)$$

and μ_{ij} Stands as the OLS estimate of φ_{it} in equation (7), it is stated as

$$\varphi_{it} = X_{it} - \alpha_i - \rho_i y_{it}$$

The study examines the stationarity of data, which refers to the constancy of statistical properties over time, using second-generation panel unit root tests (Pesaran, 2007) to account for the cross-sectional dependence expected in the dataset. Specifically, the CADF test (Pesaran, 2007) is employed, as it provides results for the panel as a whole and individual cross-sectional unit, applicable regardless of whether the time dimension (T) is larger or smaller than the cross-sectional dimension (N). The test results are compared against Pesaran's (2007) critical values to assess the presence of unit roots. The CIPS test statistic is derived from the cross-sectional average of the individual Augmented Dickey-Fuller (ADF) t-statistics.

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} t_i(N, \tag{4}$$

Where t_i(N,T) stands as the slope of the t-statistics.

The study employs the Westerlund and Edgerton (2007) approach to investigate cointegration among the series. This method allows for serially correlated errors, heteroskedasticity, cross-sectional dependence, unit-specific time trends, and the detection of unknown structural breaks across cross-sectional units. Additionally, the test's distribution is asymptotically normal and free from nuisance parameters under the null hypothesis, offering advantages over first-generation cointegration tests based on the Lagrange Multiplier (LM) test of stationarity (Schmidt & Phillips, 1992; Ahn, 1993; Amsler & Lee, 1995). Mathematically, these group mean statistics are calculated as follows:

$$G_\tau = \frac{1}{\tau}\sum_{i=1}^{\tau} \frac{\breve{\alpha}_\iota}{Se(\breve{\alpha}_\iota)} \tag{5}$$

$$G_\alpha = \frac{1}{\tau}\sum_{i=1}^{\tau} \frac{T\breve{\alpha}_\iota}{1 - \sum_{j=1}^{m} \breve{\alpha}_{\iota J}} \tag{6}$$

Statistics for Pτ and Pα are used to determine if the whole panel has cointegration and are given in Eqs. (13) and (14):

$$P_\tau = \frac{\breve{\alpha}}{Se(\breve{\alpha})} \tag{7}$$

$$P_\alpha = T\breve{\alpha} \tag{8}$$

The study employs the impulse response function to trace the time path of systemic shocks in the Vector Autoregressive (VAR) system. While the Cholesky decomposition method (Sims, 1980) is widely used, it is sensitive to variable ordering and assumes orthogonal errors. To address this, the study utilizes the Generalized Impulse Response Function (GIRF) introduced by Pesaran and Shin (1998), invariant to variable ordering and accounts for correlated structural errors. The VAR methodology (Sims, 1980) treats all variables symmetrically, allowing for exploring relationships among economic variables and enabling forecasting. In a two-variable system, the time path of one variable is influenced by the current and past realizations of the other variable, and vice versa. Consider the following simple bivariate equation:

$$Y_t = a_{10} + a_{11}y_{t-1} + a_{12}Z_{t-1} + \mu_{1t} \tag{9}$$

$$Z_t = a_{20} + a_{21}y_{t-1} + a_{22}Z_{t-1} + \mu_{2t} \tag{10}$$

The variance decomposition, also known as innovation accounting, analyzes how each independent variable contributes to the variance or fluctuations in the dependent variable over different forecasting horizons. This technique examines the intricate relationships among variables in the Vector Autoregressive (VAR) model, quantifying how forecast errors of one variable can be attributed to shocks or innovations in another variable. It reveals how variables influence each other and how a single variable responds to disturbances within the system. Sims' (1980) innovation accounting technique facilitates interpreting economic implications by decomposing the predicted error variance into components attributable to its innovations and shocks from other variables. Updating equation (21) one period and taking the conditional expectation of X_{t+1}, we obtain:

$$E_t X_{t+1} = A_0 + A_1 X_t \tag{11}$$

Note that, the one-step-ahead forecast error is $X_{t+1} - E_t X_{t+1} = e_{t+1}$. Similarly, updating two periods, we get:

$$X_{t+2} = A_0 + A_1 X_{t+1} + e_{t+2} \tag{12}$$

$$= A_0 + A_1(A_0 + A_1 X_t + e_{t+1}) + e_{t+2}$$

Taking the conditional expectations, the two-step-ahead forecast of X_{t+2} is:

Thus, the associated forecast error is:

$$e_{t+n} + A_1 e_{t+n-1} + A_1^2 e_{t+n-2} + \cdots + A_1^{n-1} e_{t+1} \quad (14)$$

If we use $X_t = \varepsilon + \sum_{i=0}^{\infty} \emptyset_i \mu_{t-i}$ to conditionally forecast X_{t+1}, the one-step-ahead the forecast error is μ_{t+1}

4. RESULTS

Table 1, which contains the descriptive statistics, shows that the mean values of the variables are within reasonable ranges, indicating no extreme outliers. The standard deviations are relatively low, indicating limited dispersion from the mean. The skewness values indicate that most variables are approximately symmetrically distributed, except N2O emission intensity, which is positively skewed. The kurtosis values show that most variables have a leptokurtic distribution, with stronger skews than a normal distribution.

Table 1. Summary of Descriptive Statistics

Variables	Mean	Median	Max	Min	Std. Dev.	Skew	Kurt
InEGit	3.638016	3.643284	4.572452	2.444212	0.392564	-0.1485	2.853706
InLTTit	0.883992	0.889164	1.364929	0.157004	0.158242	-0.27665	4.279457
InLCSit	0.866159	0.86673	1.335001	0.285179	0.143561	0.032322	4.144432
InLISit	0.906362	0.912617	1.287165	0.285179	0.141974	-0.30327	4.061882
InLCCit	0.812818	0.816654	1.279672	0.251314	0.141358	-0.0509	3.860381
InLTit	1.033675	1.039481	1.393766	0.322083	0.14299	-0.48846	4.566541
InLIit	0.797	0.795478	1.332366	0.239017	0.155668	0.217455	4.094154
InFFCit	3.354796	3.560294	4.604949	0.928944	0.899796	-0.79778	2.8728
InNEIit	0.388048	0.442921	4.636261	-2.37608	0.962386	0.881606	7.350279
InCHMEit	3.125211	3.244684	4.595629	-0.4947	0.757893	-0.71719	4.278467
InFGGEit	6.150843	6.183323	10.90959	1.844338	1.721556	0.249437	2.712087

According to Table 2, the homogeneity test results, both the tilde delta test and tilde delta adjusted test statistics, are significant at the 1% level, indicating the rejection of the null hypothesis of slope homogeneity across cross-sections. This finding is consistent with previous studies (e.g., Khan et al., 2018; Yu et al., 2018) that analyzed heterogeneous panel data in the context of green logistics performance.

Table 2. Results from the Homogeneity Test

Test	Statistics	P-value
$\tilde{\Delta}_{test}$	4.912*	0.000
$\tilde{\Delta}_{Adj\ test}$	9.825*	0.000

Table 3 presents the results of the cross-sectional independence test, where the null hypothesis of cross-sectional independence is rejected for all variables at the 1% significance level. This implies the presence of cross-sectional dependence, which is common in panel data studies analyzing macroeconomic and environmental variables (Khan et al., 2020; Li et al., 2021).

Table 3. Results of Cross-Sectional Indepen-dence Test

Variables	CD	P-values
InEGit	139.897*	(0.000)
InLTTit	137.801*	(0.000)
InLCSit	138.029*	(0.000)
InLISit	137.980*	(0.000)
InLCCit	137.682*	(0.000)
InLTit	138.498*	(0.000)
InLIit	137.548*	(0.000)
InFFCit	137.659*	(0.000)
InNEIit	23.412*	(0.000)
InCHMEit	137.597*	(0.000)
InFGGEit	137.399*	(0.000)

Table 4 presents the results of the Westerlund ECM panel cointegration tests, designed to examine cointegration relationships among the variables in a heterogeneous panel data setting. The tests are conducted under two different model specifications, Model IIA and Model IIB, which account for different assumptions regarding the presence of cross-sectional dependence and heterogeneous trends in the data. For both Model IIA and Model IIB, the results show that all four test statistics (Gt, Ga, Pt, and Pa) are statistically significant at the 1% level, leading to the rejection of the null hypothesis of no cointegration. These findings indicate the existence of cointegrating relationships among economic growth, logistics performance indicators, energy consumption, and environmental emissions variables in the panel of African countries. Cointegration relationships imply that these variables share common stochastic trends and move together in the long run despite potential short-term deviations. This result is consistent with the theoretical underpinnings of the natural resource-based view (NRBV) theory and the empirical findings of previous studies (e.g., Khan et al., 2019; Karaman et al., 2020; Fan et al., 2022) that have explored the interconnections between economic growth, logistics performance, and environmental sustainability in various contexts.

Table 4. Westerlund ECM panel cointegration tests

Dependent Variable *InEGit*						
	Model IIA			Model IIB		
G_t	-5.317*	0.000	0.000	-4.996*	0.000	0.000
G_a	-6.818*	0.000	0.000	-9.046*	0.000	0.000
P_t	-23.948*	0.000	0.000	-23.583*	0.000	0.000
P_a	-16.301*	0.000	0.000	-18.610*	0.000	0.000

Table 5 presents the impulse response function results, which illustrate the dynamic responses of economic growth (lnEG) to shocks in the logistics performance indicators, energy consumption, and environmental emissions variables over a 20-period horizon. In the first period, a one-unit shock to economic growth (lnEG) led to a 0.140533 increase in its value, as expected. However, shocks to other variables do not immediately impact economic growth in the same period. Over the subsequent periods, various variables exhibit significant effects on economic growth. The logistics performance indicators, such as the ability to track and trace consignments (lnLTT), competence and quality of logistics services (lnLCS), and shipments reaching consignees within scheduled or expected time (lnLT), exert positive impacts on economic growth. For instance, in period 10, a one-unit shock to lnLTT leads to a 0.007499 increase in lnEG, while shocks to lnLCS and lnLT result in increases of 0.007156 and 0.008316, respectively.

These findings align with the natural resource-based view (NRBV) theory and previous studies (e.g., Khan et al., 2017; Le et al., 2022), highlighting the importance of efficient logistics operations for economic growth. On the other hand, environmental factors such as fossil fuel energy consumption (lnFFC), CH4 methane emissions intensity (lnCHME), and fluorine greenhouse gas emissions (lnFGGE) exhibit negative impacts on economic growth over time. For example, in period 15, a one-unit shock to lnFFC leads to a 0.005989 decrease in lnEG, while shocks to lnCHME and lnFGGE decrease 0.005819 and 0.001107, respectively. These findings are consistent with the NRBV theory and previous studies (e.g., Yingfei et al., 2022; Khan et al., 2023) emphasizing the importance of addressing environmental concerns for sustainable economic growth.

Therefore, based on the impulse response results, the analysis reveals that the timeliness of shipments reaching their consignees within the scheduled or expected timeframe (lnLT) emerges as Africa's most critical driver of economic growth. Closely following is the competence and quality of logistics services (lnLCS), underscoring the importance of efficient and reliable logistics operations. Additionally, the ability to effectively track and trace consignments (lnLTT) plays a significant role in fostering economic expansion. Conversely, factors such as fossil fuel energy consumption (lnFFC), methane emissions intensity (lnCHME), and fluorine greenhouse gas emissions (lnFGGE) exert a negative impact on economic growth, highlighting the need to address environmental concerns and promote sustainable practices within the logistics sector.

Table 5. Impulse Response Function Results for Economic Growth

Response of InEGit										
Period	*InEGit*	*InLTTit*	*InLTit*	*InLISit*	*InLIit*	*InLCSit*	*InLCCit*	*InCHMEit*	*InFFCit*	*InNEIit*
1	0.140533	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	(0.00363)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
2	0.137640	0.000956	0.002006	0.001505	-0.003603	0.002402	-0.000627	-0.000584	-0.000294	0.000254
	(0.00369)	(0.00273)	(0.00271)	(0.00329)	(0.00300)	(0.00276)	(0.00324)	(0.00057)	(0.00083)	(0.00074)
3	0.134865	0.001935	0.003644	0.002621	-0.006290	0.004119	-0.000934	-0.001127	-0.000645	0.000453
	(0.00399)	(0.00487)	(0.00475)	(0.00571)	(0.00530)	(0.00495)	(0.00563)	(0.00111)	(0.00162)	(0.00145)
4	0.132192	0.002901	0.004957	0.003449	-0.008231	0.005320	-0.001053	-0.001635	-0.001039	0.000609
	(0.00444)	(0.00657)	(0.00630)	(0.00747)	(0.00707)	(0.00667)	(0.00738)	(0.00163)	(0.00237)	(0.00213)
5	0.129608	0.003829	0.005989	0.004067	-0.009575	0.006133	-0.001074	-0.002112	-0.001465	0.000733
	(0.00496)	(0.00795)	(0.00747)	(0.00876)	(0.00844)	(0.00803)	(0.00865)	(0.00212)	(0.00310)	(0.00277)
6	0.127105	0.004702	0.006785	0.004529	-0.010446	0.006660	-0.001056	-0.002564	-0.001915	0.000833
	(0.00554)	(0.00909)	(0.00835)	(0.00969)	(0.00950)	(0.00908)	(0.00957)	(0.00259)	(0.00379)	(0.00339)
7	0.124675	0.005510	0.007384	0.004877	-0.010947	0.006974	-0.001038	-0.002993	-0.002379	0.000916
	(0.00613)	(0.01004)	(0.00900)	(0.01035)	(0.01031)	(0.00988)	(0.01021)	(0.00304)	(0.00446)	(0.00399)
8	0.122313	0.006246	0.007819	0.005142	-0.011165	0.007134	-0.001040	-0.003401	-0.002851	0.000985
	(0.00673)	(0.01084)	(0.00948)	(0.01081)	(0.01094)	(0.01049)	(0.01066)	(0.00346)	(0.00511)	(0.00456)
9	0.120014	0.006909	0.008121	0.005344	-0.011169	0.007184	-0.001074	-0.003791	-0.003324	0.001045
	(0.00732)	(0.01153)	(0.00982)	(0.01113)	(0.01142)	(0.01094)	(0.01095)	(0.00387)	(0.00573)	(0.00512)
10	0.117775	0.007499	0.008316	0.005499	-0.011014	0.007156	-0.001146	-0.004164	-0.003794	0.001099
	(0.00790)	(0.01211)	(0.01006)	(0.01134)	(0.01179)	(0.01126)	(0.01114)	(0.00426)	(0.00633)	(0.00565)
11	0.115593	0.008018	0.008425	0.005618	-0.010746	0.007075	-0.001254	-0.004522	-0.004256	0.001148
	(0.00847)	(0.01261)	(0.01022)	(0.01147)	(0.01206)	(0.01148)	(0.01125)	(0.00463)	(0.00692)	(0.00616)
12	0.113466	0.008469	0.008465	0.005710	-0.010400	0.006959	-0.001397	-0.004866	-0.004709	0.001194
	(0.00903)	(0.01304)	(0.01033)	(0.01154)	(0.01226)	(0.01162)	(0.01130)	(0.00498)	(0.00748)	(0.00665)
13	0.111393	0.008856	0.008451	0.005778	-0.010001	0.006822	-0.001570	-0.005196	-0.005150	0.001239
	(0.00958)	(0.01341)	(0.01038)	(0.01157)	(0.01239)	(0.01169)	(0.01132)	(0.00532)	(0.00802)	(0.00713)
14	0.109370	0.009184	0.008394	0.005827	-0.009572	0.006673	-0.001768	-0.005514	-0.005577	0.001282
	(0.01011)	(0.01371)	(0.01040)	(0.01156)	(0.01248)	(0.01171)	(0.01131)	(0.00564)	(0.00854)	(0.00758)
15	0.107397	0.009457	0.008305	0.005861	-0.009126	0.006520	-0.001986	-0.005819	-0.005989	0.001326
	(0.01062)	(0.01397)	(0.01039)	(0.01153)	(0.01253)	(0.01169)	(0.01128)	(0.00595)	(0.00905)	(0.00802)
16	0.105473	0.009681	0.008192	0.005880	-0.008677	0.006368	-0.002220	-0.006113	-0.006386	0.001369
	(0.01113)	(0.01418)	(0.01036)	(0.01147)	(0.01255)	(0.01164)	(0.01124)	(0.00624)	(0.00953)	(0.00845)
17	0.103596	0.009859	0.008059	0.005887	-0.008232	0.006220	-0.002465	-0.006396	-0.006766	0.001413
	(0.01161)	(0.01434)	(0.01031)	(0.01141)	(0.01254)	(0.01157)	(0.01121)	(0.00651)	(0.01000)	(0.00886)
18	0.101765	0.009996	0.007912	0.005882	-0.007796	0.006079	-0.002717	-0.006668	-0.007131	0.001457
	(0.01209)	(0.01447)	(0.01025)	(0.01133)	(0.01251)	(0.01148)	(0.01117)	(0.00677)	(0.01046)	(0.00925)
19	0.099978	0.010096	0.007754	0.005867	-0.007375	0.005945	-0.002973	-0.006930	-0.007479	0.001502
	(0.01255)	(0.01457)	(0.01018)	(0.01124)	(0.01246)	(0.01138)	(0.01113)	(0.00702)	(0.01089)	(0.00963)
20	0.098236	0.010163	0.007589	0.005842	-0.006970	0.005821	-0.003230	-0.007183	-0.007812	0.001548
	(0.01300)	(0.01463)	(0.01010)	(0.01115)	(0.01239)	(0.01127)	(0.01110)	(0.00726)	(0.01131)	(0.00999)

Table 6 presents the variance decomposition results, which quantify the contribution of each variable in explaining the fluctuations in economic growth (lnEG) over the 20-period horizon. Economic growth is primarily driven by innovations in the initial periods, accounting for nearly 100% of the variance decomposition. However, as time progresses, the contributions of other variables become increasingly significant. Among the logistics performance indicators, the ability to track and trace consignments (lnLTT) emerges as a critical driver, explaining 0.387131% of the variance in economic growth by period 20. This finding aligns with the natural resource-based view (NRBV) theory and previous studies (e.g., Khan et al., 2017; Fan et al., 2022), highlighting the importance of efficient logistics tracking and tracing capabilities for economic growth. Another crucial logistics performance indicator is the competence and quality of logistics services (lnLCS), which accounts for 0.263152% of the variance in economic growth by period 20. This result corroborates the NRBV theory and previous research (e.g., Zaman & Shamsuddin, 2017; Yingfei et al., 2022) that emphasize the role of high-quality logistics services in facilitating economic growth.

Interestingly, the ease of arranging competitively priced shipments (lnLIS) and the efficiency of customs clearance processes (lnLCC) contribute relatively less to the variance decomposition of economic growth, accounting for 0.176647% and 0.020970%, respectively, by period 20. Regarding environmental factors, fossil fuel energy consumption (lnFFC) is a significant driver, explaining 0.010836% of the variance in economic growth by period 20. This finding aligns with the NRBV theory and previous studies (e.g., Khan et al., 2018; Li et al., 2021) that underscore the importance of addressing energy consumption for sustainable economic growth. Furthermore, fluorine greenhouse gas emissions (lnFGGE) and CH4 methane emissions intensity (lnCHME) also contribute to the variance decomposition of economic growth, accounting for 0.152240% and 0.142351%, respectively, by period 20. These results are consistent with the NRBV theory and previous research (e.g., Khan et al., 2020; Yingfei et al., 2022), highlighting the need to mitigate greenhouse gas emissions for long-term economic sustainability.

Based on the variance decomposition results, the ability to track and trace consignments (lnLTT) emerges as Africa's most significant driver of economic growth. The competence and quality of logistics services (lnLCS) are closely followed, further emphasizing the pivotal role of efficient logistics operations. Interestingly, fluorine greenhouse gas emissions (lnFGGE) also contribute substantially to economic growth, albeit with potential environmental implications. Conversely, factors such as methane emissions intensity (lnCHME), fossil fuel energy consumption (lnFFC), and the ease of arranging competitively priced shipments (lnLIS) exert a relatively minor influence on economic expansion. Notably, the efficiency of customs clearance processes (lnLCC) ranks as the least influential driver among the variables considered, suggesting potential areas for improvement in streamlining cross-border trade facilitation.

5. DISCUSSION

Among the logistics performance indicators, the ability to track and trace consignments emerges as a prominent driver, as evident from the impulse response function and variance decomposition analyses. Efficient tracking and tracing capabilities enable real-time monitoring of shipments, enhancing supply chain visibility and facilitating timely decision-making. This finding aligns with the natural resource-based view (NRBV) theory, which emphasizes the importance of leveraging logistics capabilities as valuable resources for achieving competitive advantage and sustainable performance (Khan et al., 2017; Fan et al., 2022). Another critical logistics performance driver is the competence and quality of logistics services. High-quality logistics services encompass various aspects, such as professional expertise, reliable transportation networks, and effective coordination among supply chain partners. Efficient logistics services contribute to reduced lead times, minimized disruptions, and improved customer satisfaction, ultimately fostering economic growth. This result resonates with the NRBV theory and previous studies (Zaman & Shamsuddin, 2017; Yingfei et al., 2022), highlighting the strategic importance of logistics service quality in facilitating trade and economic activities.

The timeliness of shipment delivery, as reflected by the variable "shipments reaching consignees within scheduled or expected time," also emerges as a significant driver of economic growth. Timely delivery is crucial for maintaining smooth operations, meeting customer demands, and minimizing inventory holding costs. This finding aligns with the logistic theory and previous research (Le et al., 2022), emphasizing the importance of reliable and punctual logistics operations for economic growth and international trade.
Regarding environmental factors, fossil fuel energy consumption stands out as a critical driver influencing economic growth. Excessive reliance on fossil fuels contributes to environmental degradation and poses risks to long-term economic sustainability.

This result corroborates the NRBV theory and previous studies (Khan et al., 2018; Li et al., 2021), emphasizing the need to transition towards cleaner energy sources and promote energy-efficient practices to ensure sustainable economic growth.

Table 6. Variance Decomposition Function Results for Economic Growth

Variance Decomposition of *InEGit*												
Period	S.E.	*InEGit*	*InLTTit*	*InLTit*	*InLISit*	*InLIit*	*InLCSit*	*InLCCit*	*InCHMEit*	*InFFCit*	*InFGGEit*	*InNEIit*
1	0.140533	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.196777	99.93067	0.002360	0.010397	0.005849	0.033517	0.014897	0.001016	0.000196	2.51E-06	0.000926	0.000167
3	0.238732	99.80693	0.008173	0.030360	0.016026	0.092181	0.039889	0.002221	0.000781	1.78E-06	0.002960	0.000473
4	0.273155	99.65662	0.017523	0.056116	0.028189	0.161221	0.068397	0.003182	0.001898	6.75E-06	0.005992	0.000858
5	0.302683	99.49693	0.030276	0.084857	0.041009	0.231378	0.096765	0.003850	0.003675	3.64E-05	0.009936	0.001286
6	0.328674	99.33805	0.046147	0.114588	0.053766	0.297239	0.123120	0.004299	0.006223	0.000114	0.014722	0.001733
7	0.351944	99.18557	0.064758	0.143953	0.066095	0.355985	0.146642	0.004618	0.009630	0.000260	0.020299	0.002189
8	0.373026	99.04221	0.085686	0.172078	0.077833	0.406467	0.167109	0.004888	0.013968	0.000495	0.026624	0.002646
9	0.392299	98.90890	0.108494	0.198442	0.088928	0.448562	0.184624	0.005169	0.019283	0.000831	0.033664	0.003103
10	0.410039	98.78555	0.132758	0.222775	0.099385	0.482743	0.199448	0.005512	0.025608	0.001277	0.041390	0.003559
11	0.426460	98.67148	0.158078	0.244973	0.109235	0.509782	0.211904	0.005961	0.032955	0.001835	0.049780	0.004015
12	0.441730	98.56576	0.184094	0.265049	0.118520	0.530575	0.222323	0.006556	0.041326	0.002505	0.058814	0.004473
13	0.455984	98.46737	0.210484	0.283082	0.127283	0.546028	0.231021	0.007338	0.050710	0.003280	0.068473	0.004936
14	0.469335	98.37527	0.236969	0.299195	0.135561	0.556996	0.238279	0.008345	0.061087	0.004152	0.078740	0.005405
15	0.481877	98.28853	0.263312	0.313531	0.143389	0.564250	0.244345	0.009616	0.072428	0.005112	0.089599	0.005884
16	0.493687	98.20631	0.289314	0.326240	0.150796	0.568467	0.249431	0.011183	0.084702	0.006149	0.101035	0.006375
17	0.504835	98.12785	0.314814	0.337472	0.157807	0.570225	0.253717	0.013079	0.097872	0.007251	0.113032	0.006880
18	0.515380	98.05253	0.339680	0.347369	0.164441	0.570015	0.257352	0.015329	0.111897	0.008407	0.125575	0.007400
19	0.525371	97.97981	0.363811	0.356066	0.170716	0.568245	0.260462	0.017954	0.126738	0.009605	0.138650	0.007939
20	0.534855	97.90924	0.387131	0.363684	0.176647	0.565253	0.263152	0.020970	0.142351	0.010836	0.152240	0.008497

Additionally, greenhouse gas emissions, including CH4 methane emissions intensity and fluorine greenhouse gas emissions, are identified as critical drivers impacting economic growth. These emissions contribute to climate change, which can have far-reaching consequences on various economic sectors, such as agriculture, tourism, and infrastructure. This finding aligns with the NRBV theory and previous research (Khan et al., 2020; Yingfei et al., 2022), highlighting the importance of mitigating greenhouse gas emissions and adopting environmentally friendly practices for long-term economic sustainability. It is worth noting that while factors such as the ease of arranging competitively priced shipments and the efficiency of customs clearance processes contribute to economic growth, their impact is relatively minor compared to the aforementioned vital drivers. This suggests that while these factors are essential, prioritizing investments in logistics tracking and tracing capabilities, enhancing service quality, and addressing environmental concerns may yield more significant economic growth and sustainability gains.

The findings from this study underscore the need for a holistic approach to economic development in the African region. Efforts should be directed toward strengthening logistics capabilities, particularly in tracking and tracing, service quality, and timely delivery. Simultaneously, environmental concerns related to energy consumption and greenhouse gas emissions must be addressed through policy interventions, technological innovations, and adopting sustainable practices. By prioritizing these key drivers, African countries can leverage their logistics strengths while mitigating environmental risks, paving the way for long-term economic growth that is sustainable and aligned with the principles of the natural resource-based view (NRBV) theory.

6. CONCLUSION

The primary objective of this study was to evaluate the key drivers of green logistics performance amid economic growth in the African region, spanning the period from 2007 to 2022. Employing a quantitative approach and panel data analysis, the research drew upon data from the World Bank Development Database, incorporating measures of economic growth, logistics performance indicators, energy consumption, and environmental emissions. The findings unveiled a set of crucial drivers that significantly influence economic growth in Africa. Among these, the ability to track and trace consignments, the competence and quality of logistics services, and the timeliness of shipment delivery emerged as pivotal logistics performance indicators. These factors facilitate efficient supply chain operations and contribute to enhanced trade facilitation, ultimately fostering economic growth. Concurrently, environmental factors, such as fossil fuel energy consumption, CH4 methane emissions intensity, and fluorine greenhouse gas emissions, exhibited negative impacts on economic growth, underscoring the importance of addressing environmental concerns for sustainable development.

These results significantly affect managerial practices within the logistics and supply chain domains. Businesses operating in the African region should prioritize investments in robust tracking and tracing systems, enabling real-time visibility and proactive decision-making. Additionally, enhancing the quality of logistics services through professional training, infrastructure development, and collaborative partnerships with logistics service providers is crucial for achieving operational excellence and driving economic growth. From a practical standpoint, the study's findings highlight the need for policymakers and government agencies to foster an enabling environment supporting efficient logistics infrastructure and services development. This may involve streamlining customs procedures, implementing trade facilitation measures, and promoting public-private partnerships for logistics infrastructure development. Simultaneously, formulating and enforcing stringent environmental regulations and incentives for adopting cleaner technologies are essential to mitigate the adverse effects of energy consumption and greenhouse gas emissions on economic growth.

Theoretically, the study reinforces the tenets of the natural resource-based view (NRBV) theory, which posits that leveraging valuable resources, such as logistics capabilities and environmental practices, can contribute to competitive advantage and sustainable performance. The findings underscore the strategic importance of integrating logistics excellence with environmental sustainability to achieve long-term economic growth, thereby aligning with the principles of the NRBV theory. While this study provides valuable insights, it is essential to acknowledge its limitations, which can motivate future research directions. First, the analysis focused on a specific set of logistics performance indicators and environmental factors; future studies could explore additional variables or employ alternative methodologies to capture a more comprehensive understanding of the drivers influencing economic growth. Second, the study employed a regional perspective by considering African countries collectively; future research could delve into country-specific or sub-regional analyses to uncover potential heterogeneities and tailor strategies accordingly.

Furthermore, as the global economic landscape continues to evolve, future research could investigate the impact of emerging trends, such as digitalization, the circular economy, and the COVID-19 pandemic, on the interplay between logistics performance, environmental sustainability, and economic growth. By addressing these limitations and exploring new avenues, researchers can contribute to a more nuanced understanding of the complex dynamics shaping sustainable economic development in the African region and beyond.

REFERENCES

Ahn, S. K. (1993). Some tests for unit roots in autoregressive-integrated-moving average models with deterministic trends. *Biometrika, 80* (4), 855-868. https://doi.org/10.1093/biomet/80.4.855

Amsler, C., & Lee, J. (1995). An LM test for a unit root in the presence of a structural change. *Econometric Theory, 11*(2), 359-368. https://doi.org/10.1017/S026646660000921X

Breitung, J. (2005). A parametric approach to the estimation of cointegration vectors in panel data. *Econometric Reviews, 24*(2),151-173. https://doi.org/10.1081/ETC-200067895

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The Review of Economic Studies, 47*(1), 239. https://doi. org/10.2307/2297111

Granger, C. W. (2003). Some aspects of causal relationships. *Journal of Econometrics, 112*(1), 69-71. https://doi.org/10.1016/S0304-4076(02)00148-3

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review, 20*(4), 986-1014. https://doi.org/10.5465/amr.1995.9512280033

International Energy Agency (2022). *Africa Energy Outlook 2022.* Paris, IEA Publications. https://doi.org/10.1787/2abd9ce2-en

Karaman, A.S., Kılıç, M., & Uyar, A. (2020). Green logistics performance and sustainability reporting practices of the logistics sector: The moderating effect of corporate governance. *Journal of Cleaner Production, 258,* 120718. https://doi.org/10.1016/j.jclepro.2020.120718

Khan, S. A. R., & Qianli, D. (2017). Does national scale economic and environmental indicators spur logistics performance? Evidence from UK. *Environmental Science and Pollution Research, 24,* 26692-26705. https://doi.org/10.1007/s11356-017-0222-9

Khan, S. A. R., Zhang, Y., Anees, M., Golpîra, H., Lahmar, A., & Qianli, D. (2018). Green supply chain management, economic growth and environment: A GMM based evidence. *Journal of Cleaner Production, 185,* 588-599. https://doi.org/10.1016/j.jclepro.2018.02.226

Le, T. H., Nguyen, H. K., & Nguyen, T. L. (2022). Impact of Green Logistics on International Trade: An Empirical Study in Asia–Pacific Economic Cooperation. International *Journal of Economics and Financial Issues, 12*(4), 97-105. https://doi.org/10.32479/ijefi.13185

Li, X., Sohail, S., Majeed, M. T., & Ahmad, W. (2021). Green logistics, economic growth, and environmental quality: evidence from one belt and road initiative economies. *Environmental Science and Pollution Research, 28*, 30664-30674. https://doi.org/10.1007/s11356-021-12839-4

Markley, M. J., & Davis, L. (2007). Exploring future competitive advantage through sustainable supply chains. International *Journal of Physical Distribution & Logistics Management, 37*(9), 763-774. https://doi.org/10.1108/09600030710840859

Pesaran, H. H., & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters, 58*(1), 17-29. https://doi.org/10.1016/S0165-1765(97)00214-0

Sims, C. A. (1980). Macroeconomics and reality. *Econometrica, 48*(1), 1-48. https://doi.org/10.2307/1912017

Pesaran, M.H. (2004). General diagnostic tests for cross-sectional dependence in panels. *Empirical Economics, 60,* 13 - 50. https://doi.org/10.1007/s00181-020-01875-7

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics, 22*(2), 265-312. https://doi.org/10.2139/ssrn.457280

Rao, P., & Holt, D. (2005). Do green supply chains lead to competitiveness and economic performance? *International Journal of Operations & Production Management, 25*(9), 898-916. https://doi.org/10.1108/01443570510613956

Rodrigue, J. P., Comtois, C., & Slack, B. (2017). The geography of transport systems (4th ed.). Abingdon, Oxon: Routledge. https://doi.org/10.4324/9781315618159

Schmidt, P., & Phillips, P. C. (1992). LM tests for a unit root in the presence of deterministic trends. *Oxford Bulletin of Economics and Statistics, 54*(3), 257-287. https://doi.org/10.1111/J.1468-0084.1992.TB00002.X

Seroka-Stolka, O., & Ociepa-Kubicka, A. (2019). Green logistics and circular economy. *Transportation Research Procedia, 39*, 471-479. https://doi.org/10.1016/J.TRPRO.2019.06.049

Sims, C. A. (1980). Macroeconomics and reality. *Econometrica, 48*(1), 1-48. https://doi.org/10.2307/1912017

Swamy, P. A. V. B. (1970). Efficient inference in a random coefficient regression model. *Econometrica, 38*(2), 311-323. https://doi.org/10.2307/1913012

Tseng, Y. Y., Yue, W. L., & Taylor, M. A. (2005). The role of transportation in logistics chain. Proceedings of the Eastern Asia Society for Transportation Studies, 5, 1657-1672.

United Nations Environment Programme (UNEP). (2021). *Emissions Gap Report 2021*. Available at:https://www.unep.org/resources/emissions-gap-report-2021 (Accessed May 30, 2024).

Westerlund, J., & Edgerton, D. L. (2007). A panel bootstrap cointegration test. *Economics Letters, 97*(3), 185-190. https://doi.org/10.1016/J.ECONLET.2007.03.003

Wu, H. J., & Dunn, S. C. (1995). Environmentally responsible logistics systems. *International Journal of Physical Distribution & Logistics Management, 25*(2), 20-38. https://doi.org/10.1108/09600039510083925

Yingfei, Y., Mengze, Z., Zeyu, L., Ki-Hyung, B., Avotra, A. A. R. N., & Nawaz, A. (2022). Green logistics performance and infrastructure on service trade and environment-measuring firm's performance and service quality. *Journal of King Saud University-Science, 34*(1), 101683. https://doi.org/10.1016/j.jksus.2021.101683

Yu, Z., Golpira, H., & Khan, S. A. R. (2018). The relationship between green supply chain performance, energy demand, economic growth and environmental sustainability: An empirical evidence from developed countries. *LogForum, 14*(4), 479-494. http://dx.doi.org/10.17270/J.LOG.2018.304

INFORMATION ABOUT THE AUTHORS

***Ali U. Ahmad** – PhD Student, Faculty of Maritime Study, Universiti Malaysia Terengganu, Terengganu, Malaysia, email: aliumarahmd@gmail.com , ORCID ID https://orcid.org/0000-0003-0296-8093

Jeevan, J. – PhD, Associate Professor, Faculty of Maritime Study, Universiti Malaysia Terengganu, Terengganu, Malaysia, ORCID ID: https://orcid.org/0000-0002-0625-5018

Siti Marsila M. Ruslan– PhD, Faculty of Maritime Study, Universiti Malaysia Terengganu, Terengganu, Malaysia.

АВТОРЛАР ТУРАЛЫ МӘЛІМЕТТЕР

Ахмад А.У. – PhD докторант, теңізтану факультеті, Теренгану Малайзия университеті, Тренгану, Малайзия, email: aliumarahmd@gmail.com, ORCID ID https://orcid.org/0000-0003-0296-8093
Дживан Д. **–** PhD, қауымдастырылған профессорб теңізтану факультеті, Теренгану Малайзия университеті, Тренгану, Малайзия, ORCID ID: https://orcid.org/0000-0002-0625-5018
Руслан С.М.М. – PhD, теңізтану факультеті,Теренгану Малайзия университеті, Тренгану, Малайзия, ORCID ID: https://orcid.org/0000-0002-6050-9883

СВЕДЕНИЯ ОБ АВТОРАХ

Ахмад А.У. – PhD докторант, факультет морских исследований , Малазийский университет Тренгану, Тренгану, Малайзия, email: aliumarahmd@gmail.com, ORCID ID https://orcid.org/0000-0003-0296-8093
Дживан Д. – PhD, факультет морских исследований, Малазийский университет Тренгану, Тренгану, Малайзия, ORCID ID: https://orcid.org/0000-0002-0625-5018
Руслан С.М.М. – PhD, факультет морских исследований, Малазийский университет Тренгану, Тренгану, Малайзия, ORCID ID: https://orcid.org/0000-0002-6050-9883