

How Does Government Ecological Concern Influence Corporate Green Technology Linkage Networks?

-- Empirical Evidence from A-Share Listed Companies

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Abstract

This study employs text analysis to construct a dataset reflecting the ecological concerns of local governments. Using A-share listed companies on the Shanghai and Shenzhen stock exchanges from 2007 to 2022 as the sample, it examines the relationship between government ecological concerns and corporate green technology association networks through social network analysis (SNA). Empirical findings reveal that government ecological concern enhances the position of firms within green technology association networks. Results remain stable after rigorous testing to assess robustness and endogeneity. Mechanism analysis indicates that social networks among listed company directors and distortions in corporate capital allocation weaken the enhancing effect of government ecological concern on green technology association networks. Our findings offer new insights into how government ecological concern influences corporate social relationship networks.

Keywords

Government Environmental Attention; Green IT; Government Annual Reports; Environmental Pollution.

1. Introduction

The long-standing contradiction between China's economic development and environmental degradation persists, with industries heavily reliant on coal to meet their energy demands. As of 2023, coal consumption accounted for 55.3% of China's total energy consumption, equivalent to 5.72 billion tons of standard coal. Carbon dioxide and air pollutants generated from coal combustion severely threaten the nation's ecological and environmental quality, causing immeasurable economic losses. Environmental pollution and resource scarcity have long remained inadequately addressed. Public concern for ecological and environmental issues has reached unprecedented levels, while enterprises face escalating environmental pressures (Dartey-Baah and Amoako 2021^[9]). Consequently, the importance of environmental regulation has become increasingly prominent in tackling these challenges. Concurrently, governments play a pivotal role in environmental regulation. Chinese government leaders have redirected significant attention toward ecological development and incorporated environmental governance performance into the promotion evaluation system for local officials. Current research on government ecological concern primarily focuses on: the critical role governments play in environmental governance (Bao and Liu 2022^[2]; Cheng et al. 2022^[7]); the shaping effect of government ecological concern on corporate green performance, the propelling effect of government ecological concern on regional green development, and the interactive relationship between public environmental concern and government ecological concern. Specifically, from

a macro perspective, some scholars argue that government ecological concerns drive the allocation and optimization of human, material, and financial resources related to policy implementation. This facilitates the enforcement and refinement of environmental regulations, energy governance measures, fiscal and monetary policies, and curbs corporate carbon emissions through multidimensional governmental decision-making. Consequently, it alleviates regional air pollution and significantly improves environmental quality (Cheng and Liu 2018^[8]). At the micro level, some scholars contend that governmental attention to ecological environments helps promote corporate sustainable development, heightens corporate awareness of environmental issues, incentivizes the adoption of environmentally friendly production methods and management strategies, and enhances environmental performance and value. This approach balances economic gains with social responsibilities. Furthermore, some studies indicate that governmental ecological attention can boost regional green innovation efficiency, effectively advancing sustainable development models characterized by low energy consumption and minimal environmental damage. This has become a crucial breakthrough for China in curbing environmental degradation and exploring green development pathways. Furthermore, attention from print newspapers and magazines, online and electronic media, and community residents can influence government ecological concerns, thereby indirectly affecting corporate environmental behavior.

Faced with increasingly comprehensive and stringent environmental regulations, as well as growing expectations from governments and the public regarding corporate fulfillment of environmental social responsibilities, businesses are actively engaging in green technology innovation and research and development activities. By improving product manufacturing processes and enhancing pollution control technologies, companies offset the additional costs imposed by government environmental regulations while simultaneously boosting revenue and elevating corporate reputation and goodwill. As a vital component of the public sector, governments serve as key drivers of corporate environmental practices, fundamentally influencing company behavior. Existing research on governmental ecological concerns' impact on businesses is substantial, with scholars primarily examining dimensions such as corporate ESG (Environmental, Social, and Governance) performance, carbon reduction initiatives, green technological innovation, and green investments. However, research examining how governmental ecological concerns influence corporate green technology networks from an inter-firm relational network perspective remains relatively scarce. This paper aims to fill this gap by employing Social Network Analysis (SNA) to measure corporate green technology networks and investigate the impact of governmental ecological concerns on these networks.

2. Literature Review and Hypothesis Development

2.1. Literature Review

The enterprise green technology network is a green patent citation network constructed by analyzing patent network mutual citation relationships, reviewing technological development from the unique perspective of relational networks against the backdrop of rapid advancements in science, technology, and network environments. As an informal institutional framework, the enterprise relational network constitutes a social, technological, and cultural system sharing common values. These shared values permeate all aspects of the market and influence its operations. Through frequent interactions and reciprocal transactions, enterprises strengthen their mutual environmental commitment and social recognition, thereby forming social relationship networks grounded in trust and cooperation. Patent collaboration is regarded as a crucial element within these social networks, enabling enterprises to integrate external innovation resources, enhance the conversion rate of innovation outcomes and their own innovation capabilities, offset their own shortcomings, and ultimately gain competitive

advantages. Regarding informal corporate relationships built through patent collaboration, most scholars focus on the definition and value of patent citations. Academic consensus holds that patent citation counts serve as an effective metric for gauging an invention's significance, reflecting the extent of knowledge flow between companies. Highly cited patents typically signify substantial technological and economic importance (Carpenter, Narin, and Woolf 1981^[4]; Alcácer, Gittelman, and Sampat 2009^[1]). Furthermore, extensive research indicates that a firm's patent portfolio influences its position within social networks. In social network analysis, firms with the highest network centrality exhibit the most connections to other firms, indicating their greatest influence within the network. Moreover, patent cooperation networks facilitate resource acquisition, allocation, and exchange, helping firms gain competitive advantages within their industries and enhance their market value (Burt and Soda 2021^[3]).

Green technological innovation by enterprises possesses certain externalities, creating a trade-off between individual corporate interests and societal benefits. As regulators of the external environment, government actions profoundly shape corporate perceptions of green technological innovation. Specifically, governmental environmental regulations indirectly influence corporate green innovation behavior. On one hand, governments establish stringent market entry barriers and environmental standards to prevent high-polluting enterprises from entering the market, while regularly disclosing corporate pollution data to enhance transparency. On the other hand, governments employ market-based instruments like taxes and subsidies, imposing heavy levies on polluting firms while offering incentive subsidies for green innovation. This forces enterprises to enhance their green innovation capabilities, optimize production processes, reduce costs, and cut pollution emissions—all to maximize profits while controlling expenses. Simultaneously, the allocation of government attention influences corporate green technological innovation. Firms increase environmental protection investments, actively pursue green patents, and cultivate enhanced corporate image through exemplary green performance and positive social feedback to secure broad public support and recognition. Given the scarcity of literature directly examining the impact of government ecological concerns on corporate green technological innovation from a social network perspective, this study employs social network analysis to examine green patent citation data and determine the position of enterprises within green technology-related networks. Deepening our understanding of how government ecological concerns influence these corporate green technology networks and their underlying mechanisms helps explain the role of government in shaping inter-firm technological linkages and technological evolution trends. This research aims to provide valuable insights for government policy formulation and corporate strategic planning.

This paper makes a twofold contribution. First, we expand the literature on determinants of corporate linkage networks. Unlike previous studies, our research examines the impact of government ecological concerns on firms' green technology linkage networks. Second, our study enriches the understanding of how government ecological concerns function within listed companies. The existing literature in this field has extensively explored the effects of government ecological concerns on green innovation, total factor productivity, carbon emission governance, and ESG performance. Our study adds new quantitative evidence on the allocation of political attention by analyzing a large dataset, while also expanding the understanding of how government attention shapes the importance of building corporate social networks.

2.2. Hypothesis Development

2.2.1. Government Ecological Attention and its Impact on Corporate Green Technology Networks

In recent years, the Chinese government has vigorously promoted sustainable economic development, calling for environmental protection and green innovation to create a green

future. This underscores the pivotal role of green technological innovation in achieving high-quality socioeconomic development. As the primary entities driving the development, promotion, and commercialization of new products and technologies, enterprises play a crucial role in the ecosystem of green innovation. However, the high risks and substantial investments associated with green technological innovation may deter enterprises. Regarding the handling of major economic issues and challenging problems, annual government work reports serve as a barometer. Frequently emphasized strategic priorities in these reports-such as "coordinated development," "shared environmental governance," and "complementary advantages"-offer new insights and considerations for enterprises. Extensive research indicates a profound connection between the development of social network relationships and corporate green technological innovation. By cultivating their social networks, enterprises can leverage green knowledge from diverse participants, construct inter-firm green technology networks, transcend organizational boundaries, achieve efficient reconfiguration and allocation of resources and information, and enhance green innovation performance. Concurrently, within cross-organizational linkages, firms occupying higher positions in the network enjoy "first-mover advantages," meaning they can access more valuable information from the external world, achieving priority sharing and absorption of external knowledge (Chen 2008^[6]). In summary, the ecological concerns demonstrated by the government in its annual work reports partially stimulate enterprises to engage in green technological innovation. To further enhance innovation efficiency and reduce innovation costs, enterprises will strive to elevate their position within green technology-related networks. We propose the first hypothesis:

H1: Government ecological attention has a positive impact on enterprises' green technology-related networks.

2.2.2. Government Ecological Focus, Chain Director Network, Corporate Green Technology Network

Chain director networks refer to inter-firm network relationships formed through director cross-serving, representing a significant manifestation of corporate social networks. Extensive research indicates that chain director networks facilitate information transmission and exchange between firms, promote the dissemination of successful management practices across organizations, and that a firm's degree of linkage with other network members reflects its ability to acquire external resources. Firms occupying high-level interlocking director positions may place greater emphasis on learning, imitation, knowledge transfer, information transmission, and exchange among directors, thereby influencing their attention to government policies. Through interlocking director networks, firms can significantly enhance the synergistic efficiency of production and operational activities, strengthening their capacity to identify and utilize valuable resources for innovation and precise control of pollution emissions. This directly exerts a positive influence on firms' green technology networks and partially mitigates the positive impact of government ecological concerns on these networks. We propose the second hypothesis:

H2: Social networks formed among directors of listed companies weaken the positive impact of government ecological attention on corporate green technology-related networks.

2.2.3. Government Ecological Concerns, Distorted Capital Allocation, Corporate Green Technology Networks

Against the backdrop of innovation-driven high-quality development, enhancing the allocation efficiency of production factors is a critical step for enterprises in building green technology networks. The efficiency of factor allocation manifests primarily in the input ratios of various factors and resources within the production process, as well as their utilization effectiveness. Among these, capital serves as the key source for enterprises to pursue green technological innovation. Distortions in capital allocation are primarily caused by market information

asymmetry. On one hand, market failures suppress corporate R&D capital investment and distort industry-wide capital supply-demand dynamics. Financing constraints arising from information asymmetry prevent optimal capital allocation, thereby inhibiting innovation output and efficiency. On the other hand, government innovation subsidies exhibit certain information mismatches. Some enterprises actively engage in rent-seeking behavior to obtain subsidies, thereby reducing the innovation willingness of those genuinely engaged in R&D. Particularly under conditions of information asymmetry, even with high government attention to the ecosystem, the higher risks, public benefits, and environmental externalities associated with green innovation limit the advancement of enterprises' green technology-related networks. We propose a third hypothesis:

H3: Distorted capital allocation at the corporate level weakens the positive impact of government ecological focus on enterprises' green technology-related networks.

3. Research Design

3.1. Model Construction

To examine the relationship between government ecological concerns and corporate green technology networks, we estimated the following fixed-effects panel regression:

$$\ln TNet_{i,t} = \alpha + \beta Attention_{i,t} + \delta Control_{i,t} + Firm + Year + City + Ind + \varepsilon_{i,t} \quad (1)$$

In the equation, $\ln TNet_{i,t}$ represents the position of firm i in the green technology network in year t . $Attention_{i,t}$ denotes the level of government ecological concern in the city where firm i is located in year t . To control for other factors that may influence firms' green technology networks, a set of control variables $Control_{i,t}$ was selected. The model incorporates fixed effects at the individual, year, city, and industry levels to eliminate the effects of time trends and differences across individuals, regions, and industries. $\varepsilon_{i,t}$ represents the pooled standard error at the firm level.

3.2. Definition of Variables

3.2.1. Enterprise Green Technology Network

This paper organizes citation information for green patents sourced from the China National Intellectual Property Administration (CNIPA) and Google Patents. It constructs a relationship matrix between enterprises based on the citation information of green patents granted to them, reflecting the green technology associations among enterprises. If a green patent granted to one enterprise cites another enterprise's patent (including both one-way and two-way citations) in a given year, the matrix element is set to 1; otherwise, it is set to 0.

A firm's position within a green technology network can be measured by its network centrality (G_i) and structural hole index (S_i). Network centrality reflects the degree of direct connection between a firm and other firms within a network (Freeman 1978). It is calculated as follows:

$$G_i = \frac{\sum_{j \neq i} \chi_{ij}}{N-1} \quad (2)$$

Here, χ_{ij} indicates whether a network relationship exists between firm i and firm j . If a relationship exists, $\chi_{ij} = 1$; otherwise, $\chi_{ij} = 0$. $\sum_{j \neq i} \chi_{ij}$ represents the sum of firm i 's network relationships with other firms, and N denotes the number of firms.

A structural hole refers to the gap in information flow that occurs when two non-directly connected firms are both linked to the same firm. Because firms occupying structural hole positions connect otherwise unlinked firms and serve as "bridges" or "intermediaries" in these connections, they not only gain access to more innovation resources and information from the entire network compared to firms not in structural holes, but also facilitate the flow of information and knowledge. By controlling this information flow, they can serve their own technological innovation. Therefore, an enterprise's position within a green technology relationship network is determined by a composite of network centrality and structural hole index, expressed as:

$$TNet_{it} = G_i \times S_i \quad (3)$$

The structural hole index (S_i) can be reflected by the level of constraints a firm faces within its relational network. The lower the constraints a firm encounters within its relational network, the greater its potential to serve as a "bridge" or "intermediary," and consequently, the higher its structural hole index. If R_i represents the level of constraints faced by an enterprise within its relational network, then the structural hole index is $S_i = 1/R_i$. R_i can be expressed as:

$$R_i = \sum_{i \neq j} (r_{ij} + \sum_{i \neq v, j} r_{iv} r_{vj})^2 \quad (4)$$

Among these, r_{ij} represents the direct connection strength between firm i and firm j within the relational network; $\sum_{i \neq v, j} r_{iv} r_{vj}$ denotes the sum of all indirect connection strengths that firm i establishes with firm j through firm v within the network; $(r_{ij} + \sum_{i \neq v, j} r_{iv} r_{vj})^2$ indicates the level of constraints firm i faces in the relational network due to firm j . The overall constraint level (R_i) experienced by firm i within the relational network is the aggregate of all constraints imposed by every other firm in the network.

Based on the construction of network centrality and structural hole indicators, the network position matrix derived from corporate green patent citation information enables the calculation of each enterprise's network centrality and structural hole index within the green technology association network. Finally, substituting the measured network centrality and structural hole indices into Equation (3) yields the position of each enterprise within the green technology association network.

3.2.2. Government Ecological Concerns

Our primary independent variable is government ecological attention. Drawing on existing research, we employed text analysis to quantify GEA, a cutting-edge issue in contemporary government attention allocation. We manually compiled annual work reports from local governments and extracted text content related to governmental ecological attention from these reports. Given the importance of ecological and environmental protection to local governments, corresponding keywords frequently appear in their annual work reports; thus,

we measure local governments' environmental attention using the logarithm of keyword frequency.

3.2.3. Control Variables

To enhance the accuracy of research conclusions, relevant literature (Chen et al. 2021^[5]), multiple control variables potentially impacting both corporate and regional levels were incorporated into the model. These variables encompass the financing constraint index (SA), Tobin's Q ratio (Tobin), firm size (Size), firm age (Age), total number of board members (Number), population density (Pop), technological sophistication (Tec), market openness (Open), and environmental regulation intensity (Regu). Additionally, environmental pollution (Polluit) was selected as a mediator, while director networks (Dirlock) and capital allocation distortion (Dist) were employed to examine moderating effects. Key variable definitions are presented in Table 1.

Table 1. Variable definition

Description	Name	Variable	Definition
Interpreted variable	Enterprise green technology network	InTNet	The status of the enterprise's green technology association network
Explanatory variables	Government ecological concerns	Attention	The frequency of keywords related to government ecological concern is taken logarithmically
Control variables	Financing constraint index	SA	Financing constraints SA index
	Tobin Q value	Tobin	The ratio of market value to total assets
	Company size	Size	Total assets are taken logarithmically
	Enterprise age	Age	The number of years of establishment of the enterprise is taken logarithmically
	The total number of regulators	Number	The total number of regulators
	Population density	Pop	The ratio of the permanent population of the region to the area of the city is logarithmic
	Science and technology level	Tec	The number of regional patent applications accepted is taken logarithmically
	Market openness	Open	The tertiary industry accounts for the regional GDP
	Environmental regulation strength	Regu	The comprehensive utilization rate of general industrial solid waste is taken as a logarithm
Mediating variables	environmental pollution	Polluit	Regional CO2 emissions
Moderate variables	Chain Director Network	Dirlock	The network status of chain directors
	Capital allocation is distorted	Dist	$[(1-C-D \text{ Production Function Estimated Labor Output Elasticity}) \times \text{Annual average of the total operating income of listed enterprises} / \text{annual benchmark interest rate of enterprise loans for 6 months to 1 year} \times \text{total fixed assets of listed enterprises}] - 1$

3.3. Data

We selected A-share listed companies on the Shanghai and Shenzhen stock exchanges in China from 2007 to 2022 as our sample. Data primarily originated from the CSMAR and Wind databases, with government ecological concern data manually collected from municipal government work reports sourced from local government official websites and statistical yearbooks. Based on prior research, we excluded the following observations: (1) financial sector observations; (2) ST and ST* observations; (3) Firms with fewer than five years of data; (4) Sectors with sparse annual observations. After filtering continuous variables at the 1% significance level, we obtained 39,351 firm-year observations. Table 2 presents descriptive statistics.

Table 2. Descriptive statistics of main variables

Variable	N	Mean	SD	Min	Max
lnTNet	39351	0.1204	0.0439	0.0001	0.1724
Attention	39351	4.6169	0.2851	3.7842	5.2575
SA	39351	-3.7709	0.2915	-4.4056	-2.7418
Tobin	39351	2.0559	1.3794	0.8547	9.0210
Size	39351	22.2243	1.4670	19.2175	27.1492
Age	39351	2.1313	0.8670	0.0000	3.3322
Number	39351	16.4518	3.8502	10.0000	30.0000
Pop	39351	6.4367	0.6639	4.4478	8.1147
Tec	39351	0.0416	0.0260	0.0017	0.1296
Open	39351	14.1250	1.7358	8.6362	16.5065
Regu	39351	4.4109	0.2527	3.2100	4.6052
Polluit	39351	273.3374	236.1206	4.1625	926.6566
Dirlock	39351	25.0252	9.4810	7.6000	50.6000
Dist	39351	9.5906	16.8466	1.0048	109.1461

4. Empirical Results

4.1. Baseline Regression

Table 4 reports the benchmark regression results of government ecological attention on firms' green technology networks. Column (1) controls for firm, year, city, and industry, using firm-level cluster standard errors. The coefficient for Attention is positive and statistically significant at the 1% level. As shown in Column (2) of Table 4, after incorporating a series of control variables, the Attention coefficient remains positively significant at the 1% level. These findings indicate that, ceteris paribus, government ecological attention significantly enhances a firm's position within green technology networks. The results in Table 3 validate Hypothesis 1.

Table 3. Baseline regression

Variable	(1)	(2)
	lnTNet	lnTNet
Attention	0.0060*** (0.0009)	0.0064*** (0.0009)
SA		-0.0117*** (0.0037)
Tobin		0.0010*** (0.0003)
Size		0.0032*** (0.0006)
Age		0.0029*** (0.0009)
Number		0.0007*** (0.0001)
Pop		0.0031 (0.0030)
Tec		0.0534** (0.0208)
Open		-0.0014*** (0.0005)
Regu		0.0046** (0.0021)
Constant	0.0928*** (0.0043)	-0.0657** (0.0305)
Firm	YES	YES
Year	YES	YES
City	YES	YES
Industry	YES	YES
N	39,351	39,351
R ²	0.5197	0.5239

Note: Standard errors are in parentheses. *p < .1, **p < .05, ***p < .01, same as in the table below.

4.2. Robustness Tests

4.2.1. Replacing Explanatory Variable

This study employs alternative measurement methods to replace core explanatory and dependent variables. Drawing on prior research, we use the proportion of words related to government ecological concerns (Attention1) relative to the total word count in local government reports as a proxy measure for the core explanatory variable. Columns (1) and (2) in Table 5 report the results. Additionally, we constructed a "firm-to-firm" technology linkage matrix by compiling citation information for firms' green authorized patents, thereby obtaining pairwise citation frequencies and counts between firms' green patents. A higher number of citations to or from green patents indicates increased mutual learning frequency between firms and a more pronounced knowledge spillover effect. Building upon the inter-firm technology association matrix, we further employed social network analysis software to calculate firms' centrality and structural hole indices within the green technology association network, ultimately determining their position (lnTNet1) within this network. The estimation results

obtained by changing the measurement method for the enterprise green technology association network are shown in columns (3) and (4) of Table 4. These empirical results are consistent with our benchmark regression results, regardless of changes in the measurement of core explanatory variables and dependent variables, thereby validating the robustness of the benchmark regression results in this paper.

Table 4. Replacing explained variable

Variable	(1)	(2)	(3)	(4)
	lnTNet	lnTNet	lnTNet1	lnTNet1
Attention1	0.5035***	0.6381***		
	(0.1120)	(0.1122)		
Attention			0.0044***	0.0054***
			(0.0015)	(0.0015)
Constant	0.1146***	-0.0487	0.0342***	-0.2241***
	(0.0013)	(0.0305)	(0.0069)	(0.0528)
Control	YES	YES	YES	YES
Firm	YES	YES	YES	YES
Year	YES	YES	YES	YES
City	YES	YES	YES	YES
Industry	YES	YES	YES	YES
N	39,351	39,351	39,351	39,351
R ²	0.5193	0.5237	0.4328	0.4383

4.2.2. High-dimensional Fixed Effects

Table 5. High-dimensional fixed effects

Variable	(1)	(2)	(3)	(4)
	lnTNet	lnTNet	lnTNet	lnTNet
Attention	0.0058***	0.0061***	0.0060***	0.0064***
	(0.0010)	(0.0009)	(0.0010)	(0.0010)
Constant	0.0938***	-0.0437	0.0926***	-0.0758**
	(0.0044)	(0.0324)	(0.0044)	(0.0319)
Control	YES	YES	YES	YES
Industry×Year	YES	YES	NO	NO
Industry×City	NO	NO	YES	YES
Firm	YES	YES	YES	YES
Year	YES	YES	YES	YES
City	YES	YES	YES	YES
Industry	YES	YES	YES	YES
N	39,310	39,310	39,332	39,332
R ²	0.5362	0.5395	0.5216	0.5259

This paper incorporates four fixed effects into the baseline regression model. To further test the robustness of the regression results, two additional model specifications are employed: First, building upon the inclusion of individual, year, industry, and province fixed effects, an industry × year interaction fixed effect is added and clustered at the firm level; Second, on top of including individual, year, industry, and province fixed effects, an industry × city interaction fixed effect is added, with clustering at the firm level. The corresponding estimation results are

presented in Table 5. While the different model specifications controlled for overlapping yet distinct unobservable factors, they did not alter the fundamental estimation results. The estimation results in all columns of Table 5 consistently demonstrate that government ecological attention significantly enhances the position of enterprises within green technology-related networks, indicating that the estimation results are robust to the model specifications.

4.2.3. Remove Municipalities

The cities in this sample include both ordinary prefecture-level cities and municipalities directly under the Central Government. The behavior patterns of different levels of government may be different, so the impact of government ecological concerns on the green technology network of enterprises may also be different. This article deletes the enterprise samples of all municipalities directly under the Central Government and retains only the enterprise samples of prefecture-level cities. In the case of retaining only the sample of prefecture-level cities, the government's ecological attention still has a strong effect on the green technology network of enterprises.

Table 6. Remove municipalities directly under the central government

Variable	(1)	(2)
	lnTNet	lnTNet
Attention	0.0053***	0.0058***
	(0.0011)	(0.0011)
Constant	0.0945***	-0.0560
	(0.0050)	(0.0351)
Control	YES	YES
Firm	YES	YES
Year	YES	YES
City	YES	YES
Industry	YES	YES
N	31,329	31,329
R ²	0.5173	0.5215

4.3. Analysis of Impact Mechanisms

The aforementioned study provides a comprehensive portrayal of the impact of government ecological concerns on enterprises' green technology-related networks, yet it has not examined the underlying mechanisms within this black box. In this section, we focus on identifying and testing the channel mechanisms underlying the influence between the two variables, as posited in the preceding section. To this end, we further incorporate moderating effects by regressing the interaction terms between "interlocking directorate networks" and the explanatory variable of government ecological concerns, as well as between "capital allocation distortions" and the same explanatory variable. The model design is as follows:

$$lnTNet_{i,t} = \alpha + \beta Attention_{i,t} + \gamma Dirlock_{i,t} + \varepsilon Attention_{i,t} \times Dirlock_{i,t} + \delta Control_{i,t} + Firm + Year + City + Ind + \varepsilon_{i,t} \tag{5}$$

$$lnTNet_{i,t} = \alpha + \beta Attention_{i,t} + \gamma Dist_{i,t} + \varepsilon Attention_{i,t} \times Dist_{i,t} + \delta Control_{i,t} + Firm + Year + City + Ind + \varepsilon_{i,t} \tag{6}$$

From the results of columns (2) and (3) in Table 7, it can be seen that after incorporating the moderating effect, lnTNet, The regression coefficients of Attention are significantly positive, while the Attention×Dirlock and Attention×Dist multiplication terms are significantly negative, indicating that the chain director network and capital allocation distortion have a significant inhibitory effect on the influence of government ecological attention and enterprise green technology related networks, that is, they have a significant negative moderating effect. Therefore, hypotheses 2 and 3 are true.

Table 7. Analysis of impact mechanisms

Variable	(1)	(2)	(3)
	lnTNet	lnTNet	lnTNet
Attention	0.0064*** (0.0009)	0.0056*** (0.0008)	0.0064*** (0.0009)
Dirlock		0.0025*** (0.0000)	
Attention×Dirlock		-0.0005*** (0.0001)	
Dist			-0.0000 (0.0000)
Attention×Dist			-0.0001*** (0.0000)
Constant	-0.0657** (0.0305)	-0.0842*** (0.0253)	-0.0654** (0.0305)
Control	YES	YES	YES
Firm	YES	YES	YES
Year	YES	YES	YES
Industry	YES	YES	YES
Province	YES	YES	YES
N	39,351	39,351	39,351
R ²	0.5239	0.6280	0.5241

5. Conclusion

To demonstrate the relationship between government ecological concerns and corporate green technology networks, we measured governmental ecological attention using keywords related to ecological environment in the government work reports of 247 prefecture-level cities in China. We then employed SNA to calculate the positions of A-share listed companies within green technology networks from 2007 to 2022. Our findings reveal that heightened governmental ecological attention motivates enterprises to elevate their standing within green technology networks. Robustness checks-through dependent variable substitution, high-dimensional fixed effects, and exclusion of municipality samples-confirm our findings are not incidental. Moreover, this relationship weakens in firms exhibiting stronger interlocking directorate networks and more severe capital distortion. In summary, our study offers new insights into the dynamics of government attention allocation and corporate green innovation,

underscoring the critical importance of governmental ecological attention for firms' green technology networks.

Mechanism analysis indicates that interlocking director networks and capital allocation distortions mitigate the effect of government ecological concerns on firms' green technology networks. Therefore, firms can enhance their green technology networks by alleviating capital allocation distortions and leveraging interlocking director networks. Our paper is the first to explore the relationship between the government ecological attention received by enterprises and their green technology association networks. However, our study also has certain limitations. First, our sample focuses on listed companies. Future analyses could study small and medium-sized enterprises based on industrial enterprise databases. Second, our literature lacks further analysis of corporate green technology association networks.

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