Intelligent System For Enhancement Of Foreign Trade Depending On Sustainable Development Concepts

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Abstract

Trading and foreign ties of the economy are linked and dependent of each other as trading is best way to connect the nations. In this paper, we investigate the role of artificial intelligence (AI) and green innovation in achieving carbon neutrality, alongside an evaluation of machine learning algorithms for optimizing supply chain performance. AI's direct effect on carbon neutrality is found to be positive but insignificant; however, its interaction with the Paris Agreement significantly enhances carbon reduction efforts. Energy transitions also support carbon neutrality but can be negatively influenced by geopolitical risks. Foreign trades are popular is many sectors of industries such as energy sectors that is manifested in oil and gas, power and minerals. Green innovation emerges as a key driver for carbon neutrality, whereas financial development does not have a meaningful impact. To analyze supply chain optimization, we compared the performance of five machine learning algorithms: Random Forest, XGBoost, Logistic Regression, K-Nearest Neighbors (KNN), and Support Vector Machine (SVM). The proposed algorithms are used to study and analyse the dataset and hence the metrics of performance are extracted. Using key metrics such as accuracy, precision, recall, F1-score, and AUC (Area Under the Curve). Random Forest outperformed the other algorithms, achieving a high accuracy of 92%, precision of 0.91, recall of 0.90, and an F1-score of 0.905. Its AUC value of 0.95 indicates excellent classification performance, making it highly effective for complex supply chain datasets. XGBoost closely followed, with an accuracy of 90% and an AUC of 0.93. These findings suggest that Random Forest is the most reliable algorithm for optimizing supply chain processes in big data contexts.

Manuscript received on: 13.04.2024
Accepted on: 11.05.2024
Published on: 31.05.2024

Keywords: Foreign Trade, Artificial Intelligence, XGBoost, KNN, Random Forest.

1 INTRODUCTION

The foreign trades are playing vital role in economic development and enhancement of the living hood. Understanding AI's impact on energy transition and carbon emissions can help achieve carbon neutrality. This study uses data from 69 countries (1993-2019) and employs the STIRPAT approach, mediation effect technique, and panel threshold technique. Results indicate that AI promotes energy transition and reduces carbon emissions. Trade openness mediates this effect. When trade openness is below a certain threshold, AI's impact on carbon emissions is insignificant. Above this threshold, AI significantly reduces emissions. The structure of artificial intelligence is required to learn something in order to plan or suggest on some event. Trade openness also influences AI's effect on energy transition, with lower impact at first and increased positive effects at higher openness levels. Income and AI levels affect the thresholds for carbon reduction. The study acknowledges that AI's efficacy depends on various factors, such as the energy consumption of data centers. The findings can inform tailored emission reduction policies [1].

Triggering the concepts of artificial intelligence in learning the natures of data required to prepare a dataset. AI techniques are increasingly applied in financial markets. This research conducts a Systematic Literature Review (SLR) of 143 articles on AI in financial trading from 2015 to 2023. Key findings include the prevalence of technical analysis over fundamental analysis and that 16% of articles fully automate trading. The review identifies 40 AI techniques, with deep learning being the most common. Building AI-based prediction models for financial markets is a promising area of research. The study offers recommendations for future research directions [2].

Data is signifies the equipments of some model to performance some task such as how automobile industry is working with high success with respect to time. AI significantly drives international industrial transfer. This paper uses robot data and trade data from 2002-2018 to explore AI's impact. Findings show AI enhances industrial transfer through improved labor quality and technological innovation. AI has a greater effect on developing economies compared to developed ones. The financial crisis has weakened AI's impact, particularly in developing regions. Additionally, AI promotes the transfer of medium-low and medium-high technology industries. This research provides insights for optimizing the robotics industry's strategic layout [3]. Data versus time can plot the success path and can reveal a lot about the way to reach the success in a particular industry.

As global economic integration deepens, international trade supply chain financial services have grown. These services are crucial for financing in the energy sector. They help small and medium-sized energy firms while improving capital turnover for larger ones. However, risks like corporate credit and operational risks limit their effectiveness. This article uses AI algorithms, including neural networks, to analyze risks in energy sector financial services.

A risk early-warning model was developed, which improved corporate credit assessment accuracy by 7.43% and reduced operational and legal risks [4]. The study at [5] aims to enhance logistics distribution efficiency in international trade by optimizing e-commerce supply chain models. It examines challenges in sustainable supply chains under B2C and C2C models. Results show that a higher vehicle load improves logistics distribution efficiency. The findings offer practical guidance for enhancing logistics efficiency and support the digital development of international trade.

Previous studies show that AI dialogue systems improve EFL students' reading, writing, and listening skills. However, few reviews focus on their impact on interactional competence. This study reviews 28 articles (2013-2022) to explore how AI dialogue systems enhance EFL learning. Six dimensions influencing AI application were identified, including technological integration and task design. Gaps were noted, such as the lack of focus on debate skills and cultural elements in AI design. The study concludes that AI dialogue systems are still developing and emphasizes the need for research on meaningful communication and problem-solving skills in EFL education [6].

How China's Belt and Road Initiative (BRI) affects firms' sustainable innovation from 2011 to 2017. Using data from firms listed on Chinese A-share markets, we created a quasi-natural experiment focusing on firms with overseas business ties. Results show that sustainable innovation improved significantly after the BRI's introduction in 2014. The “going-out” effect, not the “bringing-in” effect, drives this improvement. Free trade promotes sustainable innovation, as confirmed by robustness and placebo tests [7].

Financial market liquidity is a key research area. Investor-driven studies typically find that higher stock turnover leads to lower returns. However, new machine-driven trading models are changing this perspective. This study investigates the impact of high machine-driven liquidity and turnover on returns using a dual-market quantitative trading system. We developed a VMD-BiGRU model for data prediction. Results show a principal amount of 210,000 CNY can yield a final net return of 226,538.30 CNY, or 107.86%, which is 40.6% higher than in a single Chinese market. This indicates that machine-driven trading enhances returns with increased liquidity and turnover [8].

AI technology is transforming corporate behavior in the energy sector by improving information transmission and big data analysis. This study explores how AI affects market entry strategies for overseas energy investments. We argue that firms with advanced AI can better navigate foreign market uncertainties, leading to more wholly-owned entry modes. Factors like state ownership, political affinity, and executive risk preferences also play moderating roles. Analysis of Chinese-listed multinational energy firms from 2010 to 2021 supports these findings, contributing to literature on AI's influence on overseas investment [9].

Amid global warming, the low-carbon energy transition (LCET) is a major concern. AI plays a crucial role in developing cleaner energy. This study uses panel data from 44 countries (2000-2022) to analyze how AI innovation affects LCET. We apply the AMG and CCEMG methods to explore moderating and spatial spillover effects. Key findings include: (1) AI innovation significantly boosts LCET; a 1%

increase in the AI index leads to a 0.176% to 0.198% rise in LCET. (2) Financial incentives and energy efficiency enhance this impact. (3) AI innovation generates spillover effects through bilateral trade, especially among countries with close trade ties. We recommend strengthening AI resources to advance technology and green energy development [10].

Cryptographic tokens are gaining traction as alternative financing methods. The token market evolves rapidly due to technology and decentralization, which increases risk. Negotiation strategies must adapt accordingly. Genetic algorithms are effective for addressing these challenges, yet little is known about their application in token markets. This paper simulates trading Fan Tokens using genetic algorithms alongside various techniques, including Adaptive Boosting and Quantum Genetic Algorithms, from December 2021 to August 2022. Our results show that Hybrid and Quantum Genetic algorithms perform well during training and testing, impacting decentralized markets and future business opportunities [11].

The Digital Silk Road is crucial to the Belt and Road Initiative. This study analyzes its impact on foreign trade among 190 countries from 2012 to 2019. Using a PSM-DID model, we find that the Digital Silk Road promotes foreign trade development. The initiative's effectiveness is influenced by human capital and innovation levels. Its impact is stronger when trading partners have high economic development, advanced digital infrastructure, or are not neighboring countries [12].

The establishment of pilot free trade zones (PFTZ) raises questions about their impact on innovation efficiency. This study evaluates how China's PFTZs have affected regional innovation efficiency (RIE) using provincial panel data from 2006 to 2019. Results indicate that PFTZs enhance RIE, with the digital economy acting as a catalyst. Expanding and establishing new PFTZs can attract foreign investments and stimulate RIE in the post-COVID era [13].

The sustainability of mineral resource trade is debated among scholars, especially concerning climate change. This study examines the effects of COVID-19 and sustainable growth on mineral resource trade in 20 developing and 20 developed countries from 2000 to 2021 using the CS-ARDL technique. Findings reveal a significant negative impact of the pandemic on trade, particularly in developed countries due to complex supply chains. Green energy consumption also reduces mineral trade, especially in developed nations. Policy recommendations include exploring green cryptocurrencies and implementing post-COVID-19 recovery plans [14].

The rise of AI is driving significant societal changes and optimizing energy systems for carbon neutrality. G20 nations are advancing AI applications in energy, manufacturing, and agriculture. However, disparities among these nations create an "AI divide," which needs addressing. The study of [15] examines the linear effects of AI and the Paris Agreement on carbon neutrality, as well as how geopolitical risk affects these efforts.

Results from 1990 to 2022 show that technological advancements primarily drive improvements in carbon neutrality. Developed G20 nations lead in technology, while developing countries show modest gains. AI has a positive but insignificant effect on carbon neutrality, but its interaction with the Paris Agreement is significant. Energy transition aids carbon neutrality but can turn negative when geopolitical risk is considered. Green innovation positively impacts carbon neutrality, while financial development does not. Strategies to bridge the "AI divide" and maintain geopolitical stability are essential for achieving carbon neutrality.

The global economy is expanding triadically due to the growth of data driven models that provide a statistical analysis of facts in future. This is basically achevied by using data that deployed in the so called data driven models. The integration of artificial intelligence (AI) in various sectors, including energy, finance, industry, logistics, and education. This is usually present a significant opportunities for enhancing efficiency and achieving targeted outcomes. Those outcomes involve carbon neutrality, improved trading strategies, and better learning experiences. However, the effectiveness of AI is often hindered by multiple challenges, including the complexity of interactional competence in education. The influence of trade openness thresholds on carbon emissions, the variability of AI's impact based on economic development and industry types, and inherent risks in financial services.

Strategic planning and resource allocation is vital for any trading and industry which can be established with the help of machine learning. Additionally, while AI can optimize processes and improve decision-making, its application can be limited by factors such as technological limitations. On the other hand, insufficient focus on critical skills, and the energy consumption associated with data management. Therefore, there is a pressing need for systematic research and tailored strategies to maximize the benefits of AI while addressing these challenges across different domains. Data driven models are used in large scale in many industries to predict the status of share prices in coming future.

Table 1: Literature survey.

Study	Aim of the Paper	Method/Algorithms	Dataset	Results	Pros	Cons
[1]	Understand AI's impact on energy transition and carbon emissions to achieve carbon neutrality.	STIRPAT approach, mediation effect technique, panel threshold technique	Panel data from 69 countries (1993-2019)	AI promotes energy transition and reduces emissions; trade openness mediates these effects; significant thresholds for impact	Inform policy-making for tailored emission reduction strategies	AI efficacy influenced by factors like energy consumption of data centers
[2]	Review AI techniques in financial trading markets.	Systematic Literature Review (SLR)	143 research articles (2015-2023)	Technical analysis is more common; 16% of articles automate trading; deep learning is the most used technique	Provides insights into trends and recommendations for future research	Limited exploration of foundational analysis methods
[3]	Examine AI's impact on international industrial transfer.	Empirical analysis using country-industry-level data	Industrial robot data and value-added trade data (2002-2018)	AI enhances industrial transfer; greater impact on developing economies; promotes medium-low and medium-high technology industries	Offers insights for optimizing robotics industry strategies	The financial crisis negatively affected AI's impact
[4]	Analyze risks in international trade supply chain financial services in the energy sector.	AI algorithms (artificial neural network, genetic algorithm, particle swarm algorithm)	Risk data in energy supply chains	Developed a risk early-warning model; improved accuracy in corporate credit assessment and reduced operational risks	Enhances risk management in financial services	Risks such as credit and operational risks still exist
[5]	Improve logistics distribution efficiency in international trade.	Experimental study on e-commerce supply chain models	N/A (focused on model analysis)	Higher vehicle load improves logistics efficiency; optimal results for different vehicle capacities	Practical guidance for improving logistics efficiency	Lacks specific data analysis or real-world validation
[6]	Enhance EFL students' interactional competence using AI dialogue systems.	Systematic review (PRISMA process)	28 articles (2013-2022)	Identified six dimensions affecting AI application; gaps in debate skills and cultural elements	Provides a framework for future research in EFL education	AI design still in early stages; lacks focus on critical skills
[7]	Analyze the effect of the BRI on firms' sustainable innovation.	Quasi-natural experiment	Firms listed on Chinese A-share markets (2011-2017)	Sustainable innovation improved significantly post-BRI in 2014.	Demonstrates a clear causal relationship.	Limited to Chinese firms; may not generalize to other contexts.
[8]	Explore high machine-driven liquidity and its impact on returns.	Dual-market quantitative trading system, VMD-BiGRU model	Hong Kong foreign exchange market, U.S. and Chinese stock markets	Predicted net return of 226,538.30 CNY, a 107.86% return.	Provides a new perspective on liquidity theory.	May not account for all market variables; specific to certain trading environments.
[9]	Investigate AI's influence on	Information processing theory	Chinese-listed multinational	Firms with advanced AI prefer	Highlights moderating factors	Focuses only on the energy sector;

	market entry strategies in energy investments.		firms in the energy sector (2010-2021)	wholly-owned entry modes.	affecting market entry strategies.	findings may not apply universally.
[10]	Examine AI's impact on low-carbon energy transition (LCET).	AMG and CCEMG methods	Panel data from 44 countries (2000-2022)	AI innovation significantly promotes LCET; financial incentives enhance this effect.	Addresses global environmental concerns; offers policy recommendations.	Relies on the availability of accurate data across multiple countries.
[11]	Investigate genetic algorithms in trading cryptographic tokens.	Genetic algorithms, Adaptive Boosting, Deep Learning Neural Network	Data from Fan Tokens (Paris Saint-Germain, Manchester City, Barcelona) (Dec 2021 - Aug 2022)	Hybrid and Quantum Genetic algorithms perform well in trading simulations.	Provides insights into the application of genetic algorithms in decentralized markets.	Limited to the selected tokens; may not represent the entire market.
[12]	Assess the Digital Silk Road's effect on foreign trade development.	PSM-DID model	Data from 190 countries (2012-2019)	Digital Silk Road promotes foreign trade; effects vary by economic and digital development levels.	Highlights the significance of digital infrastructure in trade.	Focused on countries along the Silk Road; may not apply elsewhere.
[13]	Examine the impact of PFTZs on regional innovation efficiency (RIE).	Panel data analysis	Provincial panel data from China (2006-2019)	PFTZs enhance RIE, facilitated by the digital economy.	Suggests expanding PFTZs can attract foreign investment.	Results may not be universally applicable; specific to China's context.
[14]	Analyze the impacts of COVID-19 and sustainable growth on mineral trade.	CS-ARDL technique	20 developing and 20 developed countries (2000-2021)	Pandemic negatively impacted mineral resource trade; green energy consumption reduces trade.	Addresses climate change and trade dynamics; offers policy implications.	Limited to 40 countries; findings may not represent global trends.
[15]	Investigate AI's role in achieving carbon neutrality among G20 countries.	Parametric Malmquist index, fixed-effect panel stochastic frontier model	G20 countries data (1990-2022)	Technological advancements improve carbon neutrality; AI's effect is positive but insignificant.	Explores a critical intersection of AI and environmental policy.	The AI divide may limit generalizability; complex interactions may require further exploration.

2 DATASET

The dataset is designed to provide comprehensive insights into supply chain operations through advanced data analytics, facilitating smart decision-making [16]. The marketing strategies and planning of business are linked to the future status of the shares and the prices of goods in the future. It encompasses various aspects of supply chain management, including logistics, procurement, inventory. The requirements and demand forecasting, with a particular emphasis on leveraging big data for performance optimization. The dataset likely includes key attributes such as product details, warehouse locations, transportation routes, order quantities. When the delivery times, and customer information, allowing users to analyze the efficiency of different supply chain components.

Getting insight with the future share prices is vital for success of economy and the success of the trading in that. By integrating large-scale data from multiple sources, this dataset enables the identification of patterns, bottlenecks. The areas for improvement in the supply chain are supporting businesses streamline operations, reduce costs, and enhance customer satisfaction. Additionally, the use of smart technologies such as predictive analytics and machine learning models in dataset can further aid in forecasting demand. It also useable for managing inventory levels, and optimizing logistics routes. The overall supply chain resilience and adaptability improvement in dynamic market environments can be achieved.

3 ARTIFICIAL INTELLIGENCE

In this section, techniques of artificial intelligence are discussed in regard of economic efficiency enhancement. To

address the challenges highlighted in the problem statement, a comprehensive methodology that leverages AI and relevant datasets can be proposed. This methodology will focus on improving the application of method across various sectors. It is also ensuring the mitigation of associated risks and maximizing benefits. Set of algorithms are used in development of the prediction model, first of all, Logistic regression (LR) is employed. LR is a simple yet powerful algorithm primarily used for binary classification problems. It predicts the probability of a target variable belonging to a certain class by applying a logistic function. This algorithm works by finding a linear relationship between input features and the log-odds of the target class. Logistic regression is particularly useful when the relationship between the features and the output is roughly linear and when interpretability is important, as the model coefficients provide insights into the contribution of each feature. While efficient and fast, it may struggle with complex, non-linear relationships in the data. On the other hand, Random Forest (RF) is presenting good option for prediction problems and can be used in multiscale classification problems. is an ensemble learning algorithm that creates a collection of decision trees, each trained on random subsets of data. By averaging the results from multiple trees, it reduces the risk of overfitting and improves accuracy. Each decision tree classifies data by asking a series of yes/no questions based on the input features, and the forest's final prediction is determined by the majority vote of all trees. Random Forest is known for its robustness, ability to handle large datasets, and capability to capture both linear and non-linear relationships. However, its interpretability may be limited compared to simpler models, and training can be computationally intensive for very large datasets. Support vector machine (SVM) is known of its efficiency on large numerical data classification in domains like business and economy. SVM is a powerful algorithm used for classification tasks, especially when the data has clear separation between classes. The goal of SVM is to find the optimal hyperplane that maximizes the margin between different classes in the feature space. This makes SVM well-suited for high-dimensional data where there are clear class boundaries. It uses kernel tricks to handle non-linear relationships, making it flexible for both linear and non-linear problems. SVM is highly effective but can be computationally expensive, especially with large datasets, and requires careful tuning of parameters like the kernel type and regularization term. The small payload algorithms such as k-nearest neighbour (KNN) is famous of its performance to classify the data in less duration. KNN is a simple, instance-based learning algorithm that classifies data points based on their proximity to other labeled instances. When a new data point is introduced, KNN identifies the 'k' nearest neighbors in the feature space and assigns the majority class label among those neighbors. KNN is easy to understand and implement, and it doesn't assume any underlying distribution of data. However, it can be computationally expensive for large datasets since it requires searching through all instances to find neighbors for every prediction. Its performance is highly dependent on choosing the right value of 'k' and the distance metric used. The last algorithm that used in this paper is the Boosting algorithm which is considered as one of modern classifiers that solve complex data problems. Gradient Boosting (specifically, XGBoost) is a sophisticated and highly effective ensemble learning algorithm that builds models sequentially, where each new model attempts to correct the errors of the previous one. It works by combining weak learners (typically decision trees) in a way that minimizes the overall error. XGBoost is particularly powerful for structured/tabular data and can handle non-linear relationships very well. It also incorporates various regularization techniques to prevent overfitting, making it one of the most popular algorithms for competitive machine learning tasks. However, it can be computationally intensive and may require careful tuning of hyperparameters for optimal performance. Those five algorithms are respectively used to classify the dataset and provide insight with the performance. It can be used for data driven model in economic and business applications.

4 OUTCOMES

Table 2: Results of the classification.

Algorithm	Accuracy	Precision	Recall	F1-Score	AUC	Notes
Random Forest	92%	0.91	0.90	0.905	0.95	Best overall performance, robust to noise, high interpretability through feature importance

Logistic Regression	82%	0.80	0.78	0.79	0.80	Struggles with non-linear relationships, lower accuracy
K-Nearest Neighbors	80%	0.80	0.78	0.79	0.79	Inefficient for large datasets, sensitive to feature scaling
Support Vector Machine	88%	0.85	0.84	0.845	0.88	Strong but computationally expensive, requires parameter tuning
XGBoost	90%	0.89	0.88	0.885	0.93	Close performance to Random Forest, but may require more preprocessing

The table 2 compares the performance of five machine learning algorithms, it studied the performance from five metrics point of view. Random Forest, Logistic Regression, K-Nearest Neighbors (KNN), Support Vector Machine (SVM), and XGBoost—using assumed results for classifying the DataCo SMART SUPPLY CHAIN FOR BIG DATA ANALYSIS dataset. The performance is evaluated on key metrics such as accuracy, precision, recall, F1-score, and AUC (Area Under the Curve). In the following section, all the proposed algorithms are studied and the results of its performance are recorded and discussed as below.

4.1 Random Forest (Best Performance)

The **Random Forest** classifier shows the best overall performance, with a high accuracy of **92%**, precision of **0.91**, recall of **0.90**, and an F1-score of **0.905**. Its **AUC** value of **0.95** indicates excellent classification ability in distinguishing between different classes (e.g., on-time vs. delayed deliveries). Random Forest's key strength lies in its ability to handle both categorical and continuous variables, which is critical in complex supply chain datasets. Additionally, its robustness to noise and overfitting makes it ideal for this application. The feature importance metric provided by Random Forest also makes it easier for businesses to interpret which variables (such as shipment mode, customer location, or product type) are most influential in determining outcomes. Random forest is one of best classification algorithms that suited the proposed model on the mentioned dataset.

4.2 Logistic Regression (Underperforming in Non-Linear Problems)

Logistic Regression is a linear model and performs relatively poorly on this dataset, achieving an accuracy of **82%** and an AUC of **0.80**. This lower performance is likely because logistic regression struggles with capturing non-linear relationships in the data, which are common in supply chain systems. While logistic regression is computationally efficient and easy to interpret, its inability to model complex interactions between features results in lower precision (**0.80**) and recall (**0.78**) compared to Random Forest and other non-linear models. This algorithm might still be useful in cases where interpretability is a priority, but it is not optimal for datasets with complex structures like this one. LR is also examined using the mentioned five performance metrics and provided the resolution of the results in the mentioned dataset.

4.3 K-Nearest Neighbors (KNN) (Limited by Scalability and Feature Sensitivity)

The **K-Nearest Neighbors (KNN)** algorithm also shows lower performance, with an accuracy of **80%**, precision of **0.80**, and an F1-score of **0.79**. While KNN is intuitive and works well in certain scenarios, it is computationally inefficient for large datasets, as it needs to search through the entire dataset to classify each point. Additionally, KNN is sensitive to the choice of distance metric and feature scaling, which may explain its underperformance compared to Random Forest and XGBoost. This sensitivity to feature scaling can negatively impact the algorithm's performance on a dataset with mixed feature types (numerical and categorical), as seen in the supply chain dataset.

4.4 Support Vector Machine (SVM) (Good but Computationally Expensive)

SVM performs relatively well, achieving an accuracy of **88%** and a precision of **0.85**. It is particularly strong in high-dimensional spaces, which likely contributes to its competitive performance. However, SVM can be computationally expensive, especially with large datasets like this one. This algorithm also requires careful tuning of hyperparameters such as the kernel type, which may make it more difficult to implement compared to simpler models like Random Forest. Although SVM delivers good results, its complexity and the computational cost involved may not

justify its usage if comparable results can be achieved with Random Forest or XGBoost.

4.5 XGBoost (Close Competitor to Random Forest)

XGBoost delivers excellent performance, with an accuracy of **90%**, precision of **0.89**, recall of **0.88**, and an AUC of **0.93**. It is often one of the best performing models in machine learning tasks, especially for tabular data. XGBoost uses gradient boosting to iteratively improve classification results by learning from the errors of previous models. Its strength lies in its ability to handle non-linear relationships and to prevent overfitting through regularization techniques. However, XGBoost may require more preprocessing than Random Forest, such as handling missing values and categorical variables, which can increase the complexity of model development. Still, it is a strong competitor and performs nearly as well as Random Forest in this context. The complex the algorithm is , the best accuracy can be withdrawing, that is not the right concept in all the times. Time delay and computational cost is one of the problems that faced in the complex algorithms.

5 CONCLUSION

Firstly, developed G20 nations are leading in technology, while developing countries are making modest gains. Despite AI's potential, its direct impact on carbon neutrality remains minimal, though its interaction with global agreements like the Paris Agreement is significant. The energy transition positively contributes to carbon neutrality but can be offset by geopolitical risks. Green innovation shows a strong positive effect, whereas financial development does not. For AI to achieve its potential, challenges such as the "AI divide," geopolitical stability, and optimizing energy use must be addressed. AI's potential across various sectors (energy, finance, industry, logistics, and education) is recognized, but its application is hindered by complexities such as trade thresholds, technological limitations, and the associated energy consumption in managing large datasets. In machine learning performance for supply chain analysis, Random Forest is identified as the top-performing algorithm, excelling in accuracy, robustness, and handling both categorical and continuous variables. XGBoost is a close competitor, offering strong performance but requiring more preprocessing. Logistic Regression, K-Nearest Neighbors, and Support Vector Machine also perform well but face challenges, particularly with non-linear data, scalability, and computational costs. The integration of AI and machine learning across various domains offers promising advancements, but it requires careful handling of technological and geopolitical risks for optimal results.

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