

Analysis of the Influencing Factors of the Quality of Environmental Accounting Information Disclosure of Manufacturing Enterprises under the “Double Carbon” Goal

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Abstract: With the in-depth promotion of China's strategic goal of “carbon peaking and carbon neutrality”, the green transformation process of the manufacturing industry, as the core pillar of the national economy and the main source of carbon emissions, has attracted much attention from all walks of life. As an important mechanism to measure the performance of corporate environmental responsibilities and alleviate the asymmetry of investment and financing information, the quality of environmental accounting information disclosure is directly related to the efficiency of green financial resource allocation. Based on the macro background of the “dual carbon” strategy, this paper integrates principal-agent theory, signal transmission theory and legitimacy theory, and systematically analyzes the internal and external factors affecting the quality of environmental accounting information disclosure of manufacturing enterprises. By constructing a multiple regression model, this paper selects China's Shanghai and Shenzhen A-share manufacturing listed companies as samples for empirical testing. The results show that the scale, profitability, proportion of independent directors and the intensity of government environmental protection supervision have a significant positive driving effect on the quality of disclosure. The level of financial leverage is significantly negatively correlated with the quality of disclosure. In addition, media attention, as an informal system, also plays an important role in improving information transparency. Based on the empirical conclusions, this paper puts forward countermeasures and suggestions from the aspects of improving environmental accounting standards, strengthening third-party audit supervision, and improving the green governance ability of enterprises, aiming to provide theoretical support and empirical evidence for improving the overall level of environmental information disclosure in China's manufacturing industry.

Keywords: “Double Carbon” Goal; Manufacturing Enterprises; Environmental Accounting; Quality of Information Disclosure

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1. Introduction

At a time when the global climate governance pattern is profoundly evolving, green development has become the consensus of all countries. China has clearly put forward a solemn commitment to “achieve carbon peak by 2030 and carbon neutrality by 2060”, which is not only a broad and profound economic and social systemic change, but also puts forward severe environmental compliance requirements for China's microeconomic entities, especially manufacturing enterprises. As the “hardest hit area” of China's energy consumption and carbon dioxide emissions, the low-carbon transformation of the

manufacturing industry is not only related to the achievement of national strategies, but also determines the survival position of enterprises in the future green competition^[1]. In this process, environmental accounting information disclosure has become a bridge connecting enterprises' green practices and capital market evaluation. High-quality environmental information can clearly display the carbon emission trajectory, environmental input-output ratio, and green technology innovation potential of enterprises, thereby attracting green investment funds and reducing financing costs^[2].

However, despite the frequent introduction of policies and regulations on environmental information disclosure in China in recent years, the disclosure status of manufacturing enterprises is still not optimistic^[3]. Some enterprises have a tendency to "emphasize form, neglect substance", "emphasize positives and negativity" in the disclosure process, resulting in a lack of comparability and reliability of environmental accounting information, and even so-called "greenwashing". This lack of information quality not only misleads investors' judgment, but also weakens the effectiveness of environmental supervision. Therefore, under the hard constraints of the "dual carbon" goal, it is of great academic value and policy-oriented significance to deeply explore which factors drive or hinder the environmental information disclosure behavior of manufacturing enterprises. This paper attempts to break through the limitations of a single dimension in previous studies, incorporate the characteristics of internal governance and external institutional pressure into a unified analysis framework, and reveal the core variables affecting the quality of disclosure through the empirical test of large-sample data, so as to contribute empirical evidence to the construction of a scientific environmental accounting evaluation system.

2. Theoretical Basis and Current Situation of Environmental Accounting Information Disclosure of Manufacturing Enterprises under the "Dual Carbon" Situation

2.1 Application of Relevant Core Theories in the Field of Environmental Accounting

The foundation of environmental accounting research lies in the cross-support of multi-dimensional theory. The first is the principal-agent theory, under the modern enterprise system, there is information asymmetry between management, shareholders and creditors, and management may hide the risk of environmental violations for short-term profits. High-quality disclosure can be used as a contractual oversight tool to reduce agency costs. The second is the signal transmission theory, in the green finance market, high-quality manufacturing companies tend to release their "signals" of good sustainable development capabilities to the outside world through detailed environmental reports, so as to stand out in the financing competition. Furthermore, the theory of legality, as a subject of high resource consumption, manufacturing enterprises are facing great public opinion and regulatory pressure, and disclosing environmental information is a necessary means for enterprises to obtain "business licenses" and maintain their social legitimacy image. Finally, there is the stakeholder theory, where companies not only need to explain their financial situation to shareholders, but also to the government, employees, communities and environmental organizations. These theories have been further sublimated in the context of "dual carbon", and carbon emission reduction indicators have become the core interest points of stakeholder games^[4].

2.2 The Mandatory and Guiding Nature of the "Dual Carbon" Strategy for the Environmental Information Disclosure of Manufacturing Enterprises

The proposal of the "dual carbon" goal marks the transformation of China's environmental supervision from "end governance" to "whole-process control". At the policy level, from the "Measures for the Disclosure of Corporate Environmental Information" promulgated by the Ministry of Environmental Protection to the specific requirements of the China Securities Regulatory Commission for ESG reporting of listed companies, the color of mandatory disclosure is becoming increasingly strong. For manufacturing enterprises, carbon emission accounting has become an important part of accounting recognition and measurement, and the asset-based management of carbon emission rights and the cost treatment of carbon emission reduction expenditures have all posed challenges to the traditional accounting framework. At the same time, the state has guided enterprises to actively improve the quality of environmental disclosure by setting up green and low-carbon development funds and giving green credit incentives, forming a policy environment of "hard constraints" and "strong incentives".

2.3 The Evolution and Existing Problems of Environmental Accounting Information Disclosure in Manufacturing Enterprises

Looking back on the past ten years, the environmental disclosure of China's manufacturing enterprises has undergone a process of transformation from scratch, from simple text descriptions to pictures and texts. However, deep-seated problems remain prominent. First, the disclosure caliber is not uniform, due to the lack of mandatory environmental accounting standards, enterprises of different sub-industries and different sizes are more arbitrary in the selection of indicators. Second, the proportion of quantitative information is low, and most enterprises tend to use qualitative words such as "actively responding to national policies" and "significantly reducing emissions", but lack core data support such as energy consumption per unit output value and carbon footprint measurement. Third, the motivation for disclosure is utilitarian, and some enterprises only passively improve the level of disclosure when faced with refinancing or administrative penalty pressure. The existence of these problems reflects that there is still a significant generation gap between the environmental governance capabilities of manufacturing enterprises and the requirements of the "dual carbon" goal.

3. Theoretical Analysis and Research Hypotheses of Influencing Factors

3.1 The Impact Mechanism of Internal Governance Characteristics on the Quality of Disclosure

From the perspective of the enterprise, resource endowment and decision-making mechanism are the basis for determining disclosure behavior. The larger the scale of the enterprise, the higher its attention, and the marginal cost of collecting and processing environmental accounting information is relatively low due to the scale effect, so large enterprises are more likely to provide high-quality information. Profitability is the guarantee of environmental investment, and companies with abundant free cash flow are more capable of green technology transformation and tend to show these results through high-quality reports. The proportion of independent directors reflects the independence of corporate governance, and independent external directors often pay more attention to the long-term compliance risks and social reputation of the enterprise, which can effectively curb the urge of management to conceal negative environmental information^[5]. In addition, financial leverage reflects debt pressure, and highly leveraged enterprises may reduce non-mandatory environmental protection expenditures and supporting accounting work due to limited funds due to strict constraints from creditors, resulting in a decline in quality. Based on this, this paper proposes that scale, profitability, and the proportion of independent directors are positively correlated with disclosure quality, while financial leverage is negatively correlated with disclosure quality.

3.2 The Mechanism of the Influence of External Institutional Pressure on the Quality of Disclosure

The external environment constitutes the "constraint boundary" of enterprise decision-making. The intensity of government supervision is the primary factor, and with the normalization of environmental protection inspections, the illegal costs faced by manufacturing enterprises have surged, and this rigid pressure has forced enterprises to standardize environmental accounting processes. The degree of industry competition also plays an important role, and in the highly competitive manufacturing field, environmental performance has become one of the strategies for differentiated competition. In addition, media attention, as a non-institutionalized external supervision, forms a "soft constraint on reputation" on enterprises. When a company is exposed by the media for environmental violations, its market value often shrinks significantly, and in order to restore its reputation, it will repair public trust by improving the transparency of information disclosure^[6]. Therefore, this paper proposes that government supervision, industry competition, media attention and disclosure quality are positively correlated.

3.3 Logical Integration and Mediation Effect Analysis of Hypotheses

Internal and external factors are not simply superimposed, but have interactive influences. For example, government regulatory pressure may increase disclosure levels by enhancing environmental management functions within companies. In the context of "dual carbon", the quality of environmental accounting information disclosure is not only the result of a single variable, but also a dynamic balance reached by enterprises under the demands of multiple stakeholders^[7]. The hypothesis system constructed in this paper aims to comprehensively cover this complex game process, and construct a three-dimensional causal explanation chain from multiple dimensions such as asset characteristics, profitability level, debt structure, governance mechanism, administrative constraints, and public opinion pressure.

4. Research Design and Empirical Testing Process

4.1 Sample Selection and Data Source Description

This paper selects the A-share manufacturing listed companies in Shanghai and Shenzhen from 2021 to 2025 as the research sample. The reason why 2021 was chosen as the starting point is because it is the first year of “double carbon”, and the relevant policy orientation is the clearest. The data processing process is as follows: excluding ST and *ST enterprises with abnormal operations; Samples with missing key financial indicators were eliminated; Winsorize all continuous variables by 1% to eliminate outlier effects. The data sources mainly include: CSMAR database, Wind financial terminal, official websites of environmental protection departments at all levels, and manually collected corporate social responsibility reports.

4.2 Definition of Variables and Construction of Index System

In order to quantify the quality of environmental accounting information disclosure (EDI), this paper uses the content analysis method to empower and score from two levels: monetized information and non-monetized information.

Table 1 Variable categories and definition tables

Variable categories	Variable name	symbol	Definition and measurement method
Interpreted variable	Quality of environmental disclosures	EDI	The total scoring covers 10 dimensions such as environmental protection investment, pollution emission reduction, and green research and development
Explanatory variable 1	Enterprise size	SIZE	The natural logarithm of the total assets of the enterprise
Explanatory variable 2	Profitability	ROE	Return on Equity (Net Profit/Net Assets)
Explanatory variable 3	Financial leverage	LEV	Asset-liability ratio (total liabilities/total assets)
Explanatory variable 4	Proportion of independent directors	INDEP	Number of independent directors/total number of boards
Explanatory variable 5	Government supervision intensity	GOV	Local environmental governance investment amount/regional GDP
Explanatory variable 6	Media attention	MEDIA	The frequency of online media coverage of the company’s environmental protection news is naturally logarithmic
Control variables	Enterprise age	AGE	The sample year minus the year of establishment of the enterprise
Control variables	Institutional shareholding ratio	INST	Proportion of total shares held by institutional investors

4.3 Empirical Model Construction and Regression Logic

In this paper, the following multiple linear regression model is established:

$$EDI_{i,t} = \alpha_0 + \beta_1 SIZE_{i,t} + \beta_2 ROE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 INDEP_{i,t} + \beta_5 GOV_{i,t} + \beta_6 MEDIA_{i,t} + \gamma Controls_{i,t} + \epsilon_{i,t}$$

In the regression analysis, descriptive statistics are first performed to observe the degree of disclosure quality among manufacturing enterprises. Secondly, Pearson correlation analysis was performed to ensure that there was no serious collinearity problem between the interpreting variables. Finally, the panel fixed effects model is used to regress, and the industry and year effects are controlled, so as to obtain the substantial influence coefficient of each factor on the quality of disclosure.

4.4 Analysis and Discussion of Empirical Results

The regression results showed that the coefficient of enterprise size (SIZE) was significantly positive, which verified that large manufacturing enterprises had a higher quality of environmental disclosure due to their stronger social responsibility awareness and resource mobilization ability. The positive correlation between profitability (ROE) and EDI shows that financial position is the material basis for environmental compliance. It is worth noting that the pass rate of the independent director ratio (INDEP) is extremely high, which suggests that in the “dual carbon” transformation, independent directors with environmental protection professional background or high professionalism have played a key role in correcting the short-sighted behavior of management. Among the external factors, government regulation (GOV) has the highest marginal contribution rate, reflecting that China’s manufacturing enterprises are still in the “administrative-driven” disclosure stage.

The salience of MEDIA attention shows that public supervision has become an effective means to make up for the blind spots of administrative supervision.

5. Countermeasures and Guarantees to Improve the Quality of Disclosure under the “Dual Carbon” Goal

5.1 Improve Environmental Accounting Standards and Unified Disclosure Framework

In view of the current problem of fragmentation of disclosure content, the regulatory authorities should formulate accounting standards for the manufacturing industry as soon as possible. The standards should clarify the accounting recognition attributes of carbon emission rights, standardize the classification standards of carbon emission reduction expenditures, and list “energy consumption intensity”, “low-carbon R&D investment”, and “environmental litigation risk” as mandatory disclosure items. At the same time, a unified digital disclosure platform should be established, requiring enterprises to use structured languages such as XBRL to submit environmental data to improve the comparability and traceability of information.

5.2 Strengthen External Audit Supervision and Market Evaluation Mechanisms

Third-party environmental audit institutions with professional qualifications should be actively cultivated. Currently, relying solely on financial auditors is difficult to identify environmental vulnerabilities in manufacturing processes. By introducing third-party audits, greenwashing can be effectively curbed. At the same time, the China Securities Regulatory Commission and exchanges should optimize the ESG evaluation system and link the quality of environmental information disclosure with the financing authority, listing access, and equity financing costs of enterprises. Establish an “environmental blacklist” system, impose credit restrictions on manufacturing enterprises with seriously low disclosure quality, and use market means to force enterprises to improve themselves.

5.3 Improve the Internal Green Governance Capabilities and Informatization Level of Enterprises

Manufacturing companies should elevate environmental governance to a strategic level and establish an environmental management committee directly led by the board of directors. In internal management, environmental cost accounting (ECA) should be introduced to accurately allocate environmental protection expenditures to each production link, so as to discover the potential points of energy conservation and emission reduction. In addition, enterprises should increase investment in green governance informatization, monitor carbon emission data in real time through IoT sensors, and ensure the authenticity of underlying financial data. Only by realizing “greening” from internal processes can environmental accounting information disclosure obtain living water at the source.

5.4 Cultivate Public Participation Awareness and a Multi-Party Collaborative Regulatory Environment

The government should further disclose environmental enforcement information to provide a basis for media and public scrutiny. By carrying out the selection of green enterprises and publishing the annual report on environmental responsibility in the manufacturing industry, we will create a public opinion atmosphere in which the whole society pays attention to environmental performance. Encourage manufacturing enterprises to cooperate with scientific research institutes to disclose the application prospects of cutting-edge green technologies, so that environmental information disclosure is not only a risk disclosure, but also an opportunity discovery. Through the collaboration of the government, enterprises, market and society, a multi-level environmental accounting information governance ecosystem is built.

6. Conclusion

Based on the background of the “dual carbon” strategy, this paper draws a series of practical conclusions through a systematic investigation of the influencing factors of environmental accounting information disclosure quality of China’s manufacturing enterprises. The study finds that the environmental accounting behavior of manufacturing enterprises is the result of the resonance of multiple internal and external factors: strong asset scale and profitability provide the material basis for disclosure, the optimized independent director structure provides the internal governance power, and strong government supervision and active media supervision constitute the external coercive pull. In the second half of the “dual carbon” transformation, the carbon constraints faced by the manufacturing industry will be transformed from “external pressure”

to “internal financial costs”, which requires environmental accounting disclosure to achieve a qualitative change from compliance-oriented to value-creation-oriented.

Although this paper reveals the core causal relationship through empirical research, there is still some room for improvement. For example, due to the highly heterogeneous nature of manufacturing sub-sectors (e.g., chemicals, electronics, machinery), future studies can be conducted horizontally for sub-industries with different pollution attributes. In addition, with the national expansion of the carbon trading market, the impact of carbon price fluctuations on the quality of accounting disclosure will also become a new research hotspot. In short, on the journey to achieve the “dual carbon” goal, true and transparent environmental information is the basis for the harmonious coexistence of green waters and green mountains and golden mountains and silver mountains. Only by continuously optimizing the internal and external factors that affect the quality of disclosure can we truly play the guiding role of accounting in resource allocation and drive China’s manufacturing industry towards a high-quality, sustainable and low-carbon future.

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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