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Strategic Reaction to Environmental Regulation: The Combined Effect on Earnings Management and Environmental Information Disclosure

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ABSTRACT

We investigate firms' strategic reactions to environmental regulation enforcing China's New Environmental Protection Law (NEPL). We find that in the short term, polluting firms conduct more earnings management and the effect is stronger for firms under performance pressure. In the long term, environmental regulation facilitates environmental information disclosure, which is strengthened by better external governance. We also find that NEPL enforcement has an immediate negative effect on firm value but decreases firms' long-horizon price crash risk. Our study highlights the combined effects of environmental regulation on firm decisions and outcomes in different horizons.

JEL Classification: G32, G34, K32

1 | Introduction

In response to growing concerns about environmental issues, governments worldwide are enforcing environmental regulations aimed at improving environmental performance. These regulations significantly affect corporate decisions and economic outcomes. Although studies have demonstrated that environmental regulations promote corporate environmental investment (Liu, Yang, et al. 2022; Zhang et al. 2019) and corporate green innovation (Hu et al. 2022), the strict regulations can also impose higher compliance costs on firms and drive them to change their behaviours, such as increasing tax avoidance (Yu et al. 2021), reducing exports (Shi and Xu 2018) and manipulating real activities (Fu et al. 2023; Zhang et al. 2024).

In this paper, we aim to reconcile firms' behaviours when encountering stricter environmental regulation in a unified framework. We hypothesize that firms employ earnings management to smooth heightened compliance costs in the short term and improve environmental information disclosure in the long term to mitigate the increased regulatory risk. Enforcing stricter environmental regulations usually imposes higher costs on polluting firms, reducing profits and increasing performance pressure. In response, polluting firms might use earnings management to meet short-term earnings expectations from capital markets. However, earnings management could result in corporate financial distress and decreased market value when detected by external monitors (DuCharme et al. 2004). Thus, to mitigate long-term environmental regulatory risk, polluting

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firms may disclose environmental information, which is crucial to enhance reputation (Clarkson et al. 2011) and market value (Plumlee et al. 2015). Consequently, environmental information disclosure increases in both volume and scope under tougher regulations, conveying a long-term green transformation strategy to external stakeholders, which should result in increased market trust.

We employ the enforcement of China's New Environmental Protection Law (NEPL), which took effect on 1 January 2015 and imposed more stringent penalties for environmental offenses, to test our hypothesis. Using NEPL enforcement as an exogenous shock, we empirically test the combined impacts of environmental regulation using a difference-in-differences (DiD) model. We find, on the one hand, that after NEPL enforcement, polluting firms inflate discretionary accruals more than do nonpolluting firms. The dynamic results satisfy the parallel-trend assumption and indicate that the positive impact on earnings management is largely short term, significant only during the NEPL enforcement period. On the other hand, compared with nonpolluting firms, polluting firms have a higher tendency to publicly release environmental information after NEPL enforcement. Moreover, firms improve environmental information disclosure for 1 or more years after enforcement, which satisfies the parallel-trend assumption and indicates that NEPL enforcement pushes firms to increase environmental information disclosure in the long term.

We employ several approaches to test robustness. First, we use one-to-one propensity score matching (PSM) to address potential selection bias in observable characteristics. Second, we use entropy balancing to minimize potential pretrends in outcome variables. Third, we employ alternative sample periods with shorter postevent windows to re-estimate the impact of NEPL enforcement on confounding factors in the postperiod. Fourth, we account for other contemporaneous shocks by adding province-year fixed effects to our regressions and controlling for the impact of the 2015 stock market crash. Fifth, we use alternative methods to measure earnings management and environmental information disclosure. The results of these robustness tests support the strategic reaction to NEPL. Finally, following Ferrara et al. (2012), we randomly select some of our sample firms as a treatment group and re-estimate the baseline regressions 500 times. The placebo tests suggest that the *t*-values of the interaction terms of the treatment and timing variables largely follow a standard normal distribution, indicating that the NEPL effects are not affected by unobservable characteristics.

Furthermore, we find that the impact of NEPL on earnings management is more pronounced for firms with higher performance pressure, represented by worse accounting performance and more intense product market competition. The long-term impact is strengthened by better external governance, with increasing analyst coverage and regional marketization. We also investigate whether the NEPL has economic effects on firms' value and risk. Measured by Tobin's *Q* (Xue et al. 2021), firms' market value drops immediately after NEPL enforcement. We then examine the efforts firms exert to boost environmental performance, finding that polluting firms experience a larger and long-term increase in green innovation than nonpolluting firms after NEPL enforcement. From the perspective of risk consequences, polluting firms experience a larger decrease in stock price crash risk relative to nonpolluting firms in the long term after NEPL enforcement. Moreover, firms do not manipulate real activities to improve performance in response to environmental regulation. The reason is that the benefits of adopting technological innovation for environmental transformation outweigh the costs from a long-term perspective (Reynaert 2021) and manipulating real activities is harmful to future corporate development (Roychowdhury 2006).

Our paper contributes to the literature in the following ways. First, it adds to the burgeoning studies focused on the ramifications of environmental regulations. Previous studies have examined whether and how enforcing environmental regulations affects corporate innovation (Aghion et al. 2016; Calel and Dechezleprêtre 2016), productivity (Wang et al. 2018), investment (Cai et al. 2016; Liu, Yang, et al. 2022), cash holdings (Liu, Zhang, et al. 2022), tax avoidance (Yu et al. 2021) and cash holdings (Liao et al. 2023). Several studies document the impact of environmental regulations on earnings management activities (Fu et al. 2023; Liu and Cheng 2023; Zhang et al. 2022; Zhang et al. 2024). We differ from these papers in two aspects: (1) we reveal firms' strategic response to the NEPL in different horizons, engaging more in short-term earnings management and improving long-term environmental information disclosure, which provides a unified framework to understand firms' different behaviours when encountering stricter environmental regulation and (2) we show that stricter environmental regulation has an immediate negative effect on polluting firms' value but a positive effect on stock price crash risk in the long run, extending studies investigating the economic impacts of environmental regulation (Dumitrescu and Zakriya 2021; Xu et al. 2020).

Second, we augment the literature examining factors that influence corporate information environment. Previous studies have revealed that labour protection has a positive and significant effect on firms' information environment by improving firm transparency (Ni and Zhu 2018) and analyst forecasts (Zheng et al. 2022). Studies have demonstrated that better stakeholder orientation can effectively reduce firms' discretionary accruals (Ni 2020). Also, firms' choice to manipulate discretionary accruals can be influenced by a series of elements, such as CEO incentives (Bergstresser and Philippon 2006) and external stakeholders (Beardsley et al. 2021; Yu 2008). More recent studies have considered the effects of climate risk (Ding et al. 2021) and gross domestic product (GDP) manipulation (Cai et al. 2022). In this paper, we extend the literature on how stakeholder protection affects firms' information environment by uncovering the strategic reaction of firms to NEPL implementation. Furthermore, we explore the underlying motives and find that firms manipulate their earnings in the short term because of performance pressure from the market and improve information disclosure in the long term because of external governance requirements.

Third, our study joins the expanding studies that, inspired by La Porta et al. (1997, 1998), have provided empirical evidence on the relation between law and finance. Allen et al. (2005) discuss the link between the legal system and China's rapid economic

growth, and other related studies explore the economic impacts of bankruptcy and collateral laws (Calomiris et al. 2017; Rodano et al. 2016). We provide further empirical evidence showing that NEPL implementation drives firms to enhance earnings management.

2 | Institutional Background and Hypothesis Development

2.1 | NEPL Implementation

Although China has made remarkable strides in economic development, this rapid expansion has been accompanied by a surge in environmental pollution, raising widespread social concerns. Actually, China defined environmental protection as a fundamental national policy in the 1980s, but significant enhancements in environmental governance have not materialized. The reasons are twofold. First, local governments concerned with political advancement often prioritized economic growth over environmental regulation (Li and Zhou 2005), which resulted in less stringent oversight of corporate polluting activities. Second, the penalties imposed on firms for environmental infractions were insubstantial, and firms could evade legal sanctions through pollution transfer or rent-seeking behaviour. To reinforce environmental regulations, China undertook significant legislative reform by amending the original version of the Environmental Protection Law. The NEPL, enacted 1 January 2015, embodies a comprehensive approach to national environmental legislation, signalling a robust commitment to safeguarding the environment in China.

The NEPL marks a clear departure from its original version in the following ways. First, the NEPL has increased the severity of penalties. Before NEPL implementation, fines for environmental violations were fixed and extremely low, leading many polluters to disregard environmental regulation because of the minimal costs of noncompliance. The NEPL imposes daily accruing fines without a ceiling, significantly strengthening the enforcement power of environmental authorities and increasing firms' cost for environmental violations. In addition, the NEPL allows for the administrative detention of responsible individuals, including CEOs, in cases of serious environmental offenses. Second, the NEPL empowers local environmental authorities with supervisory abilities that were once centralized, emphasizing the accountability of local governments in regulating environmental practices. In addition, it ensures that local governments take their environmental protection duties seriously and discourages them from diminishing regulatory efforts. Third, the NEPL strengthens firms' disclosure requirements about environmental measures and emphasizes public oversight in monitoring corporate polluting activities. It harnesses society-wide vigilance to track and address firms' environmental malpractices, thus increasing the probability of exposing corporate environmental violations.

2.2 | Hypothesis Development

In this paper, we explore the effects of the NEPL on corporate information disclosure from a dynamic perspective. By imposing stricter environmental regulations, the NEPL has increased penalties and resulted in lawsuits, which can likely increase corporate operational costs. Meanwhile, the enforcement of NEPL has increased the marginal production costs, squeezing profit margins. How do firms react to the challenges caused by NEPL enforcement?

We posit that earnings management is an approach taken by firms, particularly polluting firms, to deal with NEPL implementation. Firms undertake earnings management either to influence contractual outcomes tied to reported earnings or to misrepresent their accounting performance to stakeholders (Healy and Wahlen 1999). Prior studies show that meeting or beating earnings benchmarks confers external rewards on firms (Koonce and Lipe 2010), and managers tend to manipulate discretionary accruals to build credibility and improve corporate growth prospects (Graham et al. 2005). In China, regulators usually govern listed firms according to their accounting performance, especially when deciding whether to permit firms to issue additional shares (Liu and Lu 2007). Under this tight supervision, listed firms are strongly motivated to meet or beat necessary thresholds by manipulating earnings. NEPL implementation enforces stricter environmental regulation and imposes higher compliance and production costs on firms, especially polluting firms, resulting in greater performance pressure. Furthermore, the increasing performance pressure strengthens corporate incentives to employ earnings management.

However, earnings management might not be a long-term choice for firms reacting to NEPL implementation. The literature indicates that earnings management significantly reduces future corporate stock yields and the probability of refinancing (Teoh et al. 1998). In addition, once corporate earnings management is detected by shareholders suffering losses, it increases the lawsuit risk of firms employing earnings management (DuCharme et al. 2004), which might negatively affect corporate market values. Yu (2008) finds that firms covered by more analysts reduce their manipulation of discretionary accruals. Thus, earnings management is likely a short-term choice for firms reacting to NEPL implementation. Based on this analysis, our first hypothesis is:

Hypothesis 1. *NEPL implementation encourages polluting firms, relative to nonpolluting firms, to engage more in earnings management in the short term.*

Assuming polluting firms employ earnings management as a short-term response to environmental regulation, how do they adjust information disclosure strategically in the long term? In this paper, we explore whether polluting firms increase long-term environmental information disclosure in response to environmental regulations. Enforcing the NEPL imposes more stringent penalties for environmental offenses and inflates the possibility of environmental violations. Furthermore, it damages corporate reputations and causes a potential loss of customers and investors. In reaction, it is crucial for polluting firms to improve their reputation and value under tougher regulations.

To mitigate the regulatory risk caused by NEPL implementation in the long run, polluting firms might disclose more environmental information, which enhances reputation

(Clarkson et al. 2011) and improves market value (Plumlee et al. 2015). Thus, environmental information disclosure in both volume and scope increases under the tougher regulation. Meanwhile, information disclosure allows firms to convey their long-term green transformation strategies to external stakeholders and helps them obtain trust from the market. Furthermore, environmental regulation accentuates the positive relation between corporate governance and environmental performance (Zakriya and Chams 2024). In addition, NEPL implementation shows that sustainable development is gaining significance and encourages local governments to increase pressure on corporate environmental performance. Achieving environmental targets is positively correlated with the promotion of local government officials, who tend to strengthen environmental supervision after NEPL implementation, and it pushes firms, especially polluting firms, to conduct more green innovation. Moreover, firms' managers might exert more effort on their own initiative to improve corporate environmental performance in response to NEPL implementation (Branzei et al. 2004). Nevertheless, green transformation is a long-term process requiring sufficient funds and ample innovative ability. Prior studies document that implementing environmental regulations significantly improves corporate environmental performance (Chang et al. 2015), and this positive impact is likely to be persistent (Jia and Chen 2019). Accordingly, the disclosure of reliable information about green transformation driven by NEPL implementation is likely to be long term. Thus, our second hypothesis is:

Hypothesis 2. *NEPL implementation encourages polluting firms, relative to nonpolluting firms, to improve environmental information disclosure in the long term.*

3 | Data and Variables

3.1 | Sample Selection

Our sample consists of China's A-shared listed firms, whose accounting and governance data are obtained from the China Stock Market & Accounting Research (CSMAR) database. The NEPL was formally implemented on 1 January 2015. Our sample period is 2012–2018, which includes 3 years before and after the NEPL implementation. We exclude financial firms and ST firms (i.e., firms in financial distress), and drop firms that change industries during the sample period. Additionally, we exclude observations with missing values for our main variables. Our final sample comprises 13,711 firm-year observations, and all continuous variables are winsorized at the 1% and 99% levels.

3.2 | Measuring Earnings Management

We use discretionary accruals to measure corporate earnings management. The discretionary accruals are defined as the difference between total accruals and nondiscretionary accruals based on the modified Jones model (Dechow et al. 1995; Kothari et al. 2005), obtained from the residuals of Equation (1):

$$\frac{TA_{i,t}}{A_{i,t-1}} = \alpha_0 \frac{1}{A_{i,t-1}} + \alpha_1 \frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{A_{i,t-1}} + \alpha_2 \frac{PPE_{i,t}}{A_{i,t-1}} + \varepsilon_{i,t}, \quad (1)$$

where TA is total accruals, calculated as the difference between operating profit and net cash flows from operating activities. A is firm's total assets. $\triangle REV$ is the change in revenues from the prior year. $\triangle REC$ is the change in accounts receivable from the prior year. PPE is net fixed assets, and ε is the error term. Equation (1) is estimated by industry-year group with at least 10 observations. Because our focus is on whether firms manipulate their discretionary accruals upwards, we employ the signed value of discretionary accruals, the residual of Equation (1), as our measure of corporate earnings management (DA).

3.3 | Measuring Environmental Information Disclosure

Environmental information disclosures by China's listed firms show significant qualitative variation, which provides an appropriate condition for us to measure environmental information disclosure. We quantify firms' disclosure of environmental information using item scoring as described in the literature (Liu et al. 2024; Plumlee et al. 2015). This method converts text content, and we build the index of environmental information disclosure variable (EID) from six items: (1) waste gas emission reduction; (2) wastewater reduction; (3) dust, smoke control; (4) solid waste use and disposal; (5) noise, light pollution, radiation control; and (6) cleaner production implementation. We score each of the six items based on the following criteria: 2 for disclosing monetized information, 1 for disclosing descriptive information, and 0 for disclosing no information. The data are from the CSMAR database. The sum of the six item scores obtained from Equation (2) is employed to measure EID:

$$EID_{i,t} = \sum_{j=1}^{6} EID_{i,j,t}, \quad (2)$$

where $\sum EID_{i,j,t}$ represents the total score for the six items from environmental information disclosure with a maximum score of 12. $EID_{i,t}$ is the index of environmental information disclosure.

3.4 | Independent Variables

Our independent variable is the interaction between the treatment variable and timing variable, and it is based on NEPL implementation. Following Liao et al. (2023), we define firms belonging to polluting industries as the treatment group and nonpolluting firms as the control group. The treatment variable, *Treat*, equals 1 for polluting firms and 0 otherwise. Table A1 presents the classification of industrial codes and corresponding names of polluting industries, as stipulated by China's Ministry of Environmental Protection.[1] The timing variable, *Post*, equals 1 for 2015–2018 and 0 otherwise. For polluting firms, *Treat* × *Post* equals 0 for 2012–2014 and 1 for 2015–2018, and for

nonpolluting firms, $Treat \times Post$ equals 0 during the whole sample period.

3.5 | Control Variables

We control for several firm-level characteristics that might affect earnings management and environmental information disclosure. *Size* captures the scale of firms' assets and equals the natural logarithm of total assets, *Lev* represents the ratio of total liability scaled by total assets, *ROA* represents firms' profitability and equals the ratio of net profits scaled by total assets, *OCF* is the proportion of net operating cash flows scaled by total assets, and *Growth* equals the growth ratio of firms' sales. We also include governance characteristics. *SOE* equals 1 when the firm is state-owned and 0 otherwise, *Top1* represents ownership concentration and equals the proportion of the largest stakeholder's share, *Indep* equals the proportion of independent directors on the board, and *Dual* equals 1 for firms where the CEO is simultaneously the chairman and 0 otherwise. Table A2 provides detailed definitions for all variables in this study.

Table 1 provides descriptive statistics for the main variables. For the proxy of earnings management, the mean and median values of *DA* are 0.006 and 0.011, respectively, indicating that an average firm prefers manipulating its discretionary accruals upwards. For the proxy of environmental information disclosure, the mean value of *EID* is 1.743 and its standard error is much higher at 2.538, revealing that the *EID*s of different firms exhibit significant variation. For the control variables, the mean value of *SOE* is 0.403, which reflects that nonstate-owned firms account for more than half of the observations. The mean of *Dual* is 0.252, which indicates that about a quarter of the CEOs are simultaneously the firms' chairmen.

4 | Main Empirical Results

4.1 | Impact of NEPL on Earnings Management

We first construct Equation (3) to test whether the NEPL drives firms to manipulate their discretionary accruals upwards:

$$EM_{i,t} = \beta_0 + \beta_1 Treat_i \times Post_t + \beta_2 Controls_{i,t-1} + Firm + Year + \varepsilon_{i,t}, \quad (3)$$

where *EM* is earnings management, proxied by *DA*. *Treat* is the treatment variable and equals 1 for polluting firms and 0 otherwise. *Post* is the timing variable that equals 1 for 2015–2018 and 0 otherwise. *Controls* represent the control variables, which comprise firm-level accounting and governance variables. We include firm and year fixed effects in all regressions.

Columns (1) and (2) of Table 2 present the results of Equation (3). Column (1) estimates the univariate relation between NEPL implementation and corporate earnings management, and Column (2) presents the specification controlling for firm-level accounting and governance characteristics. The positive and significant coefficients on $Treat \times Post$ show that, compared with nonpolluting firms, polluting firms manipulate their discretionary accruals upwards after NEPL implementation. After controlling for the potential effect of corporate accounting and governance characteristics, the discretionary accruals for polluting firms experience a 27.5% (=100% × 0.028/0.102) standard deviation increase relative to nonpolluting firms on average.

Next, we test the dynamics of manipulating discretionary accruals upwards and examine the parallel-trend assumption. To do this, we estimate the dynamics of firms' discretionary accruals before and after NEPL implementation using Equation (4) based on Liu and Ni (2024):

TABLE 1 | Descriptive statistics.

Variable	*N*	Mean	SD	Min.	Median	Max.
(A) Earnings management and information disclosure						
DA	13,711	0.006	0.102	−0.336	0.011	0.308
EID	13,711	1.743	2.538	0	0	12
(B) Control variables						
Size	13,711	22.187	1.265	19.880	22.006	26.105
Lev	13,711	0.430	0.210	0.056	0.424	0.870
ROA	13,711	0.040	0.046	−0.133	0.035	0.187
OCF	13,711	0.041	0.069	−0.160	0.040	0.240
Growth	13,711	0.192	0.424	−0.510	0.115	2.680
SOE	13,711	0.403	0.491	0	0	1
Top1	13,711	0.356	0.148	0.095	0.337	0.745
Indep	13,711	0.373	0.053	0.333	0.333	0.571
Dual	13,711	0.252	0.434	0	0	1

Note: This table presents the results of descriptive statistics for the main variables in this study. The full sample consists of the firms listed on Shanghai Stock Exchanges (SSE) and Shenzhen Stock Exchanges (SZSE) from 2012 to 2018. The accounting and governance data are from the CSMAR database. Variable definitions are provided in Table A2.

TABLE 2 | The impact of NEPL on earnings management.

	DA (1)	*DA* (2)	*DA* (3)	*DA* (4)
$Treat \times Post$	0.031*** (0.012)	0.028** (0.011)		
$Treat \times Post_{t-3}$			−0.007 (0.012)	−0.008 (0.012)
$Treat \times Post_{t-2}$			−0.017 (0.014)	−0.016 (0.014)
$Treat \times Post_{t}$			0.049*** (0.017)	0.047*** (0.017)
$Treat \times Post_{t+1}$			0.027 (0.041)	0.027 (0.040)
$Treat \times Post_{t+(2+)}$			0.008 (0.014)	0.001 (0.013)
Controls	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.364	0.381	0.367	0.386
N	13,711	13,711	13,711	13,711

Note: This table presents the results of the impact of NEPL on earnings management. The dependent variable is *DA*. Columns (1) and (3) present the results of univariate regressions, and columns (2) and (4) present the results adding control variables. *Treat* equals 1 if the firm belongs to polluting industries and 0 otherwise. *Post* equals 1 for years 2015–2018 and 0 otherwise. $Post_{t-3}$, $Post_{t-2}$, $Post_t$, $Post_{t+1}$ and $Post_{t+(2+)}$ equal 1 for (1) 3 years before, (2) 2 years before, (3) the current year of, (4) 1 year after, (5) 2 or more years after the implementation of NEPL, respectively, and 0 otherwise. For the sake of brevity, we only present the coefficients on the variables of interest. All regressions control for firm and year fixed effects. The accounting and governance data are from the CSMAR database. Robust standard errors are in parentheses and clustered by industry. ***, ** and * represents significance at the 1%, 5% and 10% levels, respectively. Variable definitions are provided in Table A2.

$$EM_{i,t} = \beta_0 + \beta_1 Treat_i \times Post_{t-3} + \beta_2 Treat_i \times Post_{t-2} + \beta_3 Treat_i \times Post_t + \beta_4 Treat_i \times Post_{t+1} + \beta_5 Treat_i \times Post_{t+(2+)} + \beta_6 Controls_{i,t-1} + Firm + Year + \varepsilon_{i,t} \quad (4)$$

where $Post_{t-3}$, $Post_{t-2}$, $Post_t$, $Post_{t+1}$ and $Post_{t+(2+)}$ are equal to 1 for (1) 3 years before, (2) 2 years before, (3) the current year of, (4) 1 year after, and (5) 2 or more years after NEPL implementation, respectively, and 0 otherwise. The other variables are defined as in Equation (3). The effect 1 year before NEPL implementation is the benchmark.

As shown in Columns (3) and (4) of Table 2, the dynamics of corporate discretionary accruals around NEPL implementation largely support the short-term impact of the NEPL on firms' earnings management. The insignificant coefficients on the interactions before NEPL implementation indicate that our estimation supports the parallel-trend assumption. The coefficients in the current year of NEPL enforcement are positive and significant at the 1% level in the univariate regression and the regression including control variables, whereas the other coefficients are insignificant. Taken together, the results suggest that the influence of NEPL implementation on upward discretionary accrual manipulation is short term and positive, consistent with Hypothesis 1.

4.2 | Impact of NEPL on Environmental Information Disclosure

To test Hypothesis 2, we construct Equations (5) and (6) to determine whether NEPL implementation provokes firms to increase environmental information disclosure in the long term:

$$EID_{i,t} = \beta_0 + \beta_1 Treat_i \times Post_t + \beta_2 Controls_{i,t-1} + Firm + Year + \varepsilon_{i,t}, \quad (5)$$

$$EID_{i,t} = \beta_0 + \beta_1 Treat_i \times Post_{t-3} + \beta_2 Treat_i \times Post_{t-2} + \beta_3 Treat_i \times Post_t + \beta_4 Treat_i \times Post_{t+1} + \beta_5 Treat_i \times Post_{t+(2+)} + \beta_6 Controls_{i,t-1} + Firm + Year + \varepsilon_{i,t} \quad (6)$$

where *EID* is environmental information disclosure, and the other variables are as defined in Equations (3) and (4). Equation (5) tests the impact of NEPL implementation on firms' environmental information disclosure, and Equation (6) estimates the dynamics of firm's environmental information disclosure before and after NEPL implementation.

Columns (1) and (2) of Table 3 present the results of Equation (5). The coefficients on $Treat \times Post$ in the univariate regression and the regression controlling for firm-level accounting and governance characteristics reveal that polluting firms disclose more environmental information compared with nonpolluting firms after NEPL implementation. Specifically, looking at the result in Column (2) as an example, the environmental information disclosure of polluting firms experiences a 16.7% (=100% × 0.423/2.538) standard deviation increase relative to nonpolluting firms on average.

Columns (3) and (4) of Table 3 present the results of Equation (6). The coefficients on the interactions before NEPL implementation are all insignificant, supporting the parallel-trend assumption in Equation (6). The coefficients in the current year of NEPL implementation are insignificant in both the univariate regression and the regression including control variables. On the contrary, the coefficients on the interactions

TABLE 3 | The impact of NEPL on environmental information disclosure.

	EID (1)	*EID* (2)	*EID* (3)	*EID* (4)
$Treat \times Post$	0.430*** (0.135)	0.423*** (0.135)		
$Treat \times Post_{t-3}$			−0.219 (0.141)	−0.220 (0.143)
$Treat \times Post_{t-2}$			−0.037 (0.141)	−0.036 (0.139)
$Treat \times Post_{t}$			0.010 (0.079)	0.005 (0.078)
$Treat \times Post_{t+1}$			0.358*** (0.135)	0.358*** (0.136)
$Treat \times Post_{t+(2+)}$			0.539** (0.225)	0.532** (0.225)
Controls	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.741	0.741	0.742	0.742
N	13,711	13,711	13,711	13,711

Note: This table presents the results of the impact of NEPL on environmental information disclosure. The dependent variable is *EID*. Columns (1) and (3) present the results of univariate regressions, and columns (2) and (4) present the results adding control variables. *Treat* equals 1 if the firm belongs to polluting industries and 0 otherwise. *Post* equals 1 for years 2015–2018 and 0 otherwise. $Post_{t-3}$, $Post_{t-2}$, $Post_{t}$, $Post_{t+1}$ and $Post_{t+(2+)}$ equal 1 for (1) 3 years before, (2) 2 years before, (3) the current year of, (4) 1 year after, (5) 2 or more years after the implementation of NEPL, respectively, and 0 otherwise. For the sake of brevity, we only present the coefficients on the variables of interest. All regressions control for firm and year fixed effects. The accounting and governance data are from the CSMAR database. Robust standard errors are in parentheses and clustered by industry. ***, ** and * represents significance at the 1%, 5% and 10% levels, respectively. Variable definitions are provided in Table A2.

between *Treat* and $Post_{t+1}$/$Post_{t+(2+)}$ are all positive and significant, revealing that the positive effect of the NEPL on environmental information disclosure is long term. In summary, these findings support Hypothesis 2 that NEPL implementation has a long-term effect on firms' willingness to increase environmental information disclosure.

4.3 | Robustness Tests

We employ several tests to assess the robustness of our results. First, to address the concern that the NEPL effect might be caused by discrepancies between polluting and nonpolluting firms, we turn to the PSM method. Specifically, we employ one-to-one nearest and preshock matching, using the sample the year before NEPL implementation (2014) and applying a 0.01 caliper to construct the PSM sample. The dependent variable is the treatment group dummy (*Treat*), and the independent variables are the control variables. We employ a probit regression using the full sample and PSM sample. Panel A of Table 4 shows that the coefficients on *Size*, *OCF* and *Indep* are statistically significant before matching, and the coefficients on all independent variables are insignificant after matching, indicating that PSM is effective. The results based on the PSM sample in Panel B of Table 4 indicate the robustness of the NEPL effect.

Second, we employ entropy balancing to minimize potential pretrends in the outcome variables, following Darendeli et al. (2022). Two regressions with variables the year before NEPL implementation (2014) are estimated as linear probability models. Panel C of Table 4 presents the results. Column (1) shows that the coefficients on *Size*, *OCF* and *Indep* are significant before balancing, whereas Column (2) shows that all coefficients are insignificant after balancing, indicating that entropy balancing is effective. Panel D presents the results for the sample after balancing, and our results remain robust.

Third, we employ alternative sample periods with shorter postevent windows to determine whether the NEPL minimizes the potential effect of confounding factors from the postevent period. The alternative sample periods are (1) the 3-year preevent and 2-year postevent window (2012–2017), and (2) the 2 years before and after NEPL implementation (2013–2017). Panel A (B) of Table 5 presents the results for 2012–2017 (2013–2017). The combined effect of NEPL on corporate earnings management and environmental information disclosure remains robust after employing shorter postevent periods.

Fourth, we consider the impact of other contemporaneous shocks. Although controlling for firm and year fixed effects alleviates much of the concern that omitted firm-level and year characteristics drive earnings management, the time-varying provincial characteristics and other contemporaneous shocks that might influence our results are not captured. Our first approach is to add province-year fixed effects to regressions to control for time-varying provincial characteristics and potential province-level shocks. Panel A of Table 6 shows that NEPL enforcement still positively affects firms' earnings management and environmental information disclosure. In addition, the stock market in China experienced a dramatic crash in 2015, which might affect corporate earnings management. To control for the stock market crash, we need to identify the firms whose stock prices were affected by the crash. We construct a crash shock variable, *Crash*, that equals 1 if the firm's weekly return falls 3.09 standard deviations below average one or more times in 2015 and 0 otherwise (Hutton et al. 2009; Kim et al. 2011). Panel B shows that the NEPL effect on firms' earnings management and environmental information disclosure remains robust after controlling for the crash shock, confirming that our findings are not caused by the contemporaneous stock market disaster.

TABLE 4 | Propensity score matching (PSM) and entropy balancing.

(A) PSM		
	Treat Before (1)	**Treat After (2)**
Size	0.127** (0.051)	0.004 (0.050)
Lev	−0.190 (0.403)	−0.059 (0.426)
ROA	−2.231 (2.170)	−0.486 (1.997)
OCF	2.139** (1.040)	−0.011 (0.851)
Growth	−0.040 (0.163)	−0.003 (0.075)
SOE	0.013 (0.121)	−0.019 (0.135)
Top1	0.031 (0.331)	−0.075 (0.377)
Indep	−1.289** (0.636)	0.062 (0.654)
Dual	−0.051 (0.062)	−0.020 (0.058)
Pseudo-R^2	0.023	0.000
N	1995	1114

(B) Regressions based on matched sample				
	***DA* (1)**	***DA* (2)**	***EID* (3)**	***EID* (4)**
Treat × *Post*	0.025** (0.012)	0.024** (0.011)	0.345** (0.150)	0.338** (0.150)
Controls	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.408	0.431	0.733	0.734
N	6561	6561	6561	6561

(C) Entropy balancing		
	Treat Before (1)	**Treat After (2)**
Size	0.044** (0.017)	0.000 (0.023)
Lev	−0.065 (0.134)	−0.000 (0.180)
ROA	−0.752 (0.710)	−0.001 (0.858)
OCF	0.701** (0.335)	0.002 (0.488)
Growth	−0.014 (0.052)	−0.000 (0.061)
SOE	0.005 (0.042)	−0.000 (0.053)
Top1	0.013 (0.113)	−0.000 (0.155)
Indep	−0.418* (0.212)	−0.001 (0.280)
Dual	−0.016 (0.020)	−0.001 (0.026)
R^2	0.028	0.000
N	1995	1995

(D) Regressions based on balanced sample				
	***DA* (1)**	***DA* (2)**	***EID* (3)**	***EID* (4)**
Treat × *Post*	0.023* (0.012)	0.021* (0.011)	0.342** (0.137)	0.339** (0.139)
Controls	No	Yes	No	Yes

(Continues)

TABLE 4 | (Continued)

(D) Regressions based on balanced sample				
	DA **(1)**	***DA*** **(2)**	***EID*** **(3)**	***EID*** **(4)**
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.340	0.365	0.729	0.729
N	12,258	12,258	12,258	12,258

Note: This table presents the results based on the sample after PSM. (A) The process of matching and the dependent variable is *Treat*. (B) The results of the impact of NEPL based on PSM sample. (C) The results of entropy balancing. (D) The results of the impact of NEPL after balancing. In B and D, the dependent variable in columns (1) and (2) is *DA*, and the dependent variable in columns (3) and (4) is *EID*. Columns (1) and (3) present the results of univariate regressions, and columns (2) and (4) present the results adding control variables. All regressions control for firm and year fixed effects and we only present the coefficients on the variables of interest for the sake of brevity. *Treat* equals 1 if the firm belongs to polluting industries and 0 otherwise. *Post* equals 1 for years 2015–2018 and 0 otherwise. The accounting and governance data are from the CSMAR database. Robust standard errors are in parentheses and clustered by industry. ***, ** and * represents significance at the 1%, 5% and 10% levels, respectively. Variable definitions are provided in Table A2.

TABLE 5 | Alternative sample periods.

(A) 2 years postevent window (2012–2017)				
	DA **(1)**	***DA*** **(2)**	***EID*** **(3)**	***EID*** **(4)**
Treat × *Post*	0.033* (0.017)	0.033** (0.016)	0.349*** (0.124)	0.347*** (0.122)
Controls	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.410	0.426	0.761	0.762
N	11,337	11,337	11,337	11,337
(B) 2 years before and after 2015 (2013–2017)				
	DA **(1)**	***DA*** **(2)**	***EID*** **(3)**	***EID*** **(4)**
Treat × *Post*	0.033* (0.017)	0.032* (0.017)	0.280** (0.122)	0.272* (0.122)
Controls	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.439	0.452	0.780	0.780
N	9737	9737	9737	9737

Note: This table presents the results of robustness tests using alternative sample periods. The dependent variable in columns (1) and (2) is *DA*, and the dependent variable in columns (3) and (4) is *EID*. All regressions control for firm and year fixed effects. *Treat* equals 1 if the firm belongs to polluting industries and 0 otherwise. *Post* equals 1 for years 2015–201X and 0 otherwise. Columns (1) and (3) present the results of univariate regressions, and columns (2) and (4) present the results adding control variables. For the sake of brevity, we only present the coefficients on the variables of interest. The accounting and governance data are from the CSMAR database. Robust standard errors are in parentheses and clustered by industry. ***, ** and * represents significance at the 1%, 5% and 10% levels, respectively. Variable definitions are provided in Table A2.

Fifth, we use alternative proxies of the dependent variables to retest the NEPL effect on the manipulation of discretionary accruals and environmental information disclosure. First, the alternative measure of earnings management, *DD*, is formed using the residuals of Equation (7) following Dechow and Dichev (2002):

$$WCA_{i,t}/A_{i,t} = \alpha_0 + \alpha_1 CFO_{i,t-1}/A_{i,t} + \alpha_2 CFO_{i,t}/A_{i,t} + \alpha_3 CFO_{i,t+1}/A_{i,t} + \varepsilon_{i,t}, \quad (7)$$

where *WCA* is the change in firm's working capital, defined as the change in receivables, stock, and other current assets from the prior year minus the change in accounts payable and tax payable from the prior period. *CFO* is net operating cash flow. *A* is firms' total assets. Columns (1) and (2) of Table 7 show that the overall effect of NEPL remains robust when using *DD* to measure earnings management. Columns (3) and (4) present the results when measuring firms' environmental information disclosure by the alternative measure. Specifically, we rate each of

TABLE 6 | Controlling other contemporaneous shocks.

(A) Province-year fixed effects				
	DA **(1)**	***DA*** **(2)**	***EID*** **(3)**	***EID*** **(4)**
Treat × *Post*	0.033*** (0.011)	0.030*** (0.011)	0.408*** (0.134)	0.401*** (0.134)
Controls	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes
R^2	0.382	0.399	0.747	0.747
N	13,711	13,711	13,711	13,711
(B) Stock market disaster in 2015				
	DA **(1)**	***DA*** **(2)**	***EID*** **(3)**	***EID*** **(4)**
Treat × *Post*	0.031*** (0.012)	0.028** (0.011)	0.429*** (0.135)	0.422*** (0.134)
Crash × *Post*	−0.003 (0.006)	−0.003 (0.006)	−0.141 (0.139)	−0.145 (0.138)
Controls	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.364	0.382	0.741	0.741
N	13,711	13,711	13,711	13,711

Note: This table presents the results controlling other contemporaneous shocks. (A) the results controlling firm and province-year fixed effects. (B) The results controlling the impact of stock market disaster in 2015, controlling for firm and year fixed effects. The dependent variable in columns (1) and (2) is *DA*, and the dependent variable in columns (3) and (4) is *EID*. *Treat* equals 1 if the firm belongs to polluting industries and 0 otherwise. *Post* equals 1 for years 2015–2018 and 0 otherwise. *Crash* equals 1 if the firm's stock price experienced a crash in 2015 and 0 otherwise. Columns (1) and (3) present the results of univariate regressions, and columns (2) and (4) present the results adding control variables. For the sake of brevity, we only present the coefficients on the variables of interest. The accounting and governance data are from the CSMAR database. Robust standard errors are in parentheses and clustered by industry. ***, ** and * represents significance at the 1%, 5% and 10% levels, respectively. Variable definitions are provided in Table A2.

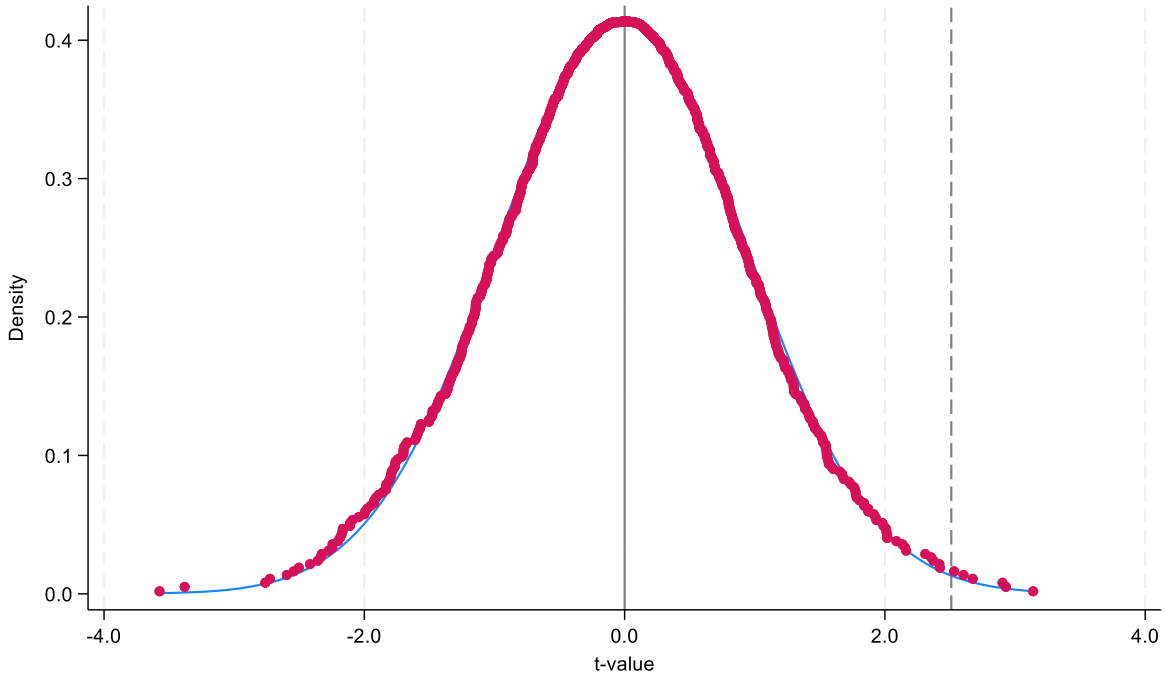
TABLE 7 | Alternative proxies for dependent variables.

	DD **(1)**	***DD*** **(2)**	***EID_R*** **(3)**	***EID_R*** **(4)**
Treat × *Post*	0.023*** (0.006)	0.018*** (0.006)	0.314*** (0.093)	0.310*** (0.094)
Controls	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.304	0.326	0.729	0.729
N	13,711	13,711	13,711	13,711

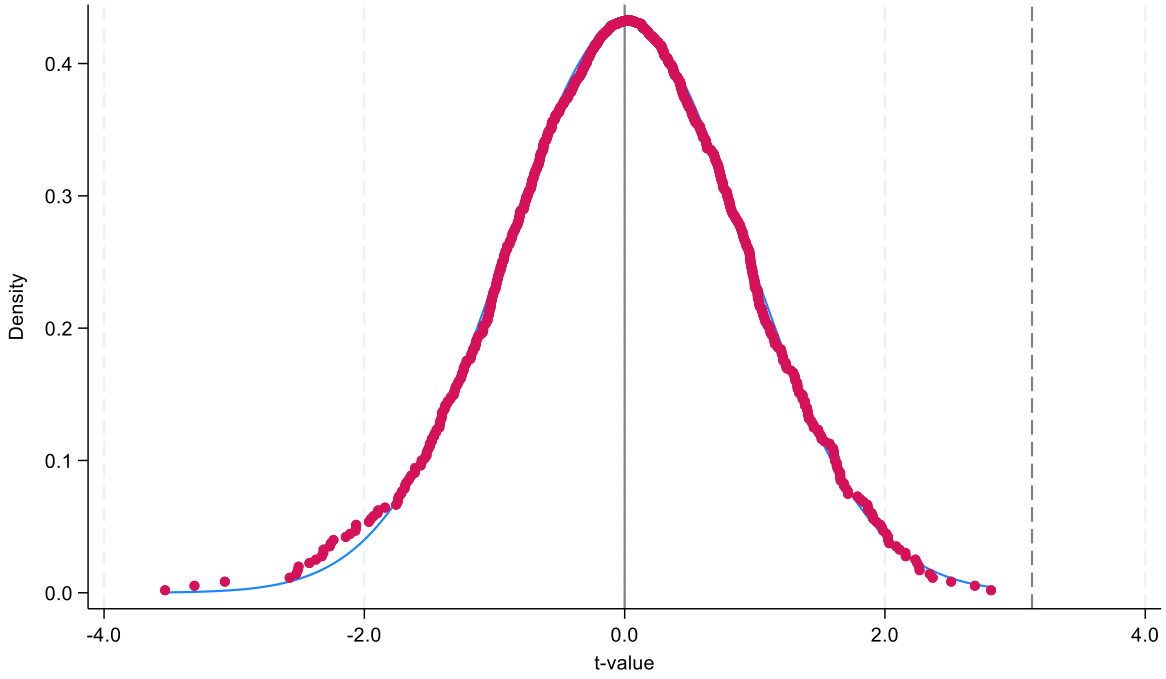
Note: This table presents the results of robustness tests using alternative proxies of dependent variables. The dependent variable in columns (1) and (2) is *DD*, and the dependent variable in columns (3) and (4) is *EID_R*. All regressions control for firm and year fixed effects. *Treat* equals 1 if the firm belongs to polluting industries and 0 otherwise. *Post* equals 1 for years 2015–2018 and 0 otherwise. Columns (1) and (3) present the results of univariate regressions, and columns (2) and (4) present the results adding control variables. For the sake of brevity, we only present the coefficients on the variables of interest. The accounting and governance data are from the CSMAR database. Robust standard errors are in parentheses and clustered by industry. ***, ** and * represents significance at the 1%, 5% and 10% levels, respectively. Variable definitions are provided in Table A2.

the six items described in Section 3.3 using the following alternative criteria: 1 for disclosing descriptive or monetized information and 0 otherwise. Then, we define the sum of the six item scores, from 0 to 6, as the alternative measure of environmental information disclosure (*EID_R*). The impact of NEPL on environmental information disclosure remains positive and robust, indicating that our findings are not influenced by the dependent variable measures.

Finally, because NEPL implementation could be affected by several unobservable characteristics, we employ a placebo test to address this concern (Ferrara et al. 2012). Specifically, we randomly select some of our sample firms as the treatment group and re-estimate Equations (3) and (5) 500 times. The results in Figure 1 show that both distributions of *t*-values of the coefficients on *Treat* × *Post* basically follow the standard normal distribution, indicating that NEPL implementation is not affected by unobservable characteristics and our results are robust.



Panel A: Distribution of t-value on *Treat* × *Post* for *DA*



Panel B: Distribution of t-value on *Treat* × *Post* for *EID*

FIGURE 1 | Placebo tests. This figure presents the results of placebo tests. (A) The distribution of *t*-value on *Treat* × *Post* for earnings management (*DA*). The grey dotted line represents the *t*-value of the coefficient on *Treat* × *Post* in column (2) of Table 2. (B) The distribution of *t*-value on *Treat* × *Post* for environmental information disclosure (*EID*). The grey dotted line represents the *t*-value of the coefficient on *Treat* × *Post* in column (2) of Table 3. (A) Distribution of *t*-value on *Treat* × *Post* for *DA*. (B) Distribution of *t*-value on *Treat* × *Post* for *EID*.

4.4 | Cross-Sectional Tests

We next investigate the impact of several cross-sectional variables in moderating the combined effects of NEPL on earnings management and environmental information disclosure. To support our analysis in Section 2.2 that firms manipulate discretionary accruals upwards to maintain their accounting appearance in response to the stricter environmental regulation, we examine whether the impact of the NEPL on firms' earnings management is differentiated by performance pressure. First, we measure performance pressure referring to firms' accounting performance in the year before NEPL implementation. When a

listed firm experiences poor accounting performance before the NEPL, it strives to improve it. Thus, managers are motivated to employ earnings management under performance pressure to meet external expectations (Kothari et al. 2016; Liu et al. 2021).

Panel A of Table 8 presents the results testing the moderating role of prior accounting performance. We designate observations as H-PAP if a firm's net-profits-to-total-assets ratio in the year before NEPL implementation (2014) is higher than the industry median and remaining observations as L-PAP. The results indicate that the coefficients on *Treat* × *Post* are positive and significant at the 1% level for the L-PAP partition regardless of whether controlling variables are included. On the contrary, the corresponding coefficients for the H-PAP partition are both fewer and less significant, indicating that prior poor accounting performance strengthens the effect of the NEPL on earnings management.

Second, we assess the impact of performance pressure on product market competition. A competitive product market drives shareholders to evaluate firms' performance against competitors, thereby reducing supervisory costs and enhancing managerial efforts (Hart 1983). Nevertheless, competitive pressure may induce managers to hide negative information (Li and Zhan 2019), resulting in earnings management (Shleifer 2004). In line with this conjecture, we anticipate that firms in more competitive industries that face more performance pressure will resort to earnings management to make their profit potential look favourable.

Panel B of Table 8 presents the results testing the moderating role of product market competition. We employ a negatively related measure, the Herfindahl–Hirschman index (HHI), as a proxy of product market competition (Hasan et al. 2021). We designate observations as H-HHI if their HHI value is greater than the current sample median, and the remaining observations as L-HHI. We find that the positive impact of NEPL enforcement on earnings management is significant for the L-HHI partition but insignificant for the H-HHI partition. This supports our proposition that a more competitive product market enhances the effect of environmental regulation on earnings manipulation.

We further explore the role external governance plays in the NEPL effect on firms' environmental information disclosure.

TABLE 8 | The moderating role of performance pressure.

(A) Prior accounting performance				
	H-PAP ***DA*** **(1)**	**L-PAP** ***DA*** **(2)**	**H-PAP** ***DA*** **(3)**	**L-PAP** ***DA*** **(4)**
Treat × *Post*	0.025** (0.012)	0.033*** (0.012)	0.021* (0.012)	0.032*** (0.011)
Controls	No	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
p-value $[\beta_1^{(1)} < \beta_1^{(2)}]$	0.09			
p-value $[\beta_1^{(3)} < \beta_1^{(4)}]$			0.05	
R^2	0.358	0.325	0.381	0.341
N	6086	6172	6086	6172
(B) Product market competition				
	H-HHI ***DA*** **(1)**	**L-HHI** ***DA*** **(2)**	**H-HHI** ***DA*** **(3)**	**L-HHI** ***DA*** **(4)**
Treat × *Post*	0.012 (0.014)	0.049*** (0.011)	0.008 (0.012)	0.047*** (0.011)
Controls	No	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
p-value $[\beta_1^{(1)} < \beta_1^{(2)}]$	0.00			
p-value $[\beta_1^{(3)} < \beta_1^{(4)}]$			0.00	
R^2	0.352	0.432	0.372	0.445
N	6378	7095	6378	7095

Note: This table presents the results of the moderating role of performance pressure in the impact of NEPL on earnings management. (A) The moderating role of prior performance. We designate observations into the "H-PAP" partition if the ratio of the net profit scaled by total asset of the firm in the year before the implementation of NEPL, 2014, is higher than the median of the same industry and the remainder in the "L-PAP" partition. (B) The moderating role of product market competition. We designate observations into the "H-HHI" partition if the HHI index is higher than the sample median in year *t* and the remainder in the "L-HHI" partition. The dependent variable is *DA*. *Treat* equals 1 if the firm belongs to polluting industries and 0 otherwise. *Post* equals 1 for years 2015–2018 and 0 otherwise. Columns (1) and (2) present the results of univariate regressions, and columns (3) and (4) present the results adding control variables. For the sake of brevity, we only present the coefficients on the variables of interest. All regressions control for firm and year fixed effects. The accounting and governance data are from the CSMAR database. Robust standard errors are in parentheses and clustered by industry. ***, ** and * represents significance at the 1%, 5% and 10% levels, respectively. Variable definitions are provided in Table A2.

TABLE 9 | The moderating roles of external governance.

(A) Analyst coverage				
	H-Analyst ***EID*** **(1)**	**L-Analyst** ***EID*** **(2)**	**H-Analyst** ***EID*** **(3)**	**L-Analyst** ***EID*** **(4)**
Treat × *Post*	0.546*** (0.164)	0.329** (0.147)	0.528*** (0.163)	0.323** (0.148)
Controls	No	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
p-value $[\beta_1^{(1)} > \beta_1^{(2)}]$	0.05			
p-value $[\beta_1^{(3)} > \beta_1^{(4)}]$			0.07	
R^2	0.734	0.737	0.735	0.737
N	6270	7059	6270	7059
(B) Regional marketization				
	H-Market ***EID*** **(1)**	**L-Market** ***EID*** **(2)**	**H-Market** ***EID*** **(3)**	**L-Market** ***EID*** **(4)**
Treat × *Post*	0.629*** (0.158)	0.349** (0.170)	0.631*** (0.157)	0.338* (0.172)
Controls	No	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
p-value $[\beta_1^{(1)} > \beta_1^{(2)}]$	0.01			
p-value $[\beta_1^{(3)} > \beta_1^{(4)}]$			0.01	
R^2	0.753	0.772	0.754	0.772
N	6375	7011	6375	7011

Note: This table presents the results of the moderating roles in the effect of NEPL on environmental information disclosure. (A) The results of the moderating role of analyst coverage. We designate observations into the "H-Analyst" partition if the number of analysts following the firm in the year before the implementation of NEPL, 2014, is higher than the median of the same industry and the remainder in the "L-Analyst" partition. (B) The results of the moderating role of regional marketization. We designate observations into the "H-Market" partition if the provincial marketization index (Wang et al. 2021) is higher than the sample median in year *t* and the remainder in the "L-Market" partition. The dependent variable is *EID*. *Treat* equals 1 if the firm belongs to polluting industries and 0 otherwise. *Post* equals 1 for years 2015–2018 and 0 otherwise. Columns (1) and (2) present the results of univariate regressions, and columns (3) and (4) present the results adding control variables. For the sake of brevity, we only present the coefficients on the variables of interest. All regressions control for firm and year fixed effects. The accounting and governance data are from the CSMAR database. Robust standard errors are in parentheses and clustered by industry. ***, ** and * represents significance at the 1%, 5% and 10% levels, respectively. Variable definitions are provided in Table A2.

First, we consider the effect of analyst coverage. Given that analysts act as external monitors over managers, analyst coverage is considered an effective deterrent (Yu 2008). Thus, we expect that firms with broader analyst coverage will be more likely to disclose environmental information.

Panel A of Table 9 presents the results examining the moderating role of analyst coverage. We designate observations as H-Analyst if the number of analysts covering the firm in the year before NEPL implementation (2014) is higher than the industry median, and the remaining observations as L-Analyst. We find that the impact is positive and significant at the 1% level for the H-Analyst partition but less significant for the L-Analyst partition. This is consistent with our earlier expectations.

Second, we consider the role of regional marketization. In a region with a better market environment, external regulators can more easily detect corporate violations and firms therefore improve information disclosure quality (Li et al. 2017). As a result, the positive impact of the NEPL on environmental information disclosure might be enhanced with regional marketization.

Regional marketization is proxied by the provincial marketization index (Wang et al. 2021). Higher marketization indicates that firms are located in a province with better market environment. We designate observations as H-Market if the provincial marketization proxy is larger than the current sample median, and the remaining observations as L-Market. The results in Panel B of Table 9 show that the impact of NEPL enforcement is positive and significant at the 1% level for the H-Market partition but less significant for the L-Market partition. This finding reveals that firms operating in higher marketization provinces experience a more pronounced increase in environmental information disclosure after NEPL implementation.

5 | Further Discussions

5.1 | Economic Impact on Firms' Value and Risk

The evidence so far supports that NEPL implementation drives polluting firms, compared with nonpolluting firms, to engage more in earnings management in the short term and disclose

more environmental information in the long term. Taking inspiration from prior studies (Dumitrescu and Zakriya 2021; Xu et al. 2020), we examine whether the operating performance of polluting and nonpolluting firms shows significant differences after NEPL enforcement, to further explore the economic impacts in both the short and long terms. Table 10 reports the mean of performance proxies for polluting and nonpolluting firms in year T based on a matched sample using the year before NEPL implementation (2014) as the base year. $T = 0$, $T = 1$ and $T = 2$ present the mean value of proxies for (1) the current year of, (2) 1 year after, and (3) 2 years after NEPL implementation, respectively.

First, we consider the effect of NEPL enforcement on market value, proxied by Tobin's Q (Xue et al. 2021), which represents firms' growth (Richardson 2006) and investment opportunities (Huseyin and Mihai 2016). Columns (1)–(3) in Panel A of Table 10 show that for $T = 0$, polluting firms have significantly lower Tobin's Q on average than nonpolluting firms. This indicates that the market value of polluting firms experiences an immediate drop with earnings management after NEPL enforcement. For $T = 1$ and $T = 2$, the difference between the market values of polluting and nonpolluting firms is insignificant, indicating that the market value of polluting firms increases more in the long term, and these firms disclose more environmental information, compared with nonpolluting firms.

Second, we investigate the economic impact on firms' green innovation. Specifically, we employ the growth in the natural logarithm of the number of firms' green patents obtained plus 1 as a measure of corporate green innovation (*GP*). Columns (4)–(6) in Panel A of Table 10 present the results testing whether the green innovation of polluting and nonpolluting firms shows a significant difference after NEPL implementation. The green innovation of polluting firms is lower for $T = 0$ but higher for $T = 1$. For $T = 2$, polluting firms enjoy a much larger boost in green innovation than nonpolluting firms. In other words, the results indicate that NEPL implementation reduces polluting firms' market values in the short term and increases their earnings management, but it also pushes them to conduct more green innovation in the long run to recover market value.

Third, we explore the risk consequences of environmental regulation by testing its impact on stock price crash risk. The literature argues that managers tend to withhold negative news for an extended period under the information asymmetry between firms' insiders and external stakeholders (Jin and Myers 2006; Kothari et al. 2009). Nevertheless, when the accumulated withholding of negative information exceeds a threshold and it is not possible to continue hiding it, the stockpiled bad news is released to the stock market all at once, resulting in a large crash of stock prices (Hutton et al. 2009). The results in Table 3 show that NEPL implementation pushes firms to improve long-term environmental information disclosure, leading to a reduction in information asymmetry. Therefore, we anticipate that the crash risk of polluting firms' stock prices will decrease in the long term after NEPL enforcement.

Following prior studies (Dumitrescu and Zakriya 2021; Liu and Ni 2024), we employ two widely use proxies, negative skewness (*Ncskew*) and down-to-up volatility (*Duvol*), to measure firms' stock price crash risk. Panel B of Table 10 presents the results and shows that the difference between the stock price crash risk of polluting and nonpolluting firms in the current year of, and 1 year after, NEPL implementation ($T = 0$ and $T = 1$) is insignificant, whereas the mean of stock price crash risk for polluting firms is significantly lower than that of nonpolluting firms 2 years after NEPL implementation ($T = 2$). This supports that polluting firms enjoy a more pronounced long-term

TABLE 10 | The economic impact of NEPL on firms' value and risk.

(A) Market value and green innovation

	Q			*GP*		
	Treat (1)	**Control (2)**	**Diff (3)**	**Treat (4)**	**Control (5)**	**Diff (6)**
$T = 0$	2.725	3.053	−0.328***	0.008	0.011	−0.003
$T = 1$	2.548	2.600	−0.522	−0.001	−0.016	0.015
$T = 2$	2.367	2.383	−0.016	0.008	−0.036	0.044**

(B) Stock price crash risk

	Ncskew			*Duvol*		
	Treat (1)	**Control (2)**	**Diff (3)**	**Treat (4)**	**Control (5)**	**Diff (6)**
$T = 0$	−0.212	−0.280	0.068*	−0.160	−0.203	0.043
$T = 1$	−0.511	−0.502	−0.009	−0.355	−0.340	−0.015
$T = 2$	−0.201	−0.098	−0.103**	−0.127	−0.036	−0.091***

Note: This table reports the differences of market value, green innovation, and stock price crash risk for treatment and control firms in a matched sample. The strategy of propensity score matching (PSM) is the one-to-one nearest and preshock matching, using the sample in the year before the implementation of NEPL, 2014, with employing a 0.01 caliper. The market value is measured by the Tobin's Q ratio (*Q*). The green innovation is measured by the growth of natural logarithm of the number of firms' green patents obtained plus 1 (*GP*). The stock price crash risk is measured by negative skewness (*Ncskew*) and down-to-up volatility (*Duvol*). Panel A (B) reports the mean values of green innovation and market value (stock price crash risk). $T = 0$, $T = 1$ and $T = 2$ present the mean value of proxies for (1) the current year of, (2) 1 year after, (3) 2 years after the implementation of NEPL. The accounting and governance data are from the CSMAR database. The data of green patents is from CNRDS database. ***, ** and * represents significance at the 1%, 5% and 10% levels, respectively. Variable definitions are provided in Table A2.

TABLE 11 | The impact of NEPL on real earnings management.

	REM (1)	*REM_CFO* (2)	*REM_PROD* (3)	*REM_DISX* (4)
Treat × *Post*	0.003 (0.005)	−0.001 (0.003)	0.001 (0.003)	−0.001 (0.001)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.615	0.403	0.550	0.808
N	13,517	13,517	13,517	13,517

Note: This table presents the results of the impact of NEPL on real earnings management. The dependent variable in column (1) is *REM*, the dependent variable in column (2) is *REM_CFO*, the dependent variable in column (3) is *REM_PROD*, and the dependent variable in column (4) is *REM_DISX*. *Treat* equals 1 if the firm belongs to polluting industries and 0 otherwise. *Post* equals 1 for years 2015–2018 and 0 otherwise. All regressions add control variables and control for firm and year fixed effects. We drop the observations with missing or abnormal variables. The accounting and governance data are from the CSMAR database. Robust standard errors are in parentheses and clustered by industry. ***, ** and * represents significance at the 1%, 5% and 10% levels, respectively. Variable definitions are provided in Table A2.

decrease in stock price crash risk relative to nonpolluting firms when environmental information disclosure increases.

5.2 | Effect on Real Earnings Management

It is hard for external parties, such as auditors and government regulators, to detect real activities manipulations (Liu and Ni 2024). In this section, we test whether firms employ real activities manipulations as an alternative approach to manipulating discretionary accruals upwards to improve performance. We employ a widely used measure to calculate real earnings management following Roychowdhury (2006). First, we calculate the abnormal levels of cash flow from operations, production costs, and discretionary expenses based on the following equations:

$$\frac{CFO_{i,t}}{A_{i,t-1}} = \alpha_0 + \alpha_1 \frac{1}{A_{i,t-1}} + \alpha_2 \frac{REV_{i,t}}{A_{i,t-1}} + \alpha_3 \frac{\Delta REV_{i,t}}{A_{i,t-1}} + \varepsilon_{i,t}, \tag{8}$$

$$\frac{PROD_{i,t}}{A_{i,t-1}} = \alpha_0 + \alpha_1 \frac{1}{A_{i,t-1}} + \alpha_2 \frac{REV_{i,t}}{A_{i,t-1}} + \alpha_3 \frac{\Delta REV_{i,t}}{A_{i,t-1}} + \alpha_4 \frac{\Delta REV_{i,t-1}}{A_{i,t-1}} + \varepsilon_{i,t}, \tag{9}$$

$$\frac{DISEXP_{i,t}}{A_{i,t-1}} = \alpha_0 + \alpha_1 \frac{1}{A_{i,t-1}} + \alpha_2 \frac{REV_{i,t}}{A_{i,t-1}} + \varepsilon_{i,t}, \tag{10}$$

where *CFO* is cash from operations; *PROD* is the total production cost, calculated as costs of goods sold plus the change in inventory; and *DISEXP* is discretionary expenses, defined as the sum of selling expenses and administrative expenses. *A* denotes total assets, and ε is the error term. Similar to Equation (1), the equations are estimated by industry-year group with at least 10 observations. Then, we employ Equation (11) to calculate corporate real earnings management:

$$REM_{i,t} = -REM\_CFO_{i,t} + REM\_PROD_{i,t} - REM\_DISEXP_{i,t}, \tag{11}$$

where *REM* is the signed proxy of firms' real earnings management; *REM_CFO* is the abnormal level of cash flow from operations, defined as the residual term of Equation (8); *REM_PROD* is the abnormal level of production costs, calculated by the residual term of Equation (9); and *REM_DISEXP* is the abnormal level of discretionary expenses, defined as the residual term of Equation (10).

Table 11 presents the results testing the impact of NEPL on corporate real earnings management. It shows that NEPL implementation does not influence corporate real earnings activities manipulations. The reasons for this are: (1) the benefits of adopting technological renewal significantly outweigh the costs in the long run for promoting green transformation (Reynaert 2021) and (2) firms employ real earnings management to sacrifice future earnings for current profits, which is more harmful than manipulating discretionary accruals to improve performance (Roychowdhury 2006). Therefore, environmental regulation mainly provokes polluting firms to manipulate discretionary accruals rather than employ real earnings management to improve accounting performance.

6 | Conclusion

Enforcing the NEPL strengthens environmental regulations in China. In this article, we argue that polluting firms react strategically in response to NEPL enforcement. Our results reveal that polluting firms, compared with nonpolluting firms, increase discretionary accruals in the short term to smooth the heightened compliance costs driven by NEPL implementation. In the long term, polluting firms enhance environmental information disclosure to mitigate the regulatory risk caused by tight environmental regulation. Our results expand the evidence on the determinants of earnings management and environmental information disclosure and reveal that polluting firms employ different strategies in different horizons to cope with environmental regulation.

Our analysis further shows that the aggravating effect of NEPL implementation on earnings management is likely exacerbated by increasing performance pressure. It indicates that regulators and stakeholders should be patient with the green transformation of polluting firms instead of focusing on their short-term profits. Moreover, it indicates that analyst coverage and marketization enhance the positive effect of environmental

regulation on environmental information disclosure, which underscores the critical role of external governance in improving the effectiveness of environmental regulation. We also find that enforcing the NEPL immediately reduces polluting firms' market value but pushes them to conduct more green innovation and decreases their stock price crash risk in the long run.

The overall effect of environmental regulation is to generate strategic reactions by polluting firms that have consequences for their value and risk. Our findings have several important implications. First, they prove the effectiveness of environmental regulation, in that enforcing the NEPL helps polluting firms improve their environmental performance. Second, governments should consider the potential loss to polluting firms when enforcing future environmental regulations and introduce auxiliary policies to mitigate the side effects. Third, polluting firms should be given financial support to alleviate their constraints in persistent environmental investment. Furthermore, we provide a combined framework to assess the dynamic effects of environmental regulations in different horizons, which could be a reference point for future studies evaluating the effectiveness of policies.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Endnotes

[1]The standard can be accessed at https://www.gov.cn/gzdt/2008-07/07/content_1038083.htm.

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Appendix

TABLE A1 | The classification of polluting industry.

CSRC code	Industry name
B06	Coal mining and dressing industry
B07	Oil and natural gas exploitation industry
B08	Ferrous metal ore mining and dressing industry
B09	Nonferrous metal ore mining and dressing industry
C17	Textile industry
C19	Leathers, furs, feathers and related products and footwear industry
C22	Papermaking and paper product industry
C25	Industries of petroleum processing, coking and nuclear fuel processing
C26	Manufacturing of chemical raw materials and chemical products
C27	Pharmaceutical industry
C28	Chemical fibre manufacturing
C30	Industry of nonmetallic mineral products
C31	Industry of ferrous metal smelting and rolling processing
C32	Industry of nonferrous metal smelting and rolling processing
C33	Metal product industry
D44	Industry of electric power and heat production and supply

Note: This table presents the code and corresponding name of polluting industries based on the industry classification of China Securities Regulatory Commission (CSRC) in 2012. The identification of polluting industry refers to the industry directory management for the listed firms' environmental protection verification, formulated by Ministry of Environmental Protection of the People's Republic of China in 2008.

TABLE A2 | Variable definitions.

Variable	Definition
DA	Discretionary accruals, defined as the difference between total accruals and accruals based on the modified Jones model referring to Dechow et al. (1995) and Kothari et al. (2005).
EID	Environmental information disclosure. Seeing Section 3.3.
Treat	A dummy variable that equals 1 if the firm belongs to polluting industries and 0 otherwise.
Post	A dummy variable that equals 1 for years 2015–2018 and 0 otherwise.
Size	The natural logarithm of total assets.
Lev	Total liability scaled by total assets.
ROA	Net profits scaled by total assets.
OCF	Net operating cash flow scaled by total assets.
Growth	The growth rate of the firm's sales.
SOE	A dummy variable that equals 1 if the firm is state-owned and 0 otherwise.
Top1	The proportion of the largest stakeholder's share.
Indep	The proportion of independent directors on the board.
Dual	A dummy variable that equals 1 if the firm's CEO is also its chairman and 0 otherwise.
Q	The ratio of total market value to the total book value.
Crash	A dummy variable that equals 1 if the firm's stock price experienced a crash in 2015 and 0 otherwise.
REM	Real earnings management, defined in Equation (11).
REM_CFO	Abnormal level of cash flow from operations, defined as the residual term of Equation (8).
REM_PROD	Abnormal level of production costs, defined as the residual term of Equation (9).
REM_DISX	Abnormal level of discretionary expenses, defined as the residual term of Equation (10).
DD	Robust measure of earnings manipulation that equals the residuals of Equation (7) referring to Dechow and Dichev (2002).
EID_R	Robust measure of environmental information disclosure. Seeing Section 4.3.