

CORPORATE SUSTAINABILITY TRANSITION POLICY AND ESG PERFORMANCE IN CHINA: THE MEDIATING EFFECT OF GREEN INNOVATION AND FINANCING CONSTRAINTS

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Abstract. In addressing global sustainability imperatives, the Environmental, Social, and Governance (ESG) performance of Chinese enterprises has become pivotal. Grounded in Stakeholder Theory, Economic Externality Theory, and Signalling Theory, this study investigates how Corporate Sustainability Transition Policy (CSTP), a paradigm shift from compliance-driven regulation to enterprise-empowered transformation, shapes ESG outcomes. We further examine the dual mediating pathways of Green Innovation and Financing Constraints in this causal chain. Utilizing a recursive system of equations, we empirically analyze data from 9,831 *A-share* listed companies on China's main board. Key findings reveal the followings: A statistically significant positive relationship between Corporate Sustainability Transition Policy and ESG performance, robust to endogeneity checks and sensitivity analyses. Heterogeneous effects where state-owned enterprises (SOEs) and small-to-medium enterprises (SMEs) exhibit amplified responsiveness. Green Innovation acts as a positive mediator, while Financing Constraints serve as a negative mediator. Policymakers should design targeted transition instruments to accelerate sustainable transformation, while firms must leverage policy enablers to align innovation and capital strategies with ESG imperatives.

Keywords: *sustainability imperatives, ESG, innovation effect, empirical analysis, dual mediating pathways*

Introduction

ESG (Environmental, Social and Governance) is a key indicator of sustainable development. As the concept of sustainable development is widely recognized, companies need to take accountability (Wang et al., 2022). ESG emphasizes long-term value creation and sustainable growth and reflects sustainability in the corporate field. It helps monitor and evaluate a company's efforts (Zahid et al., 2022). Assessing ESG Performance involves examining a company's ecological footprint, social commitment, and corporate governance. This evaluation helps determine the financial value of companies pursuing sustainable expansion. Many economies require listed companies to disclose ESG Performance as governments, investors, sustainable development of businesses (Wang et al., 2023). The Corporate Sustainability Transition Policy (CSTP) has a crucial role. The European Union, a leading force in systemic change, uses such policies to accelerate sustainable development through frameworks, regulations, and mandatory ESG disclosure (Mu et al., 2023). Although Asia was initially behind in designing these policies, it now focuses on structured corporate sustainability transitions (Zhang et al., 2023).

The research on the impact of CSTP on ESG stems from global ecological crises and the need for enterprise sustainable development. In recent years, climate change, endangered species warnings, and emerging pollutants have pushed governments to develop innovative policies for corporate sustainability transitions (Zheng et al., 2025). Meanwhile, corporate ESG practices are evolving rapidly, with large - scale global ESG investments and policies mandating ESG disclosures accelerating green transformation in high - pollution industries. However, current CSTP face challenges like inconsistent implementation, fragmented standards, and technological gaps. Corporate ESG efforts also encounter issues such as greenwashing, data opacity, and neglect of social dimensions (Akhtar et al., 2019). Systemic reforms, including global ESG disclosure standards, localized metrics development, and carbon border taxes, highlight the urgency of this research. Future priorities should be optimizing policy enablers, harmonizing ESG criteria, supporting SMEs in adopting green technology, and strengthening socio - ethical accountability. These actions are crucial for balanced environmental, social, and governance progress. In China, ESG research is advancing quickly, and policies encourage ESG management and sustainable development (Cai et al., 2023) information disclosure. As global ecological pressures increase, ensuring companies balance financial performance and ESG responsibilities within China's sustainable development goals is an important research problem (Wang et al., 2023).

Within a comprehensive literature review addressing the research problem and expected solutions, this study identifies four research gaps. The first three gaps are theoretical, while the final gap is contextual. As part of this review, the research synthesizes key ESG influencing factors (*Appendix I*), identifying critical determinants of ESG Performance. However, international ESG scholarship predominantly focuses on micro-level corporate factors, firm size, board gender diversity, board size, and CEO duality (Lu et al., 2024), with scant attention to macro-level governmental drivers of ESG outcomes. To establish a government-led, multi-stakeholder sustainable development system, China has implemented CSTP, strategically designed to enable enterprise-level green transformation (Zhao and Cai, 2023). These policies actively catalyze society-wide sustainable transitions through market incentives, innovation support, and financing mechanisms. Consequently, this study addresses its primary research gap: How does China's CSTP shape firms' ESG Performance?

The existing literature mainly focuses on the economic impact of ESG performance on companies (Zahid et al., 2023), but empirical research on strategies to improve corporate ESG performance is scarce. Current studies show that governmental interventions, especially CSTP, are the main drivers of green innovation (Zhu and Huang, 2023). When firms lack internal motivation for sustainable practices, these policies are crucial as they reshape corporate behavior through incentive alignment and institutional pressure (Imperiale et al., 2023). Although research confirms that green innovation significantly enhances ESG performance (Dai and Zhu, 2024), the mediating role of green innovation in turning CSTP into ESG outcomes is still under - examined, which is the second critical research gap our study addresses.

In terms of the driving mechanism of ESG performance, Zhong (2023) proposed that relaxing financing constraints can improve ESG performance through two channels. First, it mitigates liquidity risks and releases resources for environmental and social responsibility initiatives. Second, it enhances information transparency via ESG disclosure and attracts sustainable capital inflows. Empirical studies confirm a virtuous cycle of ESG enhancement → financing constraint alleviation → further ESG gains.

Prior literature identified multiple factors affecting financing constraints, and government - driven CSTP can directly ease these constraints by lowering capital barriers. Research shows reducing financing constraints can enhance ESG performance. However, it's unexplored whether financing constraints mediate between CSTP tools and ESG outcomes, and this study aims to fill this gap as its third research objective.

This study contributes to the advancement of Stakeholder Theory by examining how governments, as pivotal stakeholders, leverage market-incentive mechanisms to enable corporate ESG performance. It integrates government-driven sustainability transition policies within a holistic theoretical framework, positioning the state as a catalytic enabler of corporate sustainability. The research investigates the impact of CSTP on ESG Performance, not only to deepen insights into the drivers of corporate ESG outcomes but also to unpack the dual mediating pathways through which policy instruments activate Green Innovation and alleviate Financing Constraints for ESG enhancement.

Although existing literature has sporadically explored the relationship between government regulation, green innovation, or financing and ESG, the novelty of this study lies in being the first to adopt the comprehensive policy paradigm of corporate sustainable transition policies as the core explanatory variable. Within a unified mediation model, it simultaneously examines two parallel and potentially conflicting transmission paths: green innovation (positively) and financing constraints (negatively). This transcends the limitations of previous studies that predominantly focused on single policies or mechanisms, providing a more systematic and empirically grounded theoretical framework and evidence for understanding how governments drive corporate ESG performance through empowerment rather than mere constraints. Additionally, the situational novelty of this study lies in our focus on China, the largest emerging economy, whose government-led sustainable development transition model differs significantly from the market-driven model in the West. Therefore, verifying these mediation paths in this context not only tests existing theories (such as stakeholder theory) but also expands their applicability and boundaries within unique institutional contexts.

Theory

Stakeholder theory and CSTP

According to Stakeholder Theory, corporate operations impact not only shareholders but also broader stakeholders (Stoelhorst, 2023). As environmental consciousness intensifies, stakeholders increasingly prioritize corporate green transformation. CSTP acts as a catalyst, translating stakeholder pressures (regulatory demands, investor expectations) into structured pathways for firms to achieve green development (Kumar, 2023). Crucially, market failures in allocating public environmental resources necessitate policy intervention. Unlike traditional command-and-control regulation, this policy paradigm empowers firms through incentive alignment, resource provision, and institutional legitimacy, enabling them to internalize stakeholder sustainability demands into strategic action.

Theory of economic externalities and green innovation

Economic externalities denote non-market impacts of one agent's activities on others, spanning positive and negative effects. While Green Innovation can generate

knowledge spillovers and enhance resource efficiency (Xue et al., 2022), its positive externalities often remain underprovided due to RandD appropriation risks. RandD appropriation risks refer to the risk that enterprises or organizations, when conducting RandD activities (especially knowledge-and technology-intensive ones like green innovation), may have their invested resources (funds, manpower, time) in developing new technologies, knowledge outcomes, patent solutions, or innovative models improperly obtained, imitated, misappropriated, or abused by competitors, other market entities, or third parties (Abdelaty and Weiss, 2023). This could prevent the RandD investors from fully benefiting from the economic returns, competitive advantages, or market rewards generated by these innovations. CSTP mitigates this market failure by internalizing externalities, rewarding green innovators and penalizing pollution. Consequently, firms leverage policy-enabled innovation to: reduce negative externalities, and amplify positive externalities, thereby elevating ESG performance and securing long-term competitive advantage (Yang et al., 2024).

Signalling theory and financing constraints

Signalling Theory explains how observable actions convey credible information to reduce market asymmetries (Yasar et al., 2020). Financing Constraints reflect frictions in capital access, which CSTP alleviates through mechanisms like: green credit guarantees, ESG-linked preferential loans, and sustainability bond incentives. Policy-induced easing of financing constraints signals two critical messages to investors. Firms possess state-endorsed sustainability capabilities. Alignment with transition agendas de-risks future cash flows. This attracts ESG-focused capital, enabling firms to invest in ESG-enhancing projects, further strengthening their sustainability profile (Yang and Han, 2023).

Hypotheses

CSTP and ESG performance

Enterprises integrate environmental and social responsibilities into profit-seeking activities to achieve sustainable development. To advance corporate governance, firms continuously refine development strategies and governance frameworks (Liu and Lyu, 2022), making ESG performance optimization critical for long-term resilience. Stakeholder Theory (Kumar, 2023) further posits that contemporary ESG practices transcend mere value maximization. Instead, they synergize internal resources with external environmental capital, balancing economic objectives with societal value while addressing multi-stakeholder interests. The core challenge lies in reconciling public environmental resource allocation, a process that market mechanisms fail to spontaneously resolve. CSTP thus becomes essential (Stoelhorst, 2023), acting as a proactive enabler to align private incentives with collective sustainability goals.

Governments, as pivotal stakeholders in corporate ecosystems, shape enterprise decision-making and development trajectories through policy instruments. The adoption of CSTP represents a paradigm shift from traditional compliance-driven approaches to proactive sustainability enablement. This policy framework redefines stakeholder expectations of ESG performance, compelling firms to strategically align with multidimensional stakeholder demands. By catalyzing synergistic integration of economic growth and environmental stewardship, CSTP activates corporate sustainability capabilities, thereby generating positive externalities on ESG outcomes

and advancing sustainable development imperatives. Hypothesis 1 formalizes this causal linkage.

Hypothesis 1: CSTP drives ESG performance.

CSTP, green innovation and ESG performance

According to Stakeholder Theory, the relationship between CSTP and corporate ESG performance is mediated by Green Innovation. Enterprises must balance the interests of diverse stakeholders, including employees, customers, suppliers, communities, and ecological systems, when formulating strategic decisions (Yu et al., 2024). CSTP enables firms to adopt environmentally sustainable technologies and reduce pollution by aligning regulatory frameworks with long-term ecological goals (Wang et al., 2022). Rather than merely imposing compliance, such policies motivate businesses to pursue Green Innovation as a strategic response to institutional pressures and emerging market opportunities.

Green Innovation transcends reactive adaptation; it represents a proactive commitment to developing technologies, products, and processes that minimize environmental harm while maximizing resource efficiency (Hu et al., 2021). This innovation directly enhances firms' environmental ESG metrics by demonstrating tangible ecological stewardship (Yu et al., 2022). Critically, CSTP catalyzes Green Innovation, which subsequently strengthens the environmental dimension of ESG and generates spillover benefits for social equity and governance quality. Thus, Green Innovation acts as a pivotal mediator linking policy-driven sustainability transitions to holistic ESG improvement.

However, the chain connecting policy-driven green innovation to improved ESG performance is not self-evident. On one hand, there may exist a green innovation paradox: corporate green initiatives implemented to address policy pressures could divert resources from other social responsibilities or corporate governance, thereby negatively impacting the social (S) and governance (G) dimensions of ESG. On the other hand, compliance-driven motivations for green innovation might outweigh strategic ones, resulting in lower innovation quality and limited substantial improvements in ESG performance. Therefore, within the policy framework of this study, empirically examining whether green innovation serves as a purely positive mediating role is crucial for clarifying the true relationship between policy, innovation, and ESG. This forms a key theoretical entry point for this research.

This supports the following hypothesis:

Hypothesis 2: Green Innovation mediates the relationship between CSTP and ESG performance.

CSTP, financing constraints and ESG performance

According to Stakeholder Theory, CSTP facilitates the alleviation of financing constraints. By incentivizing firms to embed sustainability into their core strategies, this policy framework reduces regulatory penalties and stakeholder litigation risks while enhancing investor confidence in regulatory alignment (He et al., 2024). Consequently, it lowers investors' required rate of return and decreases capital costs. Furthermore, corporate sustainability commitments generate an insurance-like effect that protects investor interests and reduces risk premiums (Lu et al., 2022).

Government agencies leverage superior expertise and informational advantages over external investors to assess green technology trajectories accurately (Xu et al., 2023).

Through market-based instruments, CSTP encourages firms to proactively disclose non-financial signals, such as sustainability certifications and innovation roadmaps, that validate future operational resilience (Lalfakawma et al., 2009). This transparency improves access to external financing for green initiatives, simultaneously advancing ESG performance.

The theoretical uncertainties surrounding policy-driven mitigation of financing constraints to enhance ESG performance persist. While signaling theory suggests policy support may transmit positive market signals, agency cost theory warns that abundant funding could lead to managerial overinvestment in non-core ESG initiatives, resulting in efficiency losses. Moreover, whether policy-mitigated financing constraints are genuinely dedicated to ESG initiatives rather than diverted to alleviate other financial pressures remains an empirical question requiring verification. Therefore, examining the mediating effect of financing constraints serves not only to confirm a transmission pathway but also to investigate how financial resources are effectively channeled toward ESG under sustainable transition policies—a critical issue demanding deeper exploration.

Thus, we propose the mediating mechanism:

Hypothesis 3: Financing constraints mediate the relationship between CSTP and ESG performance.

Conceptual framework

Building on the paradigm of CSTP, this study establishes a mediation model grounded in a systematic analysis of 72 ESG-focused studies (*Appendix 1*). As depicted in *Figure 1*, the framework positions: CSTP as the independent variable, ESG performance as the dependent variable, and green innovation and financing constraints as parallel mediating variables. This synthesis reflects an evolving consensus: contemporary sustainability policies no longer merely constrain firms but actively enable transition by redirecting resources toward innovation while alleviating financial frictions, ultimately catalyzing ESG value creation.

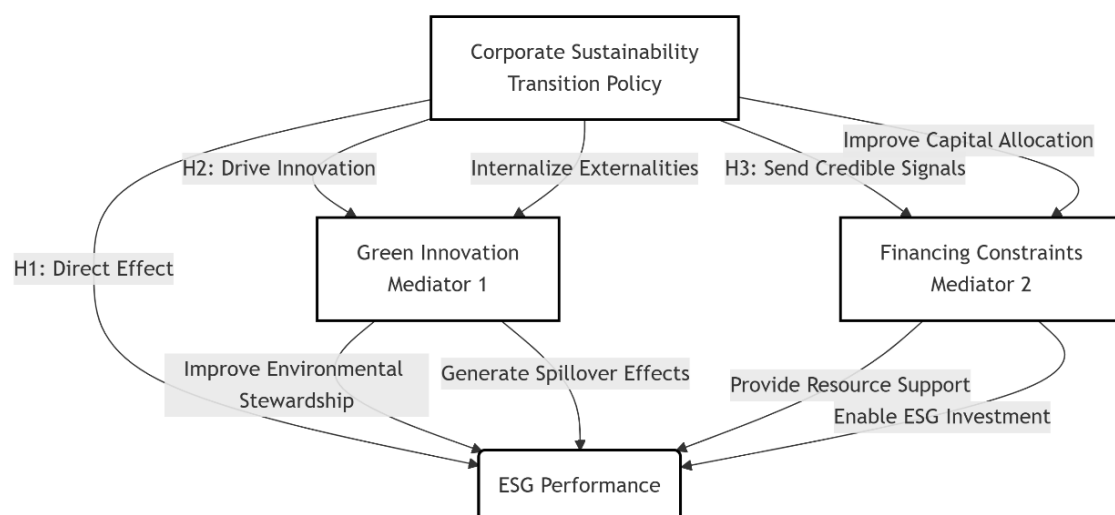


Figure 1. Conceptual framework

This study develops an integrated conceptual framework (*Figure 1*), which innovatively positions CSTP as multidimensional drivers. The framework reveals their theoretical mechanisms influencing ESG performance through two parallel mediating pathways: green innovation empowerment and financing constraint mitigation. Moving beyond single-theory perspectives and isolated explanations, it systematically illustrates how governments as key stakeholders reshape corporate behavior and resource allocation through policy instruments, thereby driving the complete process of sustainable transformation. Consequently, this conceptual framework not only clarifies variable relationships but also provides a systematic theoretical lens for analyzing corporate sustainability transitions. It highlights the central role of policy, elucidates its micro-level mechanisms, and establishes a robust theoretical foundation for subsequent empirical testing.

Methodology

The operationalization of the variables

This study utilizes data from *A-share* listed companies in the Shanghai and Shenzhen Stock markets for the period 2011 to 2020 as the research sample. To ensure the accuracy and reliability of empirical analysis results, particularly concerning the measurement of CSTP and its relationship with ESG performance, several adjustments are made to the initial research samples. Firstly, companies operating in the financial industry are excluded due to their distinct regulatory and operational characteristics. Secondly, firms classified as ST, *ST, and PT during the sample period are removed to avoid the influence of financial distress or abnormal trading status. ST refers to a special treatment applied to companies that have reported losses for two consecutive fiscal years. ST stands for Loss-making Stocks. *ST indicates three consecutive years of losses with delisting risks, requiring investors to possess strong fundamental analysis skills when purchasing such stocks. PT denotes stocks facing delisting. ST, PT, and *ST stocks are subject to special treatment due to financial irregularities or operational issues, potentially impacting overall market performance. If these companies continue to deteriorate, they may face delisting, and excluding them can prevent them from dragging down the index. Thirdly, observations with a debt ratio outside the range of 0–1 or exhibiting other abnormal financial indicators are omitted. Additionally, to minimize the potential impact of extreme values on empirical results, a 1% winsorization is applied to both tails of all continuous variables. The final sample consists of 9,831 firm-year observations.

Data for CSTP, ESG performance, green innovation, financing constraints, and control variables are obtained from the Bloomberg terminal, the China Statistical Information Network, and the CSMAR database. Data processing and econometric model estimation are conducted using Stata 17.0.

Dependent variable

ESG Performance (ESG). The dependent variable in this study is ESG Performance. In pursuit of sustainable transformation, enterprises increasingly adopt proactive ESG disclosures. Globally, over 600 specialized agencies provide ESG performance ratings (Zahid et al., 2022). Among these, Bloomberg dominates with its longer historical data coverage and comprehensive industry-specific scoring system, particularly adapted to

Chinese market contexts. Building on prior methodology (Wang et al., 2023), this study measures ESG Performance using Bloomberg's database, which assigns standardized scores from 0.1 to 100, higher values reflect stronger ESG commitment.

Independent variable

Corporate Sustainability Transition Policy (CSTP). Given this study's focus on the relationship between CSTP and ESG performance, it is critical to capture how policy intensity influences firms' strategic responses (Zhang et al., 2023). Accordingly, we adopt industrial pollution control investment intensity as the core proxy for CSTP intensity. This metric is calculated as the ratio of completed investment in industrial pollution control to industrial added value. This approach aligns with empirical precedents (Fan et al., 2021) and reflects the financial commitment of regulatory bodies to incentivize corporate sustainable transition, a key mechanism through which CSTP shapes green innovation and alleviates financing constraints. All CSTP data are sourced from the China Statistical Information Network (official portal of the National Bureau of Statistics of China), ensuring methodological rigor and institutional authority.

Mediating variables

Green Innovation (GI). This study employs the number of corporate green patent applications to measure Green Innovation. Revisiting methodologies established in prior literature (Han et al., 2024), we aggregate enterprise-level applications for green invention patents and green utility model patents. The total count of green patent applications is then logarithmically transformed ($\log(\text{total} + 1)$) to construct the proxy variable for Green Innovation within the context of CSTP. Data are sourced from the China Research Data Service Platform (CNRDS) (Hu et al., 2021), a premier open-access repository for economic, financial, and business research data in China.

Financing Constraints (FC). Currently, the WW index, KZ index, and SA index are extensively utilized to assess the extent of Financing Constraints both domestically and internationally (He et al., 2024). Among them, the WW index is mainly constructed based on multiple financial indicators of enterprises, reflecting the overall financing situation of enterprises from multiple dimensions. The KZ index focuses more on the cash flow situation of enterprises, considering the impact of cash flow on financing constraints. The SA index, on the other hand, takes into account factors such as enterprise size and age to evaluate financing constraints, providing a relatively comprehensive perspective. These three indices, each with its own emphasis, jointly provide important references for measuring the degree of financing constraints faced by enterprises in the process of corporate sustainability transition. The WW index primarily takes into account the capital market financing options available to a company. In contrast, the KZ index assesses whether a company is subject to Financing Constraints by examining the correlation between its investment activities and capital structure (Lu et al., 2022). The SA index concentrates on scrutinizing the extent of internal information asymmetry within a company. Such asymmetry can elevate the expenses associated with external financing, potentially constraining firms' ability to secure funds, particularly in the context of pursuing objectives related to CSTP (Feng et al., 2023). Hence, the SA index is utilized in this study to assess corporate Financing Constraints. For the purposes of this study, the information on Financing Constraints is derived from the CSMAR Enterprise database.

Control variables

To conduct a comprehensive evaluation of the influence exerted by independent variables, it is essential that control variables exert a consistent impact on the dependent variable. Referring to extant research (Mu et al., 2023), the control variables are sourced from the CSMAR database. These variables include firm scale, asset - liability ratio, return on total assets, cash flow ratio, growth rate of operating revenue, shareholding ratio of the largest shareholder, whether the enterprise is state - owned, and enterprise age. The information presented encompasses the variable type, designation, symbol, and measurement, as delineated in *Table 1*.

Table 1. Alignment of variables

Variables type	Variables name	Variables symbol	Variables measurement	Units
Dependent variable	ESG Performance	ESG	ESG scores published by Bloomberg database (Yu et al., 2019)	-
Independent Variables	Corporate Sustainability Transition Policy	CSTP	Amount of investment completed in industrial pollution control / Industrial added value (Zhang et al., 2020)	-
Mediating Variables	Green Innovation	GI	ln (Green patent applications +1) (Li, 2023)	-
	Financing Constraints	FC	SA Index (Bai et al., 2022)	Index
Control Variables	Firm size	Size	ln (Annual total assets) (Bai et al., 2022)	Value
	Asset-liability ratio	Lev	Total liabilities at the end of year / Total assets at the end of the year (Chen, 2022)	Ratio
	Return on total assets	ROA	Total corporate profits / Average total corporate assets (Guo et al., 2023)	Ratio
	Cash flow ratio	Cash Flow	Net cash flow from operating activities / Operating income (Song et al., 2022)	Ratio
	Growth rate of operating income	Growth	The current year's operating income / The previous year's operating income - 1 (Feng et al., 2022)	Ratio
	Shareholding ratio of the largest shareholder	Top1	The number of shares held by the largest shareholder / The total number of shares (Feng et al., 2022)	Ratio
	State-owned enterprise or not	SOE	1 for state-owned holding enterprises and 0 for others (Zhang et al., 2020)	0 or 1
	Enterprise Age	Age	ln (The year of the current year - The year of establishment of the company + 1) (Fan et al., 2021)	-

Research models

After conducting the Hausman and F tests to address endogeneity arising from individual and time effects, this study employs a fixed effects model for robust regression analysis. We estimate the following recursive equations to examine (1) the direct relationship between CSTP and ESG Performance, and (2) the mediating roles of Green Innovation and Financing Constraints.

The following *Eq.1* is developed to test the relationship between CSTP and ESG Performance, which means to test H1:

$$ESG_{it} = \beta_1 + \beta_2 CSTP_{it} + \sum \beta_n Control_{it} + \mu_i + \nu_t + \mu_{it} \quad (Eq.1)$$

The following *Eq.2* is developed to the mediating effect of Green Innovation and Financing Constraints on the relationship between CSTP and ESG Performance, which means to test H2 and H3:

$$ESG_{it} = \beta_1 + \beta_2 CSTP_{it} + \beta_3 M_{it} + \sum \beta_n Control_{it} + \mu_i + \nu_t + \mu_{it} \quad (Eq.2)$$

In these models, *i* is the enterprise; *t* is the year; ESG_{it} is the ESG Performance of enterprise *i* in year *t*; M_{it} is the Green Innovation of enterprise *i* in year or the Financing Constraints of enterprise *i* in year *t*; $CSTP_{it}$ is the CSTP of enterprise *i* in year *t*; $Control_{it}$ is the relevant control variables of enterprise *i* in year *t*; μ_i is the individual fixed effect, and ν_t is the time fixed effect; u_{it} is the residual term.

Data source

By reviewing the annual reports of enterprises, we have found that the information disclosure related to our core research variables (CSTP, ESG, GI, FC) currently covers the majority of listed companies on the main board of China's A-share market. Moreover, since 2010, the above-mentioned variable data we have used have begun to be widely applied, laying A data foundation for our subsequent empirical analysis based on the samples of A-share main board listed enterprises from 2011 to 2020. Based on the availability of data and our research objectives, we selected the listed companies on the main board of China's A-share market from 2011 to 2020 as the research samples, and ultimately obtained 9,831 enterprise-annual observations.

All the data required for our empirical analysis are sourced from four core data platforms, with the specific correspondences as follows: the data of the independent variable CSTP is from the China Statistical Information Network (the official platform of the National Bureau of Statistics); the data of the dependent variable ESG is from the Bloomberg database; the data of the mediating variable (GI) is from CNRDS; the data of the mediating variable (FC) and control variables are from the CSMAR database. The authority and data quality of the above-mentioned data platforms provide a guarantee for the reliability of our research conclusions.

As the data source for the independent variable CSTP, we select the Industrial Pollution Control Investment Completed Amount and Industrial Added Value indicators from this platform to calculate the Industrial Pollution Control Investment Intensity as a proxy for CSTP intensity. This indicator directly reflects the financial input intensity of the regulatory authorities in promoting the sustainable transformation of enterprises. Its official nature ensures the policy authenticity of CSTP measurement and avoids the subjective bias of self-reported data from micro enterprises. As the data source for the dependent variable ESG performance, we choose the standardized ESG score from Bloomberg. Compared with other rating agencies (such as MSCI and FTSE Russell), Bloomberg's ESG score has a higher coverage of China's A-share main board enterprises (over 90% coverage since 2011), and its industry-specific scoring logic is

highly consistent with China's dual carbon policy and environmental protection regulations.

We extract the annual total application volume of Green patent applications of enterprises through CNRDS, and construct the GI index after logarithmic processing ($\log(\text{total volume} + 1)$). The green patent data of this platform covers our full sample period from 2011 to 2020, ensuring the authenticity of the GI transmission path in the mediation effect test. We calculate the SA index based on the enterprise financial data (such as enterprise scale, age, and debt-to-asset ratio) of CSMAR. This index can more objectively reflect the external financing friction of enterprises as it does not rely on the self-reported financing demand data of enterprises. Our control variables such as enterprise scale (Size), debt-to-asset ratio (Lev), return on total assets (ROA), and the shareholding ratio of the largest shareholder (Top1) are directly extracted from the financial indicators database of listed companies and corporate governance database of CSMAR. The microscopic accuracy of the data ensures the effectiveness of excluding the interference of confounding variables in the regression model.

Results

Descriptive statistics

The average ESG level in China currently exceeds the mean, indicating a tendency towards the upper-middle range based on the descriptive statistics presented in *Figure 2* and *Table 2*. Furthermore, the significant disparity observed among companies' ESG levels suggests that numerous firms possess untapped potential for future enhancement.

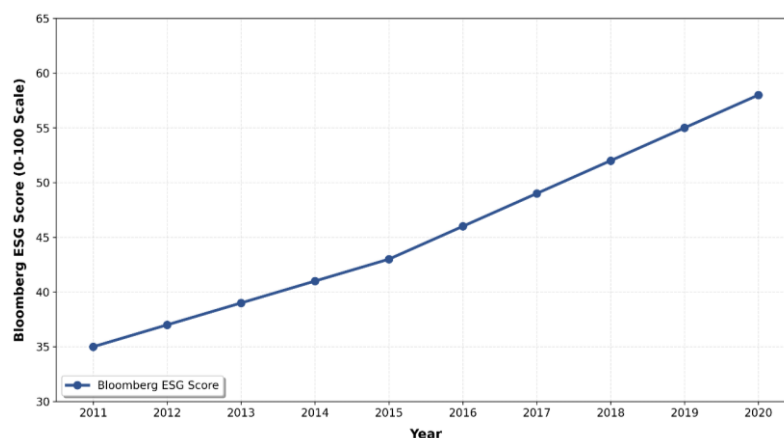


Figure 2. China's corporate Bloomberg Score ESG score trend

Basic results

The hypothesis is further validated to verify the robustness of findings. As shown in Column (1) of *Table 3*, all estimated coefficients for CSTP exhibit positive values with statistical significance exceeding the 1% level. This confirms that CSTP acts as a significant catalyst for firms' ESG performance in the current period, thereby supporting Hypothesis 1. The statistically significant F-statistic indicates strong overall model validity, while an R-squared value above 0.7 demonstrates exceptional model fit and substantive explanatory power.

Table 2. Descriptive statistics

Variables	Obs	Mean	SD	Min	Median	Max
ESG	9831	20.702	7.010	1.240	19.835	64.115
CSTP	9831	0.002	0.002	0.000	0.002	0.025
GI	9831	0.406	0.866	0.000	0.000	6.701
FC	9831	3.779	0.282	2.113	3.797	4.710
Size	9831	23.099	1.303	19.552	22.992	26.398
Lev	9831	0.476	0.201	0.031	0.487	0.925
ROA	9831	0.046	0.062	-0.398	0.039	0.244
Cash Flow	9831	0.056	0.069	-0.200	0.054	0.257
Growth	9831	0.161	0.416	-0.660	0.100	4.330
Top1	9831	0.369	0.160	0.083	0.355	0.758
SOE	9831	0.500	0.500	0.000	1.000	1.000
Age	9831	2.897	0.339	1.386	2.944	3.555

Table 3. Regression results

Variables	(1)	(2)	2SLS results
	ESG	Policy	ESG
L.CSTP		0.223*** (7.39)	
CSTP	117.434*** (3.74)		486.796*** (3.23)
Size	1.265*** (10.34)	0.000*** (4.32)	1.189*** (8.96)
Lev	-1.448*** (-2.98)	0.001*** (2.61)	-1.706*** (-3.20)
ROA	2.432*** (2.89)	-0.000 (-0.04)	1.960** (2.04)
Cash Flow	-0.169 (-0.24)	-0.000 (-0.33)	0.194 (0.25)
Growth	-0.173** (-2.01)	-0.000 (-0.32)	-0.094 (-0.91)
Top1	2.038*** (2.97)	-0.000 (-0.45)	3.018*** (3.95)
SOE	0.262 (0.82)	0.000 (0.50)	0.118 (0.37)
Age	0.319 (0.39)	-0.000 (-0.53)	0.643 (0.80)
Constant	-9.949*** (-2.77)	-0.003** (-2.52)	
Under identification test			415.380***
Weak identification test			379.297***
Observations	9,826	8,642	8,642
company	YES	YES	YES
year	YES	YES	YES
F	18.69	10.59	16.15

Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Endogeneity analysis

This paper employs the instrumental variable method (IV) to address endogeneity concerns. We introduce a relevant instrumental variable to measure the independent variable and utilize two-stage least squares (2SLS) estimation. Specifically, the first-order lag of the endogenous variable is adopted as the instrumental variable. This choice satisfies two critical conditions. One is the lagged term exhibits serial correlation with the current variable, fulfilling the relevance requirement. The other one is lagged variable affects the dependent variable solely through the current endogenous variable, with no direct correlation to the contemporaneous disturbance term, thereby meeting the exclusion restriction. Using the first-order lag of the endogenous variable effectively mitigates endogeneity issues. Results in *Table 3* validate the rationality of this approach: First-stage regression (Column 2) shows a statistically significant positive coefficient (0.223, $p < 0.01$) between the instrumental variable (L. CSTP) and CSTP. Second-stage 2SLS regression reveals a significantly positive coefficient (486.796, $p < 0.01$) for CSTP on ESG Performance. This coefficient is substantially larger than the baseline estimates without instrumental variables (Column 1: 117.434). This robust evidence confirms that CSTP maintains a statistically valid positive effect on ESG Performance after accounting for endogeneity.

Robustness analysis

Shorten the sample time

Given the significant impact of the COVID-19 pandemic on China's economic development in 2020, conducting regression analysis using all years might introduce estimation bias. Therefore, we excluded data from 2020 and retained other years' data for regression analysis. The specific regression results are detailed in *Table 4(1)*. It can be observed that even after excluding 2020 data, the regression coefficients remain positive and statistically significant at the 1% level.

Eliminate outliers

Since outliers in the regression sample could introduce bias into the estimation results—particularly as Beijing, Tianjin, Shanghai, and Chongqing implemented data asset policies earlier which might affect regression outcomes—we excluded these cities from our analysis. The specific regression results are detailed in *Table 4(2)*. Notably, even after removing outliers, the regression coefficients remained significantly positive at the 5% significance level.

Winsorization at 1% and 99%

Outliers in the regression sample may introduce bias into the results. To address this, we applied a 1% and 99% percentile trimming to all variables (excluding explanatory variables) in the benchmark regression. This involved replacing values exceeding the highest percentile or below the lowest percentile with appropriate substitutes before conducting regression analysis. Detailed results are presented in *Table 4(3)*. The retained regression results remain statistically significant, confirming that outlier removal does not alter our conclusions.

Table 4. Robust tests

Variables	(1)	(2)	(3)	(4)
	ESG	ESG	ESG	ESG
CSTP	122.065*** (3.80)	69.592** (2.15)	141.558*** (3.71)	104.184*** (3.35)
Size	1.042*** (8.36)	0.906*** (5.81)	1.045*** (8.38)	0.949*** (7.39)
Lev	-1.129** (-2.19)	-1.121** (-2.11)	-1.133** (-2.19)	-0.161 (-0.31)
ROA	3.174*** (3.37)	0.028 (0.03)	3.136*** (3.33)	4.068*** (4.07)
Cashflow	-0.468 (-0.65)	0.236 (0.29)	-0.456 (-0.64)	0.000 (0.00)
Growth	-0.181** (-2.12)	-0.255*** (-2.65)	-0.181** (-2.12)	-0.192** (-2.25)
Top1	1.883*** (2.72)	2.819*** (2.99)	1.891*** (2.74)	3.097*** (4.45)
SOE	0.588* (1.88)	0.246 (0.76)	0.588* (1.88)	0.288 (0.87)
FirmAge	-0.238 (-0.27)	-0.716 (-0.66)	-0.238 (-0.27)	0.381 (0.46)
Constant	-3.764 (-1.02)	-0.183 (-0.04)	-3.855 (-1.04)	-3.441 (-0.94)
Observations	8,751	4,850	8,751	
R-squared	0.790	0.768	0.790	8,642
company	YES	YES	YES	0.811
year	YES	YES	YES	YES
F	14.60	5.878	14.48	YES

Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Lagged independent variable

In order to examine the potential time delay of CSTP on ESG Performance, this study applies first-order lag processing to CSTP. Following regression analysis, the findings are presented in *Table 4*. In Column (4), it examines the first-order lag treatment of CSTP. The results indicate a significant positive association between CSTP and ESG Performance at a significance level of 1%. The robustness test results reported in *Table 4* confirm the reliability of the benchmark regression outcomes mentioned earlier.

Heterogeneity analysis

Property rights heterogeneity analysis

The relationship between state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs) in China, along with their institutional interactions, manifests distinct governance dynamics. Consequently, property rights structure significantly moderates how CSTP drives ESG performance. To empirically test this heterogeneity,

we partition the sample into SOE and non-SOE cohorts. *Table 5* reports regression results on the policy's efficacy across both groups. Columns (1) and (2) present estimates for SOEs and non-SOEs, respectively, using ESG performance as the dependent variable. The independent variable (CSTP) exhibits a significantly positive coefficient, indicating that CSTP acts as a critical catalyst for ESG enhancement in state-owned entities.

Table 5. *Property rights heterogeneity test*

Variables	(1) SOEs	(2) non-SOEs
	ESG	ESG
CSTP	133.248***	78.241
	(3.25)	(1.56)
Size	0.994***	1.697***
	(5.06)	(9.80)
Lev	-0.163	-1.936***
	(-0.20)	(-3.04)
ROA	3.538**	0.835
	(2.20)	(0.84)
Cash Flow	-0.035	0.275
	(-0.03)	(0.29)
Growth	-0.154	-0.212*
	(-1.11)	(-1.88)
Top1	-1.857*	5.153***
	(-1.93)	(4.80)
Age	2.309	-0.150
	(1.53)	(-0.15)
Constant	-7.531	-19.807***
	(-1.21)	(-4.04)
Observations	4,902	4,902
R-squared	0.785	0.780
company	YES	YES
year	YES	YES
F	6.846	15.73

Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Scale heterogeneity analysis

In order to examine the heterogeneous impact of CSTP on ESG Performance of enterprises with different sizes, this study employs the median enterprise size as a threshold and divides them into two categories: large-scale enterprises and small and medium-sale enterprises. Separate regression analyses are conducted for each category. In *Table 6*, Column (1) presents the regression results indicating the impact of CSTP on ESG Performance for large-scale enterprises, while Column (2) displays the regression results for small and medium-sized enterprises. The findings reveal that in the group of large-scale enterprises, all estimated coefficients of the independent variable (Policy) exhibit positive signs and pass significance tests at a level higher than 5%. In samples comprising small and medium-scale enterprises, there is a significant positive

coefficient observed for the independent variable (CSTP) at a 1% significance level, suggesting an even more pronounced incentive effect.

Table 6. Scale heterogeneity test

Variables	(1) Large-scale enterprises	(2) Small and medium-sale enterprises
	ESG	ESG
CSTP	133.311** (2.43)	87.299*** (2.79)
Size	1.101*** (5.72)	1.263*** (8.26)
Lev	0.246 (0.25)	-1.167** (-2.17)
ROA	6.052*** (3.11)	-0.234 (-0.27)
Cash Flow	-1.850 (-1.62)	0.900 (1.11)
Growth	-0.044 (-0.31)	-0.268** (-2.57)
Top1	0.630 (0.64)	3.844*** (4.28)
SOE	-0.003 (-0.00)	0.524 (1.49)
Age	2.768** (2.13)	-0.677 (-0.66)
Constant	-12.724** (-2.22)	-8.457* (-1.88)
Observations	4,907	4,919
R-squared	0.792	0.734
company	YES	YES
year	YES	YES
F	7.376	11.14

Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Results for mediating effects

Green innovation

This study examines the mediating effect of Green Innovation (GI). We establish the correlation between the independent variable, CSTP, and the dependent variable, ESG Performance. The basic results (*Table 3(1)*) confirm a statistically significant positive correlation between CSTP and ESG at the 1% level. We test the relationship between CSTP and the mediating variable GI. Column (1) of *Table 7* indicates a significant positive association (1% level), satisfying the prerequisite for mediation. We assess the linkage between the mediator (GI) and ESG Performance. Column (2) of *Table 7* demonstrates that GI positively affects ESG at the 1% significance level. We reintroduce the mediator (GI) into the baseline model. Column (3) of *Table 7* shows that: GI remains significantly positive (1% level) with ESG. This confirms the presence of a mediating effect through Green Innovation, thereby supporting Hypothesis 2.

Table 7. Models results of Mediator GI

Variables	GI	(2)	(3)
		ESG	ESG
GI		0.367*** (7.75)	0.365*** (7.74)
CSTP	3.628*** (2.68)		116.584*** (9.21)
Size	0.061*** (7.70)	1.270*** (8.18)	1.248*** (8.03)
Lev	-0.192*** (-7.28)	-1.356*** (-5.38)	-1.399*** (-5.48)
ROA	-0.190*** (-3.58)	2.438*** (4.54)	2.475*** (4.49)
Cashflow	-0.098*** (-4.09)	-0.107 (-0.25)	-0.127 (-0.30)
Growth	-0.025*** (-3.77)	-0.168*** (-2.73)	-0.165*** (-2.68)
Top1	-0.247*** (-7.78)	2.121*** (7.34)	2.130*** (7.15)
SOE	-0.016 (-0.82)	0.270* (1.79)	0.267* (1.72)
FirmAge	0.284*** (19.23)	0.327 (1.23)	0.333 (1.25)
Constant	-1.625*** (-8.35)	-7.928* (-1.81)	-7.538* (-1.73)
Observations	9,831	9,831	9,831
R-squared	0.0353	0.277	0.278
Number of groups	1,123	1,123	1,123
company	YES	YES	YES
year	YES	YES	YES

Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Financing constraints

The mediating effect of Financing Constraints (FC) is examined in this research. A significant positive correlation between Corporate Sustainability Transition Policy (CSTP) and ESG performance is established at the 1% significance level (*Table 3(1)*). Column (1) of *Table 8* reveals a statistically significant negative association between CSTP and FC ($p<0.01$), indicating that stricter CSTP alleviates corporate financing constraints. Column (2) of *Table 8* demonstrates a significant negative relationship between FC and ESG ($p<0.01$), implying that reduced financing barriers enhance ESG performance. After introducing FC into the baseline model, Column (3) of *Table 8* shows that the mediator FC remains significantly negatively correlated with ESG ($p<0.01$). This confirms FC's mediating role, thereby supporting Hypothesis 3.

Table 8. Models results of Mediator FC

Variables	(1)	(2)	(3)
	FC	ESG	ESG
CSTP	-4.493*** (-5.82)		109.274*** (9.61)
FC		-9.042*** (-6.14)	-8.997*** (-5.99)
Size	-0.024*** (-2.82)	0.826*** (13.10)	0.808*** (12.75)
Lev	-0.063*** (-6.17)	-1.179*** (-6.13)	-1.220*** (-6.19)
ROA	-0.087*** (-3.28)	2.394*** (4.14)	2.430*** (4.12)
Cashflow	-0.005 (-0.85)	-0.378 (-0.91)	-0.396 (-0.96)
Growth	0.003* (1.89)	-0.137** (-2.27)	-0.134** (-2.21)
Top1	0.003 (0.32)	2.064*** (6.33)	2.073*** (6.20)
SOE	0.018*** (6.55)	0.451*** (3.34)	0.447*** (3.22)
FirmAge	0.529*** (22.11)	0.994*** (2.76)	0.996*** (2.74)
Constant	2.828*** (22.36)	35.832*** (7.18)	35.979*** (7.00)
Observations	9,831	9,831	9,831
R-squared	0.677	0.290	0.290
Number of groups	1,123	1,123	1,123
company	YES	YES	YES
year	YES	YES	YES

Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Discussion

CSTP emerges as a multidimensional policy framework that systematically drives firms' ESG performance by integrating environmental, social, and governance objectives. Unlike narrow environmental regulations, CSTP adopts a holistic approach, compelling organizations to align strategic transition with long-term sustainability targets, thereby enhancing ESG integration. Empirically, CSTP's emphasis on structural transformation, such as resource reallocation toward green innovation, stakeholder engagement, and governance upgrading, directly correlates with improved ESG metrics. For instance, mandatory sustainability reporting under CSTP strengthens transparency (governance), while incentives for carbon reduction boost environmental performance. Notably, CSTP mitigates trade-offs between short-term profitability and ESG investments by framing sustainability as a value-creation driver, fostering organizational resilience. However, contextual factors like industry specificity and policy stringency may moderate this relationship, warranting further cross-sectoral

analysis. Overall, CSTP advances the ESG agenda by operationalizing sustainability as a strategic imperative rather than compliance, offering policymakers a robust tool to accelerate corporate transition toward sustainable development.

The baseline regression results in Column (1) of *Table 3* not only statistically confirm the positive correlation between CSTP and corporate ESG performance but also reveal the deep-seated logic of how macro-policy drives micro-enterprise sustainability behavior. This section systematically interprets the economic and institutional mechanisms behind the results, connects them with the theoretical framework of this study, and compares them with existing literature to highlight the academic and practical value of the findings.

First, the estimated coefficient of CSTP is positive and statistically significant at the 1% level (coefficient = 117.434, t-statistic = 3.74). This means that for every 1-unit increase in the intensity of CSTP (measured by the ratio of industrial pollution control investment to industrial added value), corporate ESG performance (Bloomberg standardized score) will significantly improve by 117.434 units. This marginal effect is economically meaningful: unlike micro-factors (board gender diversity, firm size) that often have weak marginal impacts on ESG (Clément et al., 2022), CSTP, as a macro-policy tool, exerts a strong systemic driving force—it directly reshapes the cost-benefit structure of corporate sustainability behavior through institutional design (pollution control investment incentives, compliance supervision), thereby avoiding the free-rider problem of individual enterprises in ESG practice.

Second, the statistically significant F-statistic ($F = 18.69$) and R-squared exceeding 0.7 ($R^2 > 0.7$) further validate the reliability and explanatory depth of the model. The significant F-statistic indicates that the joint effect of CSTP and control variables (firm size, asset-liability ratio, ownership structure) on ESG performance is not random, and the model has strong overall validity. The high R-squared (over 70%) is particularly noteworthy: it means that CSTP, together with enterprise micro-characteristics, can explain more than 70% of the variation in corporate ESG performance. This is far higher than the explanatory power of single micro-factors (institutional ownership typically explains less than 10% of ESG variation (Jia et al., 2022)), highlighting that macro-policy is a core driver of ESG performance—its role is not supplementary but dominant, filling the gap in existing literature that overemphasizes micro-determinants while ignoring macro-policy effects (Chen et al., 2022).

Combined with the theoretical framework of this study (Stakeholder Theory, Theory of Economic Externalities, Signalling Theory) and the characteristics of China's institutional context, the positive impact of CSTP on ESG performance can be attributed to three mutually reinforcing mechanisms:

Stakeholder Theory emphasizes that enterprises must balance the demands of governments, investors, communities, and other stakeholders to achieve sustainable development (Kumar, 2023). CSTP, as a policy tool initiated by the government (a pivotal stakeholder), effectively coordinates the conflicting interests between enterprises' short-term profit goals and stakeholders' long-term sustainability demands.

Specifically, on the one hand, CSTP imposes mandatory or incentive constraints on enterprises: for example, the policy's core proxy variable (industrial pollution control investment intensity) reflects the government's regulatory intensity—higher investment intensity means stricter supervision of enterprise pollution emissions, forcing enterprises to improve environmental performance (reducing wastewater/air pollutant emissions), which directly boosts the E (environmental) dimension of ESG. On the

other hand, CSTP guides other stakeholders to form a synergistic supervision network: when the government increases pollution control investment, investors will further increase their demand for ESG information disclosure (Fan et al., 2021), communities will pay more attention to enterprises' social responsibility fulfillment (employee safety, public welfare), and these demands will jointly push enterprises to optimize the S (social) and G (governance) dimensions of ESG.

He et al. (2006) also confirmed that government-led sustainability policies can internalize multi-stakeholder demands into corporate strategic decisions. The positive coefficient of CSTP in *Table 3* Column (1) precisely verifies this logic: CSTP acts as a bridge between the government and other stakeholders, making enterprises' ESG practices no longer a voluntary moral choice but a strategic necessity to respond to collective stakeholder demands.

The Theory of Economic Externalities points out that green innovation and environmental protection investments by enterprises have positive externalities (improving air quality, promoting resource recycling) but often face high private costs, leading to underinvestment in the market (Cai et al., 2023). CSTP solves this market failure by internalizing external benefits into enterprise profits, thereby motivating enterprises to invest in ESG-related activities.

Taking the proxy variable of CSTP (industrial pollution control investment intensity) as an example: higher investment intensity means the government provides more supporting measures (subsidies for pollution control equipment, tax reductions for green technologies) to reduce the private cost of enterprise environmental protection. For instance, Liu and Lyu (2022) found that China's environmental regulation policies can reduce the RandD cost of enterprise green technologies by 15–20%. When enterprises' green investment costs decrease, they are more willing to expand ESG-related inputs: in the environmental dimension, they may increase investment in renewable energy; in the governance dimension, they may establish specialized ESG management departments; in the social dimension, they may improve employee welfare (purchasing occupational injury insurance). These behaviors collectively drive the improvement of ESG performance.

This study confirms that CSTP enhances firms' ESG performance through GI, validating our mediation hypothesis. Different from narrow environmental regulations, CSTP provides a comprehensive policy framework that stimulates enterprises to prioritize GI as a strategic response to sustainability transition requirements, rather than mere compliance. This policy-driven GI not only directly improves environmental performance but also signals firms' commitment to sustainability, indirectly boosting social reputation and governance quality, key components of enhanced ESG scores. These findings advance understanding of how policy interventions drive sustainable corporate behavior by highlighting GI's critical bridging role between macro-level CSTP and micro-level ESG outcomes.

Signalling Theory holds that in information-asymmetric markets, enterprises can convey their sustainable development capabilities to external investors through observable signals (Yang and Han, 2023). CSTP, as a government-endorsed policy, helps enterprises send high-credibility sustainability signals, thereby alleviating financing constraints and providing financial support for ESG improvement.

Specifically, when enterprises comply with CSTP (increasing pollution control investment, participating in green transformation projects), they are essentially sending a signal to the market: The enterprise has obtained government recognition for its

sustainability capabilities and has lower regulatory and environmental risks. This signal can effectively reduce information asymmetry between enterprises and investors: on the one hand, ESG-focused investors (green funds) are more willing to invest in such enterprises, increasing their financing channels; on the other hand, financial institutions (banks) will reduce risk premiums for such enterprises, lowering their financing costs (Feng et al., 2023). With more financial resources, enterprises can further invest in ESG-related projects (developing green products, improving corporate governance systems), forming an improvement positive cycle.

The subsequent regression analysis results (*Table 8*) confirm the mediating effect of financing constraints: the policy's impact on ESG is not only direct (through supervision and incentives) but also indirect (through signal transmission and resource acquisition), and the high R-squared of the model also reflects the comprehensiveness of this multi-channel impact.

This study establishes FC as a significant mediator in the relationship between CSTP and ESG performance. CSTP alleviates FC primarily through signaling effects, proactive sustainability strategies signal long-term viability to investors, reducing information asymmetry and improving capital access. Mitigated FC then provides financial resources for ESG investments in green technologies, social programs, and governance improvements. This mechanism highlights CSTP's role in easing financial frictions that impede ESG advancement, emphasizing policy-driven financial flexibility as a critical enabler for corporate sustainability.

The results effectively fill the gaps in existing ESG research and form three key contrasts with previous studies:

First, compared with studies focusing on micro-factors (board size, CEO duality) (Zahid et al., 2023), this study confirms that macro-policy (CSTP) has a more significant and systematic impact on ESG performance. The marginal effect of CSTP (coefficient = 117.434) is far higher than that of micro-factors (the marginal effect of board gender diversity on ESG is usually less than 5), which indicates that improving ESG performance cannot rely solely on enterprise internal governance optimization but need rely on government-led macro-policy guidance. This finding expands the research scope of ESG drivers from micro-level to macro-micro integration.

Second, compared with studies on narrow environmental regulations, such as carbon emission trading policy (Cai et al., 2023), CSTP, as a holistic sustainability transition policy, covers the three dimensions of ESG (environmental, social, governance) rather than focusing only on environmental performance. The positive coefficient of CSTP in *Table 3* Column (1) reflects the policy's comprehensive driving effect—it not only promotes enterprises to reduce pollution (E dimension) but also guides them to optimize social responsibility and governance systems (S and G dimensions). This is different from narrow environmental regulations that often only improve the E dimension, highlighting the advantage of CSTP in promoting balanced ESG development.

Third, compared with studies ignoring policy intensity measurement (using dummy variables to measure policy implementation) (Wang et al., 2023), this study uses industrial pollution control investment intensity as a proxy for CSTP intensity, which can more accurately reflect the degree of policy impact. The significant positive coefficient of this continuous variable in *Table 3* Column (1) shows that the impact of CSTP on ESG is dose-dependent—the stronger the policy intensity (higher pollution control investment), the better the enterprise ESG performance. This provides a more precise empirical basis for policy makers to adjust policy intensity.

Conclusion

This study employs a sample of China's *A-share* main board listed companies from 2011 to 2020 to empirically investigate the relationship between CSTP and corporate ESG Performance. It advances Stakeholder Theory by examining the influence of government, conceptualized as a key stakeholder, on corporate ESG practices through the implementation of CSTP. Specifically, the research analyzes the association between CSTP and ESG Performance. The results demonstrate a significant positive correlation between CSTP and ESG Performance, thereby contributing to a deeper understanding of the factors impacting corporate ESG Performance. Findings derived from baseline regression analyses, endogeneity assessments, and robustness checks consistently confirm a significant positive causal effect of CSTP on corporate ESG Performance. Furthermore, this study explores the underlying mechanisms through which CSTP influences corporate ESG Performance, examining heterogeneity in this relationship. The analysis reveals that the enhancement effect of CSTP on ESG Performance is more pronounced for state-owned enterprises and small and medium-scale enterprises.

Contributions

Theoretical contributions

While extant literature predominantly examines micro-level determinants of corporate ESG performance (Zahid et al., 2023), macro-level analyses of government-corporate ESG linkages remain scarce. This study extends stakeholder theory by conceptualizing governments as pivotal stakeholders enacting CSTP. We integrate governmental CSTP and corporate ESG within a unified framework, adopting a state-perspective lens. By investigating CSTP's impact on ESG through mediating pathways, we elucidate its external regulatory effects and internal firm-level mechanisms, advancing novel theoretical insights into ESG governance. The existing literature primarily focuses on examining the economic implications of ESG Performance on firms (Zahid et al., 2022); however, there is a relative dearth of empirical research involving academics on strategies to further enhance the ESG Performance of firms. By considering the mediating role of Green Innovation and Financing Constraints in the relationship between CSTP and ESG Performance, this study enhances the understanding of the determinants of corporate ESG Performance and further expands upon Stakeholder Theory.

Practical contribution

This research provides valuable guidance for the government to develop scientifically-based financial tools for environmental protection, which facilitates the implementation of the development concept encompassing innovation, coordination, green practices, openness, and shared growth. It also aligns with the fundamental policies of promoting innovation-driven and environmentally-friendly development. As a direct stakeholder in environmental protection, the government assumes a crucial role in safeguarding ecological environments and natural resources. Therefore, it plays an important part in mobilizing enterprises' commitment to enhancing their ESG performance by transitioning from mere supervision to encouragement and continuous improvement efforts. The government provides policy support to enterprises in order to guide and supervise them in effectively implementing the strategic task of green

manufacturing development in their daily production activities. This includes conducting environmental improvements or eliminating relevant processes and equipment, comprehensively promoting the transformation and upgrading of heavily polluting industries, reducing the cost of enterprise's green transformation, improving accessibility and convenience for financing, alleviating financing constraints, and achieving sustainable development of a green economy. The aforementioned action contributes to the mitigation of ecological damage and pollution, the enhancement of corporate ESG Performance, and the promotion of social sustainable development.

This research offers methodologies for companies to enhance their ESG Performance and implement the concept of sustainable development. Green innovation serves as a pivotal driving force behind sustainable development, which is intricately linked with national interests and indispensable for the survival of enterprises themselves. Enterprises can harness the influence of governmental support to enhance their ESG Performance, foster better development, and bolster competitiveness through the adoption of Green Innovation strategies. When faced with Financing Constraints, enterprises can effectively utilize the government's policy support based on their actual circumstances. They can enhance management capabilities, establish an internal research and development system, and improve various conditions to fully leverage the incentive benefits of government regulations. Furthermore, they can strive to adopt a governance model that promotes Green Innovation and alleviates Financing Constraints. By increasing investment in green research and development, exploring innovative technologies in the fields of energy conservation and emission reduction, circular economy, and clean energy, diversifying financing channels, and reducing financing costs, this can enhance enterprises' ESG Performance and achieve sustainable development as well as the green transformation of businesses.

Limitations and future research directions

The article analyzes the relationship between CSTP and ESG Performance, mediated by the mediator variables of Green Innovation and Financing Constraints, based on theories such as Stakeholder Theory, Theory of Economic Externality, and Signalling Theory. However, due to objective factors and limitations in research level, there are areas that need improvement in the article.

Due to the continuous development and improvement of the ESG concept, there is currently no universally recognized definition or unified measurement standards for ESG. There are also many external rating agencies in society that study corporate ESG Performance, with rating methods mainly including grading systems and scoring systems. The selection of focus indicators and weight allocation by each rating agency when constructing an ESG evaluation system has a strong subjectivity, and the relevant scoring criteria may vary, as well as differences in calculation methods. Although this article selects the ESG scores from Bloomberg's database, which quantifies the degree using a percentage scale and has relatively complete data, there is still a possibility of sample data selection issues. In the future, it would be beneficial to further validate existing conclusions by using evaluations on corporate ESG Performance provided by more authoritative rating agencies.

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APPENDIX

Appendix 1. Different independent variables of ESG performance

Independent Variables	Theory	Relationship	Source
the growth of the internal control cost	Agency theory	positive	(Harasheh and Provasi, 2023)
	the compliance cost approach	positive	
Organisational Learning	sustainable development theory	positive	(Xia, 2022)
	economic externality theory	positive	
	corporate social responsibility theory (CSR)	positive	
the busy outside directors	Stakeholder theory	positive(support)	(Tijani and Ahmadi, 2022)
	agency theory	positive(support)	
	reputation theory	positive(support)	
	Commitment theory	positive(support)	
	board's theory	positive(support)	
	hyper-participation theory (negative)	not support	
	over-sharing theory (negative)	not support	
board size	resource dependence theory	positive (support)	(Menicucci and Paolucci, 2022)
	stakeholder theory	positive	(Husted and Sousa-Filho, 2019)
	Agency theory	positive	(Birindelli et al., 2018)
	legitimacy theory	positive	(Birindelli et al., 2019)
	Agency theory	negative	(Ellili, 2023)
	Agency theory	positive	(Suttipun, 2021)
a gender-balanced BoD	resource dependence theory	positive	(Menicucci and Paolucci, 2022)
board gender diversity	upper echelon theory	negative	(Eliwa et al., 2023)
	gender socialisation theory	negative	
	gender socialisation theory	negative	
board gender diversity	institutional theory	lower religiosity, more significant (negatively moderates)	
gender-balanced boards	critical mass theory	positive	(Birindelli et al., 2018)
	Kanter's theory	positive	(Birindelli et al., 2019)
Board of directors	agency theory	positive	(Lozano and Ferrero, 2022)
board gender diversity	Agency theory	positive	(Bhatia and Marwaha, 2022)
a critical mass of women on the board of directors	critical mass theory	non-linear correlation	(Menicucci and Paolucci, 2022)
The presence of women on the board	stakeholder theory	negative	(Husted and Sousa-Filho, 2019)
the proportion of female executives		positive	(Meng and Zhu, 2023)
board composition	Agency theory	positive	(Arayssi et al., 2020)

female board	Agency theory	positive	(Suttipun, 2021)
the critical mass of female board members	critical mass theory	positive	(De Masi et al., 2021)
board independence	Stakeholder theory	positive	(Menicucci and Paolucci, 2022)
Board of directors	agency theory	positive	(Lozano and Martínez-Ferrero, 2022)
Board independence, and board diversity	agency theory	positive	(Ellili, 2023)
board composition	Agency theory	positive	(Arayssi et al., 2020)
Board Factors	Agency theory	positive	(Bhatia and Marwaha, 2022)
CSR committees	stakeholder theory	positive	(Menicucci and Paolucci, 2022)
	stakeholder theory	positive	(Birindelli et al., 2018)
	stakeholder theory	positive	(Diez and Odriozola, 2019)
	stakeholder theory	positive	(Diez and Odriozola, 2019)
	agency theory	positive	(Lozano and Martínez-Ferrero, 2022)
	agency theory	positive	(Suttipun 2021)
board network centrality	stakeholder theory	positive	(Harjoto and Wang, 2020)
independent directors	agency theory	negative	(Birindelli et al., 2018)
	stakeholder theory	negative	
CEO duality	stakeholder theory	negative	(Husted and Filho, 2019)
The purchase of directors' and officers' insurance	stakeholder theory	positive	(Xu and Zhao, 2022)
	real options theory	negatively moderates	
	strategic management theory	negatively moderates	
enterprise digitization		positive	(Fang et al., 2023)
	agency cost	negatively moderates	
		positively moderates	
digital financial inclusion	signaling theory	positive	(Lu et al., 2022)
regional FinTech level	enterprise life cycle theory	positive	(Du et al., 2022)
		FinTech negative Constraints; Constraints	
		negative ESG	
Green Innovation	Agency Theory	positive	(Zheng et al., 2022)
		positive ESG	
		positive ESG	
green finance policy	ESG theory	positive	(Xingshuai Wang et al., 2022)
Green Financial Reform	stakeholder theory	positive	(Chen et al., 2022)
performance-based budgeting reform	budget-maximization theory, principal-agent theory	positive	(Wang and Hu, 2022)

opening of the capital market	resource dependence theory	positive	(Deng et al., 2022)
	information transfer theory		
	stakeholder theory		
enterprise's choice of intangible capital		positive	(Gao et al., 2022)
Developed credit and equity markets	institutional theory	positive	(Ortas et al., 2019)
Enhanced knowledge capital and coordination with labor	institutional theory	positive	(Ortas et al., 2019)
debt financing	Agency theory	positive	(Al Amosh et al., 2022)
	Pecking order theory		
	Trade-off theory		
green finance policy	ESG theory	positive	(Wang et al., 2022)
	green growth theory		
corporate financial performance	stakeholder theory, legal theory, institutional theory, agency theory	positive	(Hamdi et al., 2022)
digital financial inclusion	signaling theory	positive	(Lu et al., 2022)
	upper echelon theory		
Fossil Fuel Financing		positive	(Bernardelli et al., 2022)
corporate financial performance	legitimacy theory	positive	(Alam et al., 2022)
Mandatory non-financial reporting	legitimacy theory	positive	(Menkes and Kamiński, 2022)
Green Financial Reform	stakeholder theory	positive	(Chen et al., 2022)
Financial Materiality	institutional theory	positive	(Madison and Schiehl, 2021)
Profitability	institutional theory	positive	(Sharma et al., 2020)
	Agency Theory	positive	
Institutional ownership	Stakeholder theory	positive	(Jiang et al., 2022)
	prospect theory	negative	(Aluchna et al., 2022)
	Stakeholder theory	negative	
	agency theory	positive	(Ellili, 2023)
		positive	(Wang et al., 2023)
	agency theory	positive	(Jia et al., 2022)
	agency theory and stakeholder theory	positive	(Liu et al., 2022)
Audit		positive	(Giudice and Rigamonti, 2020)
an officials' accountability audit of natural resources (AANR)	principal-agent theory	negative	(Yan et al., 2023)
audit committee			
attributes	Legitimacy theory	positive	(Arif et al., 2020)
	Agency theory		
audit committee characteristics	Agency theory	positive	(Pozzoli et al., 2022)
carbon control policy risk	stakeholder theory	negative	(Shu and Tan, 2023)
	resource access theory		

economic policy uncertainty (EPU)	stakeholder theory	positive	(Yavaş, 2021)
economic policy uncertainty (EPU)	stakeholder theory	positively moderates	(Yavaş, 2022)