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Analyses of Topical Policy Issues

Green mergers and acquisitions and corporate environmental responsibility: Substantial transformation or strategic arbitrage?

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ABSTRACT

Green mergers and acquisitions (GM&A) are pivotal for attaining green competitive advantages and fostering sustainable development. This study exploits data from Chinese publicly traded companies spanning 2010–2021 to examine the impact of GM&A on corporate environmental responsibility (CER). Utilizing a difference-in-differences design, the results document that GM&A significantly enhances firms' environmental responsibility. This conclusion remains robust after a comprehensive set of checks. GM&A spurs green technology innovation, eases financial constraints, and elevates corporate environmental awareness, thus mitigating environmental pollution. Additionally, the positive impact of GM&A on CER is particularly pronounced in regions with high market liberalization and firms with substantial social capital. These findings offer valuable insights for policymakers crafting GM&A policies to raise environmental quality and contribute to the literature on the relationship between GM&A and CER.

1. Introduction

Contemporary manufacturing technologies incentivize industrial advancement and the rapidly evolving global economy, but they also generate considerable environmental externalities, posing substantial challenges for pollutant abatement, particularly in emerging developing countries (Amore and Bennedsen, 2016; Hettige et al., 2000; Wahba, 2008). A wealth of evidence associates severe environmental pollution with global warming (Bose, 2010; Sueyoshi and Yuan, 2015) and adverse health conditions (Giri et al., 2023; Shi et al., 2023), which draws widespread public attention. Consequently, combating pollution and boosting the environment have emerged as critical global concerns. In essence, plant production dramatically contributes to environmental pollution. Mitigating corporate pollutant emissions is crucial for addressing environmental threats. Among environmental practices, green mergers and acquisitions (GM&A) play a vital role in rapidly boosting corporate environmental responsibility (CER), acting as a catalyst for enhancing green innovation capacity and facilitating green development. For this reason, it is essential to examine the impact of GM&A on CER to diminish emissions and amplify the ecological environment.

GM&A refers to corporate investment practices to acquire external green technologies and protect the surroundings (Lu, 2021; Sun et al., 2023). From a theoretical standpoint, GM&A offers several advantages. First, they facilitate the adoption of green innovation technologies, enhancing pollution control capabilities and fostering eco-friendly innovation. Second, GM&A mitigates information gaps, signaling commitment to green advancement to stakeholders such as government agencies and financial institutions, thereby

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easing corporate financing constraints. Finally, GM&A boosts employee environmental awareness, promoting resource conservation and environmental protection in business operations. In the practical sense, a large body of literature has explored the response of GM&A to corporate governance, including environmental protection investment (Lu, 2021), corporate transformation (Zhang et al., 2022), and green innovation (Liang et al., 2022). However, the impact of GM&A on CER, a fundamental means of acquiring green technologies, has garnered somewhat less attention in research.

Considering the momentous role of GM&A, this paper explores whether and how GM&A affects CER. Specifically, this paper exploits the difference-in-differences (DID) design for identification, employing data from Chinese publicly traded firms spanning the period from 2010 to 2021. Moreover, this study explores the role of free-market institutions and corporate social capital in mitigating environmental pollution via GM&A. As the world's second-largest economy, China demonstrates highly active M&A activities, providing a robust dataset of GM&A that raises the reliability of our results. Furthermore, the diversity of China's financial market, characterized by different stages of development, regional variations, and industry distributions, broadens the applicability of our research findings through the use of Chinese GM&A data for empirical analysis.

This paper makes several contributions to the existing literature. First, it employs the DID strategy to capture the overall effect of GM&A on CER, effectively mitigating endogeneity concerns. While ample literature prevalently relies on traditional panel models to examine the linkage between GM&A and corporate governance, it fails to adequately address unobserved confounding variables (Liang et al., 2022). In contrast, this paper takes advantage of the DID approach for identification, treating GM&A as a quasi-natural experiment. This method allows for a clearer understanding of the response of GM&A to CER, offering valuable empirical insights for future research in this area.

Second, this paper enriches the literature by investigating the factors that affect the relationship between GM&A and CER. Current studies primarily concentrate on internal factors such as CEO age and company features (Liang et al., 2022; Lu, 2022), lacking exploration of external characteristics. To our best knowledge, we are the first to investigate the role of the external market environment in the relationship between GM&A and CER. More importantly, we conduct an analysis of the role of corporate social capital, shedding light on how GM&A boosts environmental performance.

Finally, this paper expands the discussion of potential channels for the impact of GM&A on CER. Abundant literature validates the channels of technological innovation in GM&A, such as Sun et al. (2023), who documented that GM&A predominantly amplifies technological innovation to enhance corporate governance. Together with technological innovation, this paper substantiates that GM&A alleviates financing constraints by reducing information asymmetries with stakeholders. In addition, GM&A raises corporate environmental awareness and provides opportunities for comprehensive green management as well. In summary, these findings provide empirical evidence for policymakers to incentivize GM&A.

The remainder of the paper is organized as follows: Section 2 reviews the literature and formulates hypotheses. Section 3 outlines the empirical framework and datasets. Section 4 presents empirical results, including benchmarks, heterogeneity, and channel-related discussions. Section 5 concludes the findings and offers policy recommendations.

2. Literature review and hypothesis development

2.1. Literature review

2.1.1. Green management measures and CER

Corporate environmental responsibility (CER) involves voluntarily integrating ecological initiatives into business operations, beyond legal obligations, to meet stakeholders' environmental responsibilities (Chen et al., 2021a; Gao et al., 2019; Li et al., 2022b; Wahba, 2008; Zhang, 2017). Joseph (2001) argued that institutional, ethical, and economic forces collectively promote CER. Broadly speaking, scholars contend that CER is subject to a combination of both external and internal factors.

In terms of external factors, institutional pressure plays a crucial role in affecting CSR, including environmental taxes, mandatory disclosure, and penalties. Liu et al. (2021) employed a difference-in-differences setup (DID) to assess the impact of mandatory CSR disclosure policies on CER and conclude that they raise the fulfillment of CER. Hu et al. (2022) utilized a similar design and observed substantial CER improvement in regulated industries. Furthermore, firms facing environmental violation penalties exhibit enhanced subsequent CER practices (Li et al., 2022b). In the context of imperfect competition, Bárcena-Ruiz and Sagasta (2022) discovered that government-imposed environmental taxes stimulate firms to adopt environmental corporate social responsibility. Informal institutional pressure also augments CER. In their study, Chen et al. (2021a) revealed that religion serves to amplify the positive impact of CER by reducing unit energy consumption and promoting local pollution prevention. Chen et al. (2022), utilizing a difference-in-differences design, assessed the impact of anti-corruption measures on CER performance. Their findings suggest that robust anti-corruption initiatives dramatically upgrade CER performance, particularly among state-owned and locally government-owned entities.

Apart from institutional pressures, stakeholder governance shapes CER as well. Zhu and Lu (2020) explored the response of family ownership to CER investment, finding that concentrated family ownership correlates with reduced CER expenditure (Chen et al., 2021b; Wang and Le, 2022). However, when institutional investments originate from developed markets, this relationship is reversed due to external constraints (Shi et al., 2019). Furthermore, state subsidies exhibit a positive association with environmental spending (Wang and Zhang, 2020), implying that firms receiving government subsidies are more inclined towards environmentally responsible behavior (Chen et al., 2023a). Examining related party transactions, Choi et al. (2022) observed that firms engaging in more of these transactions tend to produce controversial environmental reports and achieve fewer emissions reductions. This effect is pronounced among firms with high cash flow sensitivity and low ESG scores. Shifting the focus to peer-investees, Dong et al. (2023) documented that the CER practices of investee peers positively influence a focal firm's CER efforts, leading to increased CER investment in response to greater commitments from peer-investee firms.

2.1.2. Impact of M&A on industrial enterprises

Regarding firms' motivations for M&A, a considerable amount of literature has concluded that M&A driven by rational objectives enables access to technologies, resources, and market positions not currently available (Yaghoubi et al., 2016).

The M&A activity is accompanied by two primary drivers. First, M&A serves as a catalyst for green innovation (Phillips and Zhdanov, 2013). It facilitates the acquisition of complementary innovation resources and expands knowledge reservoirs, consequently reducing the costs and risks of innovation (Calipha et al., 2010; Stiebale, 2013). Moreover, M&A fosters economies of scale and scope in R&D, thereby augmenting innovation capabilities (Lee, 2017; Zhang et al., 2018). Numerous empirical studies have affirmed that M&A raises innovation capacity, with a more pronounced impact in the long run. Hsu et al. (2021) documented that firms from low-innovation countries generate more patents and increase their investment in research and development (R&D) following M&A. Building on organizational learning theory, Bhussar et al. (2022) found that firms harness advanced knowledge creation as a response to technological adjustments via M&A. Second, M&A mitigates corporate financing constraints. By restructuring via M&A, plants establish internal capital markets that efficiently allocate funds, raise capital turnover rates, and offer access to a variety of capital sources. De Bodt et al. (2022) observed that M&A activities elevate a firm's debt value, thereby strengthening its capacity to raise capital and reducing financial risk. Empirical evidence by Ghosh and Jain (2000) indicates a noteworthy rise in firms' financial leverage following M&A transactions, along with an expansion of their debt capacity compared to pre-merger levels for the merging entities.

The alternative literature explores the effects of M&A on firm performance, with a predominant focus on financial dimensions. Corporate M&A performance has traditionally been evaluated using financial metrics such as Tobin's Q, return on assets, and return on net assets, which gauge the economic consequences of M&A restructuring (Hitt et al., 1998). Dos Santos et al. (2008), Akben-Selcuk (2015), and Li et al. (2016) documented that shareholders participating in M&A activities generally experience positive and statistically significant cumulative abnormal returns, particularly in cross-border transactions. Some studies have also scrutinized M&A performance through the lens of capital market outcomes (Khanal et al., 2014). Tao et al. (2017) investigated stock market reactions to cross-border M&A announcements and observed a favorable stock market response, indicating a substantial wealth effect for both acquiring firms and their shareholders (Fatemi et al., 2017).

In essence, merely assessing financial and capital market performance falls short of capturing the comprehensive implications of M&A. The growing emphasis on synergy between environmental stewardship and economic advancement has prompted scholars to integrate environmental performance into the analysis of corporate M&A behavior. With GM&A emerging as a distinct approach, recent research trends in this domain, summarized in Table 1, emphasize environmental investment, green innovation, and export expansion. However, there remains a notable gap in the literature concerning the impact of GM&A on environmental enhancement, which this paper aims to address. Furthermore, while considerable attention has been devoted to the economic ramifications of M&A, relatively few studies have specifically examined GM&A. It is imperative to recognize that GM&A differs from conventional M&A, and its implications for firms extend beyond the economic sphere, necessitating a comprehensive investigation that accounts for its unique features.

Table 1
Literature on GM&A.

Research	Empirical design	Factors of impacting GM&A	Outcomes of GM&A	Findings
Lu (2021)	Empirical, 2008–2018 Chinese listed company.		Environmental protection investment	Cross-border GM&A exerts a positive and statistically significant influence on CSR, encompassing four specific dimensions: corporate governance, employee relations, environmental protection, and product quality.
Lu (2022)	Empirical, 2008–2018 Chinese listed company.		Export expansion	GM&A has the potential to enhance export performance via mechanisms such as fostering green innovation, accessing government subsidies, and bolstering bank financing capacity. Conversely, it may also diminish export performance by elevating environmental governance costs.
Liang et al. (2022)	Empirical, 2010–2018 Chinese listed company.		Green innovation	GM&A by heavily polluting enterprises serves as a catalyst for green innovation, particularly when supported by government subsidies.
Zhang et al. (2022b)	Fuzzy-set qualitative comparative analysis (fsQCA)		Green innovation performance	The substantial performance in green technology innovation following GM&A involving heavily polluting enterprises arises from various contributing factors.
Liu et al. (2022)	Empirical, 2008–2019 Chinese heavily polluting firms.	Investors' GM&A preferences		Heavily polluting firms exhibit a preference for engaging in GM&A when investors assign a higher premium to such transactions. Moreover, this relationship is time-varying, consistent with the catering effect.
Hu et al. (2022)	Empirical	Environmental tax policy		Environmental tax policies exert a positive influence on the promotion of GM&A among heavily polluting firms. Furthermore, the impact of environmental taxes is moderated by various firm-specific, industry-specific, and regional features.

2.2. Hypothesis development

2.2.1. GM&A and CER

GM&A contributes to raising corporate environmental performance via various avenues. First, GM&A enhances the capacity of green technology innovation by granting access to green technologies without undergoing the lengthy and high-risk process of R&D. This circumvents technological bottlenecks associated with green innovation (Chen, 2008; Huang and Li, 2017; Wong et al., 2020). Enterprises integrate these acquired green technologies into their production processes, thereby curbing environmental harm caused by pollutants at the source. This strategy not only elevates environmental standing but also fosters green competitive advantages. Furthermore, successful GM&A transactions amalgamate complementary innovation resources from both parties involved, augmenting the efficiency of green technologies such as recycling and pollution control (Li et al., 2020; Li, 2022; Liu et al., 2023b). This enhanced efficiency boosts the capacity for pollutant treatment and aids in mitigating the adverse effects of pollutant emissions on the environment.

Second, GM&A alleviates corporate financing constraints. According to signal theory, GM&A serves as a favorable signal of commitment to green development and active adherence to CER, thereby reducing information asymmetry between governments and financial institutions. On the one hand, GM&A facilitates government approval and access to scarce government resources, including direct financial subsidies (Chen et al., 2023b; Li et al., 2020; Zhao et al., 2024). Lu (2021) underscores that companies engaged in GM&A often receive more support compared to conventional M&A transactions when seeking credit financing and awaiting government administrative approvals. This, to some extent, enhances corporate cash flow via implicit time value and explicit tax benefits. On the other hand, GM&A bridges information gaps between enterprises and financial institutions, augmenting financing capacity, lowering financing costs, and ensuring sufficient resource availability for corporate environmental governance. Lu (2022) posited that GM&A conveys favorable signals to market investors and, particularly for institutional investors, strengthens companies' debt financing capabilities.

Finally, GM&A boosts corporate awareness of green management. In addition to gaining access to green market resources and marketing channels, GM&A fosters the adoption of environmentally conscious management practices by the acquired entities. This, in turn, elevates the company's vigilance towards environmental management (Berchicci et al., 2012; Vastola and Russo, 2021). Motivated by a commitment to environmental preservation, corporate executives typically intensify employee training in environmental conservation, embedding principles of green and sustainable production. Particularly concerning pollution control, which aligns with CER, corporate leaders frequently reinforce internal environmental regulations within production areas. They also proactively disclose environmental information to preempt negative media coverage or government criticism, safeguarding the company's public image. Sun et al. (2023) suggested that companies undergoing GM&A experience a substantial increase in environmentally friendly culture (Zhao and Jia, 2022), fostering employees' sense of environmental responsibility and integrating environmental protection into the organizational fabric. In summary, this paper posits Hypothesis 1:

H1: GM&A elevates CER.

H1–1: GM&A enhances firms' green innovation, thereby strengthening CER.

H1–2: GM&A improves CER by easing financing constraints.

H1–3: GM&A boosts corporate environmental awareness, thus enhancing CER.

2.2.2. The impact of institutional environment

Institutional economic theory underscores the market as a pivotal governance mechanism for resource allocation. As noted by Li (2022), the degree of marketization at the regional level significantly influences the efficacy of GM&A (Sun et al., 2023). In regions characterized by market orientation, GM&A is incentivized, as legal protections can safeguard green technology innovations acquired through such transactions. Additionally, intensified market competition impels enterprises to pursue GM&A as a means to swiftly enhance their capabilities in green development by accessing green production technology. Conversely, regions with robust marketization alleviate financing constraints associated with GM&A. The escalation in marketization signifies enhanced financial development and a conducive business environment, furnishing companies involved in GM&A with diversified financing options and reduced financing costs via competitive mechanisms. Moreover, deeply market-oriented regions typically offer equitable and transparent government policy support, reflecting strong service awareness. Consequently, this diminishes the institutional transaction costs of GM&A. In summary, we posit Hypothesis 2:

H2: The level of regional marketization affects the effectiveness of GM&A.

2.2.3. The impact of social capital

In situations where the market price mechanism is imperfect, enterprises often rely on social relationships to facilitate transactions. The presence of social capital across enterprises mitigates the costs associated with GM&A and aids in post-merger integration. On the one hand, corporate social capital helps alleviate financing constraints. Enterprises with extensive social networks have broader access to financing and financing channels, facilitating the procurement of capital resources and thereby reducing financing constraints in GM&A. Additionally, firms with close government ties can leverage policy resources, including financial subsidies and approvals for GM&A, which can expedite administrative processes and save time (Teegen, 2003). On the other hand, possessing social capital tends to foster self-restraint and encourage a focus on positive environmental responsibility following GM&A. Enterprises that neglect environmental protection in GM&A risk damaging their relationships with governments and financial institutions, attracting scrutiny from investors, regulators, and the media, leading to significant reputational damage. Petrick and Quinn (2001) illustrated that highly educated executives are often perceived as having higher ethical standards and integrity (Berger et al., 2014), making them more inclined to take responsibility for environmental governance to safeguard their reputation. By and large, this study proposes the following assumption:

H3: Corporate social capital contributes to lowering the costs of GM&A and fostering positive environmental responsibility.

In conclusion, Fig. 1 depicts the theoretical analysis framework of this paper.

3. Empirical framework

3.1. Empirical specification

Similar to Lu (2022) and Zhang et al. (2023a), this paper treats GM&A as a quasi-natural experiment and employs a DID strategy for identification. In this framework, firms undergoing GM&A constitute the experimental group, while those not involved in GM&A act as the control group. This paper develops the following econometric specifications:

$$CER_{i,t} = \beta_0 + \beta_1 Greenma_{i,t} + \beta_2 MAyear_{i,t} + \beta_3 Greenma_{i,t} \times MAyear_{i,t} + \sum\nolimits_{j=1}^{k} \lambda_j X + \mu_i + \gamma_t + \varepsilon_{i,t} \tag{1}$$

Where i and t represent firm and year, respectively. *CER* is corporate environmental responsibility (CER), as measured by *Enpro* and *Envres*. *Greenma* signifies GM&A, taking the value of 1 if firms engage in GM&A activities during a year and 0 otherwise. *MAyear* corresponds to the year in which the Opinions of the State Council on Further Optimizing the Market Environment for Corporate Mergers and Reorganizations were issued, reflecting efforts to upgrade environmental governance. If GM&A occurs after 2014, *MAyear* takes the value of 1; otherwise, it is 0. The interaction item *Greenma*×*MAyear* is the variable of interest, with β_3 indicating the impact of GM&A on CER. X stands for a set of control variables. μ and γ are firm- and year-fixed effects, respectively. ε is the error term. Variable definitions are provided in the appendix.

3.2. Variable measurement

3.2.1. Corporate environmental responsibility

Corporate environmental responsibility (CER) denotes a firm's dedication to mitigating environmental pollution in its production and operations while concurrently pursuing economic interests. This paper assesses CER via a comprehensive index derived from the Hexun Corporate Social Responsibility Evaluation System (*Enpro*), in line with the methodology adopted in prior literature (Shi et al., 2019). Additionally, this paper gauges CER based on environmental awareness, environmental construction, and environmental impact, adhering to the framework proposed by Chen et al. (2021b). The specific indicators for quantifying CER (*Envres*) are delineated in Table 2, with their scores aggregated using an equal-weight assignment method.

Fig. 2 illustrates the evolution of CER across Chinese provinces from 2010 to 2021. Overall, China's publicly traded companies have been consistently enhancing their environmental performance. Among the provinces, Shanghai, Fujian, Tianjin, and Beijing have exhibited strong environmental governance, whereas those in western China, such as Nei Monggol, Shanxi, Ningxia, and Heilongjiang, have shown relatively lower performance. Notably, CER shows a significant increase after 2014, contrasting with the trend before that year. Additionally, subfigure (i) within Fig. 2 highlights the prevalence of zero values in the Hexun database, underscoring the importance of utilizing comprehensive indicators to construct the CER index.

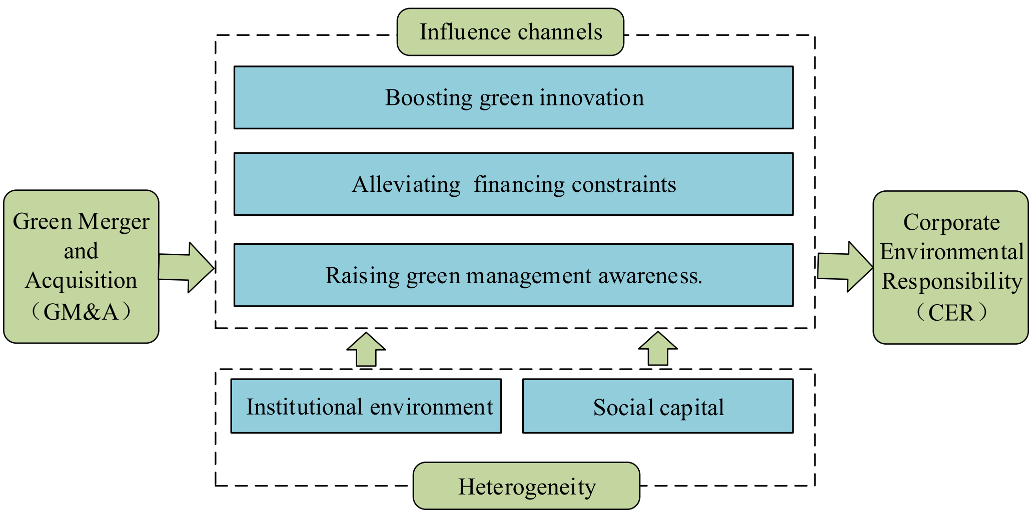
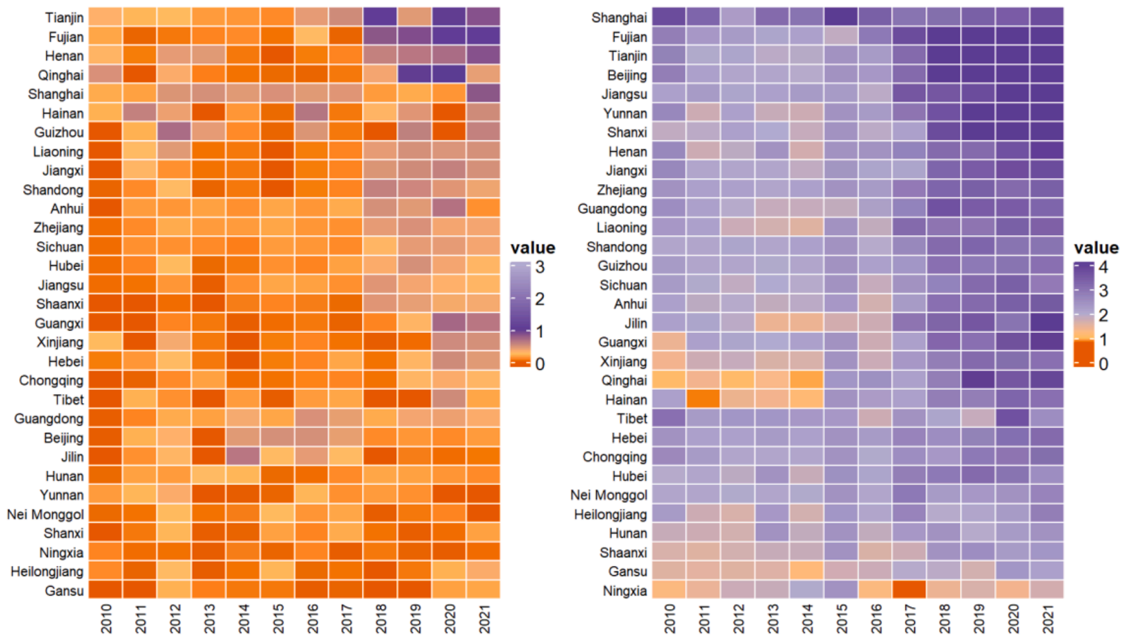


Fig. 1. Analytical framework.

Table 2
Measuring CER engagement.

Dimension	No.	Indicator	Attribution
Environmental Awareness	1	Whether to explain the concept of environmental responsibility and values.	Positive
	2	Whether environmental violations occur during the year.	Negative
	3	Whether measures are taken to prevent pollution in the project design and construction.	Positive
	4	Whether a company's environmental information is verified by third-party organizations.	Positive
Environmental Construction	1	Whether to establish environmental departments.	Positive
	2	Whether to produce environmental management systems.	Positive
	3	Whether to implement the ISO 14,001 environmental management standard.	Positive
	4	Whether to conduct environmental protection education and training for employees.	Positive
Environmental impact	1	Whether to receive environmental recognition or other positive environmental evaluation.	Positive
	2	Whether environmental petitions occur in light of environmental degradation.	Negative
	3	Whether the occurrence of major environmental pollution incidents.	Negative

Notes: In light of positive indicators, if answers are true, then take 1, otherwise take 0, and the opposite for negative indicators. The CER score is calculated using the following specifications: $Envres_{it} = \sum_{k=1}^{11} Indicator_{itk}$, where *Indicator* denotes the indicator for firm *i* in year *t* and dimension *k*. *Envres* is the final value of CER. Additionally, the data is obtained from annual corporate reports.



(i) Explained variable: *Enpro* (ii) Explained variable: *Envres*

Fig. 2. Distribution of CER.
Notes: The data in Fig. 2 is obtained by calculating the mean values of *Enpro* and *Envres* with regard to provinces and years, respectively. A light color means poor corporate environmental management, while a dark color, such as red, is the opposite.

3.2.2. Green mergers and acquisitions

Green mergers and acquisitions (GM&A) refer to investment activities aimed at acquiring technologies that advance energy efficiency, diminish emissions, and enhance environmental protection. To identify GM&A events, this paper manually collects M&A announcements from publicly traded companies listed in the Shanghai and Shenzhen A-share markets. Text analysis techniques are employed to construct a dummy variable (*Greenma*). More precisely, when M&A announcements contain text related to energy-saving, emission-reduction technologies, or green development, *Greenma* is assigned a value of 1; otherwise, it receives a value of 0.

3.2.3. Control variables

Following Zhang et al. (2018) and Lu (2021), this paper controls for various variables, including enterprise size (*Lnasset*), financial leverage (*Lev*), earnings capacity (*Roe*), debt service capacity (*Cash*), firm age (*Age*), equity structure (*First*), board governance (*Lndir, Indep*), external oversight (*Big4*), and industry competition (*Herfindahl*). All these variables are defined in Table A1 of the Appendix.

3.3. Data and samples

This study exploits Chinese A-share public companies from 2010 to 2021 for identification. Financial data is obtained from the China Stock Market and Accounting Research Database (CSMAR) and the Wind database, while CER data is obtained from the Hexun database. In addition, the sample is implemented using the following procedure: (i) ST and PT companies are excluded due to their inability to effectively fulfill CER. (ii) Companies in the finance and insurance sectors are excluded as their operations typically do not result in environmental pollution. (iii) Companies with incomplete data are excluded to ensure the reliability of the results. (iv) To mitigate the impact of extreme values, Winsorizing is applied to continuous variables at 1 % and 99 %.

3.4. Descriptive statistics

Table 3 provides descriptive statistics for the variables. *Enpro* spans from 0.000 to 3.000, with a median of 0.000. These figures indicate significant variations in environmental governance across enterprises, with a considerable number of 0 values observed in the sample. *Envres* ranges from 2.475 to 9.000, with a standard deviation of 1.064, indicating substantial discrepancies in environmental performance among listed companies. Additionally, the statistical characteristics of the alternative control variables align with those reported by Li et al. (2020) and Lu (2022).

4. Empirical analysis

4.1. Correlation analysis

Table 4 reports the Pearson correlation coefficient matrix for the main variables. It reveals a negative correlation between *Greenma* and both *Enpro* and *Envres*, which contradicts Hypothesis 1. This inconsistency could be attributed to the omission of additional variables that impact environmental governance, such as enterprise and governance characteristics. Moreover, the coefficients of *Lev, Roe, Age, Lndir, First, Big4*, and *Herfindahl* exhibit positive correlations with *Enpro* and *Envres* at a significance level of 1 %, validating the rationality of our control variables. Furthermore, aside from *Enpro* and *Envres*, the correlation coefficients do not exceed 0.5, indicating the absence of significant multicollinearity issues among the variables.

4.2. Baseline regression results

Table 5 presents the analytical outcomes concerning the impact of GM&A on CER. The main variable of interest is *Greenma*×*MAyear*, with CER serving as the dependent variable, measured by *Enpro* and *Envres. Isenpro* and *Isdis* are constructed as dummy variables using the mean values of *Enpro* and *Envres* as thresholds, facilitating the assessment of the impact of green M&A on environmental governance behaviors. Initially, this paper probes whether GM&A affects corporate environmental governance behavior. Given that environmental governance behavior is a binary variable, panel logistic regression is employed for estimation. In columns (1)-(2), the estimates on the interaction term (*Greenma*×*MAyear*) are positive and highly significant at the 1 % level, indicating that GM&A impacts firms to adopt environmental governance behaviors. Furthermore, this study scrutinizes the response of GM&A to CER performance. In columns (3)-(4), the estimates on the interaction term (*Greenma*×*MAyear*) are also significantly positive at the 1 % level. These findings, in conjunction with prior results, underscore that GM&A fosters the adoption of stewardship behaviors and augments environmental performance. In sum, the empirical analysis lends support to Hypothesis 1.

The findings of this study are partially consistent with those of Zhao and Jia (2022). However, this paper goes beyond assessing the impact of GM&A on the overall extent of corporate environmental governance; it also examines specific environmental governance behaviors, thereby expanding the existing GM&A and CER literature.

Accurate empirical estimation with the DID strategy hinges on meeting the parallel trend assumption. To evaluate whether a

Table 3
Descriptive statistics.

Variables	Obs	Mean	SD	Min	Median	Max
Enpro	16,525	0.139	0.451	0.000	0.000	3.000
Envres	16,525	3.228	1.064	2.475	3.000	9.000
Greenma	16,525	0.231	0.422	0.000	0.000	1.000
MAyear	16,525	0.716	0.451	0.000	1.000	1.000
Lnasset	16,525	22.303	1.469	19.214	22.044	27.787
Lev	16,525	0.428	0.210	0.055	0.421	0.976
Roe	16,525	0.067	0.247	−6.850	0.075	21.898
Cash	16,525	0.163	0.128	0.007	0.128	0.680
Age	16,525	2.244	0.706	0.693	2.303	3.497
Lndir	16,525	2.243	0.185	1.792	2.303	2.773
First	16,525	0.350	0.152	0.081	0.331	0.756
Indep	16,525	0.377	0.054	0.143	0.364	0.571
Big4	16,525	0.064	0.245	0.000	0.000	1.000
Herfindahl	16,525	0.165	0.121	0.000	0.135	0.810

Table 4
Correlation tests.

Variables	Enpro	Envres	Greenma	MAyear	Lnasset	Lev	Roe	Cash	Listage	Lndir	First	Indep	Big4	Herfindahl
Enpro	1													
Envres	0.881***	1												
Greenma	−0.078***	−0.085***	1											
MAyear	−0.346***	−0.374***	0.082***	1										
Lnasset	0.186***	0.226***	−0.150***	0.034***	1									
Lev	0.112***	0.142***	−0.086***	−0.075***	0.535***	1								
Roe	0.031***	0.056***	−0.027***	−0.048***	0.058***	−0.105***	1							
Cash	−0.044***	−0.026***	0.002	−0.119***	−0.249***	−0.421***	0.097***	1						
Age	0.068***	0.085***	−0.106***	−0.006	0.397***	0.380***	−0.059***	−0.252***	1					
Lndir	0.170***	0.191***	−0.088***	−0.163***	0.327***	0.186***	0.036***	−0.080***	0.163***	1				
First	0.120***	0.120***	−0.094***	−0.096***	0.250***	0.073***	0.086***	0.009	0.003	0.061***	1			
Indep	−0.029***	−0.026***	0.022***	0.069***	0.003	−0.001	−0.017**	0.018**	−0.048***	−0.523***	0.048***	1		
Big4	0.184***	0.227***	−0.081***	−0.077***	0.411***	0.149***	0.045***	−0.066***	0.062***	0.136***	0.179***	0.047***	1	
Herfindahl	0.134***	0.131***	−0.098***	−0.091***	0.295***	0.067***	0.084***	0.011	−0.029***	0.084***	0.955***	0.051***	0.231***	1

Notes: Lower-triangular cells report Pearson's correlation coefficients.* Statistical significance at the 10 % level.** Statistical significance at the 5 % level.*** Statistical significance at the 1 % level.

Table 5
Results of GM&A and CER.

	(1)	(2)	(3)	(4)
Variables	*Isenpro*	*Isdis*	*Enpro*	*Envres*
Greenma×MAyear	0.545***	0.644***	0.079***	0.187***
	(5.285)	(5.735)	(3.969)	(4.040)
Lnasset	0.198***	0.215***	0.065***	0.115***
	(7.122)	(5.555)	(5.201)	(4.133)
Lev	−0.439***	−0.426**	−0.036	−0.073
	(−2.783)	(−1.971)	(−0.666)	(−0.664)
Roe	0.066	−0.038	−0.015*	0.023
	(0.828)	(−0.361)	(−1.875)	(0.860)
Cash	−2.078***	−2.113***	−0.220***	−0.442***
	(−9.939)	(−8.122)	(−4.217)	(−3.867)
Age	−0.085*	−0.298***	0.168***	0.466***
	(−1.833)	(−4.270)	(5.294)	(6.602)
Lndir	0.937***	1.210***	0.091	0.192
	(5.036)	(5.102)	(1.341)	(1.311)
First	2.306***	2.958***	−0.562**	−1.391***
	(3.802)	(3.643)	(−2.400)	(−2.681)
Indep	0.102	1.140*	0.276	0.714*
	(0.180)	(1.646)	(1.488)	(1.810)
Big4	2.491***	3.157***	0.148***	0.222**
	(11.456)	(11.330)	(3.879)	(2.529)
Herfindahl	−1.618**	−2.362**	0.733**	1.830***
	(−2.047)	(−2.256)	(2.450)	(2.781)
Firm	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Constant	−6.578***	−8.014***	−1.887***	−0.797
	(−9.285)	(−8.689)	(−5.723)	(−1.091)
Observations	16,525	16,525	16,357	16,357
Adjusted R-squared	——	——	0.402	0.437
F	——	——	11.92	12.52

Notes: Columns (1)-(2) and (3)-(4) report z-statistics and t-statistics in parentheses, respectively. *, **, and *** represent significance at 10 %, 5 %, and 1 % levels, respectively. All control variables are defined in the appendix.

substantial variation exists between the treatment and control groups before policy implementation, this paper establishes specification (2).

$$CER_{it} = \beta_0 + \sum_{t=-4}^{7} \delta_t D_{it} \times MAyear_{i,t} + \sum\nolimits_{j=1}^{k} \lambda_j X + \mu_i + \gamma_t + \varepsilon_{i,t} \tag{2}$$

In Eq. (2), D represents a set of dummy variables, taking the value 1 if the green merger policy is enacted in year t and 0 otherwise. The symbols of the remaining variables maintain the same definitions as in specification (1). The parameter δ, our primary focus, captures the differential in CER between firms engaging in GM&A in the initial year of GM&A policy implementation and those abstaining from it.

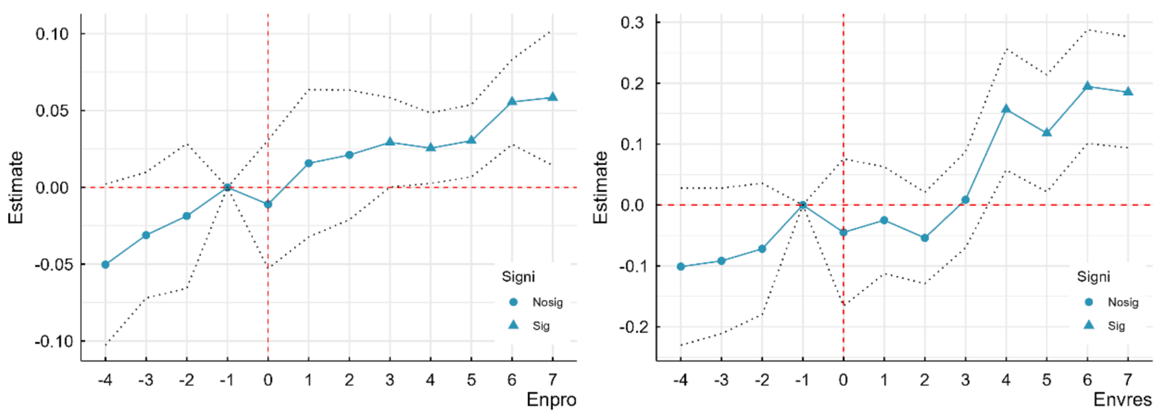


Fig. 3. Parallel trend tests.
Notes: The dotted lines in Fig. 3 represent the range of the 95 % confidence interval. If the estimates are not significant before the policy is implemented, it confirms the validity of the difference-in-differences setup through parallel trend tests.

Fig. 3 illustrates parameter estimation results for pre-GM&A policy periods. Notably, prior to the implementation of the policy, the estimated impact of GM&A on CER was not significant. This finding suggests that the DID design satisfied the parallel trend assumption for the treatment and control groups before the policy was enacted. Furthermore, the graph reveals that CER under the GM&A policy exhibits notable improvement only after some years of implementation.

4.3. Robustness check

4.3.1. Endogeneity

(1) 2SLS

While the DID strategy helps alleviate endogeneity concerns, the absolute reliability of our findings cannot be guaranteed. As depicted in Fig. 4, a positive correlation between regression residuals and CER indicates a notable degree of endogeneity in our empirical outcomes. Therefore, this paper adopts a two-stage least squares (2SLS) approach to tackle endogeneity concerns. To this end, the number of dialects (*Dialects*) in the firm's vicinity and the spherical distance to the local government (*Shdis*) are employed as instrumental variables.

Instrumental variables must satisfy both correlation and irrelevance criteria. On the one hand, GM&A, coupled with integration, involves extensive communication, and inadequate communication frequently underpins GM&A failures. Dialects within the same region can alleviate communication barriers, thereby augmenting the likelihood of GM&A success. Moreover, the proximity of firms to local governments is commonly regarded as an indicator of their receptiveness to M&A policies. Hence, dialects are pertinent to GM&A outcomes. Conversely, dialects have accumulated over a prolonged historical period, and the physical distance between enterprises and local government offices renders them irrelevant to CER.

Columns (1)-(2) in Table 6 report the two-stage least squares (2SLS) estimates for GM&A. Initially, this paper conducts statistical tests on instrumental variables. The first-stage F-statistic is 15.14, exceeding the critical value of 10, indicating a correlation between instrumental variables and GM&A. Additionally, the statistics for the Kleibergen-Paap rk LM, Cragg-Donald Wald F, and Kleibergen-Paap rk Wald F all surpass the critical value of 11.59 for the weak instrument test at the 15 % significance level, suggesting no issues of weak instrument or weak identification. Furthermore, the P-value of the Durbin-Wu-Hausman statistic is 0.000, implying the endogeneity of GM&A. Thus, employing instrumental variables for parameter estimation is deemed necessary. In columns (1)-(2), the statistically significant positive coefficients of GM&A on CER at the 5 % level confirm that our estimates remain robust even when considering mutual causation.

(2) PSM-DID

It's important to acknowledge that the DID estimates might suffer from bias due to considerable disparities between firms engaged in GM&A and those that are not. To mitigate the endogeneity stemming from sample selection bias, this paper employs the propensity score matching (PSM) method to pre-match the samples before conducting DID estimation. Specifically, this paper implements the proximity matching technique to identify a suitable control group. Columns (3)-(4) in Table 6 display the estimation results of the PSM-DID strategy. In these columns, the parameters of the interaction term (*Greenma*×*MAyear*) are significantly positive at the 1 % level. This suggests that even after accounting for variations between firms in the treatment and control groups, GM&A continues to exhibit a clear incentive effect on CER.

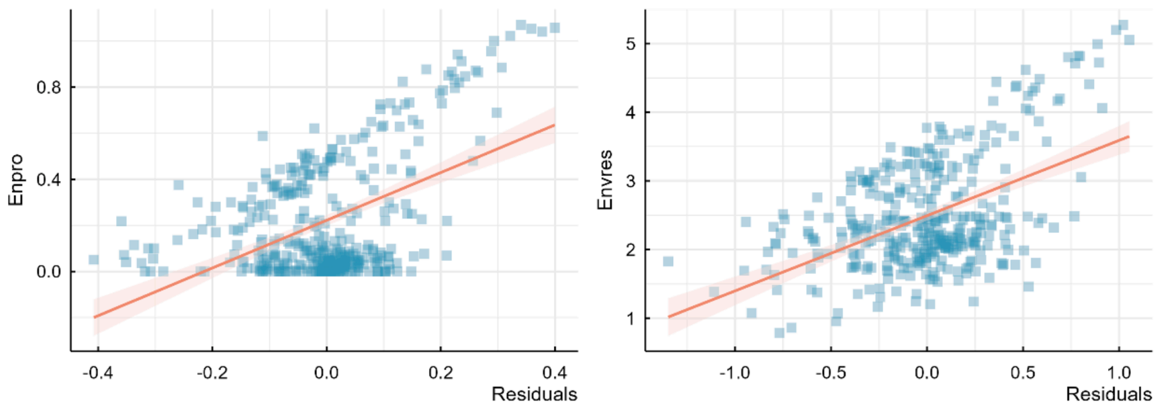


Fig. 4. Correlation between residuals and CER.
Notes: To reduce heteroskedasticity, we summarize the mean values of CER and residuals by year and province before plotting. There is a compelling linear correlation between residuals and dependent variables, implying that the baseline parameter estimates have endogeneity problems.

Table 6
Endogenous treatment.

Variables	2SLS		PSM-DID	
	(1) *Enpro*	(2) *Envres*	(3) *Enpro*	(4) *Envres*
Greenma×MAyear	3.508**	9.631**	0.084***	0.227***
	(2.017)	(2.088)	(2.709)	(3.178)
Controls	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Constant	——	——	−1.974***	−0.500
	——	——	(−4.574)	(−0.518)
Observations	16,357	16,357	10,955	10,955
Adjusted R-squared	−11.94	−17.24	0.419	0.461
F	2.946	2.175	5.712	5.345

Notes: This table summarizes the 2SLS and PSM-DID estimates of GM&A on CER. In 2SLS, *Greenma×Mayear* is instrumented with *Dialects* and *Shdis*. First-stage 2SLS results are omitted for brevity. T-statistics are provided in parentheses. *, **, and *** denote significance at 10 %, 5 %, and 1 % levels, correspondingly. All control variables are defined in the appendix.

(3) Placebo test

To enhance the reliability of estimation outcomes, this paper takes advantage of randomly generated GM&A scenarios for placebo tests. Specifically, this paper selects an equivalent number of samples from the overall dataset to constitute a new treatment group. Subsequently, the fundamental estimation procedure is followed, with t-values computed for the interaction term estimates (*Greenma×MAyear*), and each of these estimates is repeated 500 and 1000 times, respectively. As depicted in Fig. 5, kernel density plots of t-values for GM&A estimates are displayed and juxtaposed with the t-values from columns (3) and (4) in Table 5. The figure illustrates that only a limited number of estimated t-values exceed those of the actual parameters. This suggests that GM&A's impact on

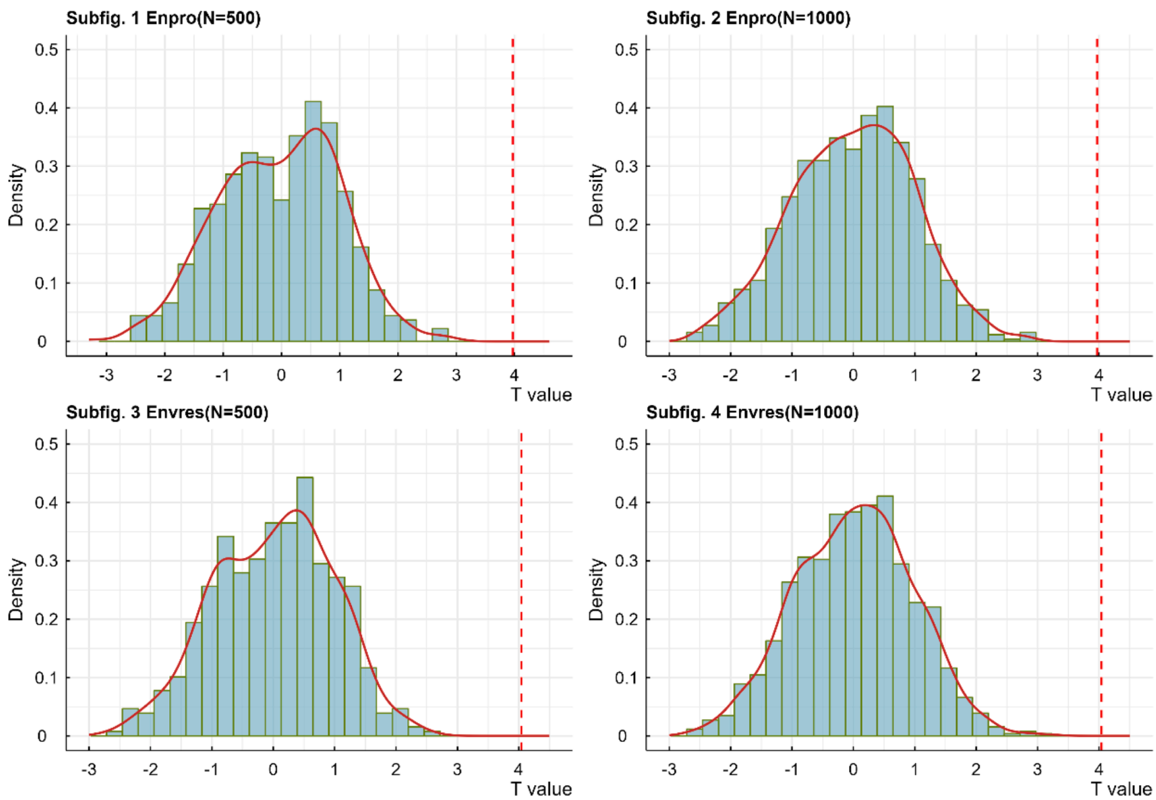


Fig. 5. T-value distribution of placebo tests.
Notes: The explanatory variables in Subfigs. 1 and 2 are GM&A, and the explained variable is *Enpro,* where Subfigs. 1 and 2 show the distribution of t-values of the parameters for 500 and 1000 repetitions of each estimation, respectively. In addition, Subfigs. 3 and 4 show the t-value distributions of the parameters for 500 and 1000 iterations of each estimation, with *Envres* as the dependent variable.

stimulating CER remains relatively robust.

4.3.2. Additional robustness tests

This study subsequently conducts comprehensive robustness tests, including adjustments to the econometric methodology, reassessment of CER, consideration of temporal fluctuations in industries and provinces, and an exploration of the influence of specific industry sectors and regional samples.

(1) Alternative econometric method

In our samples, the dependent variable is non-negative, with a few instances where it equals zero. In such cases, utilizing the OLS approach may result in biased parameter estimates (Shi and Huang, 2024). To mitigate the left-censoring bias in the sample, we employ the Tobit approach for identification, and the results are reported in Table 7, columns (1)-(2). Across these columns, the estimates of GM&A's influence on CER consistently demonstrate significant positive effects. This underscores the robustness and credibility of our main findings, even when employing an alternative estimation method.

(2) Alternative measures of CER

According to Lu (2021), this paper uses environmental investment (*Ginvest*) as a proxy for corporate environmental responsibility. In Table 7, column (3) displays the estimate of GM&A on corporate environmental investment. The estimate of the interaction term (*Greenma*×*MAyear*) with *Ginvest* is remarkably significant at the 1 % level of statistical significance, reaffirming the capacity of GM&A to augment CER.

(3) Mitigate the impact of joint effects

To address regional and industry-specific variations over time, this study integrates region-year and industry-year fixed effects into the benchmark specification. The results, displayed in Table 7, columns (4)-(5), indicate statistically significant positive coefficients for *Greenma*×*MAyear*. Although unobservable factors fluctuating temporally at regional and industry levels may have some impacts on the estimates, they do not significantly alter the core findings.

(4) Delete special industry samples

Industries with heavy pollution footprints often face increased scrutiny in environmental governance efforts (Li et al., 2020). To ensure the robustness of our outcomes, particularly in the context of these heavily polluting sectors, this study conducts estimations excluding samples from such industries. The results, presented in Table 7, columns (6)–(7), demonstrate that the estimates of the interaction term (*Greenma*×*MAyear*) remain statistically significant at the 1 % level. This underscores the consistency of our conclusion regarding the positive impact of GM&A on CER, even when samples from heavily polluting industries are excluded from the analysis.

Table 7
Additional robustness checks.

Variables	Tobit strategy		Environmental investments	Adding joint effects		Deleting samples of heavy polluting industries		Deleting samples of special districts	
	(1) *Enpro*	(2) *Envres*	(3) *Ginvest*	(4) *Enpro*	(5) *Envres*	(6) *Enpro*	(7) *Envres*	(8) *Enpro*	(9) *Envres*
Greenma×*MAyear*	0.098***	0.246***	0.399***	0.071***	0.151***	0.078***	0.205***	0.074***	0.151***
	(4.508)	(5.084)	(9.205)	(3.568)	(3.253)	(3.922)	(4.129)	(3.078)	(2.867)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry×*Year*	No	No	No	Yes	Yes	No	No	No	No
Province×*Year*	No	No	No	Yes	Yes	No	No	No	No
Constant	−0.582***	0.514*	14.374***	−1.622***	−0.550	−1.900***	−1.203	−1.365***	0.435
	(−4.356)	(1.879)	(17.039)	(−4.940)	(−0.765)	(−5.657)	(−1.549)	(−3.564)	(0.537)
Observations	16,525	16,525	16,357	16,353	16,353	12,674	12,674	12,067	12,067
Adjusted R-squared	——	——	0.528	0.451	0.481	0.395	0.441	0.386	0.421
F	——	——	23.65	9.713	10.55	9.995	11.34	6.616	6.839

Notes: (i) Heavy pollution industries include 15 sectors, including coal mining and washing, oil and gas extraction, ferrous metal mining and processing, non-ferrous metal mining and processing, textiles, leather and fur production, feather processing, and footwear manufacturing.
(ii) Z-statistics are reported in parentheses in columns (1)-(2), and T-statistics are reported in parentheses in the remaining columns. *, **, and *** denote significance at 10 %, 5 %, and 1 % levels, respectively. Definitions of all control variables can be found in the appendix.

(5) Delete special district samples

Recognizing notable regional disparities in economic development, companies may exhibit varying motivations to pursue GM&A initiatives. To mitigate the potential impact of these regional variations, this paper excludes samples from special administrative regions, specifically those situated in Beijing, Shanghai, Tianjin, and Chongqing. Subsequently, this paper re-estimates the parameters using Eq. (1). As demonstrated in Table 7, columns (8)–(9), the estimates of *Greenma*×*MAyear* remain significantly positive even following the exclusion of samples from these special regions (Eq. (2)).

4.4. Heterogeneity

4.4.1. Institutional environment

To examine how the impact of GM&A on CER varies across institutional contexts, this study constructs a triple interaction term based on specification (1) for identification. The marketability of GM&A firms in their respective locations serves as a proxy variable for the institutional environment (*Market*). *Market* is assigned a value of 1 if it exceeds the one-third quantile and 0 otherwise. Table 8, specifically Columns (1)-(2), presents the role of the institutional context in shaping the impact of GM&A on CER. Our primary interest lies in the parameters of the triple interaction term. In columns (1)-(2), the parameters for the interaction term (*Greenma*×*MAyear*×*Market*) with respect to CER are 0.173 and 0.346, both statistically significant at the 1 % level. These empirical outcomes suggest that a favorable institutional environment can amplify the positive effects of GM&A on CER. Thus, Hypothesis 2 of this study is confirmed.

In highly marketable regions, companies recognize the significance of environmental conservation and the drawbacks of unsustainable "sloppy" development, considering both explicit and implicit pollution expenses. Confronted with the substantial costs associated with violating pollution regulations, companies tend to prioritize cleaner production practices via GM&A to address pollution at source.

4.4.2. Social capital

Columns (3)-(4) in Table 8 depict the estimated results regarding the role of corporate social capital in fostering CER via GM&A. Consistent with prior studies (Adler and Kwon, 2002; Luo et al., 2004), corporate social capital (*Socap*) is defined as follows: if a corporate executive holds positions in government departments, is elected as a deputy to the National People's Congress, or becomes a member of the Chinese People's Political Consultative Conference, whether in or out of office, the company accumulates social capital, and *Socap* is given a value of 1; otherwise, it is set to 0. In column (3), the estimates for the interaction term (*Greenma*×*MAyear*×*Socap*) with respect to CER are statistically significant at the 1 % level, indicating that corporate social capital enhances the effectiveness of

Table 8
Heterogeneity analysis.

Variables	(1) *Enpro*	(2) *Envres*	(3) *Enpro*	(4) *Envres*
Greenma×*MAyear*	−0.080***	−0.160***	−0.080***	−0.162***
	(−5.973)	(−5.189)	(−5.568)	(−4.730)
Market	0.720***	1.621***		
	(29.734)	(31.185)		
Greenma×*Market*	−0.156***	−0.304***		
	(−3.429)	(−2.874)		
MAyear×*Market*	−0.725***	−1.639***		
	(−30.489)	(−33.216)		
Greenma×*MAyear*×*Market*	0.173***	0.346***		
	(3.657)	(3.146)		
Socap			0.681***	1.524***
			(27.686)	(28.618)
Greenma×*Socap*			−0.166***	−0.344***
			(−3.510)	(−3.178)
MAyear×*Socap*			−0.717***	−1.599***
			(−29.570)	(−31.738)
Greenma×*MAyear*×*Socap*			0.199***	0.417***
			(4.034)	(3.716)
Controls	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Constant	−1.049***	1.103**	−1.079***	1.019*
	(−4.541)	(2.192)	(−4.384)	(1.897)
Observations	16,357	16,357	16,357	16,357
Adjusted R-squared	0.524	0.549	0.515	0.539
F	68.36	83.57	63.18	77.38

Notes: T-statistics are reported in parentheses. *, **, and *** represent significance at 10 %, 5 %, and 1 % levels, respectively. All control variables are defined in the appendix.

GM&A in fostering CER. Consequently, Hypothesis 3 from Section 3 is corroborated.

We posit that corporate social capital enhances the ability to implicitly secure resources and alleviates the challenges and expenses associated with obtaining external resources, thereby strengthening GM&A. Aklamanu et al. (2016) documented that the social connections between top executives and financial institutions enable firms to access credit support at a reduced cost during M&A activities, consequently lowering the financial burden of M&A (Nguyen et al., 2021; Pennings et al., 1998).

4.5. Mechanisms

To investigate the channels by which GM&A affects CER, this paper extends prior research and formulates a specification (3) for empirical analysis (Yao et al., 2021).

$$\begin{aligned} Mecha_{i,t} &= \beta_0 + \beta_1 Greenma_{i,t} + \beta_2 MAyear_{i,t} + \beta_3 Greenma_{i,t} \times MAyear_{i,t} \\ &+ \sum_{j=1}^{k} \lambda_j X + \mu_i + \gamma_t + \varepsilon_{i,t} \end{aligned} \tag{3}$$

where *Mecha* indicates potential channels through which GM&A may impact CER. Building on the insights gleaned from the analysis in Section 2, this study focuses on three primary pathways: corporate green innovation, financing constraints, and environmental awareness.

Consistent with prior literature (Amore and Bennedsen, 2016; Hadlock and Pierce, 2010; Zheng et al., 2023), corporate green innovation (*GInnova*) is assessed by taking the logarithm of one plus the count of green patent applications in a given year; corporate financing constraints (*Strain*) are captured using the SA index; and environmental awareness (*Gaware*) is evaluated through a text analysis method, examining the occurrence of environmental terms in annual company reports. These terms encompass topics such as energy conservation, emissions reduction, environmental strategy, environmental philosophy, environmental management organization, environmental education, environmental training, environmental technology development, and environmental audit.

Table 9 presents an analysis of the channels through which GM&A influence CER. Columns (1)-(3) display the estimates for green innovation, financing constraints, and environmental awareness, respectively. In Columns (1)-(3), the estimates for the interaction terms (*Greenma*×*MAyear*) concerning *GInnova* and *Gaware* are significantly positive. This suggests that GM&A has a positive effect on corporate green innovation and environmental awareness, ultimately contributing to the improvement of CER. In Column (2), the estimate for the interaction term (*Greenma*×*MAyear*) related to *Strain* is significantly negative at the 1 % level of statistical significance. This signifies that GM&A can enhance the financing environment and promote CER by alleviating financing constraints. In a nutshell, the estimates corroborate the hypotheses H1–1, H1–2, and H1–3 regarding the relationship between GM&A and CER.

This study contributes to the expanding literature on the mechanisms of GM&A. Lu (2021) provided compelling evidence that GM&A can raise corporate governance by augmenting financing capabilities. Our research corroborates these findings, demonstrating that GM&A, beyond mitigating financing constraints, also elevates CER via increased environmental awareness. Furthermore, Zhang et al. (2023b) shed light on the impact of GM&A on green innovation performance. Our findings extend this body of work by showing that GM&A not only promotes green innovation but also strengthens CER, thereby enriching the existing understanding of the multifaceted impacts of GM&A.

5. Conclusions

A large bulk of evidence has documented that environmental pollution hampers economic development and poses health hazards to the public (Amore and Bennedsen, 2016; Hettige et al., 2000). Companies, both contributors to pollution and subjects of environmental management, confront the challenge of reconciling environmental preservation with economic expansion amidst escalating global pollution (Li et al., 2022a; Liu et al., 2023a; Sun et al., 2023; Zeng et al., 2022). While prior studies have predominantly focused on external factors such as environmental regulations, media scrutiny, financial incentives, and corporate governance structures, including financial characteristics and ownership arrangements (Bose, 2010; Cole, 2000; Murshed, 2022; Sueyoshi and Yuan, 2015), there has been comparatively less attention given to the role of GM&A in fostering the adoption of green technology.

To address this gap, this paper examines the impact of GM&A on CER by exploiting data from Chinese publicly traded companies between 2010 and 2021. Employing the difference-in-differences design, the study documents that GM&A is remarkably favorable to the fulfillment of CER. This finding remains robust even after addressing endogeneity and conducting additional robustness tests. Mechanistically, GM&A stimulates green technology innovation, eases financial constraints, and fosters corporate environmental awareness, leading to improvements in environmental pollution conditions. Furthermore, the response of GM&A to CER is particularly pronounced in regions with high market liberalization and among firms with substantial social capital.

This paper proposes the following policy recommendations: First, enterprises should actively pursue GM&A strategies to boost their environmental governance capabilities and meet environmental obligations. Second, policymakers should promote GM&A, facilitating the integration of production factors into efficient enterprises and improving their environmental performance via enhanced production efficiency. Additionally, governments should implement supportive measures for GM&A, such as tax reductions, fiscal subsidies, and incentives for green innovation. These actions aim to encourage enterprises, particularly those in traditional manufacturing sectors, to engage in green restructuring, thus enhancing environmental governance effectiveness. Last, governments in developing countries should accelerate market-oriented reforms to create a conducive environment for GM&A. The study documents the significant impact of GM&A on CER, particularly in highly marketable regions. Therefore, authorities should utilize market mechanisms

Table 9
Channel analysis.

Variables	(1) *GInnova*	(2) *Strain*	(3) *Gaware*
Greenma×MAyear	0.438***	−1.654***	0.318***
	(8.981)	(−2.873)	(5.963)
Controls	Yes	Yes	Yes
Firm	Yes	Yes	Yes
Year	Yes	Yes	Yes
Constant	13.292***	−32.436***	13.679***
	(14.490)	(−3.266)	(12.922)
Observations	16,357	16,357	16,357
Adjusted R-squared	0.424	0.381	0.832
F	12.77	3.214	149.0

Notes: T-statistics are reported in parentheses. *, **, and *** represent significance at 10 %, 5 %, and 1 % levels, respectively. All control variables are defined in the appendix.

to establish GM&A service systems, facilitate production integration post-mergers, and improve enterprises' sustainability capabilities.

This paper acknowledges certain limitations. First, the analysis of GM&A's impact on CER relies solely on Chinese data. Given the substantial cross-country variations, future research should expand this analysis to additional nations to validate our hypotheses. Second, this paper concentrates on GM&A among listed companies, excluding small and medium-sized enterprises (SMEs). Hence, the findings may possess limited applicability and may not be universally generalizable across all company types. Lastly, the analysis primarily addresses issues of mutual causation and sample selection bias while omitting consideration of omitted variables. To enhance the robustness of the conclusions, future studies could integrate additional control variables .

CRediT authorship contribution statement

Peihao Shi: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Qinghua Huang:** Writing – review & editing, Validation, Supervision, Project administration, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Table A1
Variable definitions.

Variables	Definitions and explanations
Dependent variables	
Enpro	Data comes from the Report on Social Responsibility of Hexun Public Companies
Envres	*Envres* is calculated by employing equal weight aggregation in light of the metrics in Table 2.
Mergers and acquisitions	
Greenma	1 means that public companies take part in GM&A activities, and 0 otherwise.
MAyear	Takes 1 if GM&A takes place after 2014, in which the Opinions of the State Council on Further Optimizing the Market Environment for Corporate Mergers and Reorganizations is promulgated, and 0 otherwise.
Controls	
Lnasset	The logarithm of assets.
Lev	Total liabilities divided by total assets.
Roe	Net income divided by net assets
Cash	Monetary funds divided by current liabilities
Age	The logarithm of the observed year plus 1 and minus the established year of firms.
Lndir	The logarithm of the total number of directors.
First	Number of shares held by the largest shareholder divided by the total number of shares
Indep	The number of Independent Directors divided by the total number of directors
Big4	Takes 1 if the auditor is from a Big Four accounting firm, and 0 otherwise.
Herfindahl	Calculate the Herfindahl index of the industry by using the company's operating income.

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