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The Impact of ESG Responsibility Fulfillment on Enterprise Value in China: A Regulated Intermediary Model Approach

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Abstract: ESG (Environmental, Social, and Governance) responsibility fulfillment increasingly affects enterprise valuation. Although researchers debate about the precise effects, the prevailing view suggests a linear relationship between ESG performance and enterprise value. This study introduces a novel ESG responsibility performance metric through the Regulated Intermediary Model to delve into this relationship within the Chinese context. Our findings reveal an inverted U-shaped relationship between ESG performance and enterprise value, with financing constraints having a significant moderating effect. These findings remain robust after employing instrumental variables to mitigate potential endogeneity. Heterogeneity analysis demonstrates that this inverted U-shaped relationship is particularly pronounced in non-polluting and non-state-owned enterprises. Moreover, a comparison between equity and debt financing mechanisms underscores that improved ESG performance is associated with lower cost of equity financing, thereby enhancing enterprise value. Financial institutions are encouraged to leverage innovative financial instruments to diversify enterprise financing channels and alleviate financing constraints of enterprises that fulfill their ESG responsibilities.

Keywords: ESG; firm valuation; corporate sustainability; the Regulated Intermediary Model

1. Introduction

Environmental, Social, and Governance (ESG) principles emphasize that enterprises ought to take into account environmental and social factors in business practices. ESG responsibility fulfillment assesses enterprise behavior by considering the interplay of environmental, social, and governance performance (Li et al., 2021; Eccles and Stroehle, 2018) 1

Although ESG practices in Chinese enterprises started later than those in their European and American counterparts, they have rapidly gained momentum in recent years. In September 2020, the Chinese government introduced an ambitious climate target known as the "Dual Carbon Goal"[1], aiming at achieving two objectives: carbon peaking by 2030 and carbon neutrality by 2060. Furthermore, 20th CPC National Congress reconfirmed the target in 2022, urging enterprises to actively participate in global environmental governance. As a result, fulfilling ESG responsibilities has become an imperative for businesses in China (Li et al., 2023) 3.

From 2016 to 2020, the global ESG responsible investment has grown sevenfold, with an annualized growth rate of 63%[2]. According to the China Listed Companies Association, over half of all Chinese enterprises had issued ESG performance reports, reflecting their commitment to responsible practices by the end of 2021.

[1]Source: address to the 75th session of the United Nations General Assembly
[2]Source:《2021 China ESG Development White Paper》

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Motivations for fulfilling ESG responsibilities may include meeting regulatory requirements (Lokuwaduge and Heenetigala, 2017) 4, enhancing reputation, mitigating competitive pressures (Jasni et al., 2020) 5, and strengthening stakeholder relationships (Li et al., 2022) 6; but the ultimate goal is to enhance enterprise value. Scholars have debated the impact of ESG performance on enterprise value, with inconsistent findings. Neoclassical theory posits that private enterprises are to maximize profits for shareholders. Fulfilling ESG responsibilities is detrimental to enterprise value, because it could divert resources, require upfront costs, and reduce short-term profits and competitive advantage (Wieczorek et al., 2021; Gillan et al., 2021) 7.

Kim and Lyon (2015) 9 posit that legal motivations, such as avoiding regulatory penalties, drive enterprises to fulfill their ESG responsibilities. Meanwhile, Porter and Kramer (2006) 10 propose that embracing ESG responsibility presents a strategic opportunity and a competitive advantage.

Beyond legal compliance, stakeholder theory (Huang, 2021) 11 suggests that fulfilling ESG responsibilities can enhance enterprise value for the following three reasons. First, strong ESG performance can build goodwill with stakeholders, facilitating communication with investors (Reverte, 2009) 12. Second, creditors may be willing to accept lower interests or lending terms (Huang et al., 2022) 13. Third, a commitment to ESG can attract a larger customer base and talent pool, potentially enhancing a company's management capabilities. (Islam et al., 2021) 14. These factors can ultimately increase enterprise value and maximize profits in the long run. Friede et al. (2015) 15 in their analysis of over 2,000 empirical studies, find that approximately 90% of them report a positive correlation between ESG performance and enterprise value, supporting this perspective.

China's listed enterprises often face special challenges in securing funding, leading to a financing gap and higher financing costs (Leitner, 2016) 16. High financing constraints may force enterprises to forgo profitable opportunities, resulting in resource loss and hamper enterprise value (Ma, 2019) 17. Several scholars have studied financing constraints, ESG responsibility fulfillment, and enterprise value. Chen and Yu (2022) 18 find that financing constraints have hampered ESG performance, damaging enterprise value. Similarly, Wang et al. (2022) 19 suggest that financing constraints play an intermediary role in the relationship between ESG performance and enterprise value.

In addition, several studies demonstrate a negative association between ESG performance and enterprise financing costs (Hamrouni et al., 2019; Raimo et al., 2021; Feng and Wu, 2021; Gigante and Manglaviti, 2022; Chouaibi et al., 2021) 20. Strong ESG performance can attract investor attention, ultimately reducing the financing cost (Mansouri and Momtaz, 2022) 25.

The connection between financing costs and enterprise value is well-established (Chen et al., 2010) 26. Liu (2020) 27 highlights that high financing costs hinder a company's growth. Recent research has investigated the interplay between ESG, financing costs, and enterprise value (Henisz et al., 2019) 28. Wang and Yang (2022) 29show that strong ESG performance improves enterprise value by lowering financing costs. Feng and Wu (2021) 30 demonstrate that companies with a history of strong ESG performance are more likely to secure funding during a crisis, such as the COVID-19 pandemic, exhibiting higher enterprise value. In summary, existing research generally suggests that a Chinese company's ESG performance is positively associated with its enterprise value by influencing financing costs.

Based on existing research, this paper identifies three key limitations and provides solutions in the realm of ESG performance and its impact on enterprise value:

(1) Previous empirical research has relied on inconsistent ESG performance indicators collected by different institutions, potentially resulting in unreliable and incomparable research findings. To address this problem, this study synthesizes data from prominent ESG rating agencies in China and constructs a comprehensive indicator for ESG performance. Given the growing popularity of ESG investing, numerous third-party ESG evaluation agencies have emerged recently. Unlike previous research, this study constructs a comprehensive ESG performance indicator. This approach mitigates the problem of unreliable results stemming from inconsistent index selection.

(2) Existing empirical studies have assumed a linear relationship between ESG performance and enterprise value, leading to incongruent results across studies. To overcome this limitation,

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this paper hypothesizes a non-linear relationship and adopts a specialized regression model, generating a cohesive empirical framework for future research.

(3) Prior studies often overlook the problem of biased estimation due to endogeneity. To tackle the issue of biased estimation stemming from endogeneity, this paper employs instrumental variables via the two-stage least squares method, mitigating potential threats to internal validity. More specifically, we employ tool variables like analyst prediction bias and the industry's mean ESG responsibility performance. These variables will undergo thorough testing to address endogeneity effectively, thereby strengthening the reliability of our analysis.

The remainder of the paper proceeds as follows: Section II presents hypotheses on how ESG responsibility fulfillment affects firm value. Section III constructs a regulated intermediary model using to test the nonlinear relationship between ESG performance and enterprise value. Section IV presents our main results on the impact of ESG performance on enterprise value. Section V concludes.

2. Theoretical Analysis and Research Hypotheses

2.1. Nonlinear Relationships and the Moderating Effect of Financing Constraints

It is widely acknowledged that enterprises should fulfill their ESG responsibilities to meet societal expectations, stakeholder demand, and regulatory requirements. Meanwhile, scholars have extensively researched methods to maximize enterprise value. According to stakeholder theory, enterprises generate value by consistently engaging with stakeholders, with stronger connections enhancing value. First, ESG performance builds a positive brand image, attracting customers (Wang and Xu, 2016) 31. Second, it fosters effective communication with employees, motivating them, boosting loyalty, and retaining talents (Greening and Turban, 2000) 32. Third, it reduces labor costs and boosts sales revenue, thereby elevating enterprise value. (Hamrouni et al., 2019) 33. Finally, it enhances investors' understanding of the enterprise's non-financial information, fostering trust and fulfilling financing needs. For example, firms with strong ESG performance face lower compliance costs and adjust faster to negative events (Walker et al., 2014) 34. Therefore, ESG-compliant firms are more likely to achieve sustainable growth, accruing intangible assets like brand goodwill.

However, continuous ESG investment does not necessarily lead to a steady increase in enterprise value (Wieczorek et al., 2021) 35. Placing excessive emphasis on ESG performance can lead to resource constraints, leading to short-term losses to stakeholders (Xue et al., 2022) 36. While enterprises might transfer short-term losses to stakeholders, this approach is not sustainable in the long run (Ohalehi, 2019) 37. Excessive ESG costs may burden firms, leading to price hikes and consumer loss. Thus, while strong ESG can enhance value within limits, exceeding them can be detrimental. Therefore, the relationship between ESG performance and enterprise value is likely non-linear.

ESG responsibility fulfillment is an internal behavior of enterprises, while financing constraints are external factors influencing enterprises' conduct. Financing constraints impede with stakeholder attention to ESG, impairing enterprises' ability to enhance their values. First, in environments with stringent financing constraints, firms mitigate risks through transparency. But as ESG becomes common, its advantage diminishes (Ma, 2019) 38. To mitigate financing risk and gain competitive advantage, some managers opt to enhance information transparency, minimize adverse selection risks, and cultivate investor trust through proactive ESG responsibility fulfillment (Alda, 2020) 39. Over time, other enterprises follow suit. As ESG responsibility becomes widespread, it ceases to be a unique competitive advantage. For early adopters, the cost of ESG responsibility fulfillment increases and may eventually become a financial burden.

Second, the market is more developed in areas of high financing constraints (Chen et al., 2012) 40. And enterprises in developed markets are more likely to fulfill ESG responsibilities, fostering intense market competition. Enterprises continuously refine their ESG practices and accumulate management experience, facilitating knowledge spillover and further enhancing value by fulfilling ESG responsibilities. However, excessive investment in ESG responsibility can deplete resources and exacerbate its adverse impact on enterprise value, particularly in areas of high financing constraints.

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Third, the level of stakeholder understanding regarding a company's ESG efforts is heavily influenced by the financing environment. In areas of high financing constraints, intense market competition often leads to greater information transparency and a more efficient market (Eccles et al., 2014) 41. This transparency facilitates smoother communication between companies and stakeholders. Stakeholders can then react promptly to a company's ESG performance through investment decisions and other actions (Gao et al., 2017) 42. Conversely, low financing constraints are often associated with a lack of awareness and competition surrounding ESG practices. Stakeholders in such environments may have limited information about a company's ESG efforts, exacerbating information asymmetry and weakening the impact of ESG performance on enterprise value. Based on the above analysis, we propose hypothesis H1 to capture these dynamics.

H1: The relationship between ESG responsibility fulfillment and enterprise value is non-linear, with financing constraints playing a significant moderating role in this relationship.

2.2. Heterogeneity of ESG Responsibility Fulfilment and Enterprise Value

Enterprises may experience varied impacts when fulfilling ESG responsibilities, influenced by factors such as industry context and ownership structure. ESG responsibility entails a focus on environmental protection, aligned with corresponding policies and regulations in China. Enterprises can be categorized into polluting and non-polluting entities based on industry characteristics, as well as state-owned and non-state-owned regarding ownership structure. Therefore, considering this diversity among enterprises is crucial for accurately assessing the influence of ESG performance on enterprise value (Wang and Yang, 2022) 29.

ESG responsibility fulfillment, as a source of competitive advantage, can have positive impacts on enterprise value. The impacts fluctuate based on industry characteristics and ownership structure. Non-polluting enterprises typically enjoy cost advantages in environmental management (Zhang and Zhao, 2019) 43, allowing them to derive additional benefits from higher ESG performance. However, the competitive and knowledge spillover effects may be limited within non-polluting industries due to resource constraints. Without sufficient investment in ESG performance, these effects may plateau, no longer enhancing enterprise value.

Moreover, intense competition and knowledge spillover in non-polluting industries from ESG responsibility fulfillment may persist in the short run and eventually saturate the market, leading to homogenized competition among enterprises. This trend can degrade the external competitive advantages, decreasing enterprise value. In contrast, polluting enterprises face pressure from public opinion to address pollution and incur additional costs for public relations (Yin et al., 2022) 44. In such industries, competitive dynamics are weaker, and the knowledge spillover effect is less pronounced, resulting in differing impacts of ESG performance compared to non-polluting sectors. Overall, the effect of ESG performance on enterprise value in non-polluting enterprises likely follows a non-linear pattern, influenced by industry-specific factors and ownership characteristics.

Heterogeneity also extends to the effect of various ownership structures (Xu et al., 2021) 45. Non-state-owned enterprises typically boast more adaptable internal controls compared to their state-owned counterparts, rendering their ESG performance more reflective of market demands. For non-state-owned enterprises, adherence to ESG responsibilities may arise from a focus on legal compliance, which could inadvertently surpass stakeholders' expectations for value creation (Xu et al., 2022) 46.

Furthermore, the input-output dynamics of ESG performance by non-state-owned enterprises align with the principle of diminishing marginal returns in economics. Initially, fulfilling ESG responsibilities contributes positively to enterprise value. However, as its intensity increases, the marginal increase in value is expected to decline. In contrast, state-owned enterprises, being closely aligned with government interests, often prioritize government-led initiatives for ESG compliance rather than value enhancement.

In essence, the impact of ESG responsibility performance on the value of non-state-owned enterprises likely follows a non-linear relationship. They may initially enhance value, but this effect

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diminishes as ESG efforts intensify. In contrast, state-owned enterprises may engage in ESG compliance primarily for political reasons rather than value creation. Based on the above analysis, we propose hypothesis H2:

H2: The effect of ESG responsibility fulfillment on enterprise value varies significantly depending on industry context and ownership structure.

2.3. Reducing Financing Cost Is the Primary Path for ESG Responsibility Fulfilment to Influence Enterprise Value

ESG compliance reduces the cost of debt and equity financing by strengthening ties between enterprises and stakeholders, increasing market information transparency, and enhancing investors' understanding of enterprise information. Investors perceive ESG-compliant enterprises as having higher credit ratings, making them more willing to provide unsecured debt when these enterprises invest in real estate trust (REIT) (Feng and Wu, 2021) 47. Limkriangkrai et al. (2016) 48studied the Australian market and found that ESG compliant enterprises pay fewer dividends after equity financing. Moreover, ESG responsibility fulfilment enhances market information transparency, reducing the risk of insufficient information for investors and thereby lowering the payoffs demanded by investors (Eliwa et al., 2021) 49. Therefore, financing cost is a crucial factor affecting enterprise value. Fulfilling ESG responsibilities can effectively reduce financing costs.

The information perfect symmetry hypothesis posits that enterprises have an optimal capital structure that maximizes value (Hovakimian and Li, 2012) 50. Changes in the capital structure affect enterprise value accordingly. However, widespread information asymmetry in the market complicates this relationship. Equity financing, unlike debt financing, lacks the rigid constraint of timely repayment. Debtors may closely monitor managers' debt financing activities, imposing constraints. In contrast, managers raising equity financing may face fewer restrictions, amplifying the effect of equity financing costs on enterprise value. Therefore, hypothesis H3 is proposed:

H3: ESG responsibility fulfilment primarily affects enterprise value by reducing financing costs, with heterogeneity observed between debt and equity financing paths.

3. Research Design

3.1. Data Sources and Processing

This paper analyzes data from Shanghai and Shenzhen A-share listed enterprises in China from 2012 to 2020. The vast majority of Chinese public companies have been listed on these two stock exchanges. The selection of these enterprises is based on two primary reasons. First, the process of getting listed on the stock exchanges is very rigorous, reflecting the stability and significant scale of listed companies, as well as providing comprehensive information on ESG responsibility fulfillment. Second, mainstream ESG rating agencies have only released data for listed enterprises from 2012 to 2020.

The data on ESG performance is derived by aggregating ratings and scores from three institutions: Sino-securities, Bloomberg, and Hexun. Sino-securities ESG data is sourced from the Wind database, while Bloomberg and Hexun data are manually collected. Other financial data are obtained from the CSMAR database. Furthermore, the raw data undergoes three processing steps. Firstly, enterprises labeled as ST and ST* are excluded, as they are experiencing financial troubles and/or facing potential delisting. Secondly, those in the financial and real estate sectors, as well as those with gearing ratios exceeding one, are also excluded. Thirdly, to mitigate the influence of outliers, all continuous variables undergo 1% and 99% tailing processing. These processing steps result in a final dataset comprising 9,076 sample observations.

3.2. Variable Descriptions

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3.2.1. Dependent Variable

Existing studies typically utilize two main categories of indicators to measure enterprise value. One category comprises accounting indicators, including metrics like return on total assets (ROA), return on net assets (ROE), growth rate of asset size (ΔSize), and sales growth rate (ΔSales). The other category involves market indicators, with Tobin's Q being a prominent example. The users of ESG performance information include both internal personnel and numerous external stakeholders in the market. External stakeholders often assess an enterprise's ESG responsibilities based on its capital market value. Therefore, this paper opts to utilize Tobin's Q as a measure of enterprise value.

3.2.2. Explanatory Variable

The current ESG performance rating provided by mainstream institutions demonstrate certain variations. Sino-securities' ESG rating data is frequently updated and encompasses a broad spectrum. Enterprises' ESG responsibility fulfillment status is categorized into three levels (e.g., 3A to A) at the A, B, and C levels in the form of a three-level, nine-grade rating. Bloomberg's ESG score data is carefully segmented, offering scores from individual perspectives and overall assessments of enterprise ESG performance. Meanwhile, Hexun's rating data is comprehensive, deriving overall ESG compliance scores from multiple dimensions, including shareholders, employees, suppliers, products, and after-sales service. Table 1 presents the ESG compliance scores from these three organizations.

Overall, with the exception of Sino-securities' ESG compliance data, both Bloomberg's and Hexun's scores are relatively low, reflecting the relatively nascent adoption of ESG compliance practices in China. Specifically, Sino-securities' ESG rating data boasts a high overall score, while Bloomberg's data registers a lower overall score, and Hexun's data exhibits the highest standard deviation. Recognizing the distinct characteristics of ESG performance ratings offered by different institutions, this paper adopts the approach outlined by Berg et al. (2022) 51.

We construct the ESG responsibility performance index (WESG) through a weighted average method. First, we standardize the ESG rating data from different institutions, then compute the weighted average based on predefined weights. This optimized approach ensures that the WESG indicator is comprehensive, comparable, and reasonably representative. The construction method for the WESG indicators is outlined as follows:

$$WESG_{it} = \sum ESG_{it} * I_i$$

ESG_{it} indicates the ESG performance rating score of each institution for the year t of the i, I_i is the weight of each agency.

Table 1. Descriptive statistics of the three major ESG rating agencies[3].

Institution	Sample size	Mean	Standard deviation	Minimum	Median	Maximum
Sino-securities	32,210	61.283	13.282	10	60	90
Bloomberg	9,340	20.771	7.084	1.240	19.835	64.115
Hexun	31,984	23.267	15.134	-18.450	21.540	90.87
WESG	9,241	40.937	9.505	6.927	39.921	68.077

[3]From: Wind et al. database

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3.2.3. Moderating and Mediating Variables

Three primary methods for assessing enterprise financing constraints include the single variable index method, the sensitivity model method, and the index method. The single variable index method relies on a single factor for measurement, making it simple but lacking in representativeness. Sensitivity models, while comprehensive, are complex to calculate, labor-intensive, and prone to significant errors. Mainstream index methods encompass KZ, SA, WW, and FC. The FC index, derived from logistic regression using standardized indicators like age and cash dividend payout rate, serves as a crucial measure. Furthermore, the FC index consistently exceeds zero, with higher values signifying greater financing constraints for enterprises. Building on the research by Kuang (2011) 52 and Zhang et al. (2017) 53, this paper adopts the FC index as the moderating variable to gauge enterprise financing constraints[4].

In terms of measuring financing costs, this paper considers both debt and equity financing. For the cost of debt financing, the paper follows the approach of Wang and Yang (2022) 29and selects the cost of enterprise debt financing (COD) as the mediating variable for assessing the impact of ESG performance on enterprise value. In addition, inspired by the methods of Li and Liu (2009)54 and Zheng et al. (2013)55, the ratio of financial expenses to liabilities is employed to calculate the cost of enterprise debt financing.

Meanwhile, the cost of equity financing (COE) is evaluated using the PEG model as suggested by Mao et al. (2012)56 and Yang et al.(2015)57. Specifically, the cost of equity financing (COE) is calculated as follows:

$$COE = \sqrt{\frac{EPS_{t+2} - EPS_{t+1}}{P_t}}$$

EPS_{t+2} and EPS_{t+1} represent the forecast earnings per share by analysts in periods $t+2$ and $t+1$. P_t represents the price per share of the enterprise at the end of the t period[5].

3.2.4. Control Variables

Drawing from the characteristics of Shanghai and Shenzhen A-share listed enterprises, this study integrates findings from Wang and Yang(2022) 29, and Xu et al. (2022) 58. Consequently, we incorporate enterprise size (Size), growth capacity (Growth), fixed asset ratio (Fixed), the proportion of the largest shareholder (Top1), along with year and industry dummy variables as control variables in our analysis. Size is measured by the natural logarithm of total assets, while Growth is determined by the operating income growth rate. Fixed represents the sum of net fixed assets and inventory divided by enterprise assets. Top1 denotes the percentage of shareholders holding the most shares in the company. To mitigate the influence of time on our empirical findings, year dummy variables are included in the regression model. Recognizing significant variations among listed enterprises across different industries in Shanghai and Shenzhen A-shares, industry dummy variables are also integrated as control variables. Table 2 presents the relevant variables used in this study.

Table 2. Description of the main variables.

Variable type	Variable name	Variable definition
Explained variable	Tobin's Q	Market value is divided by total assets at the end of the period.

[4]Note: Subsequently, we also use KZ and SA indexes to test the moderating effect, both of which passed.

[5]EPS, which stands for Earnings Per Share, follows Mao and Botosan's approach, utilizing analysts' forecasts of earnings per share as the earnings per share for the sample companies in each period.

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Explanatory variable	WESG	Weighted generated enterprise ESG responsibility fulfillment optimization indicator.
Moderating variable	FC	Enterprise age and cash dividend payout ratio after standardization.
Mediating variables	COD	The ratio of financial expenses to liabilities.
	COE	Analysts forecast the difference in earnings per share for two consecutive years divided by the closing share price and open the number.
Control variables	Size	Natural logarithm of total assets of an enterprise.
	Growth	The growth rate of revenue
	Fixed	The sum of net fixed assets and net inventory is divided by total assets.
	Top1	The shareholding ratio of the largest shareholder
	Year	2012-2020
	Ind	The SFC 2012 Industry Classification Guidelines for listed enterprises.

The descriptive statistics of the main variables are presented in Table 3. The analysis reveals that the dependent variable, Tobin's Q, exhibits a range from 0.855 to 11.980, with a standard deviation of 1.763, indicating significant variability among enterprises. The explanatory variable, WESG, ranges from 6.927 to 68.08, with a median value of 39.960, suggesting relatively modest values overall. This aligns with the nascent development of the ESG concept in China, indicating ample room for improvement in ESG responsibility fulfillment. The moderating variable, FC, ranges from 0 to 1, with an average of 0.310, indicating generally low financing constraints among the sample enterprises.

The mediating variable, debt financing (COD), ranges from -0.188 to 0.070. A negative COD does not imply negative actual debt financing costs but rather indicates a negative agent indicator for COD. Equity financing ranges from 0.012 to 0.262, with an average of 0.095, lower than the median of 0.120, indicating a left-biased trend in equity financing among the sample enterprises. Additionally, the sample size for equity financing is 3550, significantly smaller than other sample sizes, due to the stringent condition requiring a positive difference between analysts' forecast earnings per share for two consecutive years for meaningful calculation.

Table 3. Descriptive statistics of the main variables.

Variable	Sample size	Mean	Standard deviation	Minimum	Median	Maximum
Q	9,076	2.253	1.763	0.855	2.552	11.980
WESG	9,076	40.960	9.494	6.927	39.960	68.080
FC	8865	0.310	0.245	0.006	0.490	0.942
COD	9,076	0.011	0.032	-0.188	0.029	0.070
COE	3,550	0.095	0.050	0.012	0.120	0.262
Size	9,076	23.030	1.274	19.570	23.820	26.020
Growth	9,076	0.159	0.401	-0.561	0.237	2.856
Fixed	9,076	0.242	0.176	0.003	0.348	0.700
Top1	9,076	36.930	15.920	8.790	48.800	75.050

3.3. Empirical Model

To examine the non-linear relationship between ESG responsibility fulfillment and enterprise value as deduced from the theoretical analysis, we incorporate the quadratic term of enterprise ESG responsibility fulfillment ($WESG^2$) into the fixed-effect model. This inclusion allows us to assess the impact of ESG performance on enterprise value. Thus, we formulate the following model:

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$$Q = \beta_0 + \beta_1 WESG + \beta_2 WESG^2 + \beta_3 Control + YearEffect + IndEffect + \varepsilon_{i,t} \quad (1)$$

To examine the moderating impact of financing constraints on the relationship between ESG performance and enterprise value, we introduce the interaction term between financing constraints (FC) and explanatory variables (WESG) into the model (2). Testing hypothesis H1 relies on the significance of this term. If is significant, it would suggest the presence of a moderating effect of financing constraints on the relationship between ESG responsibility fulfillment and firm value.

$$Q = \beta_0 + \beta_1 WESG + \beta_2 WESG^2 + \beta_3 WESG \times FC + \beta_4 Control + YearEffect + IndEffect + \varepsilon_{i,t} \quad (2)$$

For the mechanism analysis, the cost of debt financing (COD) and cost of equity financing (COE) of enterprises serve as mediating variables and are examined using a three-step model. The model framework for the mediation test is as follows:

$$Q = \beta_0 + \beta_1 WESG + \beta_2 WESG^2 + \beta_3 Control + YearEffect + IndEffect + \varepsilon_{i,t} \quad (3)$$

$$COD\ (COE) = \beta_0 + \beta_1 WESG + \beta_2 Control + YearEffect + IndEffect + \varepsilon_{i,t} \quad (4)$$

$$Q = \beta_0 + \beta_1 WESG + \beta_2 WESG^2 + \beta_3 COD\ (COE) + \beta_4 Control + YearEffect + IndEffect + \varepsilon_{i,t} \quad (5)$$

β_0 represents a constant term; $\beta_{Control}$ is the control variables; $YearEffect$ represents the year fixed effect, $IndEffect$ represents the industry fixed effect; i represents the year; t denotes sample enterprises; $\varepsilon_{i,t}$ represents error terms.

Furthermore, given the possibility of endogeneity between ESG responsibility fulfillment and enterprise value, we employ analyst forecast bias and industry averages of ESG responsibility fulfillment for two-stage least squares estimation, effectively addressing the endogenous problem (Fatemi et al., 2017; Wang and Yang, 2022) 59.

4. Empirical Results and Analysis

4.1. Analysis of the Results of the Benchmark Regression

Table 4 presents the regression results concerning ESG performance and enterprise value. The coefficient estimate for WESG is statistically significant and positive, signifying that ESG performance is positively associated with enterprise value. Conversely, the coefficient estimate for $WESG^2$ is significantly negative, indicating a shift in the effect of ESG performance from positive to negative as resources allocated to ESG responsibility fulfillment increase. According to the regression outcomes, the mean ESG performance score at the inflection point is 28.5. Below this threshold, ESG performance is positively associated with enterprise value, while above the threshold, it detrimentally affects enterprise value. In essence, while enterprises benefit from engaging in ESG responsibility fulfillment, excessive efforts in this regard can diminish enterprise value.

In summary, the empirical regression results support a non-linear, inverted U-shaped relationship between ESG responsibility fulfillment and enterprise value, validating hypothesis H1. To account for the influence of external factors like financing constraints, we introduce the interaction term of financing constraints and ESG responsibility fulfillment (WESG×FC) to the baseline regression model. Column (2) presents the regression results. The coefficients for both the linear and quadratic terms remain significant, with one being positive and the other negative, further indicating

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an inverted U-shaped relationship between ESG performance and enterprise value. Moreover, the coefficient for the interaction term between financing constraints and ESG performance is significant at the 1% level, underscoring the moderating role of financing constraints. Specifically, a higher numeric value of the enterprise financing constraint reflects more severe constraints. After incorporating the interaction term, the coefficient for the linear term of ESG responsibility performance increases from 0.057 to 0.075. This suggests that under financing constraints, the positive impact of ESG performance on enterprise value becomes more pronounced. Thus, H1 is affirmed.

Table 4. Baseline regression and instrumental variable regression results.

Variable	(1)	(2)	(3) First stage (ESG)	(4) First stage (ESG^2)	(5) Second stage
	Q	Q	ESG	ESG^2	Q
WESG	0.057***	0.075***			1.031***
	(5.21)	(6.87)			(5.30)
$WESG^2$	-0.001***	-0.001***			-0.012***
	(-4.50)	(-5.42)			(-5.39)
WESG×FC		-0.025***			
		(-9.84)			
ERROR			-0.147***	-11.250***	
			(-8.96)	(-8.06)	
mESG			1.020***	90.635***	
			(49.58)	(51.81)	
Size	-0.746***	-0.853***	1.392***	112.373***	-0.684***
	(-23.41)	(-23.07)	(18.97)	(18.02)	(-22.33)
Growth	0.308***	0.328***	-0.898***	-81.553***	0.490***
	(10.61)	(11.26)	(-3.96)	(-4.23)	(8.93)
Fixed	-0.651***	-0.512***	-2.37***	-188.271***	-1.346***
	(-3.85)	(-3.00)	(-4.57)	(-4.27)	(-9.98)
Top1	0.000	0.002	-0.003	-0.496	0.000
	(0.24)	(0.78)	(-0.53)	(-1.00)	(0.14)
cons	17.894***	19.927***	-31.533***	-4417.133***	-2.996
	(16.56)	(17.44)	(-16.55)	(-27.27)	(-0.85)
N	9,076	8,865	8495	8495	8495
R^2	0.263	0.267	Correlation test of instrumental variables:		
Ind	Yes	Yes	Unidentifiable test: P value=0.000		
year	Yes	Yes	Weak instrumental variable test: F value=33.469		

4.2. Discussion and Treatment of Endogenous Problem

There is the potential mutual causality between ESG responsibility fulfillment and enterprise value, successful firms are more likely to fulfill ESG responsibilities to gain reputation. Here, we address this endogeneity concern by employing instrumental variables in our model. Following the approach of Fatemi et al. (2017)59 and Wang and Yang(2022)29, we conduct a two-stage least squares analysis using analyst forecast bias (ERROR) and the industry average of ESG responsibility fulfillment (mESG) as instrumental variables. Columns (3)-(5) of Table 4 present the instrumental variable regression results. Columns (3) and (4) display the first-stage regression outcomes, yielding fitted values for the endogenous explanatory variable ESG responsibility fulfillment and its squared term. Column (5) depicts the second-stage results of the instrumental variables regression.

The results reveal a significantly negative coefficient for analyst forecast bias (FERROR) among the instrumental variables, indicating a negative relationship between analyst forecast bias and ESG

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performance. This suggests that ESG performance may mitigate information asymmetry and reduce the dispersion of analyst forecasts. Furthermore, a higher ESG performance within the industry where the enterprise operates indicates a general commitment to ESG responsibilities within the industry. Consequently, the industry mean of ESG responsibility fulfillment should positively correlate with individual enterprises' efforts.

Combining the instrumental variable regression findings, we observe a positive coefficient for mESG, indicating a favorable impact. Furthermore, the second-stage analysis confirms that the linear coefficient for ESG responsibility fulfillment remains significantly positive, while the quadratic coefficient is significantly negative. This reaffirms the inverted U-shaped relationship between ESG performance and enterprise value, even after addressing the endogeneity issue.

Moreover, we conduct unidentifiable and weak instrumental variable tests, presented in columns (3)-(5) of the table. The p-value of the unidentifiable test is 0, signifying statistical significance. Additionally, the F-value of the weak instrumental variable test is 33.469, surpassing the threshold of 10, indicating the validity of the instrumental variables used in this study. As there are two endogenous variables in the model, matching the number of instrumental variables, there is no need for over-identification tests (Staiger and Stock, 1994)60.

4.3. Robustness Tests

4.3.1. Replacement of the Dependent Variable and Independent Variables

To ensure the robustness and reliability of our baseline regression results, we conduct robustness tests by experimenting with alternative variables. In measuring enterprise value, we substitute the market value of non-listed equity with net assets, dividing it by the total assets at the period's end. This substitution results in the variable Q1. Table 5 presents the outcome after incorporating this replacement variable into the benchmark regression model, displayed in column (1). Although the quadratic coefficient is small, its negative value suggests an inverted U-shaped relationship between ESG performance and enterprise value.

Furthermore, we enhance the explanatory variables by incorporating data from RunlingGlobal's ESG responsibility rating along with ratings from four other mainstream institutions. We weight these rating scores to construct ESG responsibility performance indicators (WESG1). The regression result incorporating these additional variables is presented in column (2) of Table 5. Notably, the inverted U-shaped relationship between ESG performance and enterprise value persists, affirming the robustness of our benchmark regression results.

4.3.2. Quantile Regression

Given that the panel data fixed effect model primarily examines the average-level impact of ESG performance on enterprise value, it fails to capture variations across different levels of enterprise value. To address this, we conduct regressions using quartiles—specifically, the 0.25, 0.5, 0.75, and 0.9 quartiles—to assess the effect of ESG responsibility on enterprise value. The results, displayed in columns (3)-(6) of Table 5, indicate significance for both the 25% and 90% quartiles, suggesting the effectiveness of the non-linear relationship at low and high levels of enterprise value.

Analyzing the coefficients' sign direction, we find that at the 25% level, the one-term coefficient is significantly negative, while the quadratic coefficient is significantly positive. This indicates that the impact of ESG responsibility fulfillment on enterprise value initially declines and then increases when enterprise value is low. In contrast, at the 90% level of enterprise value, the one-term coefficient is significantly positive, while the quadratic coefficient is significantly negative. This suggests that at high levels of enterprise value, ESG responsibility fulfillment initially boosts enterprise value before dampening it.

In summary, our analysis highlights a significant non-linear relationship between ESG performance and enterprise value, particularly evident at low and high levels of enterprise value.

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Table 5. Robustness test.

Variable	(1)	(2)	(3) q25	(4) q50	(5) q75	(6) q90
	Q1	Q	Q	Q	Q	Q
WESG	0.032***		-0.013***	0.003	0.027	0.081***
	(3.66)		(-2.98)	(0.41)	(1.61)	(3.36)
WESG²	-0.000***		0.000***	-0.000	-0.000	-0.001***
	(-2.63)		(3.35)	(-0.00)	(-1.43)	(-3.08)
WESG1		0.077***				
		(4.18)				
WESG1²		-0.001***				
		(-3.34)				
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	9,076	4793	9,076	9,076	9,076	9,076
R²	0.209	0.289	0.116	0.142	0.166	0.191

4.4. Heterogeneity Analysis

According to the theory of resource conservation, enterprises tend to avoid activities that deplete their resources once they reach a certain resource threshold (Grant, 1999) 61. The cost and benefits of ESG compliance vary across industries. Non-polluting enterprises, for instance, can utilize their resources more efficiently as they don't incur additional costs for pollution management. This implies that the initial impact of ESG compliance may be more pronounced for non-polluting enterprises. To explore this, we classify listed enterprises based on industry using the SFC 2012 Industry Classification Guidelines for Listed Enterprises. Subsequently, we conduct regression analysis for enterprises within different industry categories. Results presented in columns (1) and (2) of Table 6 show a significantly positive coefficient for the linear term and a significantly negative coefficient for the quadratic term in non-polluting industries. This suggests that ESG performance initially enhances enterprise value, but once the ESG score reaches 48.5, its positive impact diminishes, indicating an inverted U-shaped relationship. In contrast, for enterprises in polluting industries, the linear coefficient is significantly negative, with no significant nonlinear relationship observed.

State-owned enterprises typically respond to government-led initiatives for ESG responsibility earlier than non-state-owned enterprises. Non-state-owned enterprises, on the other hand, possess greater flexibility in internal controls and can adjust their business processes more quickly. To examine this further, we classify sample enterprises into state-owned and non-state-owned categories based on ownership structures. Subsequent group regression analysis yields results presented in columns (3) and (4) of Table 10. The regression coefficients reaffirm the presence of an inverted U-shaped relationship in non-state-owned enterprises. In summary, the nonlinear effect of ESG performance on enterprise value is more pronounced in non-polluting or non-state-owned enterprises, confirming hypothesis H2.

Table 6. Heterogeneity test of industries and ownership structures.

Variable	(1)Non-polluting	(2)Polluting	(3)Non-state-owned	(4)State-owned
	Q	Q	Q	Q
WESG	0.097***	-0.033*	0.069***	0.010
	(6.36)	(-1.78)	(3.46)	(0.75)
WESG²	-0.001***	0.000	-0.001***	-0.000
	(-5.86)	(1.62)	(-3.02)	(-0.78)
Control	Yes	Yes	Yes	Yes
N	5826	3250	4348	4728
R²	0.129	0.089	0.139	0.080

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4.5. Further Discussion: Mechanism Analysis

In the current economic landscape, transitioning from virtual to real economic growth requires stricter financial oversight, particularly concerning the disclosure of information such as financing channels and capital utilization by listed enterprises. Listed companies often grapple with limited access to financing and high financing costs in China. To explore the mechanism through which ESG responsibility fulfillment affects enterprise value, we employ a three-step method to analyze the mediating effect of financing costs.

Columns (1) and (2) of Table 7 depict the impact of debt financing costs as an intermediary variable on enterprise value. The results in Column (1) reveal a significantly negative regression coefficient for ESG responsibility fulfillment on debt financing costs, suggesting that fulfilling ESG responsibilities can mitigate the cost of debt financing for enterprises. However, the coefficient for debt financing costs in Column (2) is not statistically significant, indicating that the pathway involving debt financing costs is not supported.

Moving on to Columns (3) and (4), we examine the influence of equity financing costs as an intermediary variable on enterprise value. Column (3) demonstrates that ESG responsibility fulfillment can indeed reduce the cost of equity financing, supported by the significantly negative coefficient for equity financing costs in Column (4). This finding suggests that ESG performance can impact enterprise value by lowering the cost of equity financing.

In summary, while the pathway of ESG responsibility fulfillment affecting enterprise value through debt financing costs remains inconclusive, it appears to influence enterprise value primarily by reducing equity financing costs. Consequently, ESG responsibility fulfillment emerges as a crucial indicator for assessing enterprise value. Moreover, equity financing serves as a signaling mechanism that influences enterprise behavior. The confirmation of heterogeneity in the impact of ESG responsibility fulfillment on enterprise value through debt and equity financing pathways underscores the importance of the latter, as evidenced by the effectiveness of the equity financing cost pathway. Thus, hypothesis H3 has empirical support.

Table 7. The test of the mediating effect.

Variable	(1)	(2)	(3)	(4)
	COD	Q	COE	Q
WESG	-0.000***	0.056***	-0.001***	0.059***
	(-3.37)	(5.08)	(-3.94)	(2.85)
$WESG^2$		-0.001***		-0.001***
		(-4.38)		(-2.59)
COD		-0.742		
		(-1.44)		
COE				-1.543***
				(-3.67)
Control	Yes	Yes	Yes	Yes
N	9076	9076	3550	3550
R^2	0.095	0.263	0.076	0.278

5. Conclusions

It is imperative to examine how ESG performance impacts enterprise value, especially given the growing significance of ESG in enterprise valuation and its national mandate in China. Through a systematic examination using a nonlinear model and empirical testing, we draw four key conclusions. First, ESG responsibility fulfillment indeed affects enterprise value, displaying an inverted U-shaped relationship wherein it initially enhances value but becomes detrimental with excessive fulfillment. Second, we find that the impact of ESG responsibility fulfillment on enterprise value is amplified by high financing constraints. Third, there is heterogeneity in the relationship between ESG responsibility fulfillment and enterprise value, particularly in non-polluting or non-

state-owned enterprises, where the relationship follows an inverted U-shaped pattern. Fourth, we observe that ESG responsibility fulfillment influences enterprise value by reducing the cost of equity financing, although the mediating effect of debt financing cost is inconclusive.

Based on these findings, we propose several recommendations: (1) Enhance the guidance mechanism for ESG responsibility fulfillment at both the government and enterprise levels to avoid overinvestment or resource mismatch. (2) Improve the evaluation index system for ESG performance to prioritize indicators crucial for sustainable development and to address environmental and social concerns effectively, so as to support the national "Dual Carbon Goal". (3) Promote the concept of ESG investment among financial institutions and encourage support for enterprises with strong ESG performance. (4) Broaden financing channels by issuing bonds linked to ESG concepts to reduce financing costs for enterprises and enhance enterprise value.

Meanwhile, it is vital to shape public opinion, promote ESG investment and disclosure, and foster a market-oriented incentive mechanism for ESG investment. It is important to align businesses with sustainable development goals. Furthermore, our study highlights the potential application of nonlinear models to investigate various sustainability issues beyond ESG performance, such as employee relations, tax practices, consumer behavior, economic policies, energy strategies, environmental impacts, and leadership dynamics.

In this paper, we utilize a nonlinear model to investigate the impact of ESG responsibility fulfillment on enterprise value. Our methodology offers a versatile framework that can be applied by both researchers and practitioners to explore various sustainability-related issues. For instance, scholars could use our approach to analyze topics including employee relations (Shah, et al., 2022) 62, tax aggressiveness (Chughtai, et al., 2021) 63, purchasing intention (Moslehpour, et al., 2021) 64, economic policy (Hashmi, et al., 2021) 65, energy-induced growth (Adebayo, et al., 2021) 66, carbon emissions (Rjoub, et al., 2021) 67, nursing leadership (Wang, et al., 2022) 68. Interested readers can find further details on these topics in works by Wong, et al. (2020) 69 and Wong (2020) 70.

Lastly, our study has two notable limitations. First, we focus on examining the impact of ESG responsibility fulfillment on enterprise value. However, enterprise value is influenced by numerous factors in addition to ESG responsibility fulfillment. Future research should consider exploring these influencing factors to provide a more comprehensive understanding. Second, our research sample only includes China's Shanghai and Shenzhen A-share listed enterprises, overlooking potential insights from other countries or unlisted enterprises. Given the diverse economic landscapes globally, it is imperative to investigate the way through which ESG responsibility fulfillment affects enterprise value in different contexts. Subsequent studies could broaden their scope to encompass enterprises from other countries or unlisted ones to enrich the research findings.

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