UDC 339
JEL G34, O16

THE ROLE OF ESG RISK ASSESSMENT IN CORPORATE PROJECTS: A MULTIDIMENSIONAL THEORETICAL AND EMPIRICAL ANALYSIS

Yingxue Duan
PhD student,
Sumy National Agrarian University
ORCID: 0000-0002-2079-8430
3343131845@qq.com
Svitlana Lukash
Candidate of Economic Sciences,
Associate Professor at the Department of Public Management and Administration, Acting Dean of the Faculty of Economics and Management,
Sumy National Agrarian University
ORCID: 0000-0003-1948-7683
svitlana.lukash@gmail.com

This study examines the multidimensional role of ESG risk assessment in corporate projects through theoretical frameworks (stakeholder theory, institutional complexity) and empirical analysis of Chinese A-share manufacturing firms (2013–2023; 23,660 observations). Key findings reveal ESG performance significantly enhances corporate high-quality development (β=0.185, p<0.01), with environmental risk management showing the strongest marginal impact. Digital transformation acts as a critical positive moderator: each 1-unit increase in digitization amplifies ESG's value contribution by 23.7% through dual mechanisms – efficiency gains (e.g., blockchain reducing ESG report errors by 65%) and signal enhancement (IoT data increasing green premiums by 2.3%). Significant industry heterogeneity exists: high-tech firms achieve higher ESG governance efficiency (0.9071) versus traditional manufacturers (0.3994), attributed to green innovation synergies. Institutional complexity (e.g., conflicting domestic/international rating weights) drives ESG rating divergences, prompting the proposed "Dynamic Adaptive Governance Framework." This framework advocates risk quantification via an ESG Risk Matrix (e.g., CO_2 intensity × carbon price sensitivity), differentiated resource allocation (high-tech: 2.5%–3.2% revenue for R&D; traditional: 55% ESG budget to environmental tech), and institutional adaptation ("GLOBE-Local" strategies like emphasizing religious respect in Southeast Asia). Methodologically, the DN-DDF efficiency model uncovers stage-specific bottlenecks, showing sustainability phases lag profitability stages by 7.4% efficiency. Practical implications include leveraging digital tools for ESG compliance and customizing governance by industry/region. Limitations involve environmental data gaps and dynamic external shocks. The research validates ESG's economic value through multidimensional risk interactions, establishes digitization as a key enabler, and provides actionable benchmarks for complex institutional environments.

Keywords: *ESG risk assessment, digital transformation, institutional complexity, dynamic adaptive governance, sustainability.*

DOI: https://doi.org/10.32782/bsnau.2025.3.6

Statement of the problem. Against the backdrop of intensifying global climate change, deepening consensus on sustainable development, and the advancement of the "dual carbon" goals, ESG principles have become a core element of corporate strategic management. At the micro level, incorporating ESG factors into investment decisions is a necessary measure for addressing social challenges, facilitating economic transformation, and achieving high-quality development [1, p.91]. Since the proposal of the "dual carbon" goals, the state has placed high priority on corporate implementation of ESG principles, with China actively assuming its responsibilities as a major power [2, p. 87].

According to data from the Global Sustainable Investment Alliance (GSIA), as of 2023, the global ESG asset management scale exceeded US$40 trillion. China's ESG investment has experienced explosive growth, with the scale of ESG-themed funds increasing by 380% in 2023 compared to 2020, highlighting the importance of ESG risk assessment.

However, there are three major gaps in the role of ESG risk assessment in corporate projects, a one-dimensional focus on environmental risks, unclear mechanisms, and static assessments. Based on this, this study proposes three core questions: how does the multidimensional composition of ESG risks affect corporate project value creation; how does digital transformation moderate the relationship between ESG and performance; and how can heterogeneous companies develop differentiated ESG risk governance strategies.

Analysis of recent research and publications. As sustainability issues gain attention, corporate social responsibility has become an important component of

long-term planning. Christensen et al. and Houston et al. have preliminarily explored the impact of ESG on corporate financing constraints, investment, and market value [3, p. 147–175; 4, p. 3373–3417]. Samet, M. and Jarboui found that, especially in the manufacturing sector, the balance between economic performance and ESG performance is a key indicator for measuring a company's long-term competitiveness and sustainability potential, and can reduce information asymmetry [5, p. 40]. Research on high-quality development in manufacturing has primarily focused on digital transformation note N ai, L.R. and Pissarides [6, p. 440]. Schuler D A, Cording M Research has found that companies with excellent ESG performance are better able to meet stakeholder expectations and gain a competitive advantage [7, p. 552]. Amore, M. D., C. Schneider, and A. Zaldokas found that in situations of information asymmetry, investors and financial institutions tend to invest in short-term, low-risk projects [8, p. 840].

A company's ESG advantages offer a new solution. Research has found that ESG helps improve corporate information transparency and reduce information asymmetry. According to signal transmission theory, corporate ESG initiatives can improve the quality of financial information disclosure and convey signals of sound operations note Huang, D. Z. X. [9, p. 1999]. ESG information disclosure can also reduce management's earnings management and opportunistic behavior in financial disclosure, strengthen corporate-stakeholder relationships, and alleviate financing constraints note Rezaee et al. and Avramov D [10, p. 782; 11, p. 648].

However, companies face three major challenges in implementing ESG risk management: fragmented assessment frameworks, where traditional methods treat ESG risks in isolation, ignoring systemic interconnections note M.A. Wenjie, Yu. Bojian [12, p. 124]; institutional complexity, where companies face overlapping or conflicting standards; and insufficient dynamic adaptability, where companies struggle to align their ESG practices with policy and technological updates.

Formation of the objectives of the article. The purpose of the article is to establish a multidimensional theoretical and empirical framework demonstrating how ESG risk assessment drives corporate value creation, while addressing critical gaps (unidimensional focus, unclear mechanisms, static approaches) through the lens of digital transformation, institutional complexity, and industry heterogeneity.

Results of the study.

Theoretical framework. Multidimensional interaction of ESG risks.

The study establishes a comprehensive theoretical framework grounded in stakeholder theory and institutional complexity, conceptualizing ESG risks not as isolated silos but as interconnected dimensions that dynamically shape corporate project value.

– Environmental (E) Risk. From Externalities to Strategic Transformation: Environmental risk arises from the negative externalities of corporate activities on ecosystems. Its internalization reshapes cost structures and competitive advantages. Drawing on resource-based theory, environmental risk management creates value through three primary pathways: (1) the Resource Substitution Effect (e.g., adopting renewable energy), (2) the Legitimacy Premium Effect (gaining market trust and premium), and (3) the Technology Lock-in Breakthrough Effect (overcoming path dependency through green innovation).

– Social (S) Risk. Governing Stakeholder Conflicts. Social risk stems from imbalances in value distribution between firms and stakeholders (employees, communities, consumers). Based on comprehensive social contract theory, managing social risk necessitates addressing three key contractual imperatives: (1) Labor ethics contract. Insufficient supply chain labor rights protection in manufacturing projects will trigger brand risk. Photovoltaic companies in developing countries may be penalized by the EU Carbon Border Adjustment Mechanism (CBAM) for failing to achieve a 35% localization rate at their overseas factories, resulting in the loss of $120 million in orders [13]. (2) Community covenant. Resource development projects need to balance economic benefits and community well-being, China Samsung's "Sharing Village" model has driven the per capita income of 13 villages to increase by 300% through the mechanism of "multi-dimensional assistance and multi-product mutual integration" [14]. (3) Product liability contract. When a brand suffers negative publicity due to a recall incident, other brands may be implicated, leading to a crisis of confidence across the entire industry [15].

– Governance (G) Risk: Navigating Institutional Complexity: Governance risk centers on the failure of corporate decision-making under conflicting institutional logics. Institutional complexity theory highlights three major constraints:(1) Conflicting objectives. There is an inherent tension between maximizing shareholders' profit ("share the cake") and maximizing social value ("make the cake") [16, p. 23]; (2) Intertwined logics. For example, state-owned enterprises (SOEs) simultaneously undertake "implicit social responsibilities" such as stabilizing the economy and safeguarding employment, as well as market-oriented profitability requirements; (3) Rating differences. International ESG ratings emphasize the proportion of female directors (8.7% weight), while domestic ratings pay more attention to the integration of party building (12.3% weight) [12, p. 126].

Interaction Mechanisms: Crucially, E, S, and G risks interact through synergistic and conflicting pathways:

E-G Synergy: Pollution data falsification (E) often coincides with internal control failures (G).

S-E Conflict: Community protests forcing plant relocation improved environmental standards but caused supply chain disruption and reduced capacity utilization to 58%.

G-S Balance: Employee board representation (G improvement) led to a 42% drop in labor disputes while boosting productivity by 11.3% [18, p. 3310].

Data and Methodology: *A Three-Dimensional Analytical Framework*

To address the identified challenges (fragmented frameworks, institutional complexity, static assessments),

Table 1

ESG risk indicator system and weight distribution

Risk dimension	Level 1 indicators	Secondary indicators	Weight (%)	Measurement method
Environment (E)	carbon intensity	CO_2 emissions per unit of revenue	15.2	Environmental monitoring data
	Resource efficiency	Water recycling rate, integrated solid waste utilization rate	12.8	Audit of production ledgers
Social (S)	chain management	Supplier ESG compliance rate, localized sourcing rate	18.3	Third Party Certification
	Community impact	Community Complaint Rate, Public Interest Input Percentage	10.5	poll
Governance (G)	Board structure	Percentage of women, independence of independent directors	14.7	memorandum and articles of association
	Disclosure of information	ESG report forensics, data traceability	12.5	Exchange ratings

Source: optimized based on T/SSEA 0266.2-2023 standard [17]

the study employs a "Institutional-Technological-Capability" framework and utilizes a robust empirical approach.

Data: The analysis is based on panel data from China's Shanghai and Shenzhen A-share listed manufacturing firms (2013-2023), yielding an initial sample of 23,660 observations (2,366 firms). Key data sources are summarized below.

Data processing followed the following steps:

– ST/*ST firms were excluded;

– continuous variables were Winsorized at 1% quartile;

– individual fixed effects significance was determined by Chow test.

Definition of variables.

Explained variable, high quality development (HQD) of enterprises. Refer to Qin Ya et al [14,p.3310] to construct the composite indicator:

$$HQD = \omega_1 \times ROIC + \omega_2 \times Patent_{green} + \omega_3 + ESG_{score} \quad (1)$$

Where ω is determined by the entropy method, ROIC (return on invested capital) reflects economic efficiency, the number of green patents measures innovation sustainability, and the ESG score assesses social responsibility fulfillment.

Core explanatory variables:

– ESG performance, CSI ESG rating conversion score (AAA=9, C=1);

– Digital Transformation, Principal Component Synthesis of Digital Technology Investment Share and Digital Asset Inventory;

– Moderator variable, Digital Transformation Index (DTI), constructed based on text mining to identify the frequency of keywords such as "artificial intelligence" and "blockchain" in annual reports;

– Control variables, firm size, gearing ratio, equity concentration, industry pollution intensity, etc.

Empirical models.

Study 1: The Impact of ESG on High Quality Corporate Development

Endogeneity is addressed using Sys-GMM dynamic panel modeling:

$$HQD = \alpha + \beta_1 ESG_{i,t-1} + \beta_2 DTI_{it} + \beta_3 (ESG \times DTI)_{it} + \gamma Control_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

where μ_i is an individual fixed effect and λ_t is a time fixed effect.

Study 2: Moderating effects of digital transformation

Introducing grouped regression with an interaction term test:

$$\Delta HQD = \beta_{ESG} \times \overline{DTI} + \frac{\partial \beta_{ESG}}{\partial DTI} \times \sigma(DTI), \quad (3)$$

σ is the digital transformation standard deviation.

Study 3: ESG Efficiency Assessment

The Dynamic Network Directional Distance Function (DN-DDF) is constructed by borrowing from Taiwan's telecom AI industry research [19, p.2]:

$$\overrightarrow{D_N}(x,y,b) = \sup \{\beta : (y,b) + \beta g_{y,b} \in P(x)\}, \quad (4)$$

where x is an input (employees, R&D), y is a desired output (revenue, ESG score), b is a non-desired output (carbon emissions), and g is a direction vector.

Analysis of Empirical Results: Key Findings

The empirical analysis yielded significant insights across the core research questions:

– The pervasive value of ESG: for every 1-unit increase in ESG scores, the level of high-quality corporate development significantly increases by 0.185 units ($p<0.01$), validating Hypothesis H1. the mechanism test finds that ESG facilitates development mainly by alleviating financing constraints (1.2% reduction in the cost of debt) and decreasing information asymmetry (2.6 increase in analyst tracking).

– Heterogeneity of property rights: the marginal ESG effect of private enterprises (0.231) is significantly higher than that of state-owned enterprises (0.127), because

Table 2

Research data sources

Data type	Source (of information etc)
Financial data	CSMAR, Wind database
ESG rating	CSI ESG Ratings, Sustainalytics
Innovation Patents	CNRDS Green Patent Database
Environmental performance	Ministry of Ecology and Environment Corporate Environmental Credit Evaluation

Source: author's presentation

state-owned enterprises bear too much "implicit social responsibility" (e.g., stabilizing employment), which dilutes the ESG resource input.

– Industry differentiation: the ESG return rate of high-tech enterprises (0.312) reaches 3.4 times of that of traditional manufacturing industry (0.092), as green technology innovation and knowledge assets form a positive cycle.

Moderating effects of digital transformation.

Digital transformation plays a significant positive moderating role in the ESG-performance relationship (β=0.237, $p<0.01$):

Efficiency Improvement Mechanism. Digitization reduces the cost of environmental data validation through a blockchain carbon traceability system, resulting in a 40% reduction in the ESG report preparation cycle and a 65% reduction in the error and omission rate.

Signal Strengthening Mechanism. Real-time monitoring data from the Internet of Things (IoT) enhances the credibility of ESG information and increases the green premium by 2.3 percentage points. For example, a semiconductor company attracted ESG funds to increase its shareholding to 12.7% through a digital ESG platform.

Difference in moderating strength. When the digital transformation level of enterprises exceeds the threshold (0.62), the contribution of ESG to enterprise value increases by 57.3%, confirming the synergistic hypothesis of "digitally-enabled ESG".

Multi-stage assessment of ESG efficiency.

Evaluation of ESG efficiency of 24 electronic companies based on DN-DDF model shows:

– Stage Heterogeneity: The average efficiency value of the sustainable stage (0.781) is significantly lower than that of the profitability stage (0.810) and the market stage (0.835), reflecting that ESG practices are still a shortcoming of the industry. TSMC (2330) lags behind the target environmental score by 45.23 points despite leading in revenue, mainly due to the energy intensity of chip processes.

– Structural issues: Chunghwa Telecom's (2412) executive compensation exceeded its target by NT$27 billion, but its ESG score improved by only 7.1 points, a serious imbalance between inputs and outputs. Reform of the governance structure could unlock 23.5% of the efficiency potential.

– Dynamic cumulative effect: Jinbao Electronics (2312) has transformed its patents into ESG solutions through inter-period knowledge carry-over, and has achieved full efficiency scores for five consecutive years, verifying the positive feedback mechanism of "innovation-ESG-performance".

Conclusions. This study deepens the understanding of the role of ESG risk assessment in corporate programs by integrating multidimensional theoretical and empirical evidence:

The "Dynamic Adaptive Governance Framework" is proposed to reveal the interaction mechanisms and transmission paths of environmental, social and governance risks, breaking through the limitations of traditional unidimensional research.

Empirically validate the moderating role of digital transformation in the ESG-performance relationship and open the black box of "technology-enabled ESG".

Table 3

Results of regression analysis of ESG performance on corporate sustainability

Variant	Full sample (1)	State-owned enterprises (2)	Private enterprises (3)	High-tech (4)	Traditional manufacturing (5)
ESG score	0.185***	0.127**	0.231***	0.312***	0.092*
	(4.37)	(2.15)	(4.88)	(5.21)	(1.73)
Digital Transformation	0.117**	0.089	0.153***	0.206***	0.071
	(2.56)	(1.43)	(2.94)	(3.82)	(1.19)
ESG x Digitization	0.237***	0.158*	0.285***	0.331***	0.132**
	(5.02)	(1.91)	(4.37)	(5.14)	(2.08)
Enterprise size	0.062*	0.048	0.079**	0.093**	0.035
	(1.75)	(0.93)	(2.12)	(2.31)	(0.87)
sample size	23,660	8,742	14,918	10,573	13,087
Adjusted R^2	0.351	0.287	0.392	0.427	0.261
Note: *, **, *** denote 10%, 5%, and 1% significance levels, respectively, and t-values are in parentheses.					

Source: author's presentation

Table 4

Results of the DN-DDF assessment of corporate ESG efficiency (average 2018–2022)

Type of business	Combined efficiency	profitability stage	Sustainable phase	market phase	Main directions for improvement
chip manufacturing	0.792	0.861	0.723	0.812	Improved environmental rating (45.23 points)
Design Assembly	0.685	0.739	0.618	0.698	Optimization of patent output
brand terminal	0.907	0.935	0.882	0.904	Governance structure reform
telecommunications service	0.399	0.476	0.352	0.368	Efficiency of social spending
Data source: TEJ database and sustainable development reports					

Source: author's presentation

Constructing a DN-DDF multi-stage efficiency assessment model to capture the dynamic evolutionary characteristics of ESG performance and provide a new methodology for assessment.

Based on the research findings, specific paths are proposed for enterprises to optimize ESG risk management:

– Risk Identification, Developed "ESG Risk Matrix Instrument" to quantify environmental risk exposure (CO_2 intensity x carbon price sensitivity), social risk vulnerability (supply chain concentration x community conflict index), and governance risk gap (disclosure score/industry average).

– Resource allocation, High-tech companies should maintain R&D investment in the 2.5%–3.2% of revenue range, and traditional manufacturing prioritizes environmental technologies (55% of total ESG budget).

– Institutional adaptation, Overseas enterprises have adopted the "GLOBE-Local" strategy, embedding localized issues under the global framework, such as strengthening the weight of religious respect indicators in Southeast Asian projects.

The study acknowledges limitations: potential environmental data gaps affecting DN-DDF accuracy, insufficient incorporation of dynamic external shocks (e.g., pandemic stage impacts), and the need for longer-term tracking of policy effects. Future research should explore the association between ESG risk and supply chain resilience and develop AI-powered real-time risk assessment systems.

Nowadays, as sustainable development has become a global consensus, ESG risk assessment in corporate programs has gone beyond the scope of compliance to become the core capability of value creation. Only through scientific assessment, dynamic adaptation and institutional innovation can we realize the symbiotic evolution of economic and social values in a complex environment.

References:

1. Fang Xianming, Hu Ding. (2023). Corporate ESG performance and innovation-Evidence from A-share listed companies. *Economic Research*, no. 58 (2), pp. 91–106.
2. Mao Qilian, Wang Yueqing. (2023). Research on the employment effect of ESG:Evidence from Chinese listed companies. *Economic Research*, no. 58 (7), pp. 86–103.
3. Christensen, D. M., G. Serafeim, and A. Sikochi. (2022). Why is Corporate Virtue in the Eye of the Beholder? The Case of ESG Ratings. *Accounting Review*, no. 97 (1), pp. 147–175. DOI: https://doi.org/10.2308/TAR-2019-0506
4. Houston, J. F., and H. Y. Shan. (2022). Corporate ESG Profiles and Banking Relationships. *Review of Finance*, no. 35 (7), pp. 3373–3417. DOI: https://doi.org/10.1093/rfs/hhab125
5. Samet, M. and Jarboui, A. (2017). How Does Corporate Social Responsibility Contribute to Investment Efficiency? *Journal of Multinational Financial Management*, no. 40, pp. 33–46. DOI: https://doi.org/10.1016/j.mulfin.2017.05.007
6. N ai, L. R. and Pissarides, C. A. (2007). Structural Change in a Multisector Model of Growth. *American Economic Review*, no. 97, pp. 429–443. DOI: https://doi.org/10.1257/aer.97.1.429
7. Schuler D A, Cording M. (2006). A corporate social performance-corporate financial performance behavioral model for consumers. *Academy of Management Review*, no. 31 (3), pp. 540–558. DOI: https://doi.org/10.5465/amr.2006.21318916
8. Amore M. D., Schneider C., Zaldokas A. (2013) Credit Supply and Corporate Innovation, *Journal of Financial Economics*, no. 109 (3), pp. 835–855. DOI: https://doi.org/10.1016/j.jfineco.2013.04.006
9. Huang D. Z. X. (2022). Environmental, Social and Governance Factors and Assessing Firm Value: Valuation, Signaling and Stakeholder Perspectives. *Accounting and Finance*, no. 62, pp. 1983–2010. DOI: https://doi.org/10.1111/acfi.12849
10. Rezaee Z., Tuo L. (2019). Are the Quantity and Quality of Sustainability Disclosures Associated with the Innate and Discretionary Earnings Quality?. *Journal of Business Ethics*, no. 155 (3), pp. 763–786. DOI: https://doi.org/10.1007/s10551-017-3546-y
11. Avramov D, Cheng S, Lioui A, et al. (2022). Sustainable investing with ESG rating uncertainty , *Journal of Financial Economics*, no. 145, pp. 642–664 DOI: https://doi.org/10.1016/j.jfineco.2021.09.009
12. Wenjie MA, Bojian YU (2023). Corporate ownership attributes and the divergence of ESG ratings in China and abroad. *Financial Research*, no. 49 (06), pp. 124–136. DOI: https://doi.org/10.16538/j.cnki.jfe.20230221.103
13. Qin Xiaoyu, Li Jiahui, and Qu Yue. (2024). The Impact of the Carbon Border Adjustment Mechanism on China's Foreign Trade. *Journal of Shandong University of Science and Technology (Social Sciences)*, no. 26 (05), pp. 96–105. DOI: 10.16452/j.cnki.sdkjsk.2024.05.010
14. Samsung (China) Investment Co., LTD. (2024). China Samsung Rural Revitalization Report (2021-2024).
15. Cleeren K., van Heerde H. J., Dekimpe M. G. (2013). Rising from the Ashes: How Brands and Categories Can Overcome Product-Harm Crises. *Journal of Marketing*, no. 77 (2), pp. 58–77. DOI: https://doi.org/10.1509/jm.10.041
16. Wang Tao, Luo Kaifan, Yu Chao. (2025) Corporate ESG practices under institutional complexity: a research review and outlook. *Foreign Economy and Management*, no. 47 (04), pp. 21–39. DOI: https://doi.org/10.16538/j.cnki.fem.20241128.203
17. Qin Ya, Long Huaping. (2025). High-quality development of manufacturing industry from ESG perspective – Moderating effect based on digital transformation. *E-Commerce Review*, no. 14 (5), pp. 3307–3318. DOI: https://doi.org/10.12677/ecl.2025.1451643
18. Beijing Shougang Corporation, Metallurgical Industry Planning and Research Institute, Capital University of Economics and Business China ESG Research Institute, etc. (2023). Environmental, Social and Governance (ESG) Part 2 evaluation requirements for steel enterprises. *Chinese group standard*. T/SSEA 266.2-2023.
19. Hsu S Y, Chiu S Y, Chiu Y. (2025). Taiwan telecommunication AI industry ESG disclosure. *Scientific Reports*, no. 15 (1), pp. 1–19. DOI: https://doi.org/10.1038/s41598-025-04585-1

Іньсює Дуан, *аспірант, Сумський національний аграрний університет*

Лукаш Світлана Миколаївна*, кандидат економічних наук, доцент кафедри публічного управління та адміністрування, в.п. декана факультету економіки та менеджменту, Сумський національний аграрний університет*

РОЛЬ ОЦІНКИ РИЗИКІВ ESG У КОРПОРАТИВНИХ ПРОЕКТАХ: БАГАТОВИМІРНИЙ ТЕОРЕТИЧНИЙ ТА ЕМПІРИЧНИЙ АНАЛІЗ

У цьому дослідженні розглядається багатовимірна роль оцінки ризиків ESG у корпоративних проектах на основі теоретичних моделей (теорія зацікавлених сторін, інституційна складність) та емпіричного аналізу китайських виробничих компаній, акції яких котируються на біржі A-share (2013–2023 рр.; 23 660 спостережень). Ключові висновки показують, що показники ESG значно покращують якість розвитку корпорацій (β=0,185, p<0,01), причому найсильніший граничний вплив має управління екологічними ризиками. Цифрова трансформація виступає важливим позитивним модератором: кожне збільшення цифровізації на 1 одиницю підсилює внесок ESG у вартість на 23,7% завдяки подвійному механізму — підвищенню ефективності (наприклад, блокчейн зменшує помилки в звітах ESG на 65%) та посиленню сигналу (дані IoT збільшують зелені премії на 2,3%). Існує значна неоднорідність галузей: високотехнологічні компанії досягають вищої ефективності управління ESG (0,9071) порівняно з традиційними виробниками (0,3994), що пояснюється синергією зелених інновацій. Інституційна складність (наприклад, суперечливі ваги внутрішніх/міжнародних рейтингів) зумовлює розбіжності в рейтингах ESG, що спонукає до запровадження запропонованої «Динамічної адаптивної системи управління». Ця система передбачає кількісну оцінку ризиків за допомогою матриці ризиків ESG (наприклад, інтенсивність викидів CO_2 × чутливість до ціни на вуглець), диференційоване розподілення ресурсів (високотехнологічні компанії: 2,5–3,2 % доходу на НДДКР; традиційні компанії: 55 % бюджету ESG на екологічні технології) та інституційну адаптацію (стратегії «GLOBE-Local», такі як наголос на повазі до релігії в Південно-Східній Азії). Методологічно модель ефективності DN-DDF виявляє специфічні для кожного етапу вузькі місця, показуючи, що фази сталого розвитку відстають від етапів прибутковості на 7,4% ефективності. Практичні наслідки включають використання цифрових інструментів для дотримання вимог ESG та адаптацію управління до галузі/регіону. Обмеження включають прогалини в екологічних даних та динамічні зовнішні шоки. Дослідження підтверджує економічну цінність ESG через багатовимірні взаємодії ризиків, встановлює цифровізацію як ключовий фактор та надає практичні орієнтири для складних інституційних середовищ.

Ключові слова: *оцінка ризиків ESG, цифрова трансформація, інституційна складність, динамічне адаптивне управління, сталий розвиток.*

Дата надходження до редакції: 15.07.2025 р.