# A STUDY ON ENVIRONMENTAL INFORMATION DISCLOSURE OF GREEN MANUFACTURING IN CHINA'S GREEN PLANTS

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**Abstract.** Environmental information disclosure (EID) is an effective way for companies to perform environmental responsibility, an important channel to improve the modern environmental governance, and an important basis for the Chinese government to promote green transformation, build sustainable development, and achieve carbon neutrality. Taking the cultivation of green plants in "green manufacturing (GM) demonstration construction project" as an example, this study investigates the impact and mechanism of voluntary environmental regulations on company EID. The results showed that GM significantly enhanced the quality of EID. The mechanism analysis found that GM plays a role mainly through the reduction of pollutant emissions by green companies and the backforcing effect generated by the continuous attention of investors to the field research of companies. Further analysis shows that higher public environmental concerns and stricter local government environmental regulations can increase the impact of GM. The analysis of economic consequences showed that the quality increase of EID in green plant cultivation promoted the improvement of research and development (R&D), green innovation, and environment, society, and governance (ESG) performance of enterprises, led to the transformation of green products of supply chain companies, and also drove the improvement of environmental quality at the regional level.

**Keywords:** *green manufacturing (GM), environmental information disclosure (EID), voluntary environmental regulation, green plant*

## Introduction

Information disclosure of the company is an important basis for eliminating information asymmetry among relevant stakeholders and ensuring the efficient operation of the capital market (Zhang et al., 2024). Under the background of emission reduction and energy conservation, EID is an effective way for companies to perform their environmental protection responsibilities, and also an important channel to enhance the modern environmental governance. The Chinese government established a modern environmental governance system, committed to the reform of the ecological civilization system, and put forward higher requirements for EID. In 2022, the "Ministry of Ecology and Environment of China" promulgated "the Measures for the Management of Legal EID of Companies", which further strengthened the legal EID. EID can improve a company's reputation (Sun et al., 2025), boost investment confidence, and convey the company's social responsibility to the outside world, thus enhancing companies market value and increasing shareholder wealth (Wang and Yao, 2024). However, for a long time, scholars believed that EID is an involuntary behavior and a passive response when facing external pressure (Peng et al., 2022). At present, the EID by companies in China is still selective and self-serving (Zhang et al., 2024), and companies even deliberately conceal environmental harm behaviors. After being punished for environmental problems, companies still fail to disclose in their official websites and social responsibility reports


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(Stupak et al., 2021). The avoidance of EID will affect the asset price and refinancing of companies (Tristan, 2024), and will aggravate the risk of the stock price decline of listed companies (Mushfig et al., 2024; Jia, 2024). Therefore, how to build a long-term incentive mechanism based on a cost-benefit balance to encourage companies to spontaneously enhance the quality of their EID and achieve sustainable development is a challenging process.

The significant improvement in the quality of company EID e is a mandatory requirement of the government. Some foreign governments introduced mandatory disclosure of environment-related information systems (Khan et al., 2024; Jia, 2024), which strengthens environmental awareness and promotes the initiative of green transformation development and pollution reduction of companies. At present, China lacks a unified mandatory EID system (Liu and Bai, 2022), and the quality of EID is typically not very good (Yang et al., 2022). So, to facilitate companies to make EID, do voluntary environmental regulation policies play a role? In the absence of a mandatory EID system, how to explore the effect of voluntary environmental regulation.

In 2020, "Ministry of Industry and Information Technology" in China launched the "GM demonstration construction project", which includes green products, green plants, green supply chains, and green parks, etc. The construction of a green plant is a combination of company self-assessment and third-party independent evaluation, company independent declaration, review and recommendation by regional regulatory authorities, and finally identified by the "Ministry of Industry and Information Technology". The project conforms to the characteristics of voluntary environmental regulation policy. The project is voluntary and reflects the tendency of companies to voluntarily participate in GM and self-environmental regulation. This project is a large-scale policy experiment involving thousands of green plants, which has been implemented in batches, and the evaluation of the effectiveness of the large-scale policy experiment has credibility. Based on the policy experiment of GM in China, this study analyzes how voluntary environmental regulations change the incentive mechanism of companies' cost-benefit and trade-off, and explores how to optimize the incentive mechanism to enhance the quality of EID.

This study chooses the data of A-share listed companies in China from 2010 to 2023, takes green plant establishment as an exogenous policy, and explores its impact and mechanism on company EID. The study found that the establishment of green plants remarkably improved the quality of EID, which is more remarkable in non-key polluters, and non-state-owned companies, and significantly improved the level of voluntary disclosure, while the effect is opposite for companies with environmental violations after being selected as green companies. In addition, the shorter the time of being recommended as a green plant, the more obvious the improvement effect on the quality of EID. The mechanism analysis found that the establishment of green plants mainly plays a role through pollution reduction and emission reduction, the increasing attention of green investors, and the backforcing effect of field research by institutional investors. Greater public awareness of the environment and stricter environmental regulations can enhance the impact of green plants. The policy implementation improved the quality of EID, promoted the green innovation, research and development, and ESG performance, and also promoted the green transformation of products of supply chain companies. From the viewpoint of regional ecology, the implementation of the "GM demonstration construction project" has not only enhanced the quality of EID but also enhanced the


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environmental quality of the regions where these green plants are located. The contributions of this study are as follows.

First, based on the data on green plants, this paper studies the relationship among voluntary environmental regulations and companies' EID, revealing that the creation of green plants can remarkably enhance the quality of company EID.

Second, it expands the research on the economic impact of green transformation and provides a new viewpoint for studying the voluntary environmental regulations.

Third, it verifies the environmental spillover effect of the green transformation of companies caused by voluntary environmental regulation on supply chain companies and the regions where green plants are located.

Finally, it provides reference for the establishment of a differentiated EID framework and a scientific EID regulatory system to encourage GM and construct a modern environmental governance system.

## Theoretical analysis

Research on EID. Theories of company EID mainly include legitimacy theory, signal transmission theory, stakeholder theory, and voluntary information disclosure theory, etc. (Yang et al., 2022; Mushfig et al., 2024; Wang and Yao, 2024). The elements that affect EID can be summarized as internal and external elements. Internal elements include company size, company attributes, industry type and preference of company management, etc. (Stupak et al., 2021). External factors are mainly forced regulation and pressure from stakeholders, such as legal provisions, government regulation, public supervision, media reports, etc. (Ndi, 2024).

Study on the construction of GM. It serves as a crucial foundation for the green transformation and upgrading of the manufacturing sector. It can enhance the influence of green plants, attract green investors to invest, and increase the market value of green plants (Ankush and Sathans, 2022). The positive feedback effect of GM makes companies willing to actively fulfill their environmental responsibility and enhance the quality of EID despite the lack of a mandatory information disclosure system (Xu et al., 2024). According to the voluntary disclosure theory and signal theory, the higher the company's management level, the better the environmental effect, and the more motivated the company is to make environmental information public (Ren et al., 2024).

Study on the green plant. The selection of "GM demonstration construction project" can promote the greening of production processes of companies, reduce pollution emissions of their products and services, improve environmental performance, and motivate companies to enhance the quality of EID, to differentiate them from companies with poor environmental effect (Cai et al., 2024). The selection of green plants can help reduce the resource constraints of companies and enhance the willingness of companies to make environmental information public. Some studies showed that there are trade-offs between cost and benefit when companies make EID. The EID requires more investment by companies. Only when the benefits of EID are greater than the costs, the disclosure will be made (Gu and Shen, 2024). From the point of EID costs, the selection of green plant demonstration companies obtain government policy support and preferential interest loans from financial institutions, which reduces financing costs and remarkably reduces the cost of EID (Wei et al., 2024; Liu et al., 2025).


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## Research hypothesis

Based on the preceding information, this study puts forth the following hypothesis:

H1: The selection of the "GM demonstration construction project" can remarkably enhance the quality of EID.

H2a: From the internal viewpoint of company, the selection of "GM demonstration construction project" drives companies to enhance their environmental awareness and accelerate green transformation, which is conducive to improving the quality of EID.

H2b: From the external viewpoint of companies, the selection of "GM demonstration construction project" is conducive to increasing external attention and supervision, and drives companies to enhance the quality of EID.

H3: The stricter the environmental regulations and the more vigilant the public oversight, the more obvious the performance of enhancing the EID quality after the implementation of the "GM demonstration construction project".

## Materials and methods

### *Materials*

In 2010, the "Shanghai Stock Exchange" published the "Guidelines on EID of Listed Companies" to provide direction for the EID of listed companies. This study takes A-share listed companies from 2010 to 2023 as research samples. The companies' data are from the "China Stock Market & Accounting Research Database" (CSMAR) and "Chinese Research Data Services" (CNRDS), and the pollution data is sourced from the "China Urban Statistical Yearbook" and "China Environmental Statistical Yearbook". As per the data processing outlined above. (1) Excluding the financial industry and real estate companies. (2) Samples such as listed companies with losses and those suspended from listing are deleted. (3) Companies that have been listed for less than a year and those with an asset-liability ratio exceeding 1 are eliminated from the samples. (4) Samples lacking key variables are eliminated. The total count is 32917 observations from 3971 companies are obtained. Among them, 618 listed companies have green plants, and 3353 listed companies do not have green plants. In addition, to minimize the impact of outliers on the empirical findings, all continuous variables are curtailed by 1% at both the upper and lower ends.

### *Methods*

*Enterprise environmental information disclosure quality*

During this investigation, the "GM demonstration construction project" implemented by the "Ministry of Industry and Information Technology" in 2018 is taken as the exogenous policy impact, and the listed companies selected as green plants are taken as the treatment group, while the control group is listed companies not selected.

Due to the inconsistency in the time when companies in the treatment group are selected as green plants, according to the difference in the treatment time, this paper adopts the multi-stage differential method for regression, and the benchmark model is presented below:

$$Envidq_{i,t} = \alpha_0 + \alpha_1 GPlant_{i,t} + \alpha_2 Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad \text{(Eq.1)}$$


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where $i$ and $t$ represent the number of companies and year, respectively. $Envidq_{i,t}$ represents the quality of EID of listed company $i$ in year $t$. $GPlant_{i,t}$ is the dummy variable of whether the sample company is selected as a green plant. *Controls* represent the control variables of the company for different years. $\mu_i$ is the company fixed effect, $\boldsymbol{\lambda}_t$ represents the annual fixed effect, $\varepsilon_{i,t}$ is the random disturbance term.

Environmental information disclosure quality (*Envidq*) is the explained variable. Referring to De Luca Pena et al. (2024), environmental information is divided into two categories according to whether it can be monetized, that is, monetized and non-monetized information. The index of EID quality is obtained by adding up the scores of various categories and taking logarithms. As the index value increases, so does the quality of EID.

Whether a listed company has a green plant (*GPlant*) is the core explanatory variable. Since there are six batches of green plants selected at different times, the listed companies selected in different years are different. Therefore, according to the six batches of green plants announced by the "Ministry of Industry and Information Technology" from 2019 to 2023. If a listed company $i$ is selected as a green plant in year $t$, this variable is equal to 1 in year $t$ and subsequent years, otherwise, it is 0.

*The result of improving the quality of corporate environmental information disclosure*

This study explores the economic consequences of improving the quality of a company's EID caused by selecting green plants from three aspects: green innovation, R&D level, and ESG performance. Referring to Xu et al. (2024), the model is constructed as follows:

$$Ecoconsequences_{i,t+1} = \alpha_0 + \alpha_1 \gamma Envidq_{i,t} + \alpha_2 X_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad \text{(Eq.2)}$$

*Ecoconsequences* is the measurement index of economic consequences. Company R&D (*Innovation1*, *Innovation2*) is evaluated independently by the number of patents obtained and applications. Company green innovation (*Greeninnov1*, *Greeninnov2*) is measured separately by the total number of citations in each year and an average number of citations per year of authorized green patents. ESG rating of companies (*ESG_hz*, *ESG_shang*) is measured separately by the ESG rating index of "China Securities" and the ESG rating index of "ShangdaoRonglu". The explanatory variable $\gamma Envidq$ is the level of enhancement in the EID quality caused by the selection of green plants. Since the impact of policies generally lags, all explanatory variables are processed with a one-stage lag.

*The spillover effect of enhancing the quality of corporate environmental information disclosure*

To investigate whether the enhancement of the EID quality caused by the selection of green plants can produce a regional environmental spillover effect and thus improve the local ecological environment, the following model is constructed by referring to Wang et al. (2024).

$$Ecoeffects_{jcdt} = \beta_0 + \beta_1 ( \gamma Envidq\_citymean_{jcdt} ) + \beta_2 X + \delta_j + \tau_c + \mu_d + \lambda_t + \varepsilon_{jcdt} \text{(Eq.3)}$$

where *Ecoeffects* is the environment level at city-level, which is independently assessed utilizing night light data to match the city-level carbon emission levels (*carbonem1*),


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using the relevant conversion factors to calculate the carbon emission level (*carbonem2*) at the prefecture level (Xu et al., 2024), using the natural logarithm value of sulfur dioxide emissions from industrial sources ($lnSO_2$) and the haze pollution level at the prefecture level (*pm2.5*).

The degree of haze pollution at the prefecture level is measured using the *PM2.5* concentration data issued by the "China Air Quality Online Monitoring and Analysis Platform". *γEnvidq_citymean* is a summary of the quality improvement effect (*γEnvidq*) of EID of listed companies at the city level.

Citing the work of Feng et al. (2023), *Controls* include the per capita GDP growth rate of prefecture-level cities, the percentage of added value of the secondary industry to population density, GDP, government research and development investment, the proportion of actual foreign investment to GDP, and environmental protection efforts of prefecture-level cities. In addition, Controls include the fixed effect of provinces, cities, industries, and years.

## Empirical findings and their analysis

### *Results from the benchmark regression analysis*

*Table 1* presents the outcomes of the regression analysis for model (1), in which column (1) includes only *GPlant*, column (2) also includes company and annual fixed effect, and column (3) also includes control variables. The regression analysis indicates that the coefficient of *GPlant* is remarkably positive at least at 5% level, suggesting that the choice of "GM demonstration construction project" remarkably enhances the EID quality. Taking column (3) for instance, the *GPlant* coefficient is 0.071 and is significant at the 5% level, suggesting that after controlling other elements, the EID quality of selected companies has improved by 7.1% on average compared with that of non-selected ones.

***Table 1.*** *Benchmark regression results*

| ***Variables*** | **(1)** | **(2)** | **(3)** |
|---|---|---|---|
| | ***Envidq*** | ***Envidq*** | ***Envidq*** |
| *GPlant* | 0.792*** | 0.089*** | 0.071** |
| | (29.43) | (2.81) | (2.23) |
| *Constant* | 1.702*** | 0.862*** | -2.652*** |
| | (124.69) | (36.75) | (-6.57) |
| *Controls* | *NO* | *NO* | *Sure* |
| *Company FE* | *NO* | *Sure* | *Sure* |
| *Year FE* | *NO* | *Sure* | *Sure* |
| *N* | 32917 | 32917 | 32917 |
| $R^2$ | 0.039 | 0.302 | 0.307 |

The above results show that the choice of companies in "GM demonstration construction project" remarkably enhance the EID quality, which supports hypothesis H1. The regression outcomes of other control variables indicate that as company size increases and the number of years listed lengthens, the higher the of EID quality, as the debt ratio of companies increases, the EID quality decreases (Tian et al., 2024; Zhao et al., 2024).


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### *A robustness check*

*Test for parallel trends*

To investigate the effect of selected "GM demonstration construction project" over time, refer to Zhang et al. (2022), a parallel trend test is conducted with 2010 as the base period. The findings indicated that there are no notable statistical disparities in the EID quality between the control and treatment groups before the implementation of the "GM demonstration construction project". After the implementation of the project, the two groups of companies showed notable differentiation in the EID quality. Compared with the companies in the control group, the EID quality after the choice of green plants is remarkably improved, and the above results verified the parallel trend hypothesis.

*Other robustness tests*

Other robustness tests include: (1) Placebo test for benchmark regression results in randomly selected treatment groups. (2) Using different measures to replace the explained variables for testing. (3) Replace fixed effect and hysteresis control variables and add prefecture-level control variables. (4) The sample interval is shortened, and the annual observed value of the interference policy is removed, it is re-estimated to exclude the influence of other policies in the sample interval. (5) Redefine the control group. (6) Propensity score matching is adopted, and the DID method is used for estimation based on matching samples. (7) To overcome the estimation bias of the multi-time-point differential model (Shang et al., 2024), the dual robust estimation method is used to estimate (Li et al., 2024). (7) To overcome the estimation bias of the multi-time-point differential model (Stefano et al., 2024), the double robust estimation method is adopted to enhance the robustness and accuracy of the estimation (Wei and Xia, 2024). (8) Two-stage DID is used for testing. After the above tests, the regression findings remain in agreement with the earlier ones.

### *Endogenous processing*

The empirical results are confirmed to be robust through various methods, but potential endogeneity problems may still cause bias in the estimated results. To solve the potential endogenous problems such as sample selection bias, missing variables, model error, and time-varying effect interference, refer to Han et al. (2024), this study adopts (1) the processing effect model; (2) add third-order polynomials terms for control variables and time trends; (3) add the interaction term between the time dummy and control variables; (4) entropy balance matching method; (5) dual machine learning methods are used to deal with endogenous problems.

## Further analysis

### *Influence path analysis*

*The path analysis of the improvement of environmental awareness and behavior from an internal perspective*

Green plant is the main implementation of GM, green plant selected companies will produce green products, use clean production technology to establish a resource recovery and recycling mechanism, promote the optimization of energy use structure, reduce pollution generation and emissions, and achieve green transformation. To this end, this


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paper obtains company sustainable development reports, social responsibility reports, annual reports and based on the CNRDS database and Jichao Information Network to construct company-level pollution reduction and emission reduction indicators. First, if the company uses renewable energy, new energy, and established a mechanism for resource recovery or recycling, *RecyEcon* is 1, otherwise, it is 0. Second, if the company formulated an energy saving policy, purchased technical equipment, or introduced advanced technology, *EnerSaving* is 1, otherwise, it is 0. Third, if the company received environmental recognition or other positive reviews, *EnvRecog* is 1, otherwise, it is 0. Since the above variables are all dummy variables, this paper adopts panel fixed effect and panel logit models respectively for regression. The results of columns (1) and (2) of Panel A in *Table 2* show that the selection of green plants improves the possibility of companies adopting a circular economy. Columns (3) and (4) show that the selection of green plants stimulates energy conservation. Columns (5) and (6) show that companies received more environmental recognition after being selected as green plants. The above results show that the selection of green plants improves the environmental awareness of companies, adopts more environmental behavior, and promotes the green transformation. To prove that the selected green plants can enhance the EID quality by improving their environmental awareness and environmental behavior (Jin and Chen, 2024), this study adds an analysis of the influence of the above index changes on the EID quality. The regression outcomes presented in Panel B of *Table 2* indicate a positive correlation between the enhancement of a company's environmental awareness and behavior and the improvement of its EID quality, which supports hypothesis H2a.

***Table 2.*** *Analysis of the influence path from an internal perspective*

| **Panel A: Selected green plants improve companies' environmental awareness and behavior** | | | | | | |
|---|---|---|---|---|---|---|
| ***Variables*** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| | ***RecyEcon*** | ***RecyEcon*** | ***EnerSaving*** | ***EnerSaving*** | ***EnvRecog*** | ***EnvRecog*** |
| *Models* | *Fixed effect* | *logit* | *Fixed effect* | *logit* | *Fixed effect* | *logit* |
| *GPlant* | 0.086*** | 0.456*** | 0.056* | 0.336** | 0.179*** | 0.791*** |
| | (3.31) | (3.41) | (1.85) | (2.51) | (6.14) | (5.61) |
| *Constant* | -1.014** | | -1.149** | | -0.207 | |
| | (-2.05) | | (-2.29) | | (-0.51) | |
| *Controls* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *company FE* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *Year FE* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *N* | 8602 | 6314 | 8602 | 6611 | 8602 | 5661 |
| $R^2$ | 0.043 | | 0.042 | | 0.059 | |

| **Panel B: The impact of environmental awareness and behavioral improvement on the EID quality** | | | | |
|---|---|---|---|---|
| ***Variables*** | **(1)** | **(2)** | **(3)** | **(4)** |
| | ***Envidq*** | ***Envidq*** | ***Envidq*** | ***Envidq*** |
| *RecyEcon* | 0.091*** (6.54) | | | 0.075*** (5.44) |
| *EnerSaving* | | 0.112*** (7.49) | | 0.102*** (6.87) |
| *EnvRecog* | | | 0.089*** (6.53) | 0.079*** (6.22) |
| *Constant* | 1.639** (2.19) | 1.668** (2.21) | 1.565** (2.09) | 1.775** (2.47) |
| *Controls* | *Sure* | *Sure* | *Sure* | *Sure* |
| *company FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *Year FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *N* | 8602 | 8602 | 8602 | 8602 |
| $R^2$ | 0.159 | 0.167 | 0.161 | 0.176 |


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*Path analysis of external perspective*

As the core of GM, green plants are crucial in the realization of a low-carbon development strategy. The selection of green plants is a recognition of the leading level of the company in green development and environmental protection and energy conservation. After being selected, green investors will increase their attention and investment, which can not only increase the stock price but also stimulate the company's continuous environmental protection intention. Therefore, according to Ge et al. (2024), the green investor index is constructed. If there are green investors in companies, the value of green investor attention is 1; otherwise, it is 0. The regression overcomes in columns (1)-(3) of *Table 3* show that the selection of green plants remarkably increases green investors' attention to companies. Among the companies that did not have the attention of green investors before, the increased attention of green investors brought about by the selection of green plants has remarkably enhanced the EID quality.

***Table 3.*** *Path analysis of external perspective*

| ***Variables*** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
|---|---|---|---|---|---|---|
| | ***GInvestor*** | ***Envidq*** | | ***Inst_visit*** | ***Envidq*** | |
| | | ***GInvestor*=1** | ***GInvestor*=0** | | ***Inst_visit_high*** | ***Inst_visit_low*** |
| *GPlant* | 0.037** | -0.045 | 0.128*** | 0.232*** | 0.026 | 0.149** |
| | (2.39) | (-1.00) | (3.30) | (2.64) | (0.43) | (2.27) |
| *Constant* | -3.515*** | -3.675*** | -1.576*** | -15.336*** | -3.566*** | -1.009 |
| | (-20.69) | (-4.83) | (-3.18) | (-14.06) | (-3.60) | (-1.13) |
| *Controls* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *company FE* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *Year FE* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *N* | 32917 | 10455 | 22462 | 12911 | 6378 | 6533 |
| $R^2$ | 0.159 | 0.281 | 0.302 | 0.156 | 0.292 | 0.284 |

In addition, the current research point out that institutional investors can not only directly observe the production activities, but also indirectly understand the real situation of companies through exchanges with employees, managers, and residents (Chen et al., 2024), which contributes to enhancing the EID quality (Wang et al., 2024). Simultaneously, the introduction of external supervision has also promoted companies to enhance the environmental governance level (Wang et al., 2025A).

Given the preceding analysis, this study employs the logarithm of the cumulative number of field surveys conducted by institutional investors in the current year as the proxy index of *Inst_visit* for institutional investors, splits them into two groups, high and low, based on the median value, and regression is performed on them. The regression findings presented in columns (4)--(6) of *Table 3* indicate that the selection of green plants significantly increases the number of field surveys conducted by institutional investors. The selection of green plants increases the number of field investigations of companies by institutional investors, and the strengthening of external supervision reduces the information asymmetry on the information demand side, increasing the pressure of external supervision, and driving companies to enhance the EID quality, which supports the hypothesis H2b.


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### *Regulatory mechanism analysis*

First of all, as an external force, public supervision serves as a crucial external factor in the environmental governance (Stupak et al., 2021). As people's awareness of environmental protection grows, companies tend to improve their environmental protection efforts in response to heightened public concern. The regression analysis presented in columns (1) and (2) of *Table 4* indicates that the coefficient of *GPlant* is notably positive in areas with high public environmental awareness (*high_Awareness*), while it is not significant in areas with low levels of public environmental awareness. This is because in areas with high levels of public environmental awareness, companies selected as green plants will receive extensive attention from society, their emission reduction and energy conservation are more positive, and the enhancement of EID quality is more pronounced.

***Table 4.*** *Regulatory mechanism analysis*

| Variables | *Envidq* | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | ***high_Awareness*** | ***low_Awareness*** | ***Regulation_high*** | ***Regulation_low*** |
| *GPlant* | 0.109* | 0.047 | 0.126** | 0.095 |
| | (1.73) | (0.98) | (2.15) | (1.49) |
| *Constant* | -2.148*** | -0.935 | -1.349** | -1.769** |
| | (-2.79) | (-1.09) | (-1.98) | (-2.33) |
| *Controls* | *Sure* | *Sure* | *Sure* | *Sure* |
| *company FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *Year FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *N* | 9177 | 9231 | 9912 | 10431 |
| $R^2$ | 0.191 | 0.223 | 0.251 | 0.231 |

Secondly, local governments, as the primary entity responsible for environmental supervision, determine the list of green plants and have the obligation to guide local companies to green transformation. Drawing from the environmental survey reports of 120 prefecture-level cities conducted by the "Institute of Public and Environmental Affairs" since 2008, this study derives the urban pollution source supervision information index to assess the extent of local environmental oversight. According to the median of the indicator, it is classified into two groups with high environmental regulation (*high_Regulation*) and low environmental regulation (*low_Regulation*). The regression results presented in columns (3) and (4) of *Table 4* indicate that the greater the local environmental supervision, the more significant the improvement in the EID quality in the region selected for the green plants' demonstration list. In summary, the creation of green plants under the supervision of all parties has a more significant effect on enhancing the EID quality, which supports the research hypothesis H3.

### *Heterogeneity analysis*

*Heterogeneity analysis based on company characteristics*

Due to the differences in the degree of supervision of different companies, the policy effect of green plants will also be different. Before the execution of the "GM demonstration construction project", the Chinese government promulgated regulations


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and laws for the EID for key polluters and heavily polluting industries, like the EID guidelines for listed companies and the "Environmental Protection Law", etc. Therefore, key pollutant-discharging companies in heavily polluting industries have received more attention as key supervision objects of national environmental protection departments (Lu et al., 2023). The companies have a high EID quality, so the promotion effect brought by the selection of green plants is small, and companies in non-key polluting industries expect to enhance the EID quality obtaining a better reputation. Therefore, the selection of green plants can enable companies to improve their environmental performance, thereby improving the EID quality.

Following the preceding analysis, this study identifies the key polluters by examining whether the listed company and its subsidiaries are included in the list of key polluters published by the environmental protection department in the annual report of the listed company. If the listed company and its subsidiaries are classified as major pollutant emitters and have disclosed their specific pollutant emission details, they are considered key pollutant discharge units and assigned a value of 1; otherwise, they are deemed non-key pollutant discharge units and assigned a value of 0. The regression results in columns (1)-(4) of *Table 5* are consistent with expectations, indicating that the quality improvement effect of EID in non-key pollutant discharge units and non-heavy polluting industries is more obvious.

***Table 5.*** *Heterogeneity analysis*

| Variables | (1) Key polluting companies | (2) Non-key polluting ones | (3) Heavy polluting industries | (4) Non-heavy polluting ones | (5) State-owned companies | (6) Non-state-owned ones | (7) Mandatory disclosure | (8) Voluntary disclosure |
|---|---|---|---|---|---|---|---|---|
| *GPlant* | 0.045<br>(1.61) | 0.132***<br>(2.71) | -0.051<br>(-0.98) | 0.136***<br>(3.45) | -0.069<br>(-1.45) | 0.181***<br>(4.28) | -0.009<br>(-0.14) | 0.119***<br>(3.32) |
| *Constant* | 0.951<br>(1.23) | -2.629***<br>(-5.95) | -2.166***<br>(-2.71) | -3.015***<br>(-6.53) | -3.686***<br>(-5.31) | -2.315***<br>(-4.41) | -5.565***<br>(-5.83) | -2.291***<br>(-5.23) |
| *Controls* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *company FE* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *Year FE* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *N* | 7604 | 25313 | 9872 | 23045 | 13050 | 19867 | 4801 | 28116 |
| $R^2$ | 0.059 | 0.227 | 0.325 | 0.301 | 0.298 | 0.299 | 0.329 | 0.308 |

Due to the nature of ownership, state-owned companies bear high social responsibilities, will promptly respond to the government's appeal, pay attention to their environmental performance, and are less likely to evade the responsibility of environmental protection and reduce the EID quality, and the information enhancement effect brought by the creation of green plants is not high (Feigin et al., 2023). Different from state-owned companies, non-state-owned companies are more likely to disclose environmental information in pursuit of their long-term economic objectives (Wang et al., 2025A). Actively embracing social responsibilities is of immense importance for the sustainable development of companies, improve company reputation, attract investors' attention, and obtain lower financing costs. Therefore, the enhancement in the EID quality of non-state-owned companies is more obvious. Based on the preceding analysis, the samples are categorized into state-owned and non-state-owned companies, and the


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distinct influence of varying ownership types is examined. The regression outcomes in columns (5) and (6) of *Table 5* reveal that the *GPlant* coefficient of the non-state-owned company group stands at 0.181, with significance at the 1% level, whereas the *GPlant* coefficient of the state-owned company group lacks significance. This suggests that the "GM demonstration construction project" exerts a more notable impact on enhancing the EID quality of non-state-owned companies. According to the stakeholder theory, companies with inadequate environmental performance (such as companies in heavily polluting industries, etc.) are incentivized to enhance the EID quality due to the mandatory disclosure requirements, to alter stakeholders' perception of their environmental performance, increase social recognition, and reduce the supervision intensity of environmental protection departments. According to the voluntary disclosure theory, non-mandatory disclosure companies have better environmental performance, and to maintain their environmental performance advantages, such companies are more motivated to improve the EID quality (Sun et al., 2025).

At present, China only requires mandatory EID and social responsibility reports for the "Shenzhen 100 Index" companies of the "Shenzhen Stock Exchange" and the "Shanghai Companies Governance Sector" companies of the "Shanghai Stock Exchange", domestic and foreign listed and financial companies. This paper categorizes the sample into two groups based on the published company lists of the "Shenzhen 100 Index" and "Shanghai Companies Governance Sector" of the "Shenzhen Stock Exchange" (Wang et al., 2025B). Those on the list are mandatory disclosure companies, while the rest are considered voluntary disclosure ones. The regression results for the sub-sample are presented in columns (7) and (8) of *Table 5*. The selection of green plants notably enhances the company's incentive to voluntarily disclose its environmental information.

*Heterogeneity analysis based on green plant characteristics*

Because the companies selected as green plants have to a certain extent obtained the policy support of the government departments, such as environmental protection inspection exemption, etc. Therefore, companies selected as green plants have speculative behavior under self-interested motives. To identify the difference in motivation of companies selected as green plants, this study takes six times of "GM demonstration construction project" application time interval as the identification factor and regards the companies selected as green plants with longer application time intervals as having speculative motivation. According to the time of document issuance by Chinese government departments, the time of publication of selection documents, and the time when local governments reported the list of green plants, the interval of days between the two is used to measure the selection time of green plants, and it interacts with *GPlant*. The regression outcomes are presented in column (1) of *Table 6*. According to the data disclosed by the "Environmental Protection Service Center", it is found that some companies have a large number of environmental violation records after being selected as green plants, which is a speculative behavior under selfish motives, and will not enhance the EID quality.

Due to above, this study uses companies' environmental violation record data (*Violation_Env*) to interact with *GPlant*, and the regression outcomes are presented in column (2) of *Table 6*. The interaction results in columns (1) and (2) are both remarkably negative, suggesting that the selection of non-speculative companies in green plants has a more pronounced impact on enhancing the EID quality. In addition, according to whether the companies selected as green plants are listed ones, if the green plant is a listed


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company, the parent is 1, otherwise, it is 0. The results in column (3) of *Table 6* indicate that if the green plant is a listed company, it has a more pronounced impact on enhancing the EID quality after being selected.

***Table 6.*** *Heterogeneity analysis of green plant*

| ***Variables*** | **(1)** | **(2)** | **(3)** |
|---|---|---|---|
| | ***Envidq*** | ***Envidq*** | ***Envidq*** |
| *GPlant×ApplyDur* | -0.078** (-2.19) | | |
| *GPlant×Violation_Env* | | -0.181*** (-3.91) | |
| *GPlant×Parent* | | | 0.093** (2.19) |
| *GPlant* | 0.329** (2.30) | 0.109*** (4.71) | 0.049** (2.31) |
| *Constant* | -2.061*** (-4.79) | -2.646*** (-11.39) | -2.657*** (-11.51) |
| *Controls* | *Sure* | *Sure* | *Sure* |
| *company FE* | *Sure* | *Sure* | *Sure* |
| *Year FE* | *Sure* | *Sure* | *Sure* |
| *N* | 15817 | 32917 | 32917 |
| $R^2$ | 0.117 | 0.307 | 0.306 |

## Extended analysis of economic consequences

### *Analysis of economic consequences from the perspective of the company*

The establishment of green plants holds immense practical importance in achieving clean production, utilizing waste resources, and promoting low-carbon energy use, while also enhancing the management capabilities of GM. As a crucial method for investors and the public to access company information, EID can remarkably reduce the information asymmetry between stakeholders and managers and enhance the external financing conditions (Zhang et al., 2024). The reputation established by high-quality EID can expand cooperation channels for companies and help them obtain more financial support from financial institutions and government departments (Pan and Lin, 2025). Enhancing the EID quality can also reduce the company's environmental violations, reduce the cost of monitoring violations, and stabilize the business environment. In addition, the EID quality is also a crucial element influencing the evaluation of rating agencies (Zhang et al., 2022). The improvement of the quality of EID helps companies to obtain a higher ESG rating (Wang et al., 2024).

It can be seen that the coefficients of the core explanatory variable *γEnvidq* in *Table 7* are all remarkably positive, indicating that the quality improvement of EID caused by the selection of green plants can bring better economic consequences to companies.

### *Spillover effect analysis from supply chain perspective*

To explore whether "GM demonstration construction project" has green spillover effect on suppliers through the supply chain network, the data set is constructed regarding Li et al. (2022) on suppliers, customers, and years. Since the creation of green plants pays attention to clean production, and GM requires companies to produce green products, this study takes whether the supplier provides green product (*GreenProduct*) as the explained


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variable (Sun et al., 2024), that is, whether the company has developed and applied environmental protection products, equipment or technology. If there is, it is 1; if not, it is 0. The regression results of the green spillover effect of "GM demonstration construction project" implementation on suppliers are shown in Panel A of *Table 8*. Among them, columns (1) and (4) are regression results using the panel fixed effect and panel logit model, respectively. If the suppliers also have green plants, this interferes with the results, and column (2) indicates the regression overcomes after excluding such green plants.

***Table 7.*** *Economic results analysis*

| ***Variables*** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
|---|---|---|---|---|---|---|
| | ***Innovation1*** $_{t+1}$ | ***Innovation2*** $_{t+1}$ | ***Greeninnov1*** $_{t+1}$ | ***Greeninnov2*** $_{t+1}$ | ***ESG_hz*** $_{t+1}$ | ***ESG_shang*** $_{t+1}$ |
| *γEnvidq* | 2.551*** | 1.591** | 2.128*** | 0.441* | 2.891*** | 2.109** |
| | (4.39) | (2.44) | (2.73) | (1.71) | (4.03) | (2.05) |
| *GPlant* | -7.159*** | -6.351*** | -4.105*** | 0.059 | 4.291*** | -3.329* |
| | (-11.31) | (-9.77) | (-5.21) | (0.23) | (7.24) | (-1.90) |
| *Constant* | -7.159*** | -6.351*** | -4.105*** | 0.061 | 4.290*** | -3.331* |
| | (-11.29) | (-9.78) | (-5.21) | (0.23) | (7.24) | (-1.86) |
| *Controls* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *company FE* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *Year FE* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* | *Sure* |
| *N* | 22197 | 22487 | 11084 | 11084 | 23661 | 3688 |
| $R^2$ | 0.418 | 0.339 | 0.171 | 0.231 | 0.071 | 0.244 |

***Table 8.*** *Spillover effect analysis from supply chain*

| **Panel A: Spillover effect of selected green plants on companies in the supply chain** | | | | |
|---|---|---|---|---|
| ***Variables*** | ***GreenProduct*** | | | |
| | **(1)** | **(2)** | **(3)** | **(4)** |
| *GPlant* | 0.321*** | 0.298* | 0.486*** | 2.320** |
| | (2.69) | (1.91) | (3.10) | (1.96) |
| *Controls* | *Sure* | *Sure* | *Sure* | *Sure* |
| *company FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *Year FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *N* | 831 | 486 | 359 | 351 |
| $R^2$ | 0.230 | 0.322 | 0.309 | |
| **Panel B: The differentiated influence of inter-company dependence on spillover effect in supply chain** | | | | |
| ***Variables*** | ***GreenProduct*** | | | |
| | **(1)** | **(2)** | **(3)** | **(4)** |
| | ***Depend_high*** | ***Depend_low*** | ***YL_high*** | ***YL_low*** |
| *GPlant* | 0.481*** | 0.021 | 0.441*** | 0.049 |
| | (3.07) | (0.09) | (3.38) | (0.21) |
| *Controls* | *Sure* | *Sure* | *Sure* | *Sure* |
| *company FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *Year FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *N* | 406 | 339 | 439 | 378 |
| $R^2$ | 0.275 | 0.299 | 0.392 | 0.311 |


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In addition, since whether a customer is selected as a green plant has a certain lag effect on the supplier's decision (Yang and Jiang, 2023), column (3) shows the regression overcomes of all explanatory variables with a lag of one stage. The above results show that the choice of "GM demonstration construction project" remarkably enhances the possibility of suppliers to provide environmentally friendly products.

Previous studies have shown that the greater the dependence between companies in the supply chain, the lower the supplier-customer substitution, and the termination of cooperation will exert a more significant adverse effect on both parties (Zou et al., 2024). Therefore, the higher the supplier-customer dependence, the stronger the spillover effect. Therefore, this study uses the proportion of major suppliers (*purchasing*) or customers (*sales*) transaction volume"the current year's earnings from operations (*Depend*) and the proportion of maximum transaction volume in the current year's operating income (*YL*) to measure the supplier-customer relationship dependence, and divides it into high and low groups based on the median value. The regression results of the influence of supplier-customer relationship dependence on the green spillover effect are shown in Panel B in *Table 8*. The regression results show that the higher the supplier-customer relationship dependence, the more obvious the green spillover effect.

### *Ecological consequences analysis from a regional perspective*

The results in *Table 9* indicate that the EID quality caused by the selection of green plants has been improved, and the carbon emission level, industrial sulfur dioxide emission level, and haze pollution level of the city have been reduced, indicating that the selection of green plants has significant environmental spillover effect.

***Table 9.*** *Environmental spillover effect at the regional level*

| ***Variables*** | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| | ***carbonem1*** | ***carbonem2*** | ***ln $SO_2$*** | ***pm2.5*** |
| *γEnvidq_citymean* | -0.330*** | -0.095*** | -1.195*** | -0.099*** |
| | (-33.81) | (-10.81) | (-54.41) | (-21.09) |
| *Constant* | 4.686*** | 5.109*** | 9.189*** | 3.862*** |
| | (64.11) | (98.49) | (85.41) | (286.19) |
| *Controls* | *Sure* | *Sure* | *Sure* | *Sure* |
| *Year FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *Province FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *City FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *Industry FE* | *Sure* | *Sure* | *Sure* | *Sure* |
| *N* | 20786 | 20786 | 20786 | 20786 |
| $R^2$ | 0.721 | 0.564 | 0.821 | 0.761 |

## Discussion

This study investigates the impact of China's Green Manufacturing (GM) demonstration project on corporate environmental information disclosure (EID), revealing three key findings. First, GM significantly enhances the quality of EID, with non-key polluters and non-state-owned enterprises demonstrating more pronounced effects. This finding aligns with signal transmission theory: green-certified enterprises leverage EID to differentiate themselves and attract green investors. For instance, the selection of green manufacturers reduces information asymmetry, thereby prompting


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companies to proactively disclose environmental performance to build trust with stakeholders.

Second, the mechanism analysis shows that GM improves EID through two pathways: internal pollution reduction and external supervision. Green plants adopt clean production technologies and resource recycling mechanisms, which not only reduce emissions but also create a positive feedback loop for transparent disclosure. Meanwhile, increased attention from green investors and institutional investors' field visits further drive the quality of EID. This is consistent with stakeholder theory, as external pressures from investors and the public compel companies to enhance transparency.

Third, the study uncovers significant spillover effects. Improved EID by green firms (not "plants") not only promotes corporate green innovation and ESG performance but also drives green transformations in supply chain companies and enhances regional environmental quality. For instance, suppliers of green firms are more likely to develop eco-friendly products, and cities with green firms exhibit reduced carbon emissions and haze pollution. This highlights the critical role of voluntary environmental regulations in achieving systemic sustainability.

Notably, the effectiveness of GM is contingent on public environmental awareness and local regulatory strictness. In regions with high awareness and strict regulations, green plants face stronger incentives to maintain high-quality EID, which underscores the importance of supportive policy environments. These findings provide empirical support for constructing a differentiated EID framework and strengthening voluntary environmental governance mechanisms in China.

## Conclusions

Taking into account the aforementioned research findings, this paper draws the following conclusions for the enhancement of the EID quality of Chinese companies and the construction of GM systems.

First, more polluting companies will be included in the EID system, and a comprehensive mandatory disclosure system and a long-term environmental protection management mechanism will be established. The government should further improve the incentive mechanism of companies, optimize the top-level design, establish an information disclosure rating evaluation system, provide preferential interest rate loans for companies that implement green transformation, and simplify the handling of ecological and environmental administrative and pollutant discharge permits. In addition, more feedback channels will be set up to encourage objective media reports, and external supervision of companies' emission reduction and energy conservation will be increased through the combination of government supervision, public participation, and media reports.

Second, the government should issue more voluntary environmental regulations to encourage companies to disclose environmental information and improve the EID quality. Companies with a high level of EID should continue to improve their environmental performance, improve their ESG governance structure, transition to low-carbon environmental protection, reduce regulatory risks, and enhance their value and market competitiveness. Companies with low disclosure quality should improve their internal control and data management systems to improve their environmental performance in the production process.


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Third, local governments should reject the temptation to protect economic development and abandon environmental control. The higher level of local environmental protection supervision helps to improve the environmental performance and quality of disclosure of companies and also helps to reduce the violation of environmental regulations by companies. The incentive measures should be put forward for listed companies that are selected as "GM demonstration construction project", and preferential policies should be limited for listed companies that violate regulations and discharge pollution.

Fourth, investors and the public should continuously raise their awareness of environmental protection, and the government should broaden the channels for participating in environmental supervision. Investors should dare to supervise and complain about environmental violations of companies. The government should increase the severity of punishment for violations of EID. Financial institutions should cooperate with companies on environmental and climate information disclosure. Through multi-sectoral collaboration, the government will carry out green credit policies, encourage companies to enhance the transparency of environmental information, and provide reliable support for green finance and sustainable investment.

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