Scholar Publishing Group
International Journal of Big Data Intelligent Technology
https://doi.org/10.38007/IJBDIT.2026.070115
ISSN 2790-0932 Vol. 7, Issue 1: 122-130

The Impact Mechanism of Economic Policy Fluctuations on ESG Performance of Financial Enterprises Empowered by Artificial Intelligence

Dexi Chen

School of Computer and Big Data, Jining Normal University, Ulanqab 012000, Inner Mongolia, China

Keywords: Artificial intelligence empowerment, economic policy fluctuations, ESG performance of financial enterprises, impact mechanisms, and transmission of technological innovation.

Abstract: Against the backdrop of rapid global economic development and intensified contradictions in ecological protection, green and sustainable development has become a global consensus. As a resource allocation hub, the ESG performance of the financial industry has a leverage effect on green transformation. Artificial intelligence technology, with its data-driven and intelligent decision-making advantages, has opened up new paths for financial enterprises to improve their ESG performance. However, economic policy fluctuations may interfere with the effectiveness of technology empowerment, forming a dynamic interaction mechanism of "technology empowerment policy fluctuations ESG performance". This study adopts a logical framework of "theory empirical conclusion", constructs a model based on technological innovation theory and stakeholder theory, selects panel data of major global financial enterprises from 2012 to 2022, and uses a fixed effects model for benchmark regression, mechanism testing, and heterogeneity analysis to verify the impact of artificial intelligence on ESG performance and the moderating effect of economic policy uncertainty. Research has found that artificial intelligence has a significant positive impact on the overall ESG performance of financial enterprises, especially in the environmental and governance dimensions, but there is a negative effect in the social dimension; The impact effect is heterogeneous due to the concentration of equity and the nature of property rights, with dispersed equity and non-state-owned enterprises more likely to improve ESG performance through AI; The level of technological innovation is the core transmission path, and AI indirectly improves ESG performance by driving technological innovation; Economic policy uncertainty will weaken the role of AI in promoting ESG. This study reveals the impact mechanism of economic policy fluctuations on the ESG performance of financial enterprises under the empowerment of artificial intelligence, providing theoretical support for financial enterprises to implement precise policies and optimize technology investment decisions. At the same time, it emphasizes the importance of maintaining economic policy stability to maximize the social and environmental benefits of technology empowerment, and promotes the transformation of the financial industry towards intelligence and sustainability.

1 Introduction

In the current situation where the contradiction between rapid global economic development and ecological protection is becoming increasingly acute, green and sustainable development has become a global consensus. The promotion of the "dual carbon" goal and the "dual circulation" strategy highlights the importance of environmental, social, and governance (ESG) performance as the core benchmark for sustainable development of enterprises. As a key hub for resource allocation, the financial industry's ESG practices have a significant leverage effect on green transformation, and artificial intelligence technology, as a representative of new quality productivity, is opening up new paths for financial enterprises to improve their ESG performance with its data-driven and intelligent decision-making advantages. However, economic policy fluctuations may have a complex impact on the empowerment effect of artificial intelligence by interfering with corporate investment decisions and technological innovation pace, forming a dynamic interaction mechanism of "technology empowerment policy fluctuations ESG performance". This practical problem urgently needs to be systematically explored. There are three limitations in existing research that need to be overcome: insufficient attention to the specificity of ESG in the financial industry, especially the lack of differentiated analysis of the "environment society governance" three dimensions; Although attention is paid to the direct impact of artificial intelligence on ESG, there is limited exploration of the transmission path through which it indirectly improves ESG performance through technological innovation; The research on the interaction between macroeconomic policy fluctuations and micro enterprise behavior mostly stays at the theoretical level, and rarely incorporates empirical frameworks of artificial intelligence applications, making it difficult to reveal the moderating effect of policy fluctuations on technology empowerment. This study aims to fill the research gap mentioned above by empirically examining the impact mechanism of artificial intelligence technology on the ESG performance of financial enterprises, and focusing on the moderating effect of economic policy fluctuations. Specific goals include: analyzing the specific impact of artificial intelligence on the overall ESG performance and sub dimensions of financial enterprises; Revealing the transmission path of artificial intelligence improving ESG performance by enhancing technological innovation level; Explore how economic policy uncertainty affects the empowerment effect of artificial intelligence, and analyze its heterogeneity in financial enterprises with different equity structures and corporate natures. The contribution of this study lies in three dimensions: firstly, systematically exploring the impact of artificial intelligence on ESG performance from the perspective of the financial industry, breaking through the limitations of existing research on general enterprises; Innovatively incorporating economic policy uncertainty variables, revealing the regulatory mechanism of policy fluctuations on the effectiveness of technological empowerment, and expanding the research boundary of the interaction between macroeconomics and micro behavior; Through regression analysis of ESG sub dimensions, refine the differentiated role of artificial intelligence in specific dimensions such as environmental responsibility, social contribution, and governance effectiveness, and provide theoretical support for enterprises to implement precise policies.The study adopts a logical framework of "theory empirical conclusion": through literature review, the theoretical correlation between artificial intelligence, ESG performance, and economic policy uncertainty is sorted out; Construct a model based on technological innovation theory and stakeholder theory, and propose core hypotheses; Select panel data of financial companies listed on the Shanghai and Shenzhen A-shares from 2012 to 2022, use a fixed effects model to conduct benchmark regression, mechanism testing, and heterogeneity analysis, verify hypotheses, and reveal influencing mechanisms; The final conclusion is extracted, and practical guidelines for the government and financial enterprises are proposed to form a complete research loop. This framework provides a systematic analytical paradigm and practical

reference for understanding how financial enterprises can effectively utilize artificial intelligence technology to enhance ESG performance in policy volatility environments.

2. Correlation theory

2.1. Multidimensional research framework and impact mechanism of ESG performance

ESG performance research[1] focuses on the construction of overall rating standards and differentiated analysis of single dimensions (environment, society, governance). The overall dimension research emphasizes the importance of unified evaluation criteria - although mainstream models have integrated non-financial risk and sustainable development indicators, differences in rating agencies lead to divergent results, directly affecting investor behavior (such as high ESG rated companies may lower investor return requirements). Environmental dimension research focuses on the long-term impact of corporate green behavior on reputation and value. Executive green cognition has been proven to enhance green performance through technological innovation, production optimization, and other pathways; Social dimension research reveals that short-term social responsibility investment may reduce corporate value, but in the long run, value enhancement can be achieved through stakeholder trust and social capital accumulation, while alleviating financing constraints to accelerate the financialization process; Research on governance dimensions has confirmed that governance elements such as board structure, equity distribution, and incentive mechanisms are positively correlated with corporate value and development quality. The impact of ESG performance is concentrated on financial performance and market value. Based on stakeholder theory, good ESG performance can enhance trust, increase market value, and alleviate financing constraints, and demonstrate stronger risk resistance in crises. Its influencing factors cover multiple dimensions, both internal and external: internal factors include equity structure pressure, governance effects of major shareholders, and external factors involve investor attention, business environment optimization, and government green finance policy guidance. These factors affect ESG performance through pathways such as increased information transparency, reduced financing costs, and strengthened governance levels.

2.2. The Application and Measurement Framework of Artificial Intelligence in the Financial Sector

The deep integration of artificial intelligence and finance has given rise to diverse application scenarios, which can be divided into two dimensions: general applications and personalized applications. General applications focus on the basic scenarios of financial transactions, such as credit evaluation, customer relationship management, and business model innovation: Yeh (2012) and Han (2013) confirmed that artificial intelligence is more effective and accurate in credit rating than traditional methods; Abdou (2016), Zhou (2022), and Goode (2018) explored its value in customer information identification and fraud prevention; Mahalakshmi (2022) pointed out that artificial intelligence and machine learning have driven the transformation of data insights and business model innovation in financial enterprises; At the level of financial regulation, Thakor (2020) emphasizes that artificial intelligence can help build a more comprehensive regulatory system, while Larsen&Gilani (2017) and Buckley (2020) highlight its potential in meeting strict regulatory requirements. Personalized applications are achieved through technologies such as knowledge graphs and deep learning to customize user needs. Lee&Shin (2020) and Gigante&Zago (2023) demonstrated the practice of artificial intelligence in personalized banking services; Kadim&Sunardi (2023) and Ngai (2021) revealed its importance in personalized wealth management product recommendations and customer service; Bahrammirzaee (2010) and Dwivedi

(2019) pointed out that it can accurately analyze user preferences and influence investment decisions.

To quantify the impact of artificial intelligence, scholars have constructed multidimensional measurement indicators[2]. At the industry or sector level, it covers both single indicators (such as the penetration rate of industrial robots and the number of artificial intelligence patents) and comprehensive indicators (such as the system constructed by research institutions from environmental support, industrial competitiveness, and knowledge creativity, the system constructed by institutions from development environment, talent resources, industrial applications, and economic output, internationally renowned reports covering dimensions such as technical performance, research and development level, and economic impact, and evaluation reports evaluating industrial development from basic support, integrated applications, innovation capabilities, environmental protection, and industrial operation); At the enterprise level, a complete quantitative framework from macro to micro is formed by measuring indicators such as the penetration rate of industrial robots, the number of artificial intelligence patents, the frequency of keywords in annual report texts, and the per capita value of enterprise machinery and equipment.

3. Research method

3.1. The Impact Mechanism and Policy Uncertainty Adjustment Effect of Artificial Intelligence Empowering ESG Performance

At present, direct research on artificial intelligence technology in the field of ESG performance is still insufficient, and existing achievements mostly focus on the overall impact of digital transformation. Digital transformation, through core technologies such as artificial intelligence, blockchain, cloud computing, and big data, affects ESG performance from two aspects: enhancing external legitimacy pressure and alleviating information asymmetry. Legitimacy theory suggests that digital transformation enterprises are more proactive in improving their environmental, social, and governance levels due to higher compliance requirements; At the same time, the improvement of information processing capabilities makes enterprise operations more transparent, attracts public supervision, and promotes green innovation and responsibility fulfillment. Economic policy uncertainty, as a key moderating variable, is often measured based on media keyword frequency (such as the Baker EPU index) or political events. Its negative effects on the macro economy are reflected in the suppression of consumption, investment, and imports and exports. At the micro level, real options theory is used to reduce corporate investment willingness, increase financing costs, and promote the transfer of funds to financial assets. Existing literature mainly focuses on the impact of traditional governance structures and information infrastructure on ESG, with insufficient exploration of artificial intelligence as the core driving force of digital transformation, and a lack of targeted research on financial enterprises. Therefore, this study takes financial enterprises as samples to explore the specific impact of artificial intelligence technology on ESG performance under different policy uncertainty backgrounds, filling the research gap in the perspective of the financial industry and the moderating effect of policy fluctuations.

3.2. Analysis of ESG Theory and Practice Framework and Core Elements

ESG, as a value system for evaluating the sustainability and social impact of enterprises, covers three dimensions: environmental resource recycling, coordination of social stakeholders, and optimization of governance structure. It originated from social responsibility investment and provides long-term return evaluation basis for long-term investors. Financial institutions disclose ESG information through regular social responsibility reports, with a disclosure rate of 74% in the

financial industry in 2022. The banking industry follows the principle of balancing business expansion and social impact, the insurance industry promotes ESG product innovation, and the securities industry incorporates ESG into investment decisions. Huazheng ESG rating is characterized by market fit, wide coverage, and high timeliness. It uses natural language processing and statistical methods to process data, with a three-dimensional focus on financial importance. A BBB or higher rating in the nine levels is the leading level, and it is included in the tail risk assessment module to track and warn of ESG risks of listed companies. The theory of sustainable development emphasizes the balanced development of economy, environment, and society. Financial enterprises achieve resource optimization and risk management through ESG principles and the application of artificial intelligence technology; The theory of economic externalities requires enterprises to balance economic benefits and social environmental costs; The theory of corporate social responsibility requires companies to fulfill multidimensional social obligations while making profits; The principal-agent theory reveals the dynamic impact of agency relationships in ESG decision-making of financial enterprises, and artificial intelligence technology can alleviate such agency problems; The stakeholder theory emphasizes that companies need to balance the needs of multiple parties and enhance their reputation and risk management capabilities through ESG practices. The research hypothesis revolves around the direct impact of artificial intelligence technology on ESG performance, the mediating role of technological innovation level, the heterogeneity effect of equity concentration and property rights attributes, and the negative moderating effect of economic policy uncertainty, forming a complete analytical logic from theory to empirical evidence.

3.3. Selection of ESG research variables and analysis of data framework

ESG performance, as the dependent variable, is measured through the Huazhong ESG rating system, which combines international mainstream methods with market reality to assign 1-9 scores to 9 levels and take the annual average. The core explanatory variable is the level of application of artificial intelligence technology. Text mining method is used to calculate the frequency of artificial intelligence keywords in enterprise annual reports, which is quantified after logarithmic processing. The mediating variable is the level of technological innovation, which is synthesized as a composite indicator by weighting 50% of the number of patent applications and authorizations. The control variables include the net profit margin of total assets, cash flow level, revenue growth rate, age of the enterprise, shareholding ratio of the largest shareholder, shareholding ratio of the management team, and the integration of two positions. The data is sourced from the financial data of listed and financial enterprises in authoritative financial databases from 2012 to 2022. After removing abnormal samples, handling missing values, and rounding, an effective panel dataset containing multiple types of financial transactions is formed, providing a solid foundation for empirical analysis.

4. Results and discussion

4.1. AI driven ESG dynamic mechanism, fixed effect, mediation effect, and moderation effect testing

In panel data analysis, the fixed effects model was determined to be used using the Hausman test [4](P-value=0.0001<0.05). The benchmark regression model is set as:

$$ESG.hz_{it} = \beta_0 + \beta_1 AI_{it} + \beta_2 Controls + \mu_i + \lambda_t + \epsilon_{it}$$

Among them, ESG. hz is the dependent variable, AI is the core explanatory variable, Controls

includes control variables such as total asset net profit margin and cash flow, and μ i and λ t are individual and year fixed effects, respectively. The mechanism test adopts the mediation effect model[5] to verify the mediating effect of technological innovation (Inv) in three steps: the first step is to examine the impact of AI on ESG. Hz

$$ESG.hz_{it} = \alpha_0 + \alpha_1 AI_{it} + \alpha_3 Controls_{it} + \epsilon_{it}$$

Step 2: Verify the impact of AI on Inv

$$Inv_{it} = \gamma_0 + \gamma_1 AI_{it} + \gamma_3 Controls_{it} + \epsilon_{it}$$

The third step is to simultaneously incorporate AI and Inv (ESG. hzit= δ 0+ δ 1AIit+ δ 3Control sit+ϵ it). The moderation effect model introduces economic policy uncertainty (EPU) and constructs an interaction term to test its moderation effect

$$ESG.hz_{it} = \theta_0 + \theta_1 AI_{it} + \theta_2 EPUI_{t-1} + \theta_3 (AI_{it} \times EPUI_{t-1}) + \theta_4 Controls_{it} + \epsilon_{it}$$

where EPU is the economic policy uncertainty index lagged by one period, calculated by the frequency of news report keywords and taking the annual average

4.2. Model experiment

Table 1 Summary of Descriptive Statistics of Key Variables

Variable	Observations	Mean	Median	Standard Deviation	Minimum	Maximum
ESG.hz (Huazheng ESG Rating)	735	4.676	5	1.268	1	7
AI (Artificial Intelligence Application)	735	12.77	12.76	0.870	10.71	15.08
ROA (Return on Assets)	735	0.0200	0.0130	0.0330	-0.105	0.204
Cash Ratio (Cash & Equivalents / Total Assets)	735	0.0050	0.0140	0.101	-0.403	0.289
Growth (Revenue Growth Rate)	735	0.222	0.0990	0.639	-0.727	3.874
Age (Years Since Establishment)	735	3.044	3.091	0.305	2.079	3.555
Top 1 (Largest Shareholder's Ownership %)	735	30.95	26.99	16.86	6.080	73.30
Ownership (Management Shareholding %)	735	1.574	0	8.057	0	57.56
Dual (1 if Chairman & CEO Combined, 0 Otherwise)	735	0.808	1	0.394	0	1

The correlation test shows that the application of artificial intelligence (AI) is significantly positively correlated with the ESG rating of financial enterprises (coefficient 0.092), and cash flow level (cash), age of the enterprise, and dual roles of chairman and general manager are also positively correlated with ESG rating; The total asset net profit margin (ROA), revenue growth rate (growth), top 1 shareholder shareholding ratio, and management shareholding ratio are negatively correlated with ESG ratings, with a correlation coefficient of -0.089 for management shareholding ratio. The multicollinearity test showed that the VIF values of all variables ranged from 1.01 to 1.28, with an average VIF of 1.09, far below the threshold and without significant collinearity issues. Descriptive statistics show that the average ESG rating is 4.676, the median is 5, and the standard deviation is 1.268, with scores concentrated at the moderate level; The average of artificial intelligence applications is 12.77, the median is 12.76, the standard deviation is 0.870, and the distribution is stable; In the controlled variables, the ROA mean is 0.020 but the standard deviation is 0.033, indicating a difference in financial performance; The average shareholding ratio of the

largest shareholder is 30.95%, with significant volatility; The average value of the integration of two positions is 0.808, with a median of 1. Most companies adopt a single management structure. The specific statistical characteristics are shown in Table 1 below:

4.3. Effect analysis

This study reveals the impact mechanism of artificial intelligence technology on the ESG performance of financial enterprises through multidimensional empirical testing. The benchmark regression results show that the application of artificial intelligence (AI) has a significant positive impact on the ESG rating of Huazhong Securities: the AI coefficient in column (1) is 0.14525 ($t=2.74$, $p<0.01$), and after adding control variables, the coefficient in column (2) drops to 0.11032 ($t=2.07$, $p<0.05$), indicating that for every 1 unit increase in AI, the average ESG rating increases by 0.11-0.15 units; Among the controlled variables, cash flow level (cash, coefficient 0.81515, $p<0.1$）、 Enterprise age (age, coefficient 0.35663, $p<0.05$）Dual employment (coefficient 0.32685, $p<0.01$) is positively correlated with ESG. The robustness test[6]verified the stability of the conclusion through three methods: instrumental variable 2SLS (AI lag term), replacement of dependent variable (Bloomberg ESG index), and exclusion of epidemic year data. The AI coefficients were all significantly positive (0.17345/0.65711/0.08455, $p<0.05$). Heterogeneity test [7] grouped by equity concentration: the AI coefficient of the low concentration group was 0.27493 ($p<0.01$), and the coefficient of the high concentration group was -0.15613 ($p<0.1$); According to property rights attributes, the AI coefficient for non-state-owned enterprises is 0.19847 ($p<0.01$), while the coefficient for state-owned enterprises is 0.05257 (not significant), indicating that equity diversification and non-state-owned enterprises are more likely to improve ESG through AI. The ESG sub dimension test shows that AI has an impact on the environment (E, coefficient 0.21346, $p<0.01$）、 The dimension of governance (G, coefficient 0.30871, $p<0.01$) has a significant positive impact, while the dimension of society (S, coefficient -0.22049, $p<0.01$) has a negative impact. The intermediary mechanism test verifies the mediating role of technological innovation (Inv): AI significantly improves the level of technological innovation (coefficient 0.27269, $p<0.01$), and technological innovation is positively correlated with ESG (coefficient 0.10991, $p<0.05$). The moderation effect test introduces economic policy uncertainty (EPU), and the coefficient of the interaction term between AI and EPU is -0.01717 ($p<0.1$), indicating that an increase in EPU will weaken the positive impact of AI on ESG. All models control for year and individual effects, with a sample size of 735 financial enterprises (data from 2012-2022). The regression results robustly support the positive impact, heterogeneity, mediation, and moderating effects of artificial intelligence technology applications on the ESG performance of financial enterprises.vestors.

5. Conclusion

The research conclusion shows that the application of artificial intelligence technology has a significant positive impact on the ESG rating of financial enterprises, especially in the environmental and governance dimensions, but there is a negative effect in the social dimension; The impact effect is heterogeneous due to the concentration of corporate equity and the nature of property rights - equity dispersion and non-state-owned enterprises are more likely to improve ESG performance through AI technology; The level of technological innovation is the core transmission path, and AI indirectly improves ESG performance by driving technological innovation; Economic policy uncertainty will weaken the promoting effect of AI on ESG. Based on this, policy recommendations focus on four aspects: firstly, optimizing the development ecology of artificial intelligence, strengthening data privacy protection and ethical norms, establishing transparent

regulatory mechanisms [8] and dispute resolution legal frameworks, and promoting international standard coordination; The second is to support technological innovation in enterprises, guide financial enterprises to increase their investment in AI research and development through fiscal incentives, tax incentives, and innovation funds, improve data security regulations, and establish an ESG performance monitoring system; The third is to implement differentiated management strategies [9], formulate customized policies for enterprises with different equity structures and property rights, such as providing targeted technology transformation support for equity concentrated enterprises and optimizing innovation resource allocation for non-state-owned enterprises; The fourth is to maintain the stability of economic policies, reduce uncertainty risks through policy continuity and transparency, enhance enterprise AI investment confidence, and ensure Maximizing the social and environmental benefits empowered by technology ultimately drives the transformation of the financial industry [10]towards intelligence and sustainability.

References

[1] *Yixian Jiang. Performance Optimization and Improvement of Advertising Machine Learning Platform Based on Distributed Systems. International Journal of Big Data Intelligent Technology (2026), Vol. 7, Issue 1: 9-17*

[2] *Jin Li. Performance Analysis of Efficient Microservice Architecture in the Financial Industry. Machine Learning Theory and Practice (2026), Vol. 6, Issue 1: 1-9.*

[3] *Bukun Ren. Multimodal Learning Method for Cross-Modal Data Alignment and Retrieval. International Journal of Multimedia Computing (2026), Vol. 7, Issue 1: 1-8.*

[4] *Zhengle Wei. Research on Innovative Design of Financial Derivatives and Market Risk Management Strategies. International Journal of Social Sciences and Economic Management (2026), Vol. 7, Issue 1: 19-27*

[5] *Yuhan Zhou. Green Bonds and Sustainable Financing Models in Energy Finance. International Journal of Social Sciences and Economic Management (2026), Vol. 7, Issue 1: 28-35*

[6] *Yilin Fu. Research on the Application of Innovative Financial Technologies in Capital Market Risk Management. Socio-Economic Statistics Research (2026), Vol. 7, Issue 1: 1-9*

[7] *Linwei Wu. Data Visualization and Decision Support Analysis Based on Tableau. Socio-Economic Statistics Research (2026), Vol. 7, Issue 1: 10-18*

[8] *Wang, C. (2026). Research on the Control of Uncertainty Risks in Investment Decision-making by Financial Modeling.*

[9] *Liu, Y. (2026). The Application of Data-Driven Financial Risk Management in Multinational Enterprises. Economics and Management Innovation, 3(1), 20-26.*

[10] *Huang, J. (2026). Practice of Public Space Optimization and Functional Enhancement in Cultural Architecture. European Journal of Engineering and Technologies, 2(1), 9-21.*

[11] *Xu, D. (2026). AI-Driven Video Content Optimization Strategies for Immersive Media. European Journal of Engineering and Technologies, 2(1), 1-8.*

[12] *Sun, J. (2025). Research on Financial Systemic Risk Measurement Based on Investor Sentiment and Network Text Mining. Socio-Economic Statistics Research (2025), 6(2), 185-193.*

[13] *Zhang, X. (2025). Optimization and Implementation of Time Series Dimensionality Reduction Anti-fraud Model Integrating PCA and LSTM under the Federated Learning Framework. Procedia Computer Science, 262, 992-1001.*

[14] Yiting Gu. Application and Optimization Strategies of Cloud Services in Front end Engineering. International Journal of Big Data Intelligent Technology (2026), Vol. 7, Issue 1: 1-8

[15] Shuang Yuan. Research on Abnormal Detection and Transaction Risk Management Based on Machine Learning. International Journal of Social Sciences and Economic Management (2026), Vol. 7, Issue 1: 10-18