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Corporate Data Assets and ESG Performance: Effects and Mechanisms

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Abstract: The deep integration of corporate data assets and corporate ESG is a core strategy to promote the construction of digital China to a deeper development. This paper takes the annual report data of Shanghai and Shenzhen A-shares from 2011 to 2023 as a sample, constructs corporate data assets indicators, and explores whether corporate data assets can influence ESG performance. It is found that corporate data assets have a positive effect on ESG performance and are realized through internal governance and external monitoring mechanisms. The conclusions pass a series of robustness tests. The findings help to effectively utilize the spillover effect of corporate data assets, while providing empirical references for promoting corporate ESG performance.

Keywords: data assets, ESG performance, internal governance, external oversight

1. Introduction

In the digital age, data, as a core resource, is deeply integrated into every aspect of the economy. The EU introduced the General Data Protection Regulation (GDPR) in 2018, reshaping the rules for data asset management while protecting privacy. The Third Plenary Session of the 20th Central Committee of China emphasized deepening the integration of the digital economy with the real economy. Meanwhile, global attention to environmental, social and corporate governance (ESG) has been increasing. The EU formally adopted the Corporate Sustainability Reporting Directive (CSRD), which requires mandatory disclosure of ESG-related topics by enterprises, and the State Council promoted the establishment of a sustainability disclosure system for listed companies in 2024. The Shanghai and Shenzhen Stock Exchanges explicitly require companies to disclose ESG information in four dimensions: governance, strategy, risk management, and indicator targets. The Ministry of Finance and nine other departments issued the Corporate Sustainability Disclosure Guidelines to build a domestic standard system. Driven by the mandatory standardization and supervision of relevant external regulations and policies, China's corporate ESG performance has gained extensive attention from both the academic and practical communities.The existing literature mainly focuses on internal governance [1] [2], institutional pressure [3] [4] [5], and technological innovation [6] [7] and other perspective to discussing the path for companies to increase their ESG performance Nonetheless, enterprises in China have encountered the dilemma of inadequate incentives in improving ESG performance. On the one hand, many firms face high cost pressures when assuming ESG responsibilities, which greatly undermines their intrinsic drive to improve ESG performance. These costs include, but are not limited to, the management of environmental protection facilities, the fulfillment of social responsibilities, and the cost of optimizing the corporate governance structure.

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On the other hand, access to ESG data is plagued by information asymmetry, which manifests itself in terms of data accessibility, inter-comparability, and credibility, coupled with a lack of uniform standards and evaluation systems. These challenges are constraining the pace of ESG development in China.

Some scholars have pointed out that digital technologies represented by artificial intelligence and big data are becoming a key force in driving enterprises to improve resource utilization efficiency [8]. These technologies not only help enterprises mitigate the costs of fulfilling their environmental, social and governance responsibilities, but also further boost their sustainable development possibilities [9]. Then, as an important embodiment of corporate digital technology, what impact do data assets have on ESG performance? In the age of informationization, data assets have become an essential factor affecting the competitiveness of companies and even countries. Data asset, refers to the data resources owned by an enterprise or organization and can be used to create value [10]. It is different from traditional material assets and financial assets, and is an intangible, non-monetary resource. The value of data assets is embodied in the information and knowledge they contain, which can provide decision support, optimize business processes, improve operational efficiency, upgrade customer experience [11] [12] [13]. This paper seeks to answer the following question: do corporate data assets improve ESG performance? If such an effect exists, what is the specific mechanism of action?

Against the backdrop of digital economy and sustainable development goals, data assets are redefining enterprises' ESG practices. This paper constructs indicators based on 2011-2023 Shanghai and Shenzhen A-share annual report data and finds that data assets significantly enhance ESG performance through the dual paths of internal governance and external monitoring, and the conclusions are validated by the robustness test; the possible contributions lie in the following: first, it breaks through the limitations of the macro research [14] [15], reveals the impacts of data assets on ESG impact mechanism from the micro level, to make up for the shortcomings of unidimensional studies such as financing constraints and enterprise value [16] [17]; secondly, to break through the studies of traditional driving factors such as institutional pressure and internal control [3] [18], and to be the first to supplement the ESG driving theory with a data asset perspective; thirdly. Utilizing internal governance and external supervision to explore the mechanism of the role of data assets on ESG enriches the research system between data assets, internal governance, external supervision and ESG performance, which is of theoretical significance and practical value for strengthening the management and application of corporate data assets.

2. Theoretical analysis and hypothesis

2.1. Data assets and ESG

With the acceleration of digitization, the impact of data assets on corporate ESG performance has become a focus of academic attention. Many studies have shown that data assets play an important role in corporate ESG practices. According to the ESG theoretical framework, data assets can effectively contribute to the fulfillment of ESG responsibilities.

First, under the ESG framework, data assets strengthen environmental protection through a dual path: first, data-driven technological innovation significantly improves the efficiency of resource integration and environmental monitoring capabilities [19], reducing resource waste and environmental risks by optimizing the formulation of environmental protection strategies; second, accelerating the process of corporate green innovation [20], and attracting green financing to achieve the dual enhancement of corporate value and environmental responsibility, which is the core support for sustainable development. green innovation level to attract green financing, realize the double enhancement of corporate value and environmental responsibility, and provide core support for sustainable development.

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Second, data assets promote the fulfillment of corporate social responsibility. First, data assets combined with blockchain, IoT and other technologies greatly improve the transparency of supply chains, which in turn enhances the ability to fulfill social responsibility, and this effect is particularly significant in food processing enterprises [21]. Second, enterprises are able to capture users' personalized needs through data mining technology to optimize product design and significantly enhance social inclusion [22]. Finally, enterprises are able to use data assets to provide stakeholders with a foundational digital platform and effectively perform social responsibility and value creation through platform embedding and platform optimization mechanisms [23].

Third, data assets empower corporate governance upgrading. As a key element of ESG governance, data assets optimize the governance system in three ways: driving the digital transformation of the governance structure, optimizing the decision-making model with big data, and facilitating the digitalization of regulation [24]; inhibiting management self-interested behavior, optimizing resource allocation and decision-making quality [25]; building a data governance system to achieve accurate risk identification and dynamic control, and enhancing governance robustness and market resilience. dynamic control, enhancing governance robustness and market resilience.

In summary, based on the application of digital technology, data assets promote enterprises to improve their environmental performance, actively fulfill their social responsibilities, and significantly enhance the effectiveness of corporate governance. Data assets have gradually become an indispensable and important management tool for enterprises in the process of ESG fulfillment, helping them to move forward steadily on the path of sustainable development. Therefore, the following hypothesis is proposed in this paper:

H1: Data assets have a positive effect on the improvement of ESG performance of enterprises.

3. Design of the study

3.1. Samples and data

Considering that data assets have been widely discussed since about mid to late 2010, this paper selects the data of Shanghai and Shenzhen A-share listed companies from 2011 to 2023 as the research sample. In order to ensure the reliability of the research results, the data are processed as follows: (1) financial industry companies are excluded to avoid the influence of industry and data specificity on the results; (2) companies with ST, *ST, or PT status are excluded to eliminate the interference of outliers; (3) samples with missing correlated variables are excluded to eliminate the influence of missing values; and (4) all continuous variables are subjected to the 1 percent and 99 percent shrinking treatment to avoid the influence of extreme values. After the above processing, 10,189 sample observations are finally obtained. Data were obtained from CSMAR, Wind database and CNRDS.

3.2. Definition of variables

1. Dependent variable: corporate ESG performance. In this paper, Huazheng ESG Rating Index ratings were chosen, which are categorized into 9 levels from high to low, 9~1 respectively.

2.Independent variable: data assets (DA). Drawing on the research of He [26] , this paper builds a similar word set based on Python text-based mining techniques, using “information”, “network”, “digital” and “data” as keywords to quantify the frequency of data assets mentioned in annual reports. “data” as keywords to construct similar word sets to quantify the frequency of data assets mentioned in annual reports.

3. Control variables: Drawing on Yao and Zhang's study [27], a number of control variables are included, including firm size, profitability, gearing, and growth capacity, while controlling for year and industry fixed effects. Table1 shows the definitions of all variables.

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Table 1: Definition of variables

Variable Name	Variable Symbol	Variable Definition
ESG performance	ESG	Huazheng ESG Rating
Data Asset	DA	Extracting keywords for annual reports of enterprises
Enterprise size	Size	Natural logarithm of total assets at the end of the period
profitability	Roa	Net profit/total assets at the end of the period
gearing	Lev	Total liabilities/total assets
growth capacity	Growth	Revenue growth rate
Number of years listed	Age	Difference between the sample data year and the company's listing year plus one and take the natural logarithm.
Nature of property rights	owner	1 for state-owned enterprises, otherwise 0
two jobs in one	Dual	1 if the chairman of the board of directors is also the general manager, otherwise 0
Percentage of independent directors	Indep	Number of independent directors/total number of board members
Shareholding ratio of the largest shareholder	Top1	Shareholding ratio of the largest shareholder
Cash flows from operating activities	Cash	Net cash flows from operating activities/total assets
Audit opinion	Audop	The value of 1 is taken when the accounting firm issues a standard unqualified opinion, otherwise it is 0.
Year	Year	virtual variable
Industry	Ind	virtual variable

3.3. Model

To test hypothesis H1, this paper sets up model (1) to examine the impact of data assets on firms' ESG performance:

$$ESG_{it} = \beta_0 + \beta_1 DA_{it} + \beta_2 Controls_{it} + \sum \text{Year} + \sum \text{Ind} + \varepsilon_{it} \quad (1)$$

where ESG_{it} is a dependent variable indicating the ESG performance of firm i in year t, DA_{it} is an independent variable indicating data assets, $Controls_{it}$ is a control variable, and ε is the random error term. Year fixed effects and industry fixed effects are also introduced in the model to control for the effects of time trends and industry differences.

4. Empirical results and analysis

4.1. Descriptive statistics

According to the Table2, it can be seen that the mean value of ESG is 4.427, the standard deviation is 0.954, and the maximum and minimum values are 6.500 and 1.750, respectively, indicating that there are large differences in ESG performance among enterprises.The mean value of DA is 1.279, close to the median of 1.009, and the standard deviation is 1.040, and the difference between the maximum and minimum values is large, indicating that there are large differences in the number of data assets of the sample enterprises , basically in line with the normal distribution, to meet the needs of the study. The descriptive statistics of the control variables do not differ much from the results of

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existing studies, and the distribution of the value domain is also wider, which can play a certain control role. The correlation coefficient between variables is basically less than 0.5, and the VIF test is 1.30, so there is no multicollinearity problem.

Table 2: Descriptive statistics

Variable	Sample	Mean	Median	Standard Deviation	Minimum	Maximum
ESG	10189	4.427	4.500	0.954	1.750	6.500
DA	10189	1.279	1.099	1.040	0	4.331
Size	10189	23.33	23.23	1.317	20.56	27.04
Roa	10189	0.0420	0.0360	0.0550	-0.168	0.211
Lev	10189	0.493	0.506	0.193	0.0770	0.884
Growth	10189	0.156	0.101	0.350	-0.495	2.074
Age	10189	2.531	2.708	0.639	0.693	3.401
Indep	10189	0.375	0.364	0.0570	0.167	0.800
owner	10189	0.525	1	0.499	0	1
Dual	10189	0.200	0	0.400	0	1
Top1	10189	0.372	0.357	0.159	0.0920	0.771
Cash	10189	0.0580	0.0550	0.0670	-0.131	0.253
Audop	10189	0.980	1	0.139	0	1

4.2. Benchmark regression analysis

Table3 presents the results of the benchmark regression. According to Column 1, it can be found that corporate data assets have a significant positive effect on ESG performance (β=0.0816,P < 0.001). In the multi-model test with the addition of control variables (Column 2) and further controlling for industry and year fixed effects (Column 3), the positive effect of DA remains robust, verifying that Hypothesis H1 holds.

Table 3: Benchmark regression analysis

Variable	(1) ESG	(2) ESG	(3) ESG
DA	0.0816*** (4.8060)	0.0777*** (5.0046)	0.0841*** (4.8202)
Controls	NO	YES	YES
Year	NO	NO	YES
Industry	NO	NO	YES
Sample	10,189	10,189	10,189
Adjusted R^2	0.008	0.109	0.178

Note: * denotes p < 0.05, ** denotes p < 0.01, *** denotes p < 0.001. Same below.

4.3. Robustness tests

4.3.1. Replacement of independent variables

Referring to the methodology of He [26] , this paper categorizes data asset (DA) into own-use data asset (ODA) and deal data asset (DDA).As shown in the first two columns of Table4, the contribution of firms' data assets to the firms' ESG performance is still significant. Therefore, the results of the benchmark regression are robust.

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4.3.2. Replacement of the dependent variable

This paper remeasures the dependent variable using the data on firms' ESG performances in Bloomberg and CNRDS databases, respectively, and the results are as shown in Table4 of Columns (3) and (4), which show that firms' data assets can significantly contribute to firms' ESG performances. Therefore, the main conclusion of this paper remain unchanged

4.3.3. PSM

Using propensity score matching is applied in this paper to reduce selection bias by treating all control variables as covariates, and all matched variables pass the balance test. Column (5) of Table4 reports the results of the tests grouped by the industry-year median of the firm's data assets, so the main conclusions of the paper remain robust.

4.3.4. Independent variables lagged by one period

This paper introduces a one-period lagged data asset variable to explore the long-term influence of data assets on firms' ESG performance. This treatment not only reduces the endogeneity problem, but also better captures the dynamic relationship between the variables. Table4 Column (6) demonstrates the results that L.DA can significantly and positively affect firms' ESG performance. Once again, the robustness of the benchmark regression results is verified.

Table 4: Robustness tests

Variable	ESG	ESG	BloombergESG	CNRDSESG	ESG	ESG
	(1)	(2)	(3)	(4)	(5)	(6)
DA			0.0026**	0.0039**	0.0969***	
			(2.0080)	(2.5412)	(4.8107)	
ODA	0.0792***					
	(4.4312)					
DDA		0.1180***				
		(4.3855)				
L. DA						0.0947***
						(4.6627)
Controls	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
Sample	10,189	10,189	10,189	10,189	5,394	7,910
Adjusted R^2	0.177	0.176	0.611	0.398	0.177	0.183

4.3.5. Instrumental variables approach

To address the possible endogeneity problem, this paper adopts the instrumental variable method to ensure the reliability of the estimation results. Referring to the study of Yang and Wang [28], this paper selects the mean value of data assets of firms in the same city and the same industry as the instrumental variable (DA.IV). On the one hand, due to the social network effect, whether a firm holds more data assets is easily influenced by the data assets of other firms in the same industry in the same city; on the other hand, there is no research proving that the introduction of data assets of firms in the same industry in the same city directly affects the firm's ESG performance, so this instrumental variable satisfies the requirements of relevance and exogeneity. As shown in Table5,

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The coefficient of the instrumental variable DA.IV in Column (1) is significantly positive, indicating that the data assets of same-city same-industry firms have a significant positive effect on firms' data assets, and the F-value is 211.33, which is much larger than 10, hence there is no weak instrumental variable problem. Column (2) shows that the coefficient of DA is also significantly positive, indicating that data assets can significantly enhance firms' ESG performance. In summary, after controlling for endogeneity issues, the benchmark regression conclusions remain unchanged and robust.

Table 5: Estimated results of instrumental variables

Variable	Phase I	Phase II
	DA	ESG
	(1)	(2)
DA		0.200***
		(7.986)
DA.IV	0.784***	
	(45.269)	
Controls	YES	YES
Year	YES	YES
Industry	YES	YES
Sample	10,145	10,145
Adjusted R^2	0.456	0.167
Phase I F-value	211.33	

5. Mechanism testing

5.1. Corporate governance

The positive impact of corporate data assets on ESG performance has been found above. Further, this paper explores the mechanistic role of internal corporate governance by selecting information transparency, internal control and financing constraints to measure the effectiveness of internal corporate governance, and the results are shown in columns (1)-(3) in Table6. First, based on the results in Column (1), corporate data assets have a significant contribution to corporate information transparency, while increased information transparency reduces information asymmetry between firms and stakeholders, enhances market trust, and reduces firms' moral hazard and adverse selection problems, which in turn promotes firms' ESG performance [29]; second, based on the results in column (2), corporate data assets can greatly improve the ability of corporate internal control, in addition, a good internal control system can effectively supervise the behavior of corporate executives and ensure that corporate business activities are in compliance with laws, regulations, and ethical norms, which improves the ESG performance of corporations [1]; finally, based on the results in Column (3), corporate data assets can significantly reduce corporate financing constraints, and the alleviation of financing constraints allows corporations to have sufficient funds to enhance or maintain good environmental performance and social responsibility performance[30].

5.2. External supervision

In this paper, we measure firms' external monitoring in terms of investor attention, analyst attention, and media attention. According to the last three columns of Table6, data assets significantly increase investor attention, which pushes firms to respond to their decision-making demands by optimizing ESG practices (e.g., environmental governance); data assets enhance analysts' tracking, which

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directly affects the market's perception of ESG performance and pushes firms to improve transparency; and data assets increase media exposure, which allows firms to strengthen ESG disclosure and social responsibility fulfillment proactively in order to avoid reputational risks.

Studies have shown that external monitoring significantly enhances corporate ESG performance, with Ioannou and Serafeim [31] revealing that national legal and regulatory frameworks positively drive CSR; high-quality auditing strengthens ESG performance (especially environmental dimensions) [32]; carbon emissions trading pilots [33], environmental protection inspections [34] and the new Securities Law [35] all enhance ESG by strengthening disclosure quality or internal control.

Table 6: Mechanism test

Variable	Internal governance			External supervision		
	Trans	Internal Control	KZ	Investor	Analyst	Media
	(1)	(2)	(3)	(4)	(5)	(6)
DA	0.0062**	0.0672***	-0.0604***	0.0535***	0.0777***	0.0964***
	(2.0449)	(4.3735)	(-2.8844)	(4.1272)	(4.0367)	(3.4672)
Controls	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
Sample	10,189	10,189	10,189	10,189	10,189	10,189
Adjusted R^2	0.377	0.318	0.754	0.417	0.428	0.639

6. Conclusions and recommendations

Taking the data of Shanghai and Shenzhen A-shares from 2011 to 2023 as the research sample, this paper constructs quantitative indicators of data assets based on the text analysis method, empirically examines the impact of data assets on corporate ESG performance and its mechanism of action, and draws the following conclusions: first, data assets have a significant positive impact on corporate ESG performance, and the conclusion still holds after a number of tests such as independent variable and dependent variable replacement, PSM matching, independent variable lagged one period and instrumental variable method, the conclusion still holds; second, internal governance and external supervision mediate the relationship between data assets and corporate ESG performance. Based on the above conclusions, this paper puts forward the following policy recommendations :

Enterprise Level: Establish a data asset management system, invest in storage facilities, analytical tools, and talent development, and refine internal governance and auditing mechanisms. Integrate data assets into decision-making to create a "data assets → governance optimization → ESG enhancement" pathway. Release regular data asset reports to increase transparency and public oversight.

Government Level: Develop data asset accounting standards and assessment criteria to standardize valuation and disclosure. Strengthen market regulation to mitigate risks, while boosting R&D investment and encouraging corporate innovation in data utilization.

Social Level: Promote ESG awareness and public engagement. Use public scrutiny to drive corporate ESG performance and ensure ethical data use for ESG advancement.

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