THE IMPACT OF ENVIRONMENTAL CONSCIOUS LOGISTIC IN INDIA: AN EMPIRICAL ANALYSIS

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Abstract

The study investigates the interplay between environmentally friendly supply chains, energy demands, and socio-economic factors within the Indian context from 2007 to 2023. It highlights the growing importance of green logistics in supply chain management, particularly in response to environmental concerns and the urgent need to reduce carbon emissions. Employing comprehensive statistical analysis, the study underscores the necessity of implementing legislative measures to facilitate India's transition toward sustainable economic growth. The methodology, which includes descriptive statistics to assess central tendencies, variability, skewness, and kurtosis, along with unit root tests confirming the stationarity of time series variables post-differencing, enhances predictive accuracy. Granger causality tests reveal significant causal relationships among various economic variables, shedding light on their interdependencies. Regression analysis further elucidates the impact of green logistics on energy demand, economic stability, and environmental factors in India. Data for this study were sourced from the Worldwide Input-Output Database (WIOD, 2019) for the specified period. Policy recommendations emphasize the promotion of clean energy sources, the establishment of emissions standards, investments in sustainable infrastructure, stakeholder collaboration, and the integration of financial incentives aligned with climate goals. Additionally, the development of legal frameworks to encourage the adoption of eco-friendly logistics practices and the promotion of educational initiatives aimed at engaging both industry stakeholders and the general public are advocated. Collectively, these strategies could help India reduce transportation emissions, enhance sustainability, and contribute to global climate objectives, fostering a cleaner energy environment.

Keywords: Green Supply Chain, Econometrics, India, Economic Growth, Environmental Degradation.

1. INTRODUCTION

Supply chains rely heavily on logistics as it encompasses multiple components of the supply chain, including material handling, inventory storage, freight transportation, and information processing for enabling the smooth flow of products through effective supply chain procedures. Logistics corporations widely adopted the concept of Green Supply Chain Management in the 1990s. Logistics operations undeniably make a significant contribution to air pollution and can also have an impact on the economies of countries (Khan et al., 2017).

Recent rise in the consciousness surrounding environmental concerns and the release of greenhouse gases. Numerous businesses are actively adopting environmentally friendly methods to attain social, environmental, and economic advantages within their supply chains (Martel and Klibi, 2016).

This article focuses on analysing the correlation between environmentally sustainable supply chains and energy demands. The findings demonstrate a direct link between the demand for renewable energy and the effectiveness of environmentally-conscious logistics in India.

The study suggests that many Indian companies are actively pursuing eco-friendly logistics practices to address environmental issues. The findings also suggest that carbon emissions have a negative impact on both per capita income in the manufacturing sector and the contribution of the service sector to the Gross Domestic Product (GDP).

Based on available data from 2020, India presents significant insights regarding transportation. As the world's third-largest emitter of carbon dioxide (CO_2), India has experienced a notable increase in Per capita Carbon Dioxide (CO_2) emissions within its transportation sector over recent decades. These emissions have risen from 0.39 metric tons in 1970 to a peak of 1.91 metric tons in 2022. Furthermore, total CO_2 emissions in India reached a record high in 2022 (Statista 2022). Severe environmental degradation has resulted from regulatory bodies' incapacity to implement environmental-sustainability policies in an effective manner (Turaga & Sugathan, 2020).

Governments and communities are concerned as a result of the growth of international transportation and supply chain operations. Numerous health problems, such as impaired lung function, neurobehavioral abnormalities, and an increase in asthma attacks, have been linked to high pollution levels in society(S. Dasgupta et an., 2001). Strict regulations, greater public knowledge of environmental effects, and the adoption of efficient pollution management strategies are needed in order to meet these challenges. Societies can attempt to lessen the negative impacts of environmental deterioration by emphasising ecoefficiency, supporting alternative methods for pollution control, and concentrating on sustainable development strategies(S. N. Shah, 2022) .

Logistic management is an important part of supply chain management. The growing awareness among customers about eco-friendly and green products is putting pressure on firms to adopt green practices in their logistics and supply chain operations. Investing in green energy not only provides a competitive advantage but also ensures long-term sustainable growth for the organization. The concept of green logistics has emerged as a response to controlling eco-friendly factors that impact fuel consumption (Demir et al., 2014). The emerging concept of green logistic tend promises to crucial cut of Co_2 emissions and fuel exhaustion over the long haul, although coexisting strengthens the environmental performance of goods transportation.

Logistics are important elements in the field of Supply Chain Management across the whole world that associate suppliers and end users, even if they present ecological risks including Co_2 emissions and bad air quality (Tianqi LI1 et al., 2023). Businesses can reduce their co_2 footprint and fight environmental change while, promising efficacious delivery services in the e-commerce industry by using environment-friendly techniques like dynamic track navigation and ecological cost considerations. The industry’s reaction to the crucial ecological issues it faces is seen in this shift towards environment-friendly logistics, which highlights the significance of green practices in India logistics operation.

2. LITERATURE REVIEW

Environmental-friendly logistics stands as an important component of the eco-friendly supply chain management process, which has been a universal focus over the past few decades, projected by globalization, consumer stipulations, market rivalry, and the designing of new markets. In the following sub-sections, the detailed literature review has been given.

2.1 Association between Environmental-friendly Supply Chain and Energy need

Eco-friendly logistics and energy need has an important association with supply chain management (SCM). Environmentally conscious highlights the need for green energy sources to be included I order to reduce the negative environmental impact of worldwide logistic indicators. Study shows that an important part of logistic operations originates from non-renewable energy sources, such as fossil fuels, which has a bad impact on the environment (Yu et al., 2021a). Furthermore, it has been expressed that logistics efficiency indices affect energy consumption and eco-friendly deterioration, with a focus on the contribution of green energy and green practices to decrease the environmental impact of logistic operations (Wan et al., 2022a) (Hart, 2014). Important approaches include encouraging green innovation, using renewable energy, supporting economic globalisation, and coordinating industry regulations to sustainable development goals (Yu et al., 2021a).

While the concept of Green Logistics Performance (GLP) is assessed on variables including trade infrastructure quality, customs clearance efficiency, along with logistics provider competence to reduce emissions, sustainable logistics comprises measures targeted at improving the sustainability of the environment. The relationship between national economic indications, such as the consumption of renewable energy, and green logistics was studied by (Khan et al., 2017). Their results support sustainable supply chain management by showing a good integration between economic and logistics parameters. Energy is used in logistics operations by nature, and it plays a big role in helping them accomplish their goals.

This demonstrates the significance of incorporating energy efficiency into logistical procedures in order to comply with environmental sustainability objectives (Maurya et al., 2023a)(Pradeep & Alisher ova, 2023b). Noted that when labour and capital are added, energy efficiency has a beneficial effect on economic growth (Noor liza, 2023). promoted greener or cleaner energy as a crucial component of sustainable development and suggested laws be implemented by the government to encourage the use of cleaner technologies in commercial operations (Daniel Garcia-Rodriguez et al., 2023a). emphasised the substantial effects of trade policies, population expansion, energy consumption, and air pollution on the sustainability of the environment globally (Wan et al., 2022b). verified that there is a significant correlation between large economies' economic characteristics and the amount of energy used in logistics operations (Maurya et al., 2023b).

Businesses use eco-efficient strategies to cut carbon emissions while also deliberately implementing sustainable practices to improve economic efficiency (Xiaolong Li1 et al., 2021). By lowering carbon footprints, fostering cleaner production, and boosting the use of renewable energy, the practice of green supply chain management, or GSCM, significantly contributes to improving environmental sustainability (Tianqi LI et al., 2023& Rimi Karmakar et al., 2023). Employing GSCM techniques, such as product reuse, recycling, and remanufacturing, saves businesses a lot of money in addition to

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conserving non-renewable resources(Wei Zhao et al., 2022) (Yu et al., 2021). A lack of penalties can lead to greater emission levels and discourage eco-friendly practices, which is why studies highlight the significance of stringent regulations and carbon taxing encourage businesses to handle their supply chains more sustainably. India companies stand out in particular for their initiatives to use renewable energy sources and greener industrial techniques in order to enhance their environmental reputation. According to the article of (Times 0f India 2023) Indian logistics are currently striving to reduce their carbon footprint within their operations, with a goal of achieving zero emissions across all sectors. India is implementing GPS-enabled toll payments to minimize fuel wastage and associated emissions at the country’s numerous toll plazas. The figure below, sourced from "India Energy Outlook 2021," illustrates the CO2 emissions from various sectors in India.

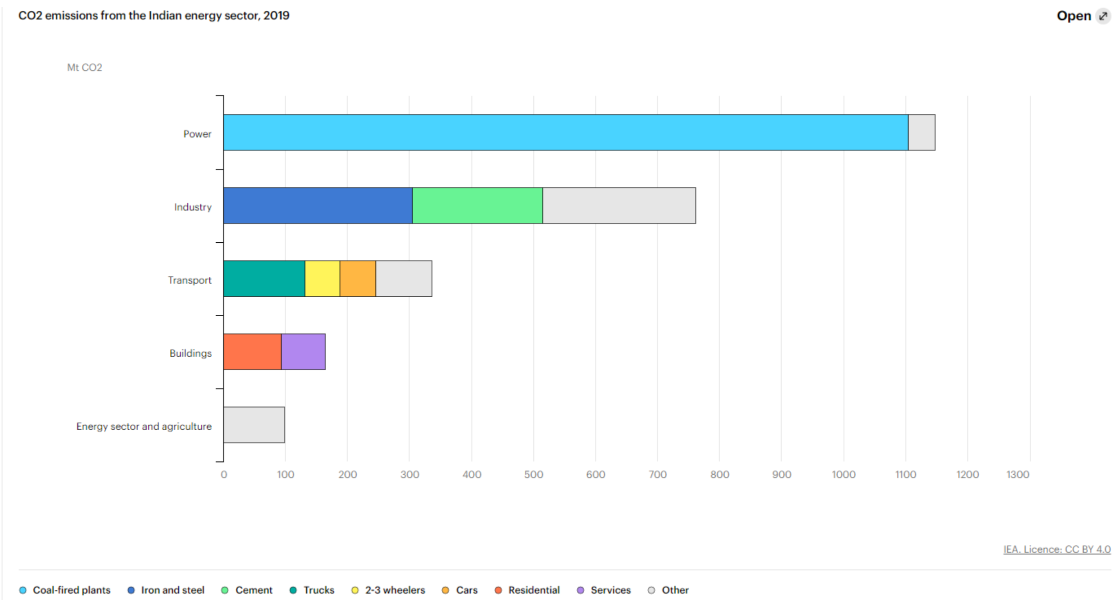

Fig 1: India-energy-outlook-2021

(Source: IEA, CO2 emissions from the Indian energy sector, 2019)

2.2 Relationship between eco-friendly logistics and Ecological Factors

Environment protection from the damaging effects of logistical operations and freight transportation, green supply chain management, or GSCM, is essential (Marchesini & Gaudêncio, 2023).Shipment and logistics operations pose serious environmental problems, underscoring the importance of supply chain policies that prioritise ecological protection (Apolaagoa et al., 2023). The ecosystem conservation, management of waste, energy conservation, alternative sources of energy, and reducing the carbon footprint are just a few of the many facets of environmental sustainability that fall under the purview of GSCM (Obádovics et al., 2023).

The earlier studies on supply chain management (GSCM) underscore the significance of putting green initiatives into action to counteract the ecological damage that supply chain operations create, as well as the need for sustainable practices to yield long-term environmental benefits (Saad & Khamkham, 2022). To strengthen GSCM and make long-lasting gains, researchers and practitioners are urged to investigate cutting-edge technologies like artificial intelligence. The environment is greatly harmed by non-green supply chain operations, and this is where Climate Friendly logistic comes into play(Daniel Garcia-Rodriguez et al., 2023b).

One way to drastically cut down harmful emissions, global warming, and environmental damage is to incorporate green practices into logistics and transportation (Ibrahim et al., 2023).An 80% reduction in detrimental environmental effects can be achieved by businesses using GSCM, notwithstanding the difficulties they encounter in organisational decision-making and performance evaluation (Rizki et al., 2022). A company's potential to reduce uncertainty, boost its reputation, and gain market share is increased when green practices are incorporated into the strategy. All things considered, adopting greener supply chain and logistics practices lowers carbon emissions, which not only improves energy efficiency and waste reduction but also advances environmental sustainability. The sustainability of the environment has been impacted globally in recent decades by the notable rise in carbon emissions caused by industrialization.

Excessive CO2 emissions per car have been found in studies conducted in Thailand and Laos, which is especially detrimental to Thailand's tourism sector (Chikezie Ekwueme et al., 2023). Companies are recommended to localise production facilities in order to cut down on lead times and use sources of environmentally friendly energy in logistics to ensure long-term sustainability in order to offset this (Chaitongrat & Areerakulkan, 2022). Extensive research on European nations highlights the necessity for strict environmental regulations for both economic prosperity and foreign investments, as CO2 and GHG emissions have a detrimental impact on economic growth, export prospects, international reputation, and FDI inflows (Vithayaporn et al., & Adebayo et al., 2023). Minimising emissions by using renewable energy sources and green logistics can have a substantial good impact on the environment and monetary outcomes. The literature study, on green logistics has a major impact on improving eco-friendly sustainability.

The customers and regulatory bodies are pressuring businesses to incorporate green practices and use ECO- friendly resources within supply chains and logistical operations (Maurya et al., 2023 & Alam, 2023). Ecological sustainability is significantly impacted by global logistics activities, which are determined by fossil fuel and energy usage (Leung et al., 2023). Study from the United Kingdom demonstrates that the use of renewable energy and green logistics techniques are positively correlated, whereas the use of fossil fuels is negatively associated, improving both environmental sustainability and economic health (Tianqi LI1 et al., 2023). To prevent climate change and global warming, businesses must develop renewable initiatives, enforce rigorous environment friendly practices, and raise customer knowledge of the serious health and environmental consequences caused by emissions from logistics operations (Daniel Garcia-Rodriguez et al., 2023b). By implementing eco-friendly techniques is important in addressing the large emissions of CO2 along with PM 2.5 produced by logistics activities, as highlighted by the scientific analysis on environmentally friendly methods in logistics activities (Maurya et al., 2023c)(Tianqi LI1 et al., 2023).

Study emphasises the need of comprehending the driving forces, interested parties, and obstacles to implementing green logistics methods, including the labour shortage and the requirement for reverse logistics expertise (Leung et al., 2023)(Daniel Garcia-Rodriguez Et Al., 2023b). As stated by the study, green technology has the ability to lessen the carbon footprint in the IT industry and cut polluting gases by as much as 15

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by 2020(Jarašūnienė & Bazaras, 2023) . Making laws that effectively encourage eco-friendly development and protect the environment in worldwide logistics operations requires the cooperation of regulatory bodies, consumer awareness campaigns, industry leaders, and lawmakers.

2.3 Interconnection between Environment-friendly Logistic and economic growth.

Environment-friendly execution in logistics and supply chain operations have encouraged economic growth through environmentally conscious purchasing habits and the environment-friendly design of goods and services, ultimately contributing to enhanced economic performance for the firm(Khan et al., 2017). The application of high levies on petroleum and coal by governments in an effort to foster green energy sources may have unpredicted implications in the field of sustainable mobility and green logistics (Thi et al., 2023). Such high levies most impacted the transportation Industry, which may make biomass projects more difficult to implement because of higher transportation costs in renewable supply chains (Shardeo & Sarkar, 2024). Research has demonstrated that foreign direct investments and tourists from other countries are drawn to sustainable transit, which in turn promotes economic growth and increases GDP (Guo & Zhang, 2023&Shayanmehr et al., 2023).

Furthermore, Renewable logistics methods contribute to advantages including tax exemptions and expedited customs clearance procedures in some countries, in addition to enhancing the reputations of businesses both nationally and internationally (Osman et al., 2023).At the last, incorporating renewable practices and green energy into transportation and transporting freight can increase foreign investment and support economic. By minimising waste and boosting sustainability, green practices such as eco-friendly sustainable practices and green production practices are essential for increasing economic. Applying green practices fosters innovation and boosts revenues in addition to having a favourable effect on a business's market share, competitive advantage, and customer loyalty (Ahsan & Ahmed, 2023)(Trisnawati et al., 2022).

Study has indicated that lean manufacturing techniques, when combined with green production methods, significantly improve production performance(Tianqi LI1 et al., 2023). Moreover, green practices have a major impact on the sustainability performance of corporations, highlighting the significance of using sustainable practices to improve market positions and reduce environmental damage (Maurya et al., 2023d). Thus, in line with the conclusions of the research articles supplied, including decreased waste through sustainable methods can ultimately result in cost savings and enhanced financial performance for businesses. To enhance both economic performance and environmental sustainability, scholars emphasize waste reduction in the realm of sustainable supply chain management and logistics (SCM). By implementing green logistics techniques, companies not only improve their financial outcomes but also expand their market share and cultivate customer loyalty(Holling & Backhaus, 2023)(Daniel Garcia-Rodriguez Et Al., 2023c) The economic progress of a nation hinges significantly on its infrastructure and logistical capacities, which are pivotal elements of logistics operations.

Evidence from studies conducted in the Indian market underscores the enduring profitability advantages of green logistics techniques. In essence, achieving robust economic growth while curbing the industry's environmental footprint necessitates the seamless integration of green practices into SCM and logistics(Zhou et al., 2023). This integration represents a multifaceted approach that not only drives financial gains but also fosters environmental stewardship, positioning businesses and nations alike for long-term success in a sustainable global economy.

Non-green systems of logistics not just discourage foreign investors however they also result in significant expenditures for logistics and supply chain activities due to ineffective customs clearance procedures and limited export options. On the other hand, by reducing waste and utilising renewable energy sources, green supply chain activities improve business financial performance in addition to protecting environmental sustainability(Hartmann et al., 2015)

Green Supply Chain in India

India has achieved notable progress in recent years by actively pushing eco-friendly supply chain practices and switching to green energy sources. The government of India has adopted many laws and measures to encourage sustainability and the usage of green energy in supply chains.

Year	Policy
2008	National Action Plan on Climate Change (NAPCC)
	• Outlines various missions and initiatives to address climate change and promote sustainable development
	• Includes missions such as the National Solar Mission, National Mission for Enhanced Energy Efficiency, and National Mission on Sustainable Habitat
2010	National Solar Mission (NSM)
	• Aims to promote the development of solar energy in India and increase the share of solar power in the country's energy mix
	• Includes targets for solar capacity addition, incentives for solar power generation, and support for solar manufacturing
2011	National Wind Energy Mission (NWEM)
	• Focuses on harnessing India's wind energy potential by facilitating the development of wind power projects
	• Includes measures to promote investment in wind energy infrastructure, streamline regulatory processes, and enhance grid integration
	• Renewable Purchase Obligation (RPO)
	• Mandates electricity consumers, including industries, to procure a certain percentage of their power from renewable sources
	• Encourages businesses to invest in renewable energy and supports the growth of the renewable energy sector
2015	Goods and Services Tax (GST) Incentives for Renewable Energy Equipment
	• Provides GST incentives for various renewable energy equipment and components
	• Makes renewable energy projects more affordable and encourages their adoption by businesses
2017	Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) Scheme
	• Promotes the adoption of electric vehicles (EVs) and hybrid vehicles in India
	• Provides incentives for the purchase of EVs, development of charging infrastructure, and manufacturing of electric and hybrid vehicles
2018	Industrial Energy Efficiency and Conservation (IEEC) Program
	• Aims to improve energy efficiency in industries through capacity building, technical assistance, and financial incentives
	• Encourages industries to adopt energy-efficient technologies and practices to reduce energy consumption and greenhouse gas emissions
2019	Energy Conservation Building Code (ECBC)

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	• Sets energy performance standards for new commercial buildings and major renovations
	• Promotes energy efficiency in the building sector through requirements for building envelope, lighting, HVAC systems, and renewable energy integration
2020	Atma Nirbhar Bharat Abhiyan (Self-Reliant India Mission)
	• Includes initiatives to promote self-reliance and economic recovery post-COVID-19 pandemic
	• Emphasizes green and sustainable development, including investments in renewable energy, energy efficiency, and green infrastructure
2021	Green Hydrogen Policy
	• Aims to promote the production and use of green hydrogen as a clean and sustainable energy carrier
	• Aims to establish India as a global leader in green hydrogen production and deployment

3. METHODOLOGY AND DATA SOURCE

This paper examines the connections between green logistics, energy demand, economic health, and environmental factors within the Indian context. Energy contributes significantly to the economic development through the mechanisms of logistics, and in the lack of green laws and practices, supply chain management (SCM) has a major impact on both the environment and the economy. To evaluate the impact, the study has identified the following variables for the conduct of regression analysis.

• CO2 Emission (CO2): Metric tons per capita
• Agriculture Value Added (AGI)
• Efficiency of Custom Clearance Process (CLEARANCE)
• GDP per unit of energy used (ENER)
• Exports of Goods and Services (EXPORTS)
• Imports of Goods and Services (IMPORTS)
• Foreign Direct Investment Net Inflow (FDI)
• Fossil Fuel Energy Consumption (FOSSILES)
• GDP per Capita (GDP)
• Industry Value Added (IVD)
• Manufacturing Value Added (MFG)
• Renewable Energy as Percentage of Total Energy Consumption (RE)
• Competitively Priced Shipment (PRICE SHIPMENT)
• Competence and Quality of Logistic Services (QUALITY)
• Shipment Reach Consignee within Schedule (SCHEDULE)
• Ability to Track Consignment (TRACK CONSIGN)
• Quality of Trade and Transport-Related Infrastructure (TRADE TRANS)

As a result, this study establishes a connection between Indian logistics operations and the country's economic standing, environmental conditions, and energy consumption in the context of national economic indicators, supporting green logistics initiatives throughout India. The dataset was derived from Worldwide Input -Output Database (WIOD,2019) for the time period of 2007-2023.

4. RESULTS AND DISCUSSION

Table 1: Descriptive Statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
CO2	0.419571	0.483981	0.585337	0.116537	0.140451	-0.91196	2.649512	2.443408	0.294727
AGI	2.825373	2.82084	2.92507	2.774564	0.032908	1.414736	6.243582	13.1231	0.001414
CLEARANCE	1.04996	1.050706	1.155125	0.98998	0.0396	0.801409	4.330443	3.073531	0.215076
ENER	2.131711	2.131727	2.287615	1.971559	0.102936	-0.14248	1.826123	1.033593	0.596428
EXPORTS	3.052736	3.034939	3.235963	2.869411	0.114056	0.108786	1.723501	1.187725	0.55219
FDI	0.600326	0.528072	1.286619	0.272265	0.264722	1.079833	3.681364	3.632626	0.162624
FOSSIL	4.304852	4.306795	4.372893	4.217792	0.04565	-0.25394	2.074332	0.789653	0.673797
GDP	8.600906	8.596436	9.036033	8.163482	0.266477	- 0.10944	1.919065	0.861565	0.65
GHG	14.90014	14.94822	15.06198	14.60818	0.144758	-0.72396	2.252726	1.880562	0.390518
IMPORTS	3.196449	3.214328	3.442317	2.867217	0.164205	-0.289	2.316516	0.567538	0.75294
INDU	3.318479	3.308621	3.438388	3.159078	0.089318	-0.03381	1.82237	0.985564	0.610924
MFG	2.722711	2.718808	2.841624	2.580374	0.08584	-0.1598	2.009976	0.766627	0.681599
PRICE SHIPMENT	1.165522	1.16604	1.252763	1.092537	0.033082	0.532025	5.249804	4.387289	0.11151
QUALITY	1.171846	1.172299	1.252763	1.108338	0.030931	0.70106	4.816078	3.728721	0.154995
RE	3.558743	3.550479	3.726657	3.483392	0.065481	1.183569	3.873242	4.509176	0.104917
SCHEDULE	1.273299	1.27341	1.318564	1.245474	0.015314	1.034754	6.172467	10.16275	0.006211
TRACK CONSIGNMENT	1.172383	1.172936	1.258171	1.109661	0.03416	0.628516	4.053542	1.905472	0.385684
TRADE TRANS	3.872346	3.877136	4.060443	3.583519	0.102405	-0.94962	5.511277	7.022136	0.029865

Table 1 presents the descriptive statistics where CO2 emissions observed the mean value (0.419571) is marginally lower than the median value (0.483981), suggesting a potential modest leftward tilt in the distribution.

The maximum and minimum represent the upper and lower bounds. In the context of carbon dioxide (CO_2) emissions, the upper limit is 0.585337, whilst the lower limit is 0.116537. In the case of Gross Domestic Product (GDP), the standard deviation exhibits a comparatively high value of 0.266477, demonstrating a substantial degree of variability in the overall economic growth. The CO2 variable has a negative skewness (-0.91196) and positive kurtosis (2.649512), indicating a distribution that is skewed to the left and has a strong peak. Gross Domestic Product (GDP), the Jarque-Bera test yields a probability value of 0.65, indicating a high likelihood of normal distribution for the GDP data.

Table 2: Unit Root Tests at Level

Im, Pesaran and Shin W-stat	-4.19838	0	18	274
ADF - Fisher Chi-square	86.1659	0	18	274
PP - Fisher Chi-square	121.06	0	18	288

Table 2 shows that statistical techniques employed in unit root tests at the level are utilized to ascertain whether a time series variable adheres to a unit root process, indicating that the series is non-stationary and demonstrates a random walk pattern.

The W-statistic of -4.19838, accompanied by a p-value of 0, by Im, Pesaran, and Shin (IPS), provides substantial evidence to reject the null hypothesis of a unit root process. In essence, there exists robust statistical evidence to support the conclusion that the

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variable being examined is stationary. These findings indicate higher degree of predictability over time.

The Augmented Dickey-Fuller (ADF) Test - Fisher Chi-square calculates a Fisher Chi-square statistic of 86.1659, which has a p-value of 0. This result provides strong evidence to reject the null hypothesis that a unit root process is present. This result indicates that the variable is stationary, the Phillips-Perron (PP) Test, the Fisher Chi-square statistic of 121.06, by a p-value of 0, provides substantial evidence to reject the null hypothesis that posits the presence of a unit root process.

Table 2.1: Unit Root Tests at First Difference

Im, Pesaran and Shin W-stat	-13.7059	0	18	261
ADF - Fisher Chi-square	212.821	0	18	261
PP - Fisher Chi-square	260.282	0	18	270

Table 2.1 the first difference unit root test to determine W-statistic of -13.7059, accompanied by a p-value of 0, indicates substantial evidence to reject the null hypothesis of a unit root process, as reported by Im, Pesaran, and Shin (IPS), the vector's first difference exhibits stationarity, rather than conforming to a random walk pattern. Hence, the IPS test provides evidence in favor of the assertion that the application of the first difference transformation has resulted in the series becoming stationary and exhibiting enhanced predictability over time.

The Augmented Dickey-Fuller (ADF) Test, the Fisher Chi-square statistic of 212.821, accompanied with a p-value of 0, provides substantial evidence to reject the null hypothesis positing the presence of a unit root process. The variable's first difference is stationary, indicating that it dont a unit root process. This finding is consistent with the conclusion reached by the IPS test. This implies that the ADF test provides evidence for the stationarity of the initial difference transformation.

The Phillips-Perron (PP) Test, the Fisher Chi-square statistic of 260.282, accompanied by a p-value of 0, provides substantial evidence to reject the null hypothesis that posits the presence of a unit root process. This finding suggests that the first difference of the variable is stationary, as opposed to displaying random walk characteristics, similar to the IPS and ADF tests. Hence, the PP test provides additional evidence to support the assertion that the initial difference transformation has established stationarity in the series.

Table 2.2 Unit Root Tests (Second Difference)

Im, Pesaran and Shin W-stat	-15.4297	0	18	233
ADF - Fisher Chi-square	239.5	0	18	233
PP - Fisher Chi-square	342.727	0	18	252

Table 2.2 shows The W-statistic of -15.4297, accompanied by a p-value of 0, by Im, Pesaran, and Shin (IPS), provides strong evidence to reject the null hypothesis that posits the presence of a unit root process. The findings indicate that upon performing a single differencing operation, the variable transitions to a stationary state instead of displaying a unit root process. Hence, the series exhibits a higher degree of predictability in its differenced form as time progresses.

The Augmented Dickey-Fuller (ADF) Test, the Fisher Chi-square statistic of 239.5, accompanied by a p-value of 0, provides substantial evidence to reject the null

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hypothesis that posits the presence of a unit root process. The variable exhibits stationarity instead of maintaining a unit root, hence enhancing its temporal predictability.

The Fisher Chi-square statistic of 342.727, accompanied by a p-value of 0, provides additional evidence to reject the null hypothesis of a unit root process in the Phillips-Perron (PP) Test.

Table 3: Granger Causality

SCHEDULE Granger Causes CO2: F-Statistic = 4.34308, Prob. = 0.0439
ENER Granger Causes FOSSIL: F-Statistic = 9.72453, Prob. = 0.0045
MFG Granger Causes ENER: F-Statistic = 16.3766, Prob. = 0.0007
INDU Granger Causes MFG: F-Statistic = 11.026, Prob. = 0.003
INDU Granger Causes GDP: F-Statistic = 12.6198, Prob. = 0.0018
GDP Granger Causes INDU: F-Statistic = 12.8905, Prob. = 0.0017
MFG Granger Causes IMPORTS: F-Statistic = 4.47015, Prob. = 0.041
FOSSIL Granger Causes INDU: F-Statistic = 4.48867, Prob. = 0.0406
GHG Granger Causes SCHEDULE: F-Statistic = 4.47703, Prob. = 0.0409

Table 3 shows Granger causality tests that were performed in order to ascertain the causal connections among different economic variables. The null hypothesis in each test posits that there is no Granger causality between the two variables. Each pair of variables is accompanied by the F-statistic and its corresponding probability (p-value).

In the examination of the relationship between AGI (adjusted gross income) and CO2 emissions, it is seen that the null hypothesis, which posits that AGI don't have a Granger causal effect on CO2 emissions, cannot be refuted. This conclusion is supported by the substantial p-value of 0.6894. In a similar vein, the examination of reverse causality, specifically the Granger causality relationship between CO2 emissions and AGI, yields a p-value of 0.9272, indicating that the null hypothesis cannot be rejected. The findings of this study indicate that there is no statistically significant causal association between AGI and CO2 emissions in either temporal or spatial dimensions.

Similar interpretations are observed in the tests conducted on various pairs of variables, including CLEARANCE, ENER (energy consumption), EXPORTS, FDI (foreign direct investment), FOSSIL (fossil fuel consumption), GDP, GHG (greenhouse gas emissions), IMPORTS, INDU (industrial production), MFG (manufacturing output), PRICE_SHIPMENT, QUALITY, RE (renewable energy consumption), SCHEDULE, TRACK_CONSIGNMENT, and TRADE_TRANS.

Based on the p-values shown, the available evidence is inadequate to support the rejection of the null hypothesis, which posits the absence of Granger causality between the majority of variable pairs. Based on the data and analysis model, it can be inferred that these economic variables do not exert a substantial causal impact on one another. However, it is important to take into account the constraints linked with Granger causality tests and the particular circumstances surrounding the data and the economic system being examined when interpreting these findings.

MAJOR FINDINGS

The major findings from the descriptive statistics, unit root tests, and Granger causality tests give a full picture of the data and its basic characteristics.

In descriptive Statistics (Table 1)

CO2 Emissions	The data is slightly skewed to the left, with a moderate range and variability. Indicates for higher values and plan for potential emissions controls or reductions accordingly.
GDP	The data is highly variable but nearly symmetrically distributed, indicating reliable economic trends. The normal distribution suggests typical economic behaviours without extreme outliers.
Other Variables	Each variable has unique distribution characteristics, indicating diverse economic behaviours.

In Unit root tests (Table-2)

Im, Pesaran, and Shin W-statistic	The result indicates that the data points in the series do not follow a random walk but rather have a stable pattern over time.
ADF - Fisher Chi-square	The test further confirms that the data behaves in a predictable manner over time.
PP - Fisher Chi-square	This test agrees with the previous ones, reinforcing the idea that the data has a stable and consistent trend.

At First Difference (Table 2.1)

Im, Pesaran and Shin W-stat	The result indicates that the data doesn't follow a trend anymore and becomes more predictable.
ADF - Fisher Chi-square	The test supports that the data is stationary after differencing once.
PP - Fisher Chi-square	This test also confirms that the data becomes stable and easier to work with after the first difference.

At Second Difference (Table 2.2)

Im, Pesaran and Shin W-stat	The second difference test suggest even stronger evidence that the data is stationary at the second difference, making it very stable.
ADF - Fisher Chi-square	The result confirms this high level of stability.
PP - Fisher Chi-square	The results indicates that the data is highly stable and predictable after the second difference.

Granger Causality (Table 3)

SCHEDULE Granger Causes CO2	This implies that how well activities are scheduled can have a direct impact on emissions.
ENER Granger Causes FOSSIL	It suggests that changes in energy usage can predict changes in fossil fuel consumption.
MFG Granger Causes ENER	It is clear that manufacturing activities can predict energy consumption.
INDU Granger Causes MFG	It indicates that industrial activities can predict manufacturing outputs.
INDU Granger Causes GDP	It shows that industrial activities can predict GDP growth.
GDP Granger Causes INDU	It shows that GDP growth can predict industrial activity.
MFG Granger Causes IMPORTS	It suggests that manufacturing activities can predict import levels.
FOSSIL Granger Causes INDU	It indicates that fossil fuel consumption can predict industrial activities.
GHG Granger Causes SCHEDULE	It shows that greenhouse gas emissions can predict scheduling efficiency.

The Granger Causality indicates the cause-and-effect relationship between the variables, showing how changes in one variable can affect changes in another variable.

MANAGERIAL IMPLICATION

INSIGHTS	IMPLICATION	ACTION
Economic growth variability	The inflated standard deviation in GDP indicates big differences in economic growth.	While making policy, the policymakers should create flexible economic policies that can change with growth fluctuations. This ensure strength when the economy is unstable.
Understanding of CO2 emission distribution	Managers should know that CO2 emissions have a left-skewed distribution with a strong peak. This suggests that most observations cluster around higher values with fewer low values.	They should apply targeted emission reduction strategies focusing on outliers that have a big impact on overall emissions.
Static economic variables	The unit root tests indicate that variables become stationary after differencing. This makes them easier to predict.	Economists should use differentiated data to forecast and model the economy. This will make future predictions and strategic planning more accurate.
Causal Relationships between Variables	Grange causality relationships hint that shifts in some variables can forecast changes in others. For example, energy consumption (ENER) has an impact on fossil fuel consumption (FOSSIL), and manufacturing output (MFG) affects energy consumption.	Make use of these cause-and-effect links to create more successful policies. For instance, boosting manufacturing efficiency could cut down energy consumption and fossil fuel use.
Policy Creation Based on Economic Links	The connections between factors, like how industrial production (INDU) and GDP affect each other, can lead to smarter policy choices.	Generate comprehensive policies that tackle multiple sectors at once boosting overall economic gains and teamwork.
Focusing on Key Drivers	Factors such as GHG emissions having an impact on schedule adherence (SCHEDULE) show areas where actions can have wider effects.	Give top priority to steps on factors that influence others, like putting in place tougher greenhouse gas rules to boost overall schedule reliability.
Resource Allocation and Investment	The results on predictability and cause-and-effect links can shape how we divide up resources and make investment choices.	Put money into areas that show strong predictive ties. This makes sure we channel resources to places that could have the biggest positive effect.
Better Forecasting for Long-Term Planning	Time series data that stays steady at different levels of change points to improved forecasting.	Use these predictable patterns to plan for the long haul. Set realistic goals and benchmarks based on reliable data trends.

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CONCLUSION

Statistical description gives a broad overview of a dataset, disclosing various aspects of its distribution. The leftward tilt in CO2 emissions distribution indicate a Mean & Median value, while standard deviation measures the variance in data points. Skewness and kurtosis statistics evaluate the distribution's symmetry and peakedness, with negative skewness and positive kurtosis indicating a left-skewed distribution. GDP data shows normal distribution by the Jarque-Bera test. Unit root testing is used to determine whether a time series variable follows a unit root process, indicating non-stationarity. The Im, Pesaran, and Shin (IPS) test, Augmented Dickey-Fuller (ADF) test, and Phillips-Perron (PP) tests are employed for this purpose. Finding from these tests indicate that the first difference of a time series variable is stationary, suggesting strengthen predictability over time. Unit root testing at the second difference evaluates whether the variable continues to demonstrate a unit root process after being differenced once. Findings from these tests indicate that the variable's second difference is stationary, indicating predictability even after differencing. Granger causality tests assess causal relationships among different economic variables. Results indicate no statistically significant causal associations among the majority of variable pairs, suggesting that economic variables do not exert substantial causal impacts on each other in the dataset. Policymakers should consider broader economic factors and constraints when formulating policies based on these findings.

POLICY RECOMMENDATIONS

The study gives a number of conclusions that provide policymakers a variety of strategic suggestions to productively guide India's transition towards a lower-carbon economy and achieve sustainable development. The advancement of green energy sources should be given preference, with a focus on employ incentives, subsidies, and regulatory frameworks to accelerate their acceptance and incorporation into the overall energy portfolio of the nation. Moreover, it is beneficial to promote consistency between the financial sector and climate goals, urging banks and investors to give preference to environment-friendly sustainable initiatives and take away from carbon-intensive sectors. In a way to facilitate India's shift towards cleaner energy sources.

INDUSTRIAL IMPLICATIONS

With the intension to encourage sustainability within India’s logistic and supply chain networks, it is crucial to execute legislative suggestions especially designed for the environment-friendly industry. The sequence of revitalizing the adoption of green logistic methods, including the implementation of alternative fuel vehicles, maximization of routs, and conversion to rail and water transport is beneficial. Similar approach comprises providing tax incentives, subsidies or grants to enterprises that encourage them to make more investments in environment-friendly green logistics infrastructure and technologies. Moreover, it is crucial to execute strict rules and emissions standards in a way to effectively lessen pollution resulting from transportation processes. Feasible measures surround the establishment of low-emission zones in urban regions, the duty of emissions limits on automobiles, and the enforcement of more stringent fuel economy regulations. Moreover, assigning resources towards the advancement of green energy sources for generating power in transportation, such as the establishment of electric vehicle charging infrastructure and the utilization of renewable fuels, can substantially diminish the environmental impact of logistics activities. The assistance of cooperation among many stakeholders is important in order to foster innovation and promote sustainability within the logistics operations. Public-private cooperation have the potential to strengthen the exchange of knowledge, support research and development activities, and allow the adoption of optimal methodologies. furthermore, the plantation of partnerships with overseas fellows can facilitate India's cooperation of technology, experience, and financial resources, consequently accelerate the implementation of environmental-friendly logistics solutions. Encourage green logistics methods necessitates the implementation of education and awareness programs that aim to hold industry stakeholders as well as the general public. These ventures have the potential to strengthen the ecological advantages of eco-friendly sustainable logistics, enhance awareness regarding the consequences of transportation emissions on air quality and climate change, and offer recommendations on how enterprises and individuals can mitigate their Co2 print. At last, it is beneficial to incorporate environmental factors into logistical planning and decision-making procedures. This may cause the implementation of environmental impact assessments for logistical projects, the association of sustainability criteria into accession procedures, and the support of circular economy principles, including recycling and waste reduction, across the network of suppliers. India may encourage the extensive implementation of eco-friendly logistics processes, decrease greenhouse gas emissions from transportation, and support the country's overall renewability objectives by implementing these policy recommendations.

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Supplementary file:

Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F- Statistic	Prob.
AGI don't Granger Cause CO2	15	0.38618	0.6894
CO2 don't Granger Cause AGI		0.0762	0.9272
CLEARANCE don't Granger Cause CO2	15	0.39636	0.6829
CO2 don't Granger Cause CLEARANCE		1.41814	0.2869
ENER don't Granger Cause CO2	15	0.51906	0.6103
CO2 don't Granger Cause ENER		0.39251	0.6853
EXPORTS do not Granger Cause CO2	15	0.68996	0.524
CO2 don't Granger Cause EXPORTS		1.01525	0.3968
FDI don't Granger Cause CO2	15	0.43091	0.6614
CO2 don't Granger Cause FDI		0.52457	0.6072
FOSSIL don't Granger Cause CO2	15	1.45114	0.2797
CO2 don't Granger Cause FOSSIL		0.26584	0.7718
GDP don't Granger Cause CO2	15	0.09228	0.9126
CO2 don't Granger Cause GDP		0.04211	0.9589
GHG don't Granger Cause CO2	15	0.17175	0.8446
CO2 don't Granger Cause GHG		0.30509	0.7437
IMPORTS do not Granger Cause CO2	15	0.51821	0.6107
CO2 don't Granger Cause IMPORTS		2.22829	0.1584
INDU don't Granger Cause CO2	15	2.21426	0.1599
CO2 don't Granger Cause INDU		3.74907	0.061
MFG don't Granger Cause CO2	15	0.46185	0.6429
CO2 don't Granger Cause MFG		1.77331	0.2192

PRICE_SHIPMENT don't Granger Cause CO2	15	0.35036	0.7127
CO2 don't Granger Cause PRICE_SHIPMENT		0.72499	0.5081
QUALITY don't Granger Cause CO2	15	1.41306	0.2881
CO2 don't Granger Cause QUALITY		0.27748	0.7633
RE don't Granger Cause CO2	15	0.08112	0.9227
CO2 don't Granger Cause RE		0.0893	0.9153
SCHEDULE don't Granger Cause CO2	15	4.34308	0.0439
CO2 don't Granger Cause SCHEDULE		0.08286	0.9211
TRACK_CONSIGNMENT don't Granger Cause CO2	15	0.39208	0.6856
CO2 don't Granger Cause TRACK_CONSIGNMENT		0.97061	0.4119
TRADE_TRANS don't Granger Cause CO2	15	0.9757	0.4101
CO2 don't Granger Cause TRADE_TRANS		0.0514	0.9501
CLEARANCE don't Granger Cause AGI	15	0.06708	0.9355
AGI don't Granger Cause CLEARANCE		0.74178	0.5007
ENER don't Granger Cause AGI	15	0.30762	0.7419
AGI don't Granger Cause ENER		0.03503	0.9657
EXPORTS do not Granger Cause AGI	15	0.04391	0.9572
AGI don't Granger Cause EXPORTS		1.66695	0.2373
FDI don't Granger Cause AGI	15	0.12928	0.8802
AGI don't Granger Cause FDI		1.08145	0.3757
FOSSIL don't Granger Cause AGI	15	0.30387	0.7445
AGI don't Granger Cause FOSSIL		0.05948	0.9426
GDP don't Granger Cause AGI	15	1.61981	0.2458
AGI don't Granger Cause GDP		2.4283	0.1382
GHG don't Granger Cause AGI	15	0.10917	0.8976
AGI don't Granger Cause GHG		0.55063	0.5931
IMPORTS do not Granger Cause AGI	15	0.02435	0.976
AGI don't Granger Cause IMPORTS		1.68822	0.2335
INDU don't Granger Cause AGI	15	1.77901	0.2183
AGI don't Granger Cause INDU		5.32491	0.0266

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MFG don't Granger Cause AGI	15	2.28863	0.1519
AGI don't Granger Cause MFG		3.04173	0.0929
PRICE_SHIPMENT don't Granger Cause AGI	15	0.50156	0.62
AGI don't Granger Cause PRICE_SHIPMENT		0.44371	0.6537
QUALITY don't Granger Cause AGI	15	0.74181	0.5007
AGI don't Granger Cause QUALITY		0.61205	0.5614
RE don't Granger Cause AGI	15	0.63735	0.5489
AGI don't Granger Cause RE		0.24763	0.7853
SCHEDULE don't Granger Cause AGI	15	2.02951	0.1821
AGI don't Granger Cause SCHEDULE		0.71375	0.5132
TRACK_CONSIGNMENT don't Granger Cause AGI	15	0.10534	0.901
AGI don't Granger Cause TRACK_CONSIGNMENT		0.89333	0.4396
TRADE_TRANS don't Granger Cause AGI	15	0.96454	0.414
AGI don't Granger Cause TRADE_TRANS		0.79712	0.4773
ENER don't Granger Cause CLEARANCE	15	1.10178	0.3695
CLEARANCE don't Granger Cause ENER		0.44118	0.6552
EXPORTS do not Granger Cause CLEARANCE	15	0.9737	0.4108
CLEARANCE don't Granger Cause EXPORTS		0.57794	0.5787
FDI don't Granger Cause CLEARANCE	15	0.40414	0.678
CLEARANCE don't Granger Cause FDI		0.99268	0.4043
FOSSIL don't Granger Cause CLEARANCE	15	1.11163	0.3665
CLEARANCE don't Granger Cause FOSSIL		1.36541	0.299
GDP don't Granger Cause CLEARANCE	15	1.12115	0.3637
CLEARANCE don't Granger Cause GDP		0.09758	0.9079
GHG don't Granger Cause CLEARANCE	15	1.4233	0.2858
CLEARANCE don't Granger Cause GHG		0.33731	0.7215
IMPORTS do not Granger Cause CLEARANCE	15	1.31841	0.3103
CLEARANCE don't Granger Cause IMPORTS		0.16263	0.8521
INDU don't Granger Cause CLEARANCE	15	1.21592	0.3368
CLEARANCE don't Granger Cause INDU		0.11074	0.8963

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MFG don't Granger Cause CLEARANCE	15	1.11565	0.3653
CLEARANCE don't Granger Cause MFG		0.12361	0.8851
PRICE_SHIPMENT don't Granger Cause CLEARANCE	15	2.37618	0.1431
CLEARANCE don't Granger Cause PRICE_SHIPMENT		0.00752	0.9925
QUALITY don't Granger Cause CLEARANCE	15	0.52304	0.6081
CLEARANCE don't Granger Cause QUALITY		0.0043	0.9957
RE don't Granger Cause CLEARANCE	15	1.06388	0.3812
CLEARANCE don't Granger Cause RE		0.35423	0.7102
SCHEDULE don't Granger Cause CLEARANCE	15	0.14917	0.8633
CLEARANCE don't Granger Cause SCHEDULE		0.28527	0.7577
TRACK_CONSIGNMENT don't Granger Cause CLEARANCE	15	0.11697	0.8908
CLEARANCE don't Granger Cause TRACK_CONSIGNMENT		0.00037	0.9996
TRADE_TRANS don't Granger Cause CLEARANCE	15	0.04965	0.9518
CLEARANCE don't Granger Cause TRADE_TRANS		0.00479	0.9952
EXPORTS do not Granger Cause ENER	15	1.30624	0.3133
ENER don't Granger Cause EXPORTS		2.68962	0.1162
FDI don't Granger Cause ENER	15	1.92905	0.1957
ENER don't Granger Cause FDI		0.50573	0.6177
FOSSIL don't Granger Cause ENER	15	9.72453	0.0045
ENER don't Granger Cause FOSSIL		7.96928	0.0085
GDP don't Granger Cause ENER	15	3.59562	0.0666
ENER don't Granger Cause GDP		1.22685	0.3338
GHG don't Granger Cause ENER	15	0.70604	0.5166
ENER don't Granger Cause GHG		0.96356	0.4143
IMPORTS do not Granger Cause ENER	15	0.11126	0.8958
ENER don't Granger Cause IMPORTS		5.02829	0.0308
INDU don't Granger Cause ENER	15	0.02833	0.9721
ENER don't Granger Cause INDU		6.75093	0.0139
MFG don't Granger Cause ENER	15	0.08665	0.9177

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ENER don't Granger Cause MFG		16.3766	0.0007
PRICE_SHIPMENT don't Granger Cause ENER	15	3.7992	0.0592
ENER don't Granger Cause PRICE_SHIPMENT		1.61943	0.2459
QUALITY don't Granger Cause ENER	15	0.06687	0.9357
ENER don't Granger Cause QUALITY		0.942	0.4219
RE don't Granger Cause ENER	15	0.50877	0.616
ENER don't Granger Cause RE		0.01395	0.9862
SCHEDULE don't Granger Cause ENER	15	0.58775	0.5737
ENER don't Granger Cause SCHEDULE		0.00095	0.9991
TRACK_CONSIGNMENT don't Granger Cause ENER	15	1.5625	0.2567
ENER don't Granger Cause TRACK_CONSIGNMENT		0.8376	0.461
TRADE_TRANS don't Granger Cause ENER	15	0.02223	0.9781
ENER don't Granger Cause TRADE_TRANS		0.17595	0.8412
FDI don't Granger Cause EXPORTS	15	3.2654	0.081
EXPORTS don't Granger Cause FDI		0.03703	0.9638
FOSSIL don't Granger Cause EXPORTS	15	1.02885	0.3924
EXPORTS do not Granger Cause FOSSIL		0.89084	0.4405
GDP don't Granger Cause EXPORTS	15	1.27946	0.3201
EXPORTS do not Granger Cause GDP		1.08866	0.3735
GHG don't Granger Cause EXPORTS	15	1.23509	0.3316
EXPORTS do not Granger Cause GHG		0.66763	0.5344
IMPORTS do not Granger Cause EXPORTS	15	0.78468	0.4825
EXPORTS do not Granger Cause IMPORTS		0.59255	0.5712
INDU don't Granger Cause EXPORTS	15	1.48379	0.2727
EXPORTS do not Granger Cause INDU		1.09553	0.3714
MFG don't Granger Cause EXPORTS	15	1.62691	0.2445
EXPORTS do not Granger Cause MFG		1.50346	0.2686
PRICE_SHIPMENT don't Granger Cause EXPORTS	15	1.57625	0.2541
EXPORTS do not Granger Cause PRICE_SHIPMENT		0.01775	0.9824

QUALITY don't Granger Cause EXPORTS	15	0.02291	0.9774
EXPORTS do not Granger Cause QUALITY		0.31699	0.7354
RE don't Granger Cause EXPORTS	15	0.51966	0.6099
EXPORTS do not Granger Cause RE		0.17037	0.8458
SCHEDULE don't Granger Cause EXPORTS	15	0.51674	0.6116
EXPORTS do not Granger Cause SCHEDULE		1.57628	0.2541
TRACK_CONSIGNMENT don't Granger Cause EXPORTS	15	0.63603	0.5495
EXPORTS do not Granger Cause TRACK_CONSIGNMENT		1.17643	0.3477
TRADE_TRANS don't Granger Cause EXPORTS	15	0.01518	0.985
EXPORTS do not Granger Cause TRADE_TRANS		1.92288	0.1965
FOSSIL don't Granger Cause FDI	15	0.95471	0.4174
FDI don't Granger Cause FOSSIL		4.39061	0.0428
GDP don't Granger Cause FDI	15	0.39727	0.6823
FDI don't Granger Cause GDP		2.2167	0.1596
GHG don't Granger Cause FDI	15	0.5134	0.6134
FDI don't Granger Cause GHG		0.26037	0.7758
IMPORTS do not Granger Cause FDI	15	0.12959	0.8799
FDI don't Granger Cause IMPORTS		2.56251	0.1263
INDU don't Granger Cause FDI	15	1.01907	0.3956
FDI don't Granger Cause INDU		3.33776	0.0776
MFG don't Granger Cause FDI	15	0.28696	0.7565
FDI don't Granger Cause MFG		3.25579	0.0815
PRICE_SHIPMENT don't Granger Cause FDI	15	0.24031	0.7908
FDI don't Granger Cause PRICE_SHIPMENT		0.66078	0.5376
QUALITY don't Granger Cause FDI	15	1.25686	0.3259
FDI don't Granger Cause QUALITY		0.02611	0.9743
RE don't Granger Cause FDI	15	0.54778	0.5946
FDI don't Granger Cause RE		0.01002	0.99
SCHEDULE don't Granger Cause FDI	15	2.35254	0.1454
FDI don't Granger Cause SCHEDULE		0.11345	0.8939

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TRACK_CONSIGNMENT don't Granger Cause FDI	15	0.55219	0.5923
FDI don't Granger Cause TRACK_CONSIGNMENT		0.19159	0.8286
TRADE_TRANS don't Granger Cause FDI	15	0.48244	0.6309
FDI don't Granger Cause TRADE_TRANS		0.65391	0.5409
GDP don't Granger Cause FOSSIL	15	2.50264	0.1315
FOSSIL don't Granger Cause GDP		1.99466	0.1866
GHG don't Granger Cause FOSSIL	15	0.12161	0.8868
FOSSIL don't Granger Cause GHG		1.31481	0.3112
IMPORTS do not Granger Cause FOSSIL	15	1.29446	0.3163
FOSSIL don't Granger Cause IMPORTS		3.55004	0.0684
INDU don't Granger Cause FOSSIL	15	3.947	0.0545
FOSSIL don't Granger Cause INDU		4.48867	0.0406
MFG don't Granger Cause FOSSIL	15	1.59274	0.2509
FOSSIL don't Granger Cause MFG		5.25237	0.0276
PRICE_SHIPMENT don't Granger Cause FOSSIL	15	3.45084	0.0725
FOSSIL don't Granger Cause PRICE_SHIPMENT		1.87248	0.2038
QUALITY don't Granger Cause FOSSIL	15	0.49318	0.6248
FOSSIL don't Granger Cause QUALITY		1.97475	0.1893
RE don't Granger Cause FOSSIL	15	0.78746	0.4813
FOSSIL don't Granger Cause RE		0.4248	0.6652
SCHEDULE don't Granger Cause FOSSIL	15	0.21778	0.808
FOSSIL don't Granger Cause SCHEDULE		0.23774	0.7927
TRACK_CONSIGNMENT don't Granger Cause FOSSIL	15	2.0167	0.1837
FOSSIL don't Granger Cause TRACK_CONSIGNMENT		1.28409	0.3189
TRADE_TRANS don't Granger Cause FOSSIL	15	0.46156	0.6431
FOSSIL don't Granger Cause TRADE_TRANS		1.58104	0.2532
GHG don't Granger Cause GDP	15	0.02432	0.976
GDP don't Granger Cause GHG		0.27938	0.762
IMPORTS do not Granger Cause GDP	15	2.92974	0.0997
GDP don't Granger Cause IMPORTS		4.12956	0.0493

INDU don't Granger Cause GDP	15	12.6198	0.0018
GDP don't Granger Cause INDU		12.8905	0.0017
MFG don't Granger Cause GDP	15	11.026	0.003
GDP don't Granger Cause MFG		12.7372	0.0018
PRICE_SHIPMENT don't Granger Cause GDP	15	0.38041	0.6931
GDP don't Granger Cause PRICE_SHIPMENT		2.08576	0.175
QUALITY don't Granger Cause GDP	15	0.42596	0.6645
GDP don't Granger Cause QUALITY		1.89072	0.2012
RE don't Granger Cause GDP	15	0.07226	0.9308
GDP don't Granger Cause RE		0.09941	0.9063
SCHEDULE don't Granger Cause GDP	15	0.67812	0.5295
GDP don't Granger Cause SCHEDULE		0.07409	0.9291
TRACK_CONSIGNMENT don't Granger Cause GDP	15	0.15385	0.8594
GDP don't Granger Cause TRACK_CONSIGNMENT		1.05632	0.3835
TRADE_TRANS don't Granger Cause GDP	15	0.32215	0.7318
GDP don't Granger Cause TRADE_TRANS		0.03638	0.9644
IMPORTS do not Granger Cause GHG	15	0.60681	0.564
GHG don't Granger Cause IMPORTS		2.96842	0.0973
INDU don't Granger Cause GHG	15	2.66523	0.1181
GHG don't Granger Cause INDU		5.7988	0.0213
MFG don't Granger Cause GHG	15	0.55282	0.5919
GHG don't Granger Cause MFG		2.84403	0.1052
PRICE_SHIPMENT don't Granger Cause GHG	15	0.30597	0.7431
GHG don't Granger Cause PRICE_SHIPMENT		1.04186	0.3881
QUALITY don't Granger Cause GHG	15	1.83683	0.2092
GHG don't Granger Cause QUALITY		0.54328	0.5971
RE don't Granger Cause GHG	15	0.00614	0.9939
GHG don't Granger Cause RE		0.07849	0.9251
SCHEDULE don't Granger Cause GHG	15	4.47703	0.0409
GHG don't Granger Cause SCHEDULE		0.05771	0.9442

TRACK_CONSIGNMENT don't Granger Cause GHG	15	0.35502	0.7096
GHG don't Granger Cause TRACK_CONSIGNMENT		1.06587	0.3805
TRADE_TRANS don't Granger Cause GHG	15	1.17355	0.3485
GHG don't Granger Cause TRADE_TRANS		0.0611	0.9411
INDU don't Granger Cause IMPORTS	15	4.01305	0.0525
IMPORTS do not Granger Cause INDU		2.69423	0.1159
MFG don't Granger Cause IMPORTS	15	4.47015	0.041
IMPORTS do not Granger Cause MFG		2.23481	0.1577
PRICE_SHIPMENT don't Granger Cause IMPORTS	15	0.19941	0.8224
IMPORTS do not Granger Cause PRICE_SHIPMENT		0.31824	0.7345
QUALITY don't Granger Cause IMPORTS	15	0.22688	0.801
IMPORTS do not Granger Cause QUALITY		0.73455	0.5039
RE don't Granger Cause IMPORTS	15	0.65186	0.5419
IMPORTS do not Granger Cause RE		0.02122	0.979
SCHEDULE don't Granger Cause IMPORTS	15	0.75264	0.496
IMPORTS do not Granger Cause SCHEDULE		0.37564	0.6961
TRACK_CONSIGNMENT don't Granger Cause IMPORTS	15	0.05516	0.9466
IMPORTS do not Granger Cause TRACK_CONSIGNMENT		1.30245	0.3143
TRADE_TRANS don't Granger Cause IMPORTS	15	0.32095	0.7327
IMPORTS do not Granger Cause TRADE_TRANS		1.06057	0.3822
MFG don't Granger Cause INDU	15	1.84218	0.2084
INDU don't Granger Cause MFG		1.96609	0.1905
PRICE_SHIPMENT don't Granger Cause INDU	15	0.1367	0.8738
INDU don't Granger Cause PRICE_SHIPMENT		1.19004	0.3439
QUALITY don't Granger Cause INDU	15	0.28057	0.7611
INDU don't Granger Cause QUALITY		0.85894	0.4526
RE don't Granger Cause INDU	15	1.38896	0.2936
INDU don't Granger Cause RE		2.76155	0.1109
SCHEDULE don't Granger Cause INDU	15	0.43855	0.6568

INDU don't Granger Cause SCHEDULE		0.18116	0.837
TRACK_CONSIGNMENT don't Granger Cause INDU	15	0.0631	0.9392
INDU don't Granger Cause TRACK_CONSIGNMENT		1.0287	0.3924
TRADE_TRANS don't Granger Cause INDU	15	0.32631	0.729
INDU don't Granger Cause TRADE_TRANS		0.49149	0.6257
PRICE_SHIPMENT don't Granger Cause MFG	15	0.139	0.8719
MFG don't Granger Cause PRICE_SHIPMENT		1.54671	0.2599
QUALITY don't Granger Cause MFG	15	0.02228	0.978
MFG don't Granger Cause QUALITY		0.85778	0.4531
RE don't Granger Cause MFG	15	0.60393	0.5654
MFG don't Granger Cause RE		2.44194	0.1369
SCHEDULE don't Granger Cause MFG	15	0.21886	0.8072
MFG don't Granger Cause SCHEDULE		0.49409	0.6243
TRACK_CONSIGNMENT don't Granger Cause MFG	15	0.11414	0.8933
MFG don't Granger Cause TRACK_CONSIGNMENT		1.10224	0.3693
TRADE_TRANS don't Granger Cause MFG	15	0.02001	0.9802
MFG don't Granger Cause TRADE_TRANS		1.30276	0.3142
QUALITY don't Granger Cause PRICE_SHIPMENT	15	0.21294	0.8118
PRICE_SHIPMENT don't Granger Cause QUALITY		1.2968	0.3157
RE don't Granger Cause PRICE_SHIPMENT	15	0.10705	0.8995
PRICE_SHIPMENT don't Granger Cause RE		0.39234	0.6854
SCHEDULE don't Granger Cause PRICE_SHIPMENT	15	0.62852	0.5532
PRICE_SHIPMENT don't Granger Cause SCHEDULE		1.04892	0.3859
TRACK_CONSIGNMENT don't Granger Cause PRICE_SHIPMENT	15	0.26327	0.7737
PRICE_SHIPMENT don't Granger Cause TRACK_CONSIGNMENT		3.29501	0.0796
TRADE_TRANS don't Granger Cause PRICE_SHIPMENT	15	0.59991	0.5675
PRICE_SHIPMENT don't Granger Cause TRADE_TRANS		2.71175	0.1146
RE don't Granger Cause QUALITY	15	0.0132	0.9869

QUALITY don't Granger Cause RE		0.13042	0.8792
SCHEDULE don't Granger Cause QUALITY	15	0.55702	0.5897
QUALITY don't Granger Cause SCHEDULE		1.79818	0.2152
TRACK_CONSIGNMENT don't Granger Cause QUALITY	15	0.01829	0.9819
QUALITY don't Granger Cause TRACK_CONSIGNMENT		0.47521	0.6351
TRADE_TRANS don't Granger Cause QUALITY	15	0.00973	0.9903
QUALITY don't Granger Cause TRADE_TRANS		0.40363	0.6783
SCHEDULE don't Granger Cause RE	15	1.06806	0.3798
RE don't Granger Cause SCHEDULE		0.58102	0.5771
TRACK_CONSIGNMENT don't Granger Cause RE	15	0.52338	0.6079
RE don't Granger Cause TRACK_CONSIGNMENT		0.53929	0.5992
TRADE_TRANS don't Granger Cause RE	15	0.26202	0.7746
RE don't Granger Cause TRADE_TRANS		0.11358	0.8938
TRACK_CONSIGNMENT don't Granger Cause SCHEDULE	15	0.01483	0.9853
SCHEDULE don't Granger Cause TRACK_CONSIGNMENT		0.43568	0.6585
TRADE_TRANS don't Granger Cause SCHEDULE	15	0.67484	0.531
SCHEDULE don't Granger Cause TRADE_TRANS		0.6235	0.5557
TRADE_TRANS don't Granger Cause TRACK_CONSIGNMENT	15	0.1487	0.8637
TRACK_CONSIGNMENT don't Granger Cause TRADE_TRANS		0.02356	0.9768