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Data Assetization and Carbon Information Disclosure Quality of Listed Enterprises

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Abstract: In the context of the digital economy and carbon neutrality goals, data assetization has emerged as an important approach for improving corporate governance and information management. This study examines the impact of data assetization on carbon information disclosure quality among Chinese listed companies. Drawing on signaling theory, stakeholder theory, and institutional theory, the paper proposes that data assetization enhances carbon disclosure quality by improving data governance capabilities and reducing information asymmetry. Furthermore, ESG environmental performance is expected to mediate this relationship, while environmental regulation strengthens the positive effect of data assetization on carbon disclosure quality. A theoretical framework is developed using Chinese A-share listed companies from 2020 to 2025 as the research context. The study contributes to the literature on digital governance and environmental disclosure by highlighting the role of data assets in promoting transparency and sustainability. The findings are expected to provide practical implications for enterprises seeking to improve carbon disclosure practices and for policymakers promoting carbon neutrality and sustainable development.

Keywords: Data Assetization; Carbon Information Disclosure Quality; ESG Environmental Performance; Environmental Regulation; Digital Governance.

1. Introduction

The acceleration of global climate change has prompted governments, investors, and stakeholders to demand greater transparency regarding corporate environmental performance. Carbon information disclosure has gradually become an essential component of corporate sustainability reporting and ESG evaluation systems. High-quality carbon disclosure enables investors to assess climate-related risks, facilitates regulatory oversight, and promotes green economic transformation [1].

At the same time, the digital economy has transformed data into a core strategic resource. In China, the implementation of the Interim Provisions on Accounting Treatment of Enterprise Data Resources in 2024 marked a significant milestone in recognizing data as an accounting asset. This policy shift reflects the transition of enterprise data from an operational by-product to a measurable and manageable economic resource.

Data assetization refers to the process through which enterprise data resources are standardized, quantified, recognized, and managed as valuable assets. Through data governance mechanisms, enterprises establish data collection, storage, processing, and utilization systems, thereby enhancing organizational information management capabilities.

Carbon information disclosure fundamentally relies on the quality and availability of environmental data. Accurate carbon accounting, emissions monitoring, and environmental reporting require extensive data support. Therefore, the emergence of data assetization may significantly influence carbon disclosure practices.

Existing studies have extensively explored determinants of environmental disclosure, including corporate governance, institutional pressure, digital transformation, and ESG performance [5]. However, limited attention has been paid to the specific role of data assetization in improving carbon disclosure quality.

This study aims to address the following research questions: Does data assetization improve the quality of corporate carbon information disclosure? Through what mechanisms does data assetization influence carbon disclosure? What implications does data assetization have for ESG environmental performance?

2. Literature Review

2.1. Data Assetization

With the rapid development of the digital economy, data has evolved from a by-product of business operations into a strategic production factor. Data assetization refers to the process of identifying, measuring, managing, and utilizing data resources as economic assets. Through standardized collection, storage, and governance mechanisms, enterprises transform fragmented data into valuable resources that support decision-making and value creation [2].

According to Resource-Based Theory (RBT), sustainable competitive advantages stem from valuable, rare, and difficult-to-imitate resources. As a strategic resource, data possesses these characteristics and can generate long-term economic benefits [3]. By establishing effective data governance frameworks, firms can improve data quality, traceability, and utilization efficiency, thereby enhancing organizational performance and competitiveness.

Existing studies suggest that data assetization improves information management efficiency, supports data-driven decision-making, strengthens digital governance, and enhances enterprise transparency. Beyond its economic value, data assetization also contributes to environmental governance by improving the quality and reliability of environmental data [6]. As environmental management increasingly relies on emissions and operational data, stronger data governance provides an important foundation for sustainability reporting and carbon disclosure [7].

2.2. Carbon Information Disclosure Quality

Carbon information disclosure quality refers to the completeness, accuracy, timeliness, comparability, and verifiability of carbon-related information disclosed by enterprises. High-quality disclosure helps stakeholders assess a firm's environmental performance, climate-related risks, and sustainability strategies.

Carbon disclosure generally includes information on carbon emissions, emission reduction targets, climate risks, carbon management practices, and carbon accounting methods. Comprehensive disclosure can improve transparency, reduce information asymmetry, and strengthen stakeholder confidence.

Previous studies indicate that carbon disclosure quality is influenced by both internal and external factors. Internal factors include corporate governance, ownership structure, and managerial incentives, while external factors include environmental regulation, stakeholder pressure, media attention, and market supervision. Technological innovation has also been found to enhance environmental monitoringand reporting capabilities.

However, existing research primarily focuses on governance structures and external institutional pressures, while the role of internal data governance mechanisms remains underexplored. Since carbon disclosure depends heavily on the collection, processing, and verification of environmental data, investigating the impact of data assetization on carbon disclosure quality represents an important research direction [4].

2.3. Data Governance and Environmental Disclosure

The application of digital technologies has significantly transformed environmental management practices. Previous studies suggest that big data analytics can improve environmental monitoring, artificial intelligence can enhance emissions forecasting, and digital platforms can strengthen information transparency and stakeholder communication [9].

These technologies help enterprises collect and process environmental information more efficiently, thereby improving the quality of sustainability reporting. As a result, digitalization is generally considered beneficial for environmental governance and disclosure practices.

Nevertheless, most existing studies focus on digital transformation rather than data assetization. Digital transformation emphasizes the adoption of digital technologies, while data assetization focuses on the formal recognition, governance, and management of data resources as organizational assets [7]. Therefore, data assetization represents a deeper institutional arrangement for improving information quality and governance effectiveness.

From the perspective of environmental disclosure, high-quality carbon reporting requires reliable, traceable, and standardized environmental data. Data assetization can improve the collection, integration, and verification of carbon-related information, thereby enhancing disclosure accuracy and transparency. However, empirical evidence on the relationship between data assetization and carbon information disclosure remains limited.

Therefore, this study seeks to fill this gap by examining whether data assetization can improve carbon information disclosure quality and exploring the mechanisms through which this effect occurs.

3. Theoretical Analysis and Research Hypotheses

3.1. Data Assetization and Carbon Information Disclosure Quality

Carbon information disclosure involves the collection, processing, verification, and communication of environmental information to external stakeholders. The quality of carbon disclosure largely depends on the accuracy, reliability, and completeness of underlying environmental data. Therefore, firms with stronger data governance capabilities are generally more capable of providing high-quality carbon-related information.

According to signaling theory, information asymmetry exists between firms and external stakeholders regarding environmental performance and climate-related risks. To enhance transparency and stakeholder confidence, enterprises have incentives to disclose credible environmental information. Firms with superior information management capabilities are more likely to send positive signals through transparent and reliable carbon disclosure.

Data assetization provides an important foundation for such disclosure. By recognizing and managing data as an organizational asset, enterprises establish standardized procedures for data collection, storage, verification, and utilization. These mechanisms improve data quality, consistency, and traceability, enabling more accurate measurement and reporting of carbon-related information.

Furthermore, data assetization strengthens environmental monitoring and internal governance. Through integrated data management systems, firms can more effectively track energy consumption, production activities, and carbon emissions. The availability of high-quality environmental data supports more accurate carbon accounting and improves the credibility of disclosed information.

In addition, enterprises with higher levels of data assetization often have stronger incentives to demonstrate the value of their data governance capabilities. High-quality carbon disclosure can enhance corporate transparency, strengthen stakeholder trust, and improve organizational legitimacy. Consequently, firms with greater data assetization are more likely to provide comprehensive and reliable carbon information [2].

Based on the above analysis, data assetization is expected to improve carbon information disclosure quality by enhancing data governance, reducing information asymmetry, and strengthening environmental information management. Therefore, the following hypothesis is proposed:

H1: Data assetization positively affects the quality of carbon information disclosure among listed enterprises.

3.2. Mediating Role of ESG Environmental Performance

While data assetization may directly improve carbon information disclosure quality, its effect may also operate indirectly through ESG environmental performance. Environmental performance reflects a firm's ability to manage environmental risks, reduce emissions, and achieve sustainability objectives, making it an important link between internal data governance and external environmental disclosure [10].

Data assetization enhances environmental performance by improving the quality, integration, and utilization of

environmental data. Environmental management activities, such as carbon accounting, energy monitoring, and pollution control, rely heavily on accurate and timely information. Through standardized data collection and management procedures, firms can establish more effective environmental management systems, improve resource allocation, and reduce carbon emissions. As a result, enterprises with higher levels of data assetization are more likely to achieve superior ESG environmental performance.

According to stakeholder theory, firms with better environmental performance have stronger incentives and greater capabilities to disclose environmental information. Strong environmental performance signals corporate responsibility and sustainability commitment, encouraging firms to provide more transparent carbon disclosures [5]. Moreover, enterprises with higher ESG environmental ratings often possess more comprehensive environmental management systems and more reliable environmental data, which further support high-quality carbon reporting.

Therefore, data assetization is expected to improve ESG environmental performance, which subsequently enhances carbon information disclosure quality. Based on this reasoning, the following hypothesis is proposed:

H2: ESG environmental performance mediates the relationship between data assetization and carbon information disclosure quality.

3.3. Moderating Role of Environmental Regulation

Environmental regulation is an important external factor influencing corporate environmental behavior and disclosure practices. As governments strengthen climate governance and carbon neutrality policies, enterprises face increasing requirements regarding environmental compliance, carbon reporting, and sustainability disclosure. Consequently, environmental regulation creates stronger incentives for firms to improve the quality of environmental information disclosure.

According to institutional theory, firms are influenced by the regulatory environment in which they operate. Under stricter environmental regulations, enterprises face greater pressure from regulators, investors, and the public to provide transparent and reliable carbon information. As a result, firms have stronger incentives to enhance environmental monitoring and reporting capabilities.

Environmental regulation may strengthen the governance effects of data assetization. To meet disclosure requirements, enterprises must collect, verify, and manage large amounts of environmental data. Firms with higher levels of data assetization possess more advanced data governance systems, enabling them to process carbon-related information more efficiently and accurately. Therefore, the benefits of data assetization are likely to become more significant under stronger regulatory pressure.

In addition, stricter environmental regulations increase stakeholder attention to environmental performance and carbon disclosure. Enterprises with well-developed data asset management systems are better able to respond to these expectations by providing comprehensive and credible environmental information. Consequently, the positive impact of data assetization on carbon information disclosure quality is expected to be stronger in highly regulated environments.

Based on the above analysis, the following hypothesis is proposed:

H3: Environmental regulation positively moderates the relationship between data assetization and carbon information disclosure quality, such that the positive effect of data assetization is stronger under higher levels of environmental regulation.

4. Research Design

4.1. Sample Selection

This study selects Chinese A-share listed companies from 2020 to 2025 as the research sample. The sample period covers the implementation stage of data asset accounting reforms and the rapid development of corporate ESG and carbon disclosure practices, making it suitable for examining the relationship between data assetization and carbon information disclosure quality.

To ensure the reliability and comparability of the data, several screening procedures are applied. First, financial firms are excluded because their accounting standards, regulatory requirements, and financial structures differ substantially from those of non-financial enterprises. Second, ST and *ST companies are removed due to their abnormal operating conditions and potential financial distress, which may bias the empirical results. Third, observations with missing data on ESG ratings, carbon information disclosure, or other key variables are excluded. To reduce the influence of extreme values, all continuous variables are winsorized at the 1% and 99% levels.

The data used in this study are collected from multiple sources. Financial and corporate governance data are obtained from the CSMAR and WIND databases. Information related to carbon disclosure and ESG performance is manually collected from annual reports, sustainability reports, ESG reports, and other publicly available corporate disclosures. After applying the above screening procedures, the final sample consists of firm-year observations suitable for empirical analysis.

4.2. Variable Definition

Dependent Variable: Carbon Information Disclosure Quality (CIDQ)

The dependent variable is Carbon Information Disclosure Quality (CIDQ). Following previous studies on environmental and sustainability disclosure, a disclosure scoring index is constructed based on six key dimensions of carbon reporting: carbon emissions data, carbon reduction targets, carbon governance structure, climate-related risk disclosure, carbon accounting methodology, and third-party verification. A score of one is assigned if a firm discloses the relevant information and zero otherwise. The total score ranges from 0 to 6, with higher values indicating higher carbon information disclosure quality.

Independent Variable: Data Assetization (DA)

The independent variable is Data Assetization (DA). Consistent with the emerging literature on data asset accounting, DA is measured as the ratio of recognized data assets to total assets. A higher ratio indicates a greater degree of data assetization within the enterprise. To ensure robustness, alternative measures are also adopted, including a dummy variable indicating whether a firm recognizes data assets and the amount of capitalized data resources disclosed in financial statements.

Mediating Variable: ESG Environmental Performance

(ENV)

The mediating variable is ESG Environmental Performance (ENV). This variable reflects a firm's environmental management and sustainability performance and is measured using the environmental dimension score provided by professional ESG rating agencies. Higher scores indicate better environmental performance and stronger environmental governance capabilities.

Control Variables

To mitigate potential omitted-variable bias, several firm-level control variables are included in the empirical models. These variables include firm size (Size), measured by the natural logarithm of total assets; leverage (Lev), measured by the ratio of total liabilities to total assets; profitability (ROA), measured by return on assets; board independence (Indep), measured by the proportion of independent directors; ownership concentration (Top1), measured by the shareholding ratio of the largest shareholder; and firm age (Age), measured by the number of years since listing. In addition, industry and year fixed effects are included to control for industry-specific and time-specific influences.

5. Expected Results

The empirical results are expected to support the proposed hypotheses. First, data assetization is anticipated to have a significantly positive effect on carbon information disclosure quality. Enterprises with higher levels of data assetization are likely to possess stronger data governance capabilities, enabling them to collect, process, and disclose carbon-related information more accurately and transparently. Therefore, firms with greater data asset recognition are expected to achieve higher carbon disclosure scores.

Second, ESG environmental performance is expected to play a partial mediating role in this relationship. Data assetization can improve environmental management efficiency by enhancing carbon emissions monitoring, optimizing energy utilization, and supporting data-driven environmental decision-making. Improved environmental performance subsequently increases both the capability and willingness of firms to disclose high-quality carbon information, thereby strengthening disclosure quality.

Third, environmental regulation is expected to positively moderate the relationship between data assetization and carbon information disclosure quality. In regions with stricter environmental policies and stronger regulatory oversight, firms face greater compliance requirements and disclosure pressure. As a result, the governance benefits generated by data assetization are likely to be more pronounced, leading to stronger improvements in carbon disclosure quality.

Furthermore, heterogeneity analyses are expected to reveal that the positive effect of data assetization is stronger among high-pollution industries, state-owned enterprises, and firms with advanced digital infrastructure. These firms typically face higher environmental scrutiny, possess greater resources for data governance, and have stronger incentives to improve environmental transparency. Consequently, the impact of data assetization on carbon information disclosure quality is expected to be more significant within these groups.

6. Discussion

This study investigates the relationship between data assetization and carbon information disclosure quality among Chinese listed enterprises from the perspective of digital governance and sustainable development. Drawing on signaling theory, stakeholder theory, and institutional theory, this paper develops a theoretical framework linking data assetization, ESG environmental performance, environmental regulation, and carbon information disclosure quality.

The analysis suggests that data assetization can significantly improve carbon information disclosure quality by enhancing data governance capabilities, reducing information asymmetry, and strengthening the accuracy and reliability of environmental information. In addition, ESG environmental performance is expected to serve as an important mediating mechanism through which data assetization influences carbon disclosure. By improving environmental monitoring, resource allocation, and sustainability management, data assetization contributes to better environmental performance, which subsequently promotes higher-quality carbon disclosure. Furthermore, environmental regulation is expected to strengthen this relationship, as firms operating under stricter regulatory environments face greater incentives to utilize data governance capabilities to meet disclosure requirements.

This study contributes to the existing literature in two ways. First, it extends research on data assetization by examining its environmental governance implications rather than focusing solely on economic and financial outcomes. Second, it enriches the carbon disclosure literature by identifying data assetization as an important internal governance mechanism that can improve disclosure quality.

From a practical perspective, enterprises should strengthen data asset management systems, improve environmental data integration, and establish standardized carbon data governance frameworks to support high-quality sustainability reporting. At the same time, policymakers should continue to refine data asset accounting standards and carbon disclosure regulations, thereby promoting both data factor marketization and the achievement of carbon neutrality goals. Through the coordinated development of digital governance and environmental governance, enterprises can enhance transparency, improve ESG performance, and contribute to sustainable economic growth.

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