Article

Executive Gender and Firm Environmental Management: Evidence from CFO Transitions

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Abstract: We investigate whether female executives influence corporate environmental management (green management). Based on a difference-in-difference approach, our study provides evidence that female CFOs conduct more environmentally responsible activities, and the effects are more prominent when firms are of high risks. Female CFOs are more likely to involve in environmental management voluntarily. Further, environmental management improves firm performance such as debt cost saving. This research advances the gender diversity literature and suggests that female executives play an important role in corporate decisions and firm performance.

Keywords: CFO; corporate social responsibilities; environmental management; executive gender; firm performance; female; green management

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1. Introduction

Environmental management (green management) has gained significant popularity recently for practitioners, academics, and policymakers. With the rising recognition of environmental fragility and global warming concerns, firms pay close attention to environmentally responsible activities that go beyond the compliance of regulations and laws [1]. Failing to consider the influence of corporate environmental-related decisions brings more challenges in the financial market. Firms with environmental issues are found to experience a higher cost of capital due to potential regulatory, compliance, and litigation risks [2]. Socially responsible (green) investors clearly show preferences for sustainable firms; thus, polluting firms are more likely to be eschewed by such investors [3]. Meanwhile, active environmental management generates multiple benefits. For example, firms with responsible environmental performance are associated with better performance [4–6], higher resource efficiency [7], lower cost of capital [2,8,9] and larger stock returns [10].

Providing the broad benefits and potential misconduct costs, environmental management becomes a unique and critical strategy that enhances the firm's competitive advantages [11,12]. An emerging line of research emphasizes the critical role of executives in designing and implementing a firm's strategies (e.g., Benmelech and Frydman [13]; Bertrand and Schoar [14]; Lewis, Walls, and Dowell [15]). In this study, we intend to empirically investigate the relationship between corporate environmental management and executive gender.

Nowadays, CFOs are beyond the image of 'bean counter' and deeply involved in firms' accounting, financing, and investment decision-making [16,17]. CFOs are responsible for evaluating the costs and benefits before making decisions on how to allocate the firm's capital and resources to green activities. Gender diversity, as one of the fundamental demographic differences among executives, is identified as an essential determinant of corporate decision-making [18–20]. We compare whether and how female and male CFOs implement green management differently.

We posit that gender differences may lead female CFOs to pay more attention to corporate environmental management for several reasons. First, psychology and finance literature has revealed that women have a higher risk aversion than men [21,22]. The upper echelons theory suggests that those preferences on risks will influence female CFOs' choices and decisions [23,24]. Second, women are found to show more work ethics and sensitivity to ethical codes [25,26]. Therefore, female CFOs are more likely to follow environmental regulations and codes. Third, women demonstrate closeness to nature and the environment [27] and are expected to participate in more green behaviors [28,29].

To mitigate potential endogeneity concerns, we adopt a difference-in-difference (DID) approach in our analysis. We utilize the Compustat Execucomp database with 94 male-to-female CFO transitions and 388 male-to-male CFO transitions in U.S. public firms between 2006 and 2015. Consistent with our expectation, we find that after the transition, firms with female CFOs significantly improve overall environmental performance compared to those with male CFOs post transitions.

If female CFOs are more risk-averse than male CFOs, the gender effects on environmental management will be stronger when a CFO belongs to a high-risk firm. We construct subsamples based on different measures of risks before the transition and find consistent results. Stakeholder value-maximization theory suggests that managers should balance the interests of all the stakeholders to maximize the firm value [30,31]. We adopt a quasi-natural experiment, the passage of state constituency statutes, which requires firm managers to consider the interest of all stakeholders when making decisions. Our results demonstrate that the executive gender effects on environmental management are stronger when one state does not pass the constituency statutes.

In addition, we examine the effects of environmental management on the cost of newly issued bonds. According to the stakeholder theory, better environmental management leads to lower firm risk, which permits the bondholder to require lower risk premiums. Using two measures of the cost of bonds, the bond yield spread and Standard & Poor (S&P) credit ratings, we find that overall environmental responsibility performance is negatively associated with yield spread and positively associated with credit ratings.

The remainder of our paper is structured as follows. In Section 2, we review previous literature and build our hypotheses. In Section 3, we introduce the data, sample, and measure construction. In Section 4, we present the empirical results and in Section 5 we conclude.

2. Literature Review and Hypotheses Building

Firms' decision-making process is associated with managerial traits and experiences, for instance, management style [14], executive's confidence level [32], education background [15], and early-life experience [13,33]. There is also evidence that executive gender, an essential demographics factor, impacts corporate decisions and policies (e.g., Cumming, Leung, and Rui [34]; Manner, [35]; Peni and Vähämaa [36]).

Gender difference literature has acknowledged that women are more risk-averse than men [21,22]. Early empirical evidence shows that females tend to allocate investments to less risky assets [37,38]. Olsen and Cox [39] suggest that professionally trained female investors weigh risk attributes more heavily than male peers do. Upper echelons theory suggests that executives' choices are made based on their personalized experiences, values, and personalities [23,24]. Therefore, the difference in risk aversion will be reflected in firm decisions. Huang and Kisgen [20] provide evidence that male executives are relatively overconfident and optimistic in making corporate decisions compared to female executives. Francis et al. [19] find that female CFOs are inversely associated with tax aggressiveness. Li and Zeng [40] show that there is a negative relationship between female CFOs and future stock price crash risk.

Researchers in psychology, ethics, and finance have noticed that women are more sensitive to ethicality [25]. Dawson [41] argues that, according to gender socialization theory, males and females demonstrate different work-related moral principles due to the

masculine and feminine personalities formed in childhood. Mason and Mudrack [42] provide evidence that employed women show to be more ethical, which supports the gender socialization theory that women share communal values reflecting concerns for others, selflessness, and compassion. Regarding managers and executives, Ibrahim et al. [26] find that female managers are more sanguine and sensitive to the ethical codes. Xia et al. [43] find that female top managers are less likely to engage in corruption. As a result, female CFOs are expected to follow environmental regulations and codes and avoid activities that cause potential environmental concerns.

Furthermore, Wehrmeyer and McNeil [27] document a close relationship between females and the environment due to the female's reproductive nature. Women are more concerned about perceived environmental risks than men [28,44]. Thus, females are expected to express a higher level of concern and participate in more green behaviors than males [29].

Based on the identified differences in risk aversion, ethics, and nature closeness, we propose our first hypothesis, which is that female CFOs would pay more attention to corporate environmental management.

Hypothesis 1 (H1). *Firms with female CFO conduct more environment management activities.*

Since female CFOs are generally more risk-averse [21,22], we expect female CFOs would use green management to reduce the firm environment risks. Literature shows that improved corporate environmental performance is valued by the investors and helps reduce the cost of capital [9]. Thus, the effects of female CFOs on corporate environment performance shall be more prominent when firms are of high risks. We then present our second hypothesis as follows.

Hypothesis 2 (H2). *Female CFOs from high-risk firms perform more environmental management activities.*

Stakeholder theory posits that managers have to balance the interests of all the stakeholders to maximize the firm value [30,31]. Evidence shows that other stakeholders, such as institutional investors, assess firms' risks related to their environmental performance, including climate change risk and carbon emission control [45]. Environmentally responsible performance, along with other dimensions of corporate social responsibility (CSR), has been utilized in market valuation models [46,47]. Hence, firms' pro-environment activities will be valuable since such management mitigates corporate risks. Nielsen and Huse [48] point out that women may be involved more in issues that concern the firm and stakeholders, such as CSR and environmental politics, due to their consideration of the needs of others. Thus, we posit our next hypothesis:

Hypothesis 3 (H3). *Female CFOs are more likely to conduct environmental management voluntarily.*

There is extant evidence that environmental management brings significant benefits to firms. Firms with more environmental concerns and worse environmental profiles may be considered riskier by investors. Sharfman and Fernando [9] posit that improved environmental risk management mitigates the market's risk perception of the firm. Firms with fewer environmental concerns are more desirable by those green investors who are looking for socially responsible investments [3]. The strategic environmental investment could also help improve resource efficiency [7]. Jin et al. [8] demonstrate that environmental-friendly practices are associated with low bank loan costs and more favorable terms. Chava [2] provides evidence that the environmental profile of a firm, especially the environmental concerns, significantly affects stock returns, the cost of equity, and debt capital. Fernando et al. [10] show that only environment policies alleviating concerns increase shareholder value and no shareholder values are created by increasing firm greenness. The corporate bond risk premium is the compensation to the bondholders for not investing over risk-free

assets. Following the stakeholder theory, if environmental management reduces firms' risk, the bondholders will require less risk premium for firms with better environment responsible performance. Thus, we expect that environmental management would benefit the firm in terms of the cost of debt.

Hypothesis 4 (H4). *Corporate environmental performance is negatively associated with the cost of newly issued bond.*

3. Data, Sample, and Measures

3.1. Data and Sample

We constructed our sample from various databases. We began with collecting the firm-level CFO gender information from the Compustat Execucomp database, which includes most of U.S. S&P 1500 public firms. Following Chava and Purnanandam [16] and Huang and Kisgen [20], we identified a firm's CFO by the 'CFOANN' variable. If there was no CFO found, we searched the executive title variable with specific keywords such as 'finance,' 'treasure,' or 'controller.' When there was still no CFO or more than one possible CFO for a firm, we manually checked the firm's 10-K filings from the Electronic Data Gathering, Analysis, and Retrieval system (EDGAR) at the U.S. Securities and Exchange Commission (SEC) to acquire correct CFO information. Next, we categorized CFO transitions by the gender of predecessor and successor. We applied the following requirements for any transitions to be included in our sample [20,49]. First, we required a CFO to be in the position for at least three years to exclude any temporary CFO turnovers. Second, the predecessor of transition must be male, and the successor is either male or female. Third, each firm was selected with one transition in our sample. That is, if a firm has conducted both male-to-female and male-to-male CFO transitions, we picked the male-to-female one since the major purpose of this study is to identify potential effects of female CFOs [18]. We kept the first change if there were multiple same-type transitions [19]. Fourth, financial and utility firms were excluded from the sample based on the SIC codes. We identified 94 male-to-female CFO transitions and 388 male-to-male CFO transitions between 2006 and 2015 in U.S. public firms. Table 1 presents the transition distribution by transition year and industry.

Table 1. Distribution of CFO transitions.

Panel A. By Transition Year		
Year	Male to Female	Male to Male
2006	8	65
2007	12	48
2008	8	47
2009	3	30
2010	3	34
2011	13	36
2012	15	35
2013	8	27
2014	13	39
2015	11	27
Total	94	388
Panel B. By Fama–French 5 industries		
Industry	Male to Female	Male to Male
Consumer	25	104
Manufacture	24	87
Health	29	107
High-Tech	4	32
Other	12	58
Total	94	388

Next, we matched the transition firms with the MSCI ESG KLD STATS (KLD) database for environmental management measures. KLD is the most widely used database to measure CSR as well as environmental management [9,10,50]. Our board-of-director measures are drawn from the ISS Directors database. We obtained firm financials and stock prices from Compustat and CRSP, respectively. We dropped any observations with missing variables and deleted any firms with only pre- or post-transition observations. Finally, our sample includes 4886 firm-year observations with 482 unique firms.

3.2. Measures

Our environmental management measures were obtained from the KLD database. KLD evaluates firms' CSR performance from multiple dimensions and we specifically focus on the environmental dimension. *EM strength* is the sum of firms' environmentally responsible activities and *EM concern* is the sum of firms' environmentally irresponsible activities. Consistent with previous literature, we scaled the count number by the number of maximum possible items in each year. *EM net index* measures the net environmental effect and equals the difference between *EM strength* and *EM concern*.

For executives other than CFOs, we controlled for whether a firm has a female CEO in a year (*Female CEO*). Execucomp provides information to up to nine executives for a company in a year. We then controlled for whether a firm has a female executive other than CFO or CEO (*Other female executives dummy*). In addition, the board of directors has been found to play critical roles in firms' CSR and environmental performance [51–54]. We included two variables to control the board size and female composition effects. *Board size (log)* is the natural logarithm of one plus the number of board members. *Board gender diversity* is the percentage of female board members of all board members.

Following prior studies [2,20], we included firm-level financial variables in our regressions to control for any firm characteristics effects. *Firm size* is the natural logarithm of the firm's asset. *Book leverage* is the sum of long-term and short-term debts divided by total assets. *Profitability (ROA)* is the EBITDA scaled by total assets. *R&D intensity* is the ratio of R&D expense to the total assets. *Number of segments (log)* is the natural logarithm of one plus the number of firm segments. *Market-to-book ratio* is the market capitalization scaled by the book value of equity. *Tangible assets* is the net property, plant, and equipment value divided by total assets. We further included a dummy (*financial crisis*) to control for any market effects during the 2008 financial crisis [55–57]. We also counted the CFO tenure (*Tenure*) as the number of years a CFO is in the position [40]. Table 2 presents the summary statistics for our sample.

Table 2. Summary statistics.

Variables	N	Mean	SD	Min	P25	Median	P75	Max
EM net index	4886	0.03	0.15	−0.71	0.00	0.00	0.00	0.80
EM strength	4886	0.06	0.14	0.00	0.00	0.00	0.00	0.80
EM concern	4886	0.03	0.10	0.00	0.00	0.00	0.00	0.86
Post	4886	0.48	0.50	0	0	0	1	1
Male-to-Female CFO	4886	0.20	0.40	0	0	0	0	1
Female CEO	4886	0.02	0.15	0	0	0	0	1
Other female executives dummy	4886	0.25	0.43	0	0	0	1	1
Board size (log)	4886	2.30	0.21	1.10	2.20	2.30	2.49	3.09
Board gender diversity	4886	0.12	0.10	0.00	0.00	0.11	0.18	0.70
Firm size	4886	7.89	1.51	4.82	6.73	7.78	8.87	12.01
Book leverage	4886	0.21	0.18	0.00	0.06	0.20	0.32	0.78
Profitability (ROA)	4886	0.15	0.08	−0.17	0.10	0.14	0.19	0.41
R&D intensity	4886	0.03	0.05	0.00	0.00	0.00	0.03	0.27
Number of segments (log)	4886	1.31	0.60	0.69	0.69	1.39	1.79	2.64
Market-to-book ratio	4886	3.26	3.37	−9.37	1.62	2.50	3.85	21.77
Tangible assets	4886	0.25	0.21	0.01	0.09	0.19	0.34	0.88
Financial crisis	4886	0.16	0.37	0	0	0	0	1
Tenure	4886	3.86	2.68	1	2	3	5	19
Return volatility	4877	0.02	0.01	0.01	0.02	0.02	0.03	0.08
FF beta	4877	1.07	0.32	0.30	0.84	1.04	1.25	2.14
Idiosyncratic risk	4877	0.61	0.79	−1.07	0.05	0.57	1.13	2.96

4. Empirical Results

4.1. Identification Strategy

Potential endogeneity problems exist, as female CFOs are not assigned to firms randomly. Firms hiring female CFOs may be fundamentally different from those firms preferring male CFOs. Female executives may also have specific preferences on firm or industry, which indicates potential self-selection bias. Furthermore, there may exist omitted variables that influence the firms' choice on CFO gender and the environmental management decisions simultaneously. Following Huang and Kisgen [20] and others, we adopted a DID approach to mitigate those concerns by comparing the environment activities before and after male-to-female CFO transitions with a control sample of male-to-male CFO transitions. Comparing pre- and post-transition results helps to remove any time-invariant unobservable firm effects. The model is as follows:

$$\begin{aligned} \text{Environmental management measure} = & \beta_0 + \beta_1 \text{Post} + \beta_2 \text{Post} \times \text{Male-to-Female CFO} + \beta_3 \text{Female CEO} \\ & + \beta_4 \text{Other female executive dummy} + \beta_5 \text{Board size}(\log) + \beta_6 \text{Board gender diversity} + \beta_7 \text{Firm size} \\ & + \beta_8 \text{Book leverage} + \beta_9 \text{Profitability}(\text{ROA}) + \beta_{10} \text{R\&D intensity} + \beta_{11} \text{Number of segments}(\log) \\ & + \beta_{12} \text{Market-to-book ratio} + \beta_{13} \text{Tangible assets} + \beta_{14} \text{Financial crisis} + \beta_{15} \text{Tenure} + \text{Firm FE} + \text{Year} \\ & \times \text{Industry FE} + \epsilon \end{aligned} \quad (1)$$

where Environmental management measure includes the *EM net index*, *EM strength*, and *EM concern* we discussed previously. *Post* equals 1 if a year is post-transition and equals 0 if it is pre-transition. *Male-to-Female CFO* is a dummy variable that identifies our treatment group and the control group. *Post* $\times$ *Male-to-female CFO* is the interaction term from the DID design and is the variable of our interest. We include firm, year, and industry fixed effects in our regression. Regarding the coefficients, β_1 captures the difference in environment score before and after CFO transitions. β_2 is the coefficient of the main explanatory variable, which captures the DID effect of transiting to female CFOs on environment score comparing with transiting to male CFOs.

4.2. Baseline Regression Results

Table 3 presents the results of our baseline DID regression. In column 1, our dependent variable is the net score of environmental management. The coefficient of the *Post* variable is insignificant, indicating that there is no significant difference before and after male-to-male CFO transitions. The effect of the treatment variable (*Male-to-Female CFO*) is absorbed in the firm fixed effects. The interaction term, the variable of our interest, shows a significantly positive coefficient. Holding other variables constant, firms with male-to-female CFO transitions demonstrate higher overall environmental performance after transitions comparing to those firms with male-to-male CFO transitions.

In column 2, we use *EM strength* as the dependent variable and the interaction term is positive and significant at 10% level. Given that the mean value of *EM strength* is 0.062, female CFOs engage 39% more environmentally responsible activities after transitions than male CFOs do. In column 3, we examine the effect of female CFOs on environmentally irresponsible activities. The dependent variable is *EM concern* and the coefficient is negative and significant at 10% level. After the transition, female CFOs reduce about 44% of environmentally irresponsible activities comparing to their male colleagues.

Our results support Hypothesis 1 and suggest that female CFOs are positively associated with overall environmentally responsible performance compared to male CFOs. Firms with female CFOs conduct more environmentally responsible activities and avoid environmentally irresponsible activities.

Table 3. Difference-in-difference regression results.

	(1)	(2)	(3)
Variables	EM Net Index	EM Strength	EM Concern
Post	−0.014 (0.013)	−0.006 (0.011)	0.008 (0.005)
Post * Male-to-Female CFO	0.038 ** (0.016)	0.024 * (0.014)	−0.015 * (0.008)
Female CEO	−0.007 (0.026)	−0.003 (0.016)	0.004 (0.018)
Other female executives dummy	0.010 (0.011)	0.002 (0.008)	−0.007 (0.005)
Board size (log)	0.009 (0.022)	0.008 (0.017)	−0.001 (0.012)
Board gender diversity	0.013 (0.049)	0.018 (0.039)	0.005 (0.024)
Firm size	−0.024 *** (0.008)	−0.005 (0.006)	0.019 *** (0.005)
Book leverage	0.051 ** (0.024)	0.043 ** (0.021)	−0.008 (0.012)
Profitability (ROA)	0.004 (0.042)	0.015 (0.035)	0.011 (0.019)
R&D intensity	−0.249 ** (0.120)	−0.161 (0.106)	0.088 ** (0.042)
Number of segments (log)	0.001 (0.009)	−0.001 (0.008)	−0.002 (0.004)
Market-to-book ratio	0.000 (0.001)	0.000 (0.001)	−0.000 (0.000)
Tangible assets	−0.132 *** (0.047)	−0.129 *** (0.039)	0.003 (0.030)
Financial crisis	0.182 * (0.107)	0.123 ** (0.051)	−0.059 (0.061)
Tenure	−0.000 (0.002)	−0.000 (0.002)	0.000 (0.001)
Constant	0.090 (0.070)	0.028 (0.055)	−0.062 (0.041)
Observations	4886	4886	4886
R-squared	0.204	0.196	0.153

Note: Standard errors are clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

We conducted a placebo test on our sample by assigning a fake transition year. Specifically, we kept observations of each firm before the real transition year t and assign the $t-3$ year as an assumed transition year. Those after $t-3$ years are labeled as new post years. We expect to observe insignificant interaction terms. Otherwise, our previous findings may be biased by potential pre-transition trends of environmental social activities. We reran our DID regression with the same control variables and model setting. For brevity, we only report the interaction terms in Table 4. In line with our expectations, none of the three interaction terms are significant.

Table 4. Placebo tests regression results.

	(1)	(2)	(3)
Variables	EM Net Index	EM Strength	EM Concern
Post (Placebo) × Male-to-Female CFO	0.027 (0.019)	0.021 (0.016)	−0.006 (0.009)
Board Characteristics	Yes	Yes	Yes
Executive Characteristics	Yes	Yes	Yes
Firm Characteristics	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year × Industry FE	Yes	Yes	Yes
Observations	2523	2523	2523
R-squared	0.226	0.218	0.138

Note: Standard errors are clustered at the firm level. ** $p < 0.05$, * $p < 0.1$.

In addition, we examined whether there is any change when a female CFO is replaced by a male CFO as a further robustness test. If female CFOs tend to conduct more (less) environment responsible (irresponsible) activities, we expect to see the opposite or no difference when a female CFO is replaced by a male CFO. We identified 60 female-to-male CFO transitions applying the same requirements during the same transition period as our main sample. Then we ran firm fixed effect regressions on male-to-female CFO transition firms. Table 5 presents the regression results. The dependent variables are EM net score, strength, and concerns respectively. *Post* is a dummy variable, which equals 1 if it is a post-transition year and 0 otherwise. We found a significant negative coefficient on *post* when the dependent variable was the EM net score and significantly positive coefficients when the dependent variable was the environmental concerns. These results indicate that male CFOs tend to undertake more environmentally irresponsible activities while showing no incentives for improving environmentally responsible activities. This result triangulates Hypothesis 1 that female CFOs pay more attention to environmental management.

Table 5. Female-to-male transition regression results.

	(1)	(2)	(3)
Variables	EM Net Index	EM Strength	EM Concern
Post	−0.082 ** (0.037)	−0.043 (0.027)	0.040 ** (0.019)
Board Characteristics	Yes	Yes	Yes
Executive Characteristics	Yes	Yes	Yes
Firm Characteristics	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year * Industry FE	Yes	Yes	Yes
Observations	580	580	580
R-squared	0.309	0.328	0.427

Note: Standard errors are clustered at the firm level. ** $p < 0.05$, * $p < 0.1$.

4.3. Female CFOs, Environmental Management, and Firm Risks

Following Hypothesis 2, one of the reasons that female CFOs emphasize environmental management more is due to their risk aversions. Hence, when a firm has high risks before the transition, we expected that the previously found effects would be prominent as the female CFOs would be more likely to take action to reduce environmental risks. In this section, we construct subsamples by multilevel risk measures and compare the DID results.

Our first risk measure is total risks based on the daily return volatility. We first calculated the standard deviation of daily stock returns for each firm in each year. Then we categorized a firm as high (low) total risk if its total risks measure is above (below) the median in the year prior to the transition year. For the second risk measure, we evaluated the firm's systematic risks using the beta from the Fama–French (FF) three-factor model with a momentum factor [58,59]. The Fama–French four-factor model has been considered as a better estimate for stock returns than the CAPM model [60,61] (Using CAPM model beta does not change our results materially). We regressed firms' return on the market risk factor, book-to-market factor, size factor, and momentum factor using daily data. The factor data were collected from Kenneth R. French's website. (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_factors.html, 23 March 2021) We classified a firm as a high (low) systematic risk firm if its regression beta on market risk factor was greater (less) than 1 because the market risk has a beta equal to 1. Third, we measured firms' idiosyncratic risk as suggested by Luo and Bhattacharya [61]. Specifically, we first obtained the R-square (R^2) from the Fama–French four-factor regressions that we used to estimate the systematic risks. The ratio of idiosyncratic risks to the total risks was then calculated as $1 - R^2$. Next, we performed a logistic transformation to obtain the final measure of firm idiosyncratic risk. Firms were classified to high (low) idiosyncratic risk firms if they have above (below) median measure before the CFO transitions. Our final measure of firm risk

is firm leverage. High leverage firms generally face more financial risks and are sensitive to financial shocks. Similar to the previous approach, firms were split into subgroups by the relationship between pre-transition year leverage and the median leverage.

Table 6 presents the results of the subsample regression results. The first three columns show the regression results for firms with high risks before CFO transition and the last three columns show the results for firms with low risks before CFO transition. Consistent with Hypothesis 2, female CFOs from high-risk firms conduct more overall environmentally responsible activities while female CFOs from low-risk firms show barely any difference after transitions. From the perspective of strengths and concerns, female CFOs in high-risk firms pay more attention to reducing environmentally irresponsible activities.

Table 6. Female CFO, environment CSR, and firm risks.

Variables	(1) EM Net Index	(2) EM Strength	(3) EM Concern	(4) EM Net Index	(5) EM Strength	(6) EM Concern
Panel A. Subsamples by total risks						
	Return volatility > median			Return volatility < median		
Post × Male-to-Female CFO	0.036 * (0.021)	0.013 (0.019)	−0.023 * (0.012)	0.039 * (0.021)	0.033 * (0.020)	−0.006 (0.010)
All control variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year × Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2338	2338	2338	2539	2539	2539
R-squared	0.196	0.176	0.177	0.278	0.272	0.204
Panel B. Subsamples by systematic risks						
	FF Beta > 1			FF Beta < 1		
Post × Male-to-Female CFO	0.048 ** (0.019)	0.026 (0.017)	−0.022 ** (0.010)	0.025 (0.027)	0.022 (0.023)	−0.003 (0.013)
All control variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year × Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2701	2701	2701	2176	2176	2176
R-squared	0.210	0.198	0.176	0.261	0.261	0.188
Panel C. Subsamples by idiosyncratic risks						
	Idiosyncratic risks > median			Idiosyncratic risks < median		
Post × Male-to-Female CFO	0.050 ** (0.022)	0.032 (0.020)	−0.018 * (0.010)	0.035 * (0.020)	0.019 (0.019)	−0.016 (0.011)
All control variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year × Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2339	2339	2339	2538	2538	2538
R-squared	0.236	0.242	0.145	0.235	0.207	0.207
Panel D. Subsamples by financial leverage						
	Book leverage > median			Book leverage < median		
Post × Male-to-Female CFO	0.059 ** (0.028)	0.034 (0.025)	−0.024 * (0.014)	0.027 (0.018)	0.020 (0.016)	−0.008 (0.008)
All control variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year × Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2451	2451	2451	2435	2435	2435
R-squared	0.261	0.240	0.216	0.205	0.202	0.194

Note: This table presents the results of the DID setting in Table 3 for subsamples. For brevity, only the interaction terms are reported. Standard errors are clustered at the firm level. ** $p < 0.05$, * $p < 0.1$.

4.4. Female CFOs, Environmental Management, and Stakeholder Values

To test Hypothesis 3, we adopted an exogenous shock to exam the potential impact of female CFO's attention on nonfinancial stakeholders. Specifically, we used the passage of constituency statutes as a quasi-natural experiment, the statutes of which require corporate directors to consider stakeholders' interests when making business decisions. The constituency statutes have been passed in different states gradually since 1984. We divided our

sample based on whether constituency statutes are passed at the firm incorporating state when CFO transition occurs. If the female CFOs pay more attention to the environment and other nonfinancial stakeholders, we expected to see a stronger change of environmental management in those firms incorporated in states without the passage of constituency statutes. In such a situation, female CFOs choose to conduct more environmental management and male CFOs are not necessarily conduct similar policies. On the contrary, if the incorporating states have already passed the constituency statutes, we expect to see no significant difference between male and female CFOs and pre- and post-transitions, as male CFOs are also required to take care of all the stakeholders. We test this hypothesis and show our results in Table 7. In the first three columns, we rerun our baseline regression for the firms of which the incorporation states have passed the statutes prior to the transition and in the last three columns we report the results for those firms without the requirements by the constituency statutes. Consistent with our Hypothesis 3, female CFOs tend to voluntarily engage in environmental management when they are not required to do so.

Table 7. Female CFO, environment CSR, and stakeholder orientation.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	EM Net Index	EM Strength	EM Concern	EM Net Index	EM Strength	EM Concern
	State with Constituency Statute			State without Constituency Statute		
Post × Male-to-Female CFO	0.008 (0.028)	0.016 (0.027)	0.008 (0.010)	0.058 *** (0.018)	0.034 ** (0.016)	−0.024 ** (0.010)
All control variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year × Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1425	1425	1425	3452	3452	3452
R-squared	0.219	0.224	0.266	0.238	0.230	0.154

Note: This table presents the results of the DID setting in Table 3 for subsamples. For brevity, only the interaction terms are reported. Standard errors are clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.5. Environmental Management and Cost of Newly Issued Bonds

In this section, we examine Hypothesis 4, which is whether better environmental management reduces firms' cost of newly issued bonds. We matched firms in our sample with SDC Platinum Global New Issues Database for the corporate bond information. Following Qi, Roth, and Wald [62] and Liu, Ning, and Davidson [63], we constructed two measures of the cost of bonds. The first measure is the yield spread at the time of issue, which is the difference between the yield-to-maturity of the bond and a duration-equivalent risk-free bond. When a firm issues multiple bonds within a year, the yield spread is averaged using the bond proceedings as the weights. Our second measure is the bond credit rating by S&P. Following conventions, we recoded the credit ratings from letters to numbers between 21 (AAA) and 1 (C).

Table 8 reports the OLS regression results. In the first two columns, the dependent variables are the natural logarithm of the yield spread. Consistent with the stakeholder theory, we found that *EM net index* is negatively related to the yield spread and the relation is significant at 1% level. The firm's overall environmental performance indeed reduces the bond yield spread. When substituting the net index with *EM strength* and *EM concern*, we found that bondholders pay attention to the firm's environmentally responsible performance over irresponsible activities. In the last two columns of Table 8, we use credit rating as the ex-ante cost of bond. The results are similar: firms with better environmental management are associated with higher credit ratings and the positive effect is mainly from environmentally responsible activities.

Table 8. Environmental management and cost of newly issued debt.

Variables	(1) Yield Spread (log)	(2) Yield Spread (log)	(3) S&P Credit Rating	(4) S&P Credit Rating
EM net index	−0.222 ** (0.094)		1.144 ** (0.567)	
EM strength		−0.205 ** (0.100)		2.292 *** (0.700)
EM concern		0.253 (0.179)		1.019 (1.000)
Firm size	−0.108 *** (0.023)	−0.110 *** (0.022)	1.535 *** (0.141)	1.370 *** (0.150)
Book leverage	0.054 (0.156)	0.053 (0.155)	−5.003 *** (0.944)	−4.985 *** (0.921)
Profitability (ROA)	−0.801 *** (0.252)	−0.799 *** (0.251)	14.408 *** (1.956)	14.214 *** (1.934)
R&D intensity	−0.005 (0.436)	−0.033 (0.435)	3.553 (3.242)	1.486 (3.246)
Number of segments (log)	0.024 (0.031)	0.023 (0.031)	0.314 (0.250)	0.239 (0.253)
Market-to-book ratio	−0.006 (0.004)	−0.006 (0.004)	0.053 (0.035)	0.053 (0.033)
Tangible assets	0.134 (0.092)	0.133 (0.092)	−1.591 ** (0.689)	−1.639 ** (0.664)
Financial crisis	1.425 *** (0.200)	1.430 *** (0.205)	−1.656 (1.273)	−1.292 (1.360)
Bond proceeds (log)	0.085 *** (0.021)	0.085 *** (0.021)	0.065 (0.177)	0.076 (0.175)
Bond maturity (log)	0.117 *** (0.040)	0.117 *** (0.040)	−0.122 (0.231)	−0.138 (0.235)
S&P credit rating	−0.144 *** (0.008)	−0.145 *** (0.008)		
Constant	6.431 *** (0.274)	6.444 *** (0.266)	−0.118 (1.708)	0.784 (1.813)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	803	803	803	803
R-squared	0.778	0.778	0.655	0.663

Note: Standard errors are clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5. Conclusions

In this paper, we investigate how executive gender influences firm environmental management. Based on the upper echelon theory, we built the hypotheses that female CFOs' personality and characteristics are critical to a firm's environmental responsibility performance. Specifically, female CFOs' risk aversion, ethicality, and closeness to the environment and stakeholders could lead female CFOs to pay more attention to the green strategy. We found evidence supporting our hypotheses. Female CFOs tend to conduct more environmentally responsible activities and reduce irresponsible activities. Our findings shed new light on the determinants of green management and gender difference literature.

We acknowledge that scholars have investigated the relation between gender diversity in top management and corporate environmental performance. Previous studies document that corporate environment investment and corporate social responsibility are significantly associated with gender diversity in the boardroom [64–66] and the CEO gender [67,68]. Our work differs from theirs in several aspects. We focused on the increasing role of CFOs that is often neglected by scholars previously. We further adopted DID regression settings that mitigate potential endogeneity concerns. We also provide evidence on the benefits of

environmental management. Firms with a better environment responsible performance tend to save costs of newly issued bonds and be rated higher by the credit rating agency.

We recognize that our study is not without limitations. For example, the impacts of female CFOs on corporate environmental management are drawn from data from the U.S. market. Our findings may not be able to generalize to other markets. For another instance, in our model we control for the female presence in the board and top executives. Nonetheless, we do not control for the gender diversity of rank-and-file employees due to data limitations. We assume that ordinary employees have less impact on the decision-making of environmental management strategy than the board of directors and top executives based on their different job functions. In most cases, directors and executives are in charge of determining firm strategies and ordinary employees are only responsible for executing those decisions. Furthermore, empirical evidence suggests a reverse direction in which CSR and corporate environmental performance plays a critical role in attracting and retaining ordinary employees [69,70].

Despite the above-mentioned possible limitations, we believe that our contributions are multifold. First, we extend the green management literature by linking the effect of executive gender differences on environmental responsibility performance. Previous literature recognizes multiple factors that influence firms' decisions on corporate environmental and social responsibility practices, such as the board of director composition [54] and institutional investors [50]. However, there is less known about how executives' managerial traits drive the firm environmental policy. Our work helps to fill the gap between executive demographics and the firm's environmental practices. Second, we advance the gender diversity literature and provide evidence on how the risk preference built in the executive gender influences corporate strategy and decision-making. Specifically, we show that female CFOs' risk aversion plays a critical role in environmental management, as female CFOs in high-risk firms tend to pay more attention to environmental management. Third, we extend the stakeholder value maximization theory and find that the female executive voluntarily pays more attention to the stakeholders. Lastly, we provide new evidence on the benefits of green management, which is that female CFOs' concern to environmental management leads to cost savings on newly issued corporate bonds.

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