Executive compensation and environmental performance: Evidence from CEO inside debt

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Abstract

In this paper, we explore the relationship between CEO inside debt and environmental performance in the US. We provide strong and robust evidence that CEO inside debt significantly improves firms' use of water, energy, and materials, and their commitment to and effectiveness in reducing environmental emissions. We also report that variations in inside debt significantly influence the evolution of environmental performance and incentivize the production of less pollution. Additional analyses reveal that the relationship between CEO inside debt and environmental performance is stronger in firms with high CEO power, low institutional ownership, and less socially responsible investors. Taken together, our results highlight the important role of CEO compensation in improving firms' engagement in favor of the climate.

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Abstract

Using a sample of 6,989 firm-year observations from 1,156 individual firms, we explore the relationship between CEO inside debt and environmental performance in the US. We provide strong and robust evidence that CEO inside debt significantly improves firms' use of water, energy, and materials, and their commitment to and effectiveness in reducing environmental emissions. We also report that variations in inside debt significantly influence the evolution of environmental performance and incentivize the production of less pollution. Additional analyses reveal that the relationship between CEO inside debt and environmental performance is stronger in firms with high CEO power, low institutional ownership, and less socially responsible investors. Taken together, our results highlight the important role of CEO compensation in improving firms' engagement in favor of the climate.

Keywords: Environmental emissions, CEO inside debt, CEO power, Institutional ownership

1. Introduction

Climate change, which has become central to academic, practical, and political debates, is posing pressing ethical challenges for current and future generations (Dahlmann et al. 2019). The dramatic changes observed in our natural ecosystem highlight the urgency of the situation and support claims that global warming has become a reality (e.g. Lee et al. 2015). International initiatives have established stringent goals to mitigate climate change while protecting human livelihoods and intergenerational fairness (e.g. Knutti and Rogelj 2015).

Academic research on the topic has evolved from a macroeconomic focus (e.g. Daubanes et al. 2020; Chevallier et al. 2019) to addressing other climate-related research questions relating to financial markets (e.g. Busch 2019; Busch et al. 2016) and microeconomic issues (e.g. Liesen et al. 2015, 2017). For instance, Liesen et al. (2015) investigate external stakeholders' influence on the existence and completeness of voluntary GHG emissions disclosures. Using a sample of 431 European companies, they show that only 15% of companies disclose complete GHG reports between 2005 and 2009 and that external stakeholders' pressure determines the existence but not the completeness of emissions disclosures. Liesen et al. (2017) focus on the relevance of climate change disclosure information for asset pricing and conclude that between 2005 and 2009, investors who use inefficiently priced positive effects of GHG emissions and good corporate climate change performance as indicators benefit from abnormal risk-adjusted returns of up to 13.05%. These findings clearly identify carbon disclosure as a determinant of investment decisions.

In this paper, we question the potential ethical role of CEO compensation in addressing climate change, focusing particularly on the relationship between CEO inside debt and environmental performance.[1] Building on the theoretical framework of Jensen and Meckling (1976) and Edmans and Liu (2011) that managers with large inside debt holdings have strong alignment of interests with creditors and thus display lower levels of risk-seeking behavior, we posit that large inside debt holdings are likely to elicit managers to enhance firm's

[1] To measure environmental performance, we use two scores provided by Thomson Reuters: the RES USE score "reflects a company's performance and capacity to reduce the use of materials, energy or water," and the EMIS score measures "a company's commitment and effectiveness towards reducing environmental emissions." In our robustness tests, we also use an actual emissions variable from EPA's TRI data to ensure that our findings are not driven by Thomson Reuters data and are supported by different dimensions of environmental performance.

environmental performance. Specially, we expect that firm level environmental emissions and impact will be reduced in the presence of large CEO inside debt holdings and that this reduction in emissions will be driven, in part, by an increase in the conservative nature of CEO's corporate policies.

After controlling for previous determinants of environmental emissions and performance, our sample consists of 6,989 firm-year observations from 1,156 individual US firms between 2002 and 2016. We provide robust evidence that CEO inside debt is positively associated with (1) companies' environmental performance as measured by their capacity to reduce their use of materials, energy and water, and to find more eco-efficient solutions, and (2) companies' commitment to reducing environmental emissions in their production and operational processes. Our main finding is robust to a battery of sensitivity tests including alternative dependent and interest variables, additional controls, and several approaches to control for endogeneity. In particular, we use (1) a propensity score matching approach to alleviating selection bias, (2) high-dimensional fixed effects and additional control variables to account for omitted variables, and (3) Granger causality procedure to mitigate reverse causality concerns.

We also investigate the impact of variations in inside debt holdings on the evolution of environmental performance. We argue that, if inside debt reduces the agency cost of debt and helps align the functions of management and debtholders, increasing amounts of inside debt will result in improvement in firms' environmental performance as assessed by their efforts to reduce their use of materials, energy, and water, and their commitment to and effectiveness in reducing environmental emissions. Our empirical findings strongly support this expectation, showing that, changes in CEO inside debt holdings are positively associated with improved environmental performance.

A further avenue of exploration is the role of different firms' characteristics in explaining the CEO inside debt–environmental performance relationship. First, we argue that CEO power may influence firms' environmental strategy and decisions and is likely to be an underlying factor explaining the interaction between inside debt compensation and environmental performance. Our empirical analysis strongly supports this claim and confirms that CEO inside debt has a stronger effect on environmental performance in companies with powerful CEOs as compared to less powerful CEOs.

We also investigate the role of ownership structure, and argue that, in companies with

less concentrated institutional ownership, CEOs have more freedom to apply their strategies and act in favor of the environment. Our findings corroborate this claim, showing that CEO inside debt positively affects capacity to engage in environmental practices only in firms with low institutional ownership, whereas, in firms with high institutional ownership, the impact of inside debt holding on environmental performance does not seem to be significant.

Finally, we turn on to consider the role of socially responsible institutions in explaining the relationship between inside debt holdings and environmental performance. We argue that, the relationship between CEO inside debt holdings and environmental performance is likely to be stronger for less socially responsible institutions, as CEOs' objective of reducing emissions will be in line with less socially responsible institutions' need to improve their environmental and social practices. Consistent with this expectation, our findings clearly show that the relationship between inside debt and environmental performance is only statistically significant with less socially responsible institutional ownership firms.

Our paper makes significant contributions to the related literature. First, our work is closely related but distinct from Ben-Amar et al.'s (2017) study and Haque's (2017) work on the relationship between board characteristics and polluting emissions. To the best of our knowledge, our study is the first to explore the interaction between debt-like compensation and environmental emissions and suggests that CEO compensation plays a significant role in enhancing firms' overall environmental performance.

Second, our work extends prior determinants of GHG emissions and environmental performance and confirms that firms' characteristics are also important for managing climate change. For decades, academics have focused on macroeconomic drivers of emissions, such as economic developments (e.g. Friedl and Getzner 2003), energy consumption (e.g. Iwata et al. 2011), political democracy and economic freedom (e.g. Benlemlih et al. 2022a), and liberalization (e.g. Lo et al. 2020). Our work shifts attention to a different determinant of environmental performance and emissions and supports the interest of appropriate executive compensation in improving firms' engagement in favor of the environment.

Third, our work complements previous literature on the link between executive compensation and corporate social responsibility. For instance, Mahoney and Thorn (2006) show the importance of executive compensation in increasing firms' socially responsible actions and conclude that compensation may be an effective tool to align executives' benefits

with the "common good". Our empirical work is among the first to focus on environmental performance and use an objective measure of emissions to explore how executive compensation affects firms' environmental sphere.

Finally, our work contributes to the regulatory debate on climate change and environmental responsibility. It clearly identifies the need for a global strategy that aims at improving firms' emissions and environmental performance through the inclusion of all firms' stakeholders.

In the remainder of this paper, we begin by discussing relevant literature and presenting our hypotheses. We then explain the sample construction and descriptive statistics, and present our empirical findings, before drawing some conclusions.

2. Literature Review and Hypotheses

2.1. Literature Review

Previous literature on sustainability clearly identifies the potential agency conflicts in top management decisions between financial and environmental performance. Superior environmental performance does not always enhance financial performance, especially in the short run. For instance, Horváthová's (2010) exploration of whether environmental performance affects financial performance shows that, of 64 empirical studies investigating the question, 35 find a positive relationship, 10 a negative relationship, and 19 no significant relationship. Horváthová (2010) claims that using simple correlation coefficients rather than more advanced econometric analysis increases the likelihood of finding a negative link between the two types of performance.

Environmentally friendly practices are costly for firms and may result in rejection of positive NPV projects that might increase toxic emissions or incur costs for complying with environmental regulations (Benlemlih and Cai 2020). Similarly, environmentally friendly projects are likely to be associated with high levels of uncertainty or upfront costs. Therefore, boards that value environmental performance but do not clearly identify whether it positively affects financial performance may withdraw from acting in favor of the environment unless their compensation is correlated with their environmental performance.

Cordeiro and Sarkis's (2008) empirical study of the relationship between top executive compensation and environmental performance uses a sample from Standard & Poor's (S&P)

500 and data on environmental performance from the Investor Responsibility Research Council. They show that in firms where environmental performance is a determinant of executive compensation, the two are positively related. However, their results are relatively weak, as they only hold when the performance measure is adjusted for industry benchmarks.

Haque and Ntim (2020) mobilize neo-institutional theory to examine interrelationships between executive compensation, ESG compensation policy, carbon performance, and firm value. Using data from 13 European countries over the 2002–2016 period, they confirm that executive compensation moderates the relationship between market value and carbon performance. Their findings accord with legitimization theory, which states that executive engagement in favor of the climate is driven by economic motives such as firm value.

Moving a step further, extant literature shows that executives' incentives may go beyond environmental performance to include social practices (e.g. Berrone and Gomez-Mejia 2009). Maas (2018) investigates this hypothesis empirically using a sample from S&P 500-listed companies between 2008 and 2012 and MSCI ESG STATS scores to measure corporate social performance. She shows that when firms use quantitative, difficult-to-achieve social performance goals as executive incentives, their social performance increases dramatically. Her study's empirical design indicates that this improvement is mainly a result of reducing social and environmental weaknesses.

Other recent studies investigate the direct relationship between top management inside debt and corporate social responsibility (e.g. Boubaker et al. 2019; Wu and Lin 2019; Kim et al. 2020). Based on agency theory and using an extensive sample of US companies, with MSCI ESG STATS as the main measure of social responsibility, this line of research strongly supports the proposition that CEO inside debt significantly and positively affects various dimensions of corporate social responsibility.

2.2. Discussion of Hypotheses

In order to establish a theoretical explanation for the relationship between CEO inside debt and environmental performance, we draw on arguments from the agency cost of debt and managerial short-termism.

According to the agency cost of debt (e.g. Jensen and Meckling 1976; Myers 1977), conflict arises between shareholders and debtholders owing to the differing risk profiles of

projects undertaken by the firm and financed by creditors. Management tends to invest in risky projects with higher expected returns, which raises the cost of financing and decreases the value of outstanding debt. If investments are successful, shareholders are likely to enjoy significant returns, whereas the amount of interest received by debtholders is fixed and limited. On the other hand, if investments fail, debtholders are likely to share the losses. Jensen and Meckling (1976) argue that granting management an equal proportion of debt and equity is likely to reduce the shareholder–debtholder conflict that emerges when management is mainly equity-aligned. Managers will consequently have no incentives to reallocate wealth from debtholders to shareholders, and CEOs holding inside debt will instead have incentives to align their interests with those of debtholders, as their payout function is likely to be more closely aligned with that of debtholders.

Previous literature provides extensive theoretical and empirical evidence of debtholders preferring lower risk profiles and tending to take short-term perspectives (e.g. Bhanot and Mello 2006). Building on this theoretical background, some recent studies suggest that CEOs with inside debt are exposed to a default risk similar to that of outsiders (e.g. debtholders) and that they favor a more conservative management approach, especially when the debt proportion of the compensation rises (Cassell et al. 2012). For instance, Cassell et al. (2012) document that high CEO inside debt lowers firms' future stock volatility, R&D expenditure, and financial leverage, and improves their asset diversification and liquidity. Brisker and Wang (2017) also report that CEO inside debt is associated with lower leverage.

Anantharaman et al.'s (2014) study of corporate debt contract design reveals that higher CEO debt-like compensation plays an important role in reducing promised yields and numbers of covenants. Similarly, Kabir et al. (2013) indicate that CEOs with inside debt avoid risky investments, make more conservative decisions, and have less incentive to expropriate debtholders, potentially explaining why creditors are found to require lower yield spread for such companies. These results may also be explained by Milidonis et al.'s (2019) finding of a significant negative impact of CEO inside debt on firms' risk-taking behavior.

Finally, Dhole et al. (2016) focus on the relationship between inside debt and earnings management. Based on the prediction that CEOs with higher inside debt are likely to engage in less risky corporate investments, with less volatile earnings and less need for income smoothing, the authors document a significant negative relationship between CEO inside debt

and several measures of earnings management. They conclude that inside debt compensation is a real incentive that helps avoiding earnings management and enhances investors' trust. Overall, previous research clearly identifies inside debt as a mechanism that aligns managers' and debtholders' interests through greater conservatism, lower long-term risk taking, and lower information asymmetry.

According to the Toxic Release Inventory (TRI) program of the US Environmental Protection Agency (EPA), in 2019, companies in the US collectively generated 30.7 billion pounds of toxic chemical waste (e.g. asbestos, benzidine, bisether, dioxin and dioxin-like compounds). These compounds can cause cancer, birth defects, or other serious harm to people (Currie et al., 2014; Xu and Kim, 2021) which exposes firms to high risk of detection and reputational loss along with litigation and regulatory actions. For example, Keele (2018) states that in the last decade, US courts have experienced a spectacular rise in climate change- and environment-related claims, with climate change litigation arising from 80 cases per year in 2014 to over 120 in 2015 and over 100 cases in 2016, more than half of which related to federal statutory claims. Markell and Ruhl (2012) emphasize that impact assessment, information reporting, and substantial mitigation regulation and enforcement remain the main reasons for environment-related claims. Their studies strongly support that environmental litigation has become a significant component of firms' overall governance framework, with a significant impact on their reputation and returns.

As public environmental awareness rapidly grows worldwide and emissions litigation risk has become a reality, the potential harm in regard with low environmental performance would attract enhanced scrutiny and monitoring from all related stakeholders. This is likely to jeopardize the firm's ability to finance or contract for investments and operation activities in the future. Especially, firm's value would decrease, and its default risk would increase accordingly. Thus, we expect that CEOs with large debt claims who are concerned about default risk and the recovery value in default exhibit a strong commitment to reduce their firms' emissions and maintain high environmental performance. This is likely to reduce the risk of costly sanctions for non-compliance with laws and regulations (e.g. Benlemlih and Girerd-Potin 2017), maintain firms' returns and resources (Cai et al. 2016), and create an insurance-like protection that improves firms' reputation (Godfrey et al. 2009). Accordingly, we formulate our first hypothesis:

H1. Inside debt compensation is positively associated with firms' environmental engagement in favor of low emissions.[2]

Next, we consider how the evolution of CEO inside debt over time may affect environmental performance. Given that firms' environmental strategies may be sticky, firm-level environmental performance may not fully demonstrate the impact of CEO inside debt holding. Furthermore, with ever-growing political and social climate-related discussions and pressure to reduce emissions, variations in CEO inside debt compensation from one year to another are likely to create additional incentives and influence variations in environmental performance. Thus, we expect firm-level environmental practices to respond positively to changes in CEO inside debt holdings. This is consistent with our second hypothesis:

H2. Inside debt compensation variations are positively associated with changes in environmental practices in favor of low emissions

According to Cannella and Shen (2001), CEOs that are also chairs can exert a greater impact on their boards. Chairs play a determining role in setting the agenda for the meetings and are therefore able to control which issues are brought before the board (Imhoff 2003). We conjecture that powerful CEOs may dominate boards' decisions on firms' policies and strategies relating to organizational environmental performance. CEOs perceiving inside debt have incentives to increase their environmental performance as we stated earlier in H1 and are rewarded for a higher level of social and environmental engagement as stated in Ho et al. (2022). They are likely to benefit from their power within the boards to influence firms' decisions toward high environmental performance investments. We, therefore, posit that the relationship between CEO inside debt holdings and environmental management is stronger for firms with greater CEO power as the latter enables CEOs to make a material impact on their organizations' environmental emissions. Hence, we formulate our third hypothesis:

H3a. Inside debt compensation influences firms' environmental performance through high CEO power.

The second variable that we expect to drive the relationship between CEO inside debt and environmental emissions is institutional ownership. Given that CEOs with inside debt holdings

[2] In testing all our hypotheses, we rely on the two measures of environmental performance (RES USE and EMIS scores) explained in the introduction and presented in discussing the details of the variables.

have the same exposure to default risk as external lenders, they have an incentive to mitigate agency problems arising from conflicts between shareholders and bondholders and curb their own risk-seeking behavior (Jensen and Meckling 1976). We posit that the impact of CEO inside debt holdings on environmental performance is stronger for firms with less monitoring by institutional investors, since such monitoring may constrain CEOs with high inside debt holdings to make decisions that benefit creditors. Shleifer and Vishny (1986) argue that large shareholders have considerable power and resources to collect relevant information, control insiders' and CEOs' decisions within the company, and implement contracts that are in line with their financial expectations and objectives. Thus, firms with high institutional ownership are likely to focus on optimizing their investment strategies and improving their financial performance. at the expense of other considerations such as environmental practices. This leads to our fourth hypothesis:

H3b. Inside debt compensation influences environmental performance through low institutional ownership.

Hwang et al. (2015) explore observed differences in institutional investors' tastes and show that institutions may have an impact on corporate behavior. Specifically, they find that firms held by more "non-socially responsible institutions" are likely to increase their socially responsible activities less than other firms. Based on their findings, we conjecture that the association between CEO inside debt holdings and environmental emissions is likely to be stronger when firms have more socially responsible institutional ownership since socially responsible institutions are likely to encourage CEOs' decisions to enhance firms' environmental activities. Consequently, we formulate the following hypothesis:

H3c. Inside debt compensation influences environmental performance through high socially responsible institutional ownership.

3. Research Design

3.1. Sample Construction

We collect data from ExecuComp, Compustat, and Thomson Reuters. The ExecuComp database covers all public firms currently and formerly in the S&P 1500 index, which includes all stocks in the S&P 500, S&P MidCap 400, and S&P SmallCap 600 indexes, representing 90% of US stock market capitalization. To create our dataset, we started with all CEOs included

in ExecuComp from 2002 to 2016. The ExecuComp database contains detailed information on executives, such as compensation, ownership, and biographical data. Executive compensation data were matched with firm-level accounting data from Compustat, and ESG data from Thomson Reuters. To remove outliers, all continuous variables are winsorized at the 1% and 99% levels. These procedures yielded a sample of 6,898 firm years from 1,156 firms for our analysis.

3.2. Construction of Variables

CEO Inside Debt

Our test variable is our proxy for CEO inside debt. First, we identify firm CEOs based on the "CEOANN" item. We measure CEO leverage in two ways. CEO inside debt is measured as the sum of CEOs' pension benefits and deferred compensation scaled by their equity value (He 2015; Dang and Phan 2016). In order to improve the robustness of our findings, in some tests, we also use the proxy, CEO_ID_DUM, which is an indicator variable equal to one if the CEO's relative leverage, measured as the CEO's debt-to-equity ratio scaled by the firm's debt-to-equity ratio, is greater than 1, and 0 otherwise (see Appendix A for a detailed summary of our calculation of CEO inside debt holdings). Consistent with previous studies, we only included firm-year observations with positive CEO inside debt values.

Environmental Performance

To measure environmental performance, we use two proxies constructed from the Thomson Reuters Eikon database. The first is the **TRESG Resource Use Score** (RES_USE_SCORE). According to Thomson Reuters, "*The Resource Use Score reflects a company's performance and capacity to reduce the use of materials, energy or water, and to find more eco-efficient solutions by improving supply chain management*" (Thomson Reuters 2017). Our second proxy is the **TRESG Emissions Score** (EMIS_SCORE), which is defined as "*a company's commitment and effectiveness towards reducing environmental emission in the production and operational processes*." The Thomson Reuters Eikon database constructs TRESG emission scores by including metrics such as hazardous waste, estimated CO_2-equivalent emissions totals, and total waste. Thomson Reuters employs a percentile rank scoring approach to construct the **TRESG Resource Use Score and Emissions Score**. Since these two proxies are calculated based on rank, they are not very sensitive to outliers.

Control Variables

We control for firm characteristics that might influence firms' environmental performance as indicated in prior literature (e.g. Benlemlih et al., 2022b). Our control variables included *SIZE*, calculated as the natural logarithm of a firm's total assets; *ROA*, which is operating income after depreciation divided by the book value of total assets; *Leverage*, the ratio of total liabilities to book value of total assets; *MTB*, market capitalization plus total assets minus book value of equity scaled by the book value of total assets; *Cash*, the ratio of cash and short-term investments to the book value of total assets; *Age*, the natural logarithm of the firm's listing age defined as the number of years since its IPO was reported in the Center for Research in Security Prices (CRSP) database; and *PPENT*, which is tangibility measured as the ratio of property plant and equipment to the book value of total assets.

3.3. Summary Statistics

Panel A of Table 1 presents the distribution of industry membership in the sample using Fama and French's (1997) 12-industry classification, and Panel B breaks down the sample by year. Both panels indicate that our sample was well distributed over industries and years.

Insert Table 1 here

Table 2 reports summary statistics for the dependent, interest, and control variables used in our main analyses on the full sample. All continuous variables were winsorized at the 1st and 99th percentiles to alleviate the influence of extreme values. The table presents the number of observations, mean, standard deviation, 25th percentile, median, and 95th percentile. The mean of CEO inside debt is 31.2%, showing that, on average, CEO inside debt holdings were about one third of CEO equity holdings. Firms in our sample had an average leverage ratio of around 59%.

Insert Table 2 here

Table 3 reports the correlations between the main variables used in our main regression model. Consistent with our conjectures, CEO inside debt is positively correlated with environmental performance on three environmental performance measures. Note that firm size, firm age, and firm profitability are also positively correlated with environmental performance.

Insert Table 3 here

4. Empirical Specifications and Results

4.1. Baseline OLS Regression Results

We first test the effect of CEO inside debt holdings on environmental emissions by estimating the following equation using ordinary least squares (OLS):

$$\textit{Environmental performance} = \alpha_1 + \beta_1 \text{CEO\_ID}_{i,t} + \gamma \textit{CONTROLS}_{i,t} + \textit{YEAR} + \textit{INDUSTRY} + \varepsilon_{i,t} \quad \textbf{(1)}$$

Where *i* is the firm; and *t* is the year. In all regressions, we control for Fama and French's (1997) 48-industry and year fixed effects. Robust *t*-values were corrected for clustering of the regression residuals at the firm level.

Columns (1) to (4) of Table 4 present the results of tests relating to our first hypothesis (H1) on the association between CEO inside debt holdings and firm-specific environmental performance. The estimated coefficients of CEO inside debt are positive and statistically significant across all four models with regards to the two measures of environmental performance. These results clearly indicate that firm-level environmental performance, measured by RES_USE_SCORE and EMIS_SCORE, improves significantly with CEO inside debt holdings, supporting H1.

In addition, the estimated coefficients of our control variables are generally consistent with prior economic theory and empirical literature (e.g. Jo and Harjoto 2012). For example, larger firms, firms with more growth options (proxied by market-to-book ratio), firms with more cash holdings, and firms with more tangible assets tend to have better environmental performance.

Insert Table 4 here

4.2. Changes Model

Thus far, we have focused on the relationship between corporate environmental performance and CEO inside debt holdings. We recognize that some firms' environmental strategies may remain unchanged for several years. CEO inside debt holdings may therefore impact differently on these firms compared with those with more flexible environmental strategies. To address this concern and test H2, we adopt a change model and included firm and industry-year fixed effects. In columns (1) and (2) from Table 5, we estimate the empirical

association between changes in CEO inside debt holdings and changes in environmental performance while controlling for the industry and year-fixed effects. In columns (3) and (4) of Table 5, we estimate the changes models while controlling for unobserved time invariable firm characteristics and time-varying industry effects (firm and year × Fama–French 48 industry dummies). In line with our main results and the expectation of H2, the coefficient of ΔCEO_ID is positive and statistically significant at the 10% significance level or better, indicating that changes in CEO inside debt holdings are an additional explanatory variable for changes in environmental emissions. In summary, changes in CEO inside debt holdings seem to improve corporate environmental performance, as assessed by both resource use and emissions scores.

Insert Table 5 here

4.3. Endogeneity

Although our regression models included as many firm-specific control variables as possible that had been proved in previous literature to influence firm-specific environmental performance and emissions, our findings may arguably suffer from endogeneity concerns. Such concerns may arise from omitted variables that impact both CEO inside debt holdings and firm-level environmental emissions. For example, if our measure of CEO inside debt captures the non-linear effects of our control variables on firm-level environmental emissions, then the linear combination of control variables in our analyses might be insufficient to take adequate account of differences between firms with CEO inside debt and those without. To alleviate this endogeneity concern, we adopt four approaches that consist of **1)** instrumental variables, **2)** propensity score matching (PSM), **3)** higher-order fixed effects, and **4)** Granger causality tests. These are explained in the next sub-sections.

Instrumental Approach

Environmental emissions and corporate culture may be jointly determined, giving rise to a potential simultaneity problem. To alleviate this concern, we perform a two-stage regression using the generalized method of moments (GMM) estimator (Brockman et al. 2010). Ideally, instruments should capture variation in CEO inside debt holdings but be exogenous to firm-level environmental performance and emissions. Murphy et al. (1999) show that both managerial compensation levels and structure vary by industry. Sundaram and Yermack's (2007) examination of a sample of 237 large capitalization firms provides evidence that CEOs

hold a portfolio of incentives arising from both inside debt and inside equity compensation. This portfolio tends to shift in favor of inside debt instruments as CEOs grow older. Thus, following previous studies, we use the annual industry median of CEO inside debt holdings and CEO age as two instruments for firms' CEO inside debt holdings (Sundaram and Yermack 2007; Cassell et al. 2012; Anantharaman et al. 2014; Dang and Phan 2016). Table 6 presents our analysis. Column (1) reports the results of the first-stage regression of the GMM estimation for potential endogenous variables. In the first stage, we regress CEO inside debt on its two instruments, with the same control variables as in the baseline regression of equation (1). The estimated coefficients of our two instruments, CEO age and industry-median CEO leverage, are both positive and statistically significant, as predicted. The significant F-statistics provide further support for the joint relevance of our instruments in the first stage. By comparing the F-statistics with critical values of Hausman et al.'s (2005) test for weak instruments, we were able to reject the null hypothesis that our instruments are weak. Columns (2) and (3) of Table 6 present the second-stage regressions, which estimate equation (1) with the independent variable of interest replaced by its fitted value from the first-stage regression. The positive relationship between CEO inside debt holdings and firm-level environmental emissions remains statistically significant after controlling for the potential endogeneity of CEO inside debt holdings.

Insert Table 6 here

Propensity Score Matching

Our second identification method employed PSM (Rosenbaum and Rubin 1983) to estimate the treatment effect of CEO inside debt holdings on firms' environmental emissions. If the difference in environmental performance between firms with CEOs whose leverage is greater than the firms' debt-to-equity ratio and those with CEOs whose leverage is lower depends on firm characteristics affecting the design of CEO compensation, then the relationship between CEO inside debt holdings and environmental performance is not attributable to CEO inside debt holdings per se. If we were to directly study the impact of CEO inside debt holdings and environmental performance, measured by the two proxies for emissions used in Table 4, the estimated regression coefficients might be biased due to potential confounding variables. To mitigate this estimation bias, we employ a PSM procedure (Rosenbaum and Rubin 1983) and estimated the treatment effect of CEO inside debt holdings on corporate environmental performance. PSM is a non-parametric approach involving statistical selection of a subset of

untreated firms with a covariate distribution indistinguishable from that of treated firms. The PSM approach helps address concerns about non-random mutual selection and improves the causal inference of our empirical analysis.

To implement PSM, we first use a logit model to calculate the probability of a firm having a CEO whose leverage is greater than the firm's debt-to-equity ratio (referred to as "treatment firms") based on the firm's characteristics. Second, we match each treatment firm with a control firm (with CEO relative leverage equaling 0) using the nearest neighbor matching approach, with a requirement that the maximum difference between the propensity scores of the control and matched firms must not exceed 0.5% in an absolute value. We use the single nearest neighbor, without replacement, with a caliper of 0.005. Each firm with CEOs' relative leverage equaling one is matched with a firm with CEO relative leverage equaling zero and with the closest propensity score. For robustness, we also adopt other matching algorithms—single nearest neighbor without replacement and a caliper of 0.01, and single nearest neighbor with replacement and a caliper of 0.01—which produce consistent results.

We conduct diagnostic tests to ensure that firms in the treatment and control groups had similar observable characteristics (Dhaliwal et al. 2016). Panel A of Table 7 shows that all univariate difference test statistics are insignificant. The PSM procedure has left us with a PSM sub-sample of 3,056 firm-year observations, comprising 1,528 firm-year pairs with CEO relative leverage equaling one, and the same number with CEO relative leverage equaling zero.

We next re-estimate Equation (1) using the PSM sub-sample over the sample period. The regression results are reported in Panel B of Table 7. The results clearly show that the estimated coefficients of CEO inside debt remain positive and statistically significant, substantiating our conclusion that higher CEO inside debt holdings improve firms' resource use and environmental emissions.

Insert Table 7 here

High-Dimensional Fixed Effects

One weakness of our PSM approach is that we only control for observed firm characteristics. The findings presented in Table 4 might conceivably be driven by unobservable firm characteristics not accounted for in our PSM procedure. Thus, any hidden bias due to latent variables might still exist after matching. Gormley and Matsa (2014) recommend implementing

a fixed effects model to mitigate potential endogeneity due to unobserved heterogeneity across firms and time-varying heterogeneity across industries. Following their advice, we conduct high-dimensional fixed effects analyses. Columns (1) and (2) of Table 8 present the results of re-estimating equation (1) while controlling for unobserved time-invariable firm characteristics and time-varying industry effects (firm and year × Fama–French 48 industry dummies). Consistent with the findings in Table 4, after controlling for unobserved firm characteristics, the estimated coefficients of CEO inside debt holdings were positive and statistically significant, irrespective of how environmental emissions were measured.

Insert Table 8 here

Granger Causality Tests

Lastly, following previous literature (e.g. Benlemlih and Girerd-Potin, 2017; Kim et al. 2013), we run Granger causality tests (Granger 1969; Dunbar et al. 2020) to examine potential reverse causality issues. We conjecture that CEO inside debt holdings would enhance firm-level environmental performance by better aligning the long-term interests of the company and its management team. However, reverse causality might exist if environmentally friendly firms strategically design CEO compensation packages with a greater proportion of pension benefits and deferred compensation. To empirically determine the dominant direction of causality, we ran vector autoregressions using two models. In model 1, the environmental performance measure (RES_USE_SCORE or EMIS_SCORE) is regressed on its lagged value and lagged CEO inside debt holdings, as well as the control variables defined in equation (1). In model 2, CEO inside debt holding is regressed on its lagged value and the environmental emissions measure (RES_USE_SCORE or EMIS_SCORE), as well as the control variables defined in equation (1).

Table 9 presents the results of this analysis. We find that the causality from CEO inside debt holdings is much stronger than the reverse causality. Based on the Chi-squares and their marginal significance level, we can reject the hypothesis that environmental emissions cause CEO inside debt holdings but cannot reject the hypothesis of Granger causality between CEO inside debt holdings and environmental emissions. We thus conclude that CEO inside debt holdings have a significant impact on reducing environmental emissions, and that corporate environmental strategy has only a marginal impact on CEO compensation design.

Insert Table 9 here

4.4. Additional Robustness Tests

Additional Controls

Even after controlling for the impact on firm-level environmental performance of an extensive set of explanatory variables suggested by the previous literature, the positive relationship between CEO inside debt holdings and firm-level environmental emissions might arguably be due to omitted variables. Table 10 examines this concern by including several additional control variables to ensure that our results are robust to potential omitted variable bias. Each column in Table 10 re-examines equation (1) with the inclusion of one additional variable. The literature on environmental performance and GHG emissions present other less commonly used explanatory variables that affect organizational environmental emissions, including research and development expenses (models 1 and 5), capital expenditure (models 2 and 6), and dividend payouts (models 3 and 7). Moreover, to rule out the possibility of our results being driven by other CEO characteristics, we directly control for CEO age, CEO tenure, CEO gender, and CEO power in equation (1) (models 4 and 8). Finally, we include all these additional control variables in a single model (models 9 and 10). The results of these regressions have the predicted signs for most of these variables. For instance, the coefficients for research and development expenses are positive and statistically significant at the 1% significance level. Dividend payout is positive and significant at the 5% significance level, except in model 6. The coefficients for capital expenditure are statistically insignificant, suggesting that this has no impact on environmental emissions. In summary, the results in Table 10 indicate that CEO inside debt improves firm-level environmental performance, even after controlling for a battery of additional firm characteristics.

Insert Table 10 here

Alternative Proxy for CEO Inside Debt

The main analysis presented in Table 4 uses a continuous variable, CEO leverage, which is the ratio of CEOs inside debt holdings to their equity value. Here, we use a dummy variable, relative CEO leverage, which takes a value of 1 if the CEO's debt-to-equity ratio divided by the firm's debt-to-equity ratio is greater than 1, and 0 otherwise. Table 11 reports the results of employing this alternative measure of CEO inside debt holdings. The association between

relative CEO leverage and firm-level environmental performance continues to be positive and statistically significant at the 1% significance level. These findings reaffirm the effects of CEO inside debt on improving environmental performance and use of natural resources.

Insert Table 11 here

4.5. Cross-Sectional Analysis[3]

CEO Power

Next, we consider hypothesis H3a, which posits that the relationship between CEO inside debt holdings and environmental performance is stronger for firms with higher CEO power since greater managerial power enables CEOs to make a material impact on organizational environmental emissions.

To assess CEO power, we use a dummy variable, CEO duality, which equals 1 when the CEO also serves as chair of the board, and 0 otherwise. Table 12 reports the findings of this analysis. The estimated coefficients of CEO inside debt are positive for both sub-samples. However, the coefficients are statistically significant only in the high CEO power sub-sample for both measures of environmental performance. Furthermore, the absolute values of the estimated coefficients of CEO inside debt are much larger in the high CEO power sub-samples than in the corresponding low CEO power sub-samples.

In summary, our findings indicate that the impact of CEO inside holdings on environmental performance is more pronounced for firms with high CEO power. This provides strong support for H3a, as improved environmental performance is more likely to be observed in firms with greater CEO power.

Insert Table 12 here

[3] In this cross-sectional analysis, we decide to compare the coefficients of CEO_ID across two corresponding partitions, rather than using a three-way interaction term because the coefficients of our control variables might vary across sub-samples, as discussed by DeFond et al. (2015). To ensure that the differences between the variables of interest in the two constructed sub-samples were statistically significant, we also perform F-tests and ensure they were statistically significant at the 5% level or better. Finally, in unreported results for the lack of space, we also run these cross-sectional analyses using an approach with interaction terms. The findings are similar to those from the sub-sample regressions and remain available from the authors upon request.

Monitoring Institutional Investors

In examining the role of institutional ownership in driving CEOs holding inside debt to improve their environmental performance, as a proxy for monitoring by institutional ownership, we use a variable defined as the percentage of shares outstanding held by dedicated and quasi-index institutional investors at the end of the fiscal year.[4] We then divided our sample into two sub-samples based on the median of monitoring institutional ownership.

Table 13 reports the relationships between CEO inside debt holdings and environmental emissions in high versus low monitoring institutional ownership sub-samples. The estimated coefficients of CEO inside debt are positive for both sub-samples. However, the coefficients are statistically significant only in the low monitoring institutional ownership sub-sample for both measures of environmental emissions. In addition, the absolute values of the estimated coefficients of CEO inside debt are much larger in the low monitoring institutional ownership sub-samples than in the corresponding high monitoring institutional ownership sub-samples. Taken as a whole, this result confirms the expectation of H3b, and suggests that the impact of CEO inside holdings on environmental emissions is associated with low monitoring by institutional ownership.

Insert Table 13 here

Socially Responsible Investors

H3c proposes that the association between CEO inside debt holdings and environmental performance is likely to be stronger when firms have high socially responsible institutional ownership. To perform this analysis, we divide the sample into high and low socially responsible institutional ownership using SRIs, calculated as the previous four quarters' average socially responsible ownership (Hwang et al. 2015). Socially responsible ownership was measured as the number of shares held by socially responsible investors, scaled by the total number of shares outstanding.[5] Firms with SRIs above (below) the median are classified as high

[4] Bushee (1998) classifies institutional investors into three categories: dedicated, quasi-index, and transient. Following Chen et al. (2007), we combine dedicated and quasi-index institutions and treated them as monitoring institutional investors.

[5] Following Hwang et al. (2015), we calculate institutional investors' taste for social responsibility (SR) by aggregating the KLD scores of firms whose stocks they held to determine the SR rating for each institution. For each quarter, we sort the institutional SR ratings into three groups, with institutions in the bottom group with the lowest ratings defined as NSRIs, and the remaining institutions defined as SRIs. Below-median values of *SRIs*

(low) SRI sub-samples.

Table 14 presents the results for the relationship between CEO inside debt holdings and environmental emissions in high versus low socially responsible institutional ownership sub-samples. Inconsistent with H3c, the estimated coefficients for CEO inside holdings are statistically significant only in the low socially responsible institutional ownership sub-samples for both measures of environmental emissions. These findings at the opposite of our expectations may find their explanation in the work of Hwang et al. (2015) that points out the role of socially responsible investors activists in improving firms' social and environmental engagements. Indeed, with pressure towards fewer emissions from different stakeholders, it is expected that low socially and environmentally responsible institutions face higher pressure (higher than the one faced by high socially and environmentally responsible institutions) to improve their environmental emissions. Consequently, CEOs with inside debt are more inclined to act in favor of the environment in low socially responsible institutions to maintain their reputation and satisfy the demand from investors activists which explains that the relationship between inside debt and environmental performance is rather driven by low socially responsible institutional ownership.

Insert Table 14 here

5. Conclusion

With increasing regulatory and ethical debates on the climate, this paper sheds light on a less frequently discussed topic in relation to climate change, namely the relationship between executive compensation and environmental emissions. Using an extensive dataset of 6,989 firm-year observations from more than 1,156 individual US firms over 15 years, we find strong evidence that CEO inside debt improves firms' environmental emissions, as measured by their performance in finding more eco-efficient solutions, optimizing their use of materials, energy, and water, and reducing environmental emissions in their production and operational processes. Our findings are robust to using alternative dependent variables, alternative control variables, and several techniques to control for endogeneity.

In additional analyses, we investigated underlying channels that might explain the

represent lower-quality external corporate governance and monitoring intensity, and above-median values of *SRIs* represent higher-quality external corporate governance and monitoring intensity.

relationship between inside debt and environmental emissions, resulting in several findings. First, we highlight the significant role played by CEO power in reducing environmental emissions. Second, we show that low institutional ownership explains the relationship between inside debt and emissions. Third, we provide evidence that the relationship between CEO inside debt and environmental emissions is driven by low socially responsible institutional investors. Finally, we highlight the importance of CEO inside debt in reducing polluting emissions in industries with high litigation risk.

Our paper fills a gap in the literature and enhances understanding of how executive compensation may be a significant driver of firms' environmental practices. Despite the importance of this research question from the perspective of regulating and reducing GHG emissions, existing literature is silent on how executives' decisions and motivations influence firms' emissions. Huge regulatory efforts are being made in favor of the climate, highlighting the need for all stakeholders to contribute to cleaning up the planet. Top executives have power to influence the deployment of environmental resources and initiatives across organizations, and their support is critical for implementing innovative environmental systems (e.g. Sharma 2000). Future research might examine the relationship between characteristics of boards and environmental innovation and management.

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Appendix A. CEO_ID and CEO_ID_DUM calculations

We use Black and Scholes's (1973) model, as modified by Merton (1973), to account for dividend payouts, and estimate a stock option's value or sensitivity to the stock price or stock return volatility.

$$\textit{Option value} = [Se^{-dt}N(Z) - Xe^{-rT}N(Z - 6T^{(\frac{1}{2})})],$$

where $Z = \frac{[\ln(\frac{S}{X}) + T(r - d + \frac{6^2}{2})]}{6T^{(\frac{1}{2})}}$; N = cumulative probability function for the normal distribution; S = price of the underlying stock; X = option's exercise price; σ = expected stock return volatility over the life of the option; r = log transformation of the risk-free interest rate; T = option's time to maturity in years; and d = log transformation of the expected dividend yield over the life of the option.

We follow Core and Guay's (2002) and Frank and Goyal's (2007) methods to estimate the value of unexercised options held by executives (i.e. options granted in previous years for which values are not reported). The inputs are obtained as follows.

Exercise price for unexercised options: We follow a two-step process to estimate the average exercise price for unexercised exercisable options. First, we calculate the ratio of the realizable value of in-the-money exercisable options to the number of unexercised exercisable options. Second, we subtract this ratio from the fiscal year-end stock price to obtain an estimate of the average exercise price for unexercised exercisable options. Similarly, we estimate the average exercise price of unexercised unexercisable options by subtracting the ratio of the number of in-the-money unexercisable options to the number of unexercised unexercisable options from the fiscal year-end stock price.

Maturity of unexercised exercisable options: We assume the maturity of unexercised exercisable options to be four years less than the average maturity of new option grants. If no option grants are made in the year, we set the maturity to six years. We set the maturity of

unexercisable options at one year less than the average maturity of new grants. If no new grants are made in the year, we set the maturity of unexercisable options at nine years.

CEO_ID is the ratio of CEOs' inside debt to their inside equity, and CEO_ID_DUM is an indicator variable equaling one if the relative CEO leverage exceeds one, and zero otherwise. Relative CEO leverage is calculated as $(D_{CEO}/E_{CEO})/(D_{Firm}/E_{Firm})$.

Appendix B. Definitions of variables

Variable	Description	Source
CEO_ID	The ratio of the sum of the present value of accumulated pension benefits and deferred compensation to the sum of the value of stock and stock options held by the CEO	ExecuComp
CEO_ID_DUM	An indicator variable equaling one if the ratio of the CEO's debt-to-equity ratio to the firm's debt-to-equity ratio exceeds one, and zero otherwise.	ExecuComp & Compustat
RES_USE_SCORE	A score that reflects a company's performance and capacity to reduce its use of materials, energy, and water, and to find more eco-efficient solutions by improving its supply chain management.	Thomson Reuters
EMIS_SCORE	A score that captures a company's commitment to and effectiveness in reducing environmental emissions in its production and operational processeses, derived from a percentile ranking.	Thomson Reuters
CASH	The ratio of cash and short-term investments (*che*) to total assets (*at*).	Compustat
AGE	The natural logarithm of the number of years between the fiscal year and the first year in which the firm was listed in CRSP.	CRSP
MTB	The ratio of the market capitalization plus total assets minus the book value of equity to the book value of total assets.	Compustat
SIZE	The size of the firm, defined as the natural logarithm of the book value of total assets.	Compustat
PPENT	The ratio of the net value of property plant and equipment to total assets.	Compustat
LEV	The ratio of total liabilities to total assets.	Compustat
ROA	The ratio of operating income after depreciation to total assets	Compustat
CAPEX	The ratio of capital expenditure to total assets.	Compustat
DIV_PAY	An indicator variable equaling one if the firm pays dividends during the fiscal year.	Compustat
R&D	The ratio of research and development expenses (*xrd*) to total assets (*at*).	Compustat
CEO_POWER	An indicator variable equaling one if the CEO is also chair of the board. and zero otherwise.	Compustat
CEO_AGE	The age of the CEO.	ExecuComp
IO	The proportion of shares owned by dedicated and quasi-index institutional investors.	s34 files & Bushee's site
SRI	Average of the previous four quarters' SRI ownership, defined as shares held by all SRIs divided by total shares outstanding.	s34 files & KLD

Table 1. Sample distribution

Panel A. Sample breakdown by by Fama and French's (1997) 12-industry classification		
Included industries	**Number**	**Percentage**
Consumer nondurables—food, tobacco, textiles, apparel, leather, toys	513	7.34
Consumer durables—cars, TVs, furniture, household appliances	195	2.79
Manufacturing—machinery, trucks, planes, office furniture, paper, commercial printing	1,107	15.84
Oil, gas, and coal extraction and products	540	7.73
Chemicals and allied products	375	5.37
Business equipment—computers, software, and electronic equipment	1,061	15.18
Telephone and television transmission	245	3.51
Utilities	649	9.29
Wholesale, retail, and some services (laundries, repair shops)	688	9.84
Healthcare, medical equipment, and drugs	647	9.26
Finance	90	1.29
Other—mines, construction, building materials, transportation, hotels, business services, entertainment	879	12.58

Panel B. Sample breakdown by year		
	Number	**Percentage**
2002	259	3.71
2003	263	3.76
2004	334	4.78
2005	391	5.59
2006	360	5.15
2007	390	5.58
2008	476	6.81
2009	522	7.47
2010	511	7.31
2011	542	7.76
2012	521	7.45
2013	522	7.47
2014	485	6.94
2015	663	9.49
2016	750	10.73

This table reports the sample breakdown by industry according to Fama and French's (1997) 12-industry classification (Panel A), and by year (Panel B).

Table 2. Descriptive statistics for the sample

Variable	N	Mean	Std.Dev	Min	Q1	Median	Q3	Max
CEO_ID	6,989	0.312	0.606	0.000	0.000	0.053	0.342	3.568
CEO_ID_DUM	6,989	0.298	0.457	0.000	0.000	0.000	1.000	1.000
RES_USE_SCORE	6,989	49.430	28.390	5.294	25.000	44.410	75.000	99.000
EMIS_SCORE	6,989	49.490	27.860	1.768	27.140	45.450	73.810	99.110
CASH	6,989	0.111	0.116	0.001	0.027	0.073	0.154	0.569
AGE	6,989	3.250	0.802	0.693	2.773	3.367	3.871	4.290
MTB	6,989	1.894	0.944	0.845	1.245	1.610	2.204	5.876
SIZE	6,989	8.878	1.224	6.252	7.982	8.763	9.694	12.170
PPENT	6,989	0.306	0.243	0.011	0.110	0.222	0.467	0.797
LEV	6,989	0.591	0.167	0.200	0.476	0.596	0.709	0.863
ROA	6,989	0.101	0.070	-0.143	0.060	0.095	0.139	0.311
CEO_POWER	6,529	0.525	0.499	0.000	0.000	1.000	1.000	1.000
IO	5,407	0.587	0.124	0.050	0.509	0.590	0.672	1.000
SRI	6,989	0.356	0.119	0.000	0.284	0.363	0.436	0.785

This table reports the number of observations, mean, standard deviation, first quartile, median, third quartile and maximum for the 6,989 firm-year observations of the sample.

Table 3. Pairwise correlation coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) RES_USE_SCORE	1									
(2) EMIS_SCORE	0.747*	1								
(3) CEO_ID	0.137*	0.139*	1							
(4) MTB	0.047*	0.023	-0.196*	1						
(5) LEV	0.112*	0.138*	0.178*	-0.208	1					
(6) CASH	-0.013	-0.006	-0.149*	0.377*	-0.315*	1				
(7) SIZE	0.494*	0.505*	0.175*	-0.251*	0.285*	-0.238*	1			
(8) PPENT	0.031*	0.070*	0.167*	-0.246	0.124*	-0.399*	0.204*	1		
(9) AGE	0.238*	0.217*	0.196*	-0.111*	0.120*	-0.137*	0.294*	0.134*	1	
(10) ROA	0.077*	0.058*	-0.103*	0.578*	-0.162*	0.101*	-0.094*	-0.193*	0.011	1

This table presents pairwise correlation coefficients between CEO inside debt and the other control variables. The sample comprises 6,989 observations covering the period 2002–2016. See Appendix B for definitions and sources of variables. * refers to significance at the 5% significance level or better.

Table 4. Main evidence for relationship between inside debt compensation and environmental performance

VARIABLES	RES_USE_SCORE (1)	RES_USE_SCORE (2)	EMIS_SCORE (3)	EMIS_SCORE (4)
CEO_ID	6.858***	3.413***	6.001***	2.851***
	(5.772)	(3.735)	(4.959)	(2.929)
MTB		3.228***		2.522***
		(4.308)		(3.472)
LEV		3.266		8.135**
		(0.838)		(2.181)
CASH		17.055***		26.550***
		(2.821)		(4.494)
SIZE		13.166***		12.647***
		(26.231)		(24.261)
PPENT		9.649**		5.892
		(2.311)		(1.381)
AGE		3.274***		2.288***
		(3.822)		(2.821)
ROA		9.723		19.213**
		(1.207)		(2.292)
INTERCEPT	18.058***	-102.437***	16.960***	-98.523***
	(5.007)	(-15.942)	(4.337)	(-15.446)
Observations	6,989	6,989	6,989	6,989
Adjusted R^2	0.098	0.377	0.081	0.348
IND. FE	Yes	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes	Yes

This table reports the results of our baseline model regressing the measures of environmental performance on CEO inside debt and the control variables. See Appendix B for definitions of the variables. All models include industry and year fixed effects. Robust t-statistics corrected for clustering at the firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Relationship between changes in inside debt compensation and changes in environmental performance

VARIABLES	**Δ RES_USE_SCORE**	**Δ EMIS_SCORE**	**Δ RES_USE_SCORE**	**Δ EMIS_SCORE**
	(1)	**(2)**	**(1)**	**(2)**
⊿CEO_ID	0.603*	1.037**	0.926*	0.879*
	(1.645)	(2.157)	(1.848)	(1.781)
⊿ MTB	-0.755	-1.004**	-0.898	-0.880
	(-1.630)	(-2.095)	(-1.510)	(-1.502)
⊿ LEV	0.519	-0.165	-0.876	1.661
	(0.162)	(-0.049)	(-0.237)	(0.456)
⊿ CASH	4.133	0.032	2.939	-1.542
	(1.138)	(0.009)	(0.668)	(-0.355)
⊿ SIZE	1.019	0.516	1.004	-0.894
	(0.917)	(0.442)	(0.641)	(-0.578)
⊿ PPENT	2.294	-0.728	6.330	-3.446
	(0.354)	(-0.108)	(0.822)	(-0.454)
⊿ AGE	3.462	2.778	5.775	-4.514
	(1.350)	(1.123)	(0.521)	(-0.413)
⊿ ROA	7.342*	17.169***	2.766	13.204**
	(1.780)	(3.870)	(0.500)	(2.421)
INTERCEPT	-2.420**	1.317	1.904***	2.377***
	(-2.405)	(1.297)	(3.313)	(4.197)
Observations	5,566	5,566	5,334	5,334
Adjusted R^2	0.009	0.014	0.002	0.003
IND. FE	Yes	Yes	No	No
YEAR FE	Yes	Yes	No	No
FIRM FE	No	No	Yes	Yes
IND × YEAR	No	No	Yes	Yes

This table reports the results of analysing the impact of changes in CEO inside debt on changes in environmental performance using the control variables from the baseline model. See Appendix B for definitions of the variables. All models include industry and year fixed effects. Robust t-statistics corrected for clustering at the firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6. Relationship between inside debt compensation and environmental performance: Instrumental variables

VARIABLES	**First-stage**	**RES_USE_SCORE**	**EMIS_SCORE**
	(1)	**(2)**	**(3)**
Predicted_CEO_ID		5.023***	6.353***
		(2.877)	(3.475)
MTB	-0.043***	3.250***	2.671***
	(-4.520)	(7.670)	(6.245)
LEV	0.222***	3.482*	7.796***
	(5.070)	(1.757)	(3.900)
CASH	-0.042	17.394***	26.654***
	(-0.590)	(5.693)	(8.677)
SIZE	0.028***	13.071***	12.503***
	(4.600)	(51.969)	(47.528)
PPENT	0.095**	9.287***	5.332***
	(2.090)	(4.650)	(2.640)
AGE	0.066***	3.107***	2.023***
	(7.510)	(7.569)	(4.953)
ROA	0.097	10.756**	19.358***
	(0.830)	(2.203)	(3.757)
CEO_ID_MEDIAN	0.933***		
	(24.510)		
CEO_AGE	0.006***		
	(5.970)		
Constant	-1.002***	-101.348***	-95.440***
	(-5.490)	(-20.738)	(-21.244)
Observations	6,903	6,903	6,903
Adjusted R^2	0.348	0.376	0.342
IND FE	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes
F-statistic	5046.861***		

This table reports the results of instrumental variables analysis while controlling for endogeneity. Model 1 shows the first-stage regression of the inside debt dummy on the control variables from the baseline model, using the median inside debt and CEO age as instruments. Models 2 and 3 show the results of using the predicted CEO inside debt from model 1. See Appendix B for definitions of the variables. All models include industry and year fixed effects. Robust t-statistics corrected for clustering at the firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7. Relationship between inside debt compensation and environmental performance

Panel A. Differences in firms' characteristics

	CEO_ID_DUM=1 **(N=1,528)**	***CEO_ID_DUM=0*** **(N=1,528)**	**Difference**	**T-stat**
MTB	1.874	1.896	0.022	0.683
Leverage	0.580	0.581	0.001	0.215
Cash	0.108	0.110	0.002	0.431
Size	8.992	9.006	0.013	0.302
PPENT	0.321	0.317	-0.004	-0.435
Age	3.408	3.426	0.018	0.706
ROA	0.109	0.109	0.000	0.060

Panel B. Results of propensity score matching

VARIABLES	**RES_USE_SCORE** **(1)**	**EMIS_SCORE** **(2)**
CEO_ID	4.281***	4.928***
	(3.111)	(3.694)
MTB	2.840**	1.794*
	(2.562)	(1.678)
LEV	11.420**	13.304**
	(2.091)	(2.422)
CASH	19.337**	24.789***
	(2.312)	(3.076)
SIZE	13.514***	13.575***
	(21.623)	(20.601)
PPENT	7.508	7.225
	(1.428)	(1.291)
AGE	2.497**	1.717
	(2.211)	(1.552)
ROA	9.074	26.122**
	(0.755)	(2.147)
INTERCEPT	-86.504***	-92.944***
	(-11.059)	(-11.987)
Observations	3,056	3,056
Adjusted R^2	0.396	0.387
IND FE	Yes	Yes
YEAR FE	Yes	Yes

This table reports the results of PSM analysis while controlling for endogeneity. Panel A reports comparisons between the control variables for two matched samples. Panel B show the results of running the baseline model on the matched samples. To calculate the matching scores, we use the control variables from the baseline model and the same instruments as in the 2SLS approach. See Appendix B for definitions of the variables. All models include industry and year fixed effects. Robust t-statistics corrected for clustering at the firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8. Relationship between inside debt compensation and environmental performance: High-dimensional fixed effects

VARIABLES	**RES_USE_SCORE**	**EMIS_SCORE**
	(1)	**(2)**
CEO_ID	0.931*	1.291**
	(1.794)	(2.491)
MTB	0.886*	0.185
	(1.668)	(0.349)
LEV	2.903	5.892**
	(0.991)	(2.015)
CASH	-2.093	-6.126
	(-0.488)	(-1.431)
SIZE	4.222***	2.510***
	(5.045)	(3.004)
PPENT	-7.897	-9.239*
	(-1.585)	(-1.856)
AGE	8.734***	11.470***
	(6.171)	(8.113)
ROA	2.744	22.317***
	(0.466)	(3.793)
INTERCEPT	-48.075	-129.020
	(-0.450)	(-1.211)
Observations	6,649	6,649
Adjusted R^2	0.019	0.025
FIRM FE	Yes	Yes
IND× YEAR	Yes	Yes

This table reports the results of including firm fixed effects in our baseline model, regressing the measures of environmental performance on alternative CEO inside debt and the control variables. See Appendix B for definitions of the variables. All models include industry and year fixed effects. Robust t-statistics corrected for clustering at the firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 9. Relationship between inside debt compensation and environmental performance: Granger causality tests.

Emission	**Panel A: RES_USE_SCORE**		**Panel B: EMIS_SCORE**	
H_0:	CEO_ID does not cause RES_USE_SCORE	RES_USE_SCORE does not cause CEO_ID	CEO_ID does not cause EMIS_SCORE	EMIS_SCORE does not cause CEO_ID
Chi-square	**2.94**	**1.91**	**45.98**	**1.44**
p-v**alue**	**0.02**	**0.11**	**0.00**	**0.22**

This table presents the results of Granger causality tests. For each environmental performance measure (RES_USE_SCORE in Panel A and EMIS_SCORE in Panel B), we test two null hypotheses: that CEO inside debt holdings do not cause environmental emissions, and that environmental emissions do not cause CEO inside debt holdings. F-statistics and p-values are reported.

Table 10. Relationship between inside debt compensation and environmental emissions: Additional control variables

VARIABLES	RES_USE_SCORE				EMIS_SCORE				RES_USE_SCORE	EMIS_SCORE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CEO_ID	3.508***	3.431***	3.270***	3.282***	2.953***	2.798***	2.801***	2.815***	3.262***	2.819***
	(3.935)	(3.756)	(3.599)	(3.588)	(3.112)	(2.876)	(2.881)	(2.849)	(3.679)	(2.930)
MTB	2.284***	3.180***	3.343***	3.524***	1.507*	2.670***	2.563***	2.742***	2.606***	1.933**
	(2.988)	(4.235)	(4.526)	(4.674)	(1.934)	(3.646)	(3.544)	(3.812)	(3.475)	(2.517)
LEV	3.290	3.338	3.116	3.817	8.160**	7.912**	8.082**	9.302**	3.654	8.923**
	(0.856)	(0.853)	(0.799)	(0.954)	(2.215)	(2.116)	(2.167)	(2.415)	(0.925)	(2.341)
CASH	10.646*	17.185***	18.278***	16.786***	19.660***	26.148***	26.981***	26.743***	11.283*	19.880***
	(1.751)	(2.836)	(3.010)	(2.694)	(3.270)	(4.411)	(4.562)	(4.372)	(1.810)	(3.207)
SIZE	13.207***	13.185***	12.886***	13.128***	12.692***	12.588***	12.549***	12.686***	12.886***	12.553***
	(26.607)	(26.162)	(25.424)	(26.026)	(24.730)	(24.031)	(23.603)	(23.561)	(25.670)	(23.149)
PPENT	9.823**	8.670*	9.580**	10.108**	6.079	8.920*	5.868	7.300*	9.260**	10.404**
	(2.366)	(1.959)	(2.305)	(2.342)	(1.436)	(1.950)	(1.379)	(1.651)	(2.048)	(2.209)
AGE	3.107***	3.289***	2.646***	2.886***	2.108***	2.241***	2.067**	2.160**	2.033**	1.667*
	(3.664)	(3.826)	(2.923)	(3.250)	(2.624)	(2.765)	(2.385)	(2.518)	(2.205)	(1.841)
ROA	19.401**	9.797	4.518	9.939	29.616***	18.983**	17.379**	19.673**	14.122*	27.213***
	(2.432)	(1.220)	(0.558)	(1.182)	(3.425)	(2.264)	(2.062)	(2.271)	(1.676)	(3.024)
R&D	66.422***				71.399***				70.032***	69.751***
	(3.296)				(3.496)				(3.392)	(3.357)
CAPX		6.663				-20.604			6.687	-20.172
		(0.483)				(-1.618)			(0.446)	(-1.506)
DIV_PAY			3.775**				1.330		4.167***	1.613
			(2.449)				(0.869)		(2.721)	(1.058)
CEO_AGE				-0.006				0.089	-0.015	0.084
				(-0.063)				(0.890)	(-0.153)	(0.850)
CEO_TENURE				-0.974				-0.804	-0.907	-0.735
				(-1.412)				(-1.223)	(-1.328)	(-1.125)
CEO_GENDER				4.150				1.051	4.401	1.401
				(1.483)				(0.387)	(1.592)	(0.513)
CEO_POWER				2.079*				0.096	2.068*	0.189
				(1.777)				(0.082)	(1.773)	(0.163)
INTERCEPT	-	-		-101.522***	-	-		-102.871***	-96.525***	-100.072***
	101.958***	102.603***	-98.664***		98.008***	98.012***	-97.194***			
	(-16.096)	(-15.853)	(-14.787)	(-12.513)	(-15.647)	(-15.418)	(-14.709)	(-12.788)	(-11.621)	(-12.419)
Observations	6,989	6,989	6,989	6,591	6,989	6,989	6,989	6,591	6.591	6,591
Adjusted R^2	0.382	0.377	0.380	0.381	0.354	0.349	0.348	0.351	0.388	0.357
IND FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table reports the results of our baseline model, regressing environmental performance on CEO inside debt and the control variables after controlling for potential omitted variables, namely research and development, capital expenditure ratio, dividend payout, CEO age, CEO tenure, CEO gender, and CEO power. See Appendix B for definitions of the variables. All models include industry and year fixed effects. Robust t-statistics corrected for clustering at the firm level are reported in parentheses. *, **, and *** indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 11. The relation between Inside debt compensation and environmental emission. Alternative measure

VARIABLES	Alternative Inside Debt Variable	
	RES_USE_SCORE	EMIS_SCORE
	(1)	(2)
Kdummy	5.098***	4.833***
	(4.073)	(3.866)
MTB	3.068***	2.386***
	(4.144)	(3.315)
LEV	5.533	10.219***
	(1.416)	(2.713)
CASH	16.720***	26.263***
	(2.782)	(4.492)
SIZE	13.074***	12.546***
	(26.076)	(24.076)
PPENT	9.633**	5.827
	(2.313)	(1.371)
AGE	3.126***	2.122***
	(3.652)	(2.607)
ROA	4.860	14.575*
	(0.605)	(1.768)
INTERCEPT	-100.917***	-96.746***
	(-15.544)	(-14.986)
Observations	6,989	6,989
Adjusted R	0.379	0.350
IND FE	Yes	Yes
YEAR FE	Yes	Yes

This table reports the results from using alternative measures of CEO Inside debt holdings. Models 1 & 2 shows the findings from using a dummy variable to assess whether the firm pays inside debt or not as an alternative measure of our main measure of inside debt. For the definition of the variables, please refer to Appendix A. All the models include industry and year fixed effects. Robust t-statistics corrected for clustering at the firm level are reported between parenthesis. *, **, *** indicate statistical significance at the 1%, 5%, 10%, respectively.

Table 12. Relationship between inside debt compensation and environmental emissions: Role of CEO power

VARIABLES	RES_USE_SCORE		EMI_SCORE	
	HIGH CEO POWER	*LOW CEO POWER*	*HIGH CEO POWER*	*LOW CEO POWER*
	(1)	(2)	(3)	(4)
CEO_ID	3.475***	2.421*†	3.430***	1.570†
	(3.346)	(1.708)	(3.133)	(1.052)
MTB	1.969*	4.028***	2.290**	2.277**
	(1.936)	(3.905)	(2.332)	(2.160)
LEV	11.902**	-1.518	14.474***	4.855
	(2.318)	(-0.273)	(2.787)	(0.919)
CASH	16.880**	19.219**	26.315***	30.838***
	(2.026)	(2.505)	(3.172)	(4.077)
SIZE	13.637***	13.221***	13.207***	12.632***
	(22.273)	(18.372)	(19.894)	(16.386)
PPENT	8.746	12.196**	7.721	5.330
	(1.620)	(2.277)	(1.353)	(0.955)
AGE	2.567**	4.203***	2.009*	3.058***
	(2.315)	(3.498)	(1.788)	(2.636)
ROA	23.178**	-0.463	28.146***	18.964*
	(2.213)	(-0.042)	(2.612)	(1.714)
INTERCEPT	-104.199***	-129.524***	-103.807***	-119.814***
	(-19.423)	(-17.696)	(-16.981)	(-15.863)
Observations	3,430	3,099	3,430	3,099
Adjusted R^2	0.406	0.371	0.374	0.336
IND. FE	Yes	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes	Yes

This table reports the results of examining the role of different firms' characteristics in explaining the relationship between inside debt and environmental emissions. We use CEO power measured by CEO duality. Models 1 and 3 report the findings for high CEO power, and models 2 and 4 report the findings for low CEO power. See Appendix B for definitions of the variables. All models include industry and year fixed effects. Robust t-statistics corrected for clustering at the firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. † denotes statistical significance of the difference at the 5% significance level or better.

Table 13. Relationship between inside debt compensation and environmental emissions: Role of institutional ownership

VARIABLES	**RES_USE_SCORE**		**EMI_SCORE**	
	HIGH INST OWN	***LOW INST OWN***	***HIGH INST OWN***	***LOW INST OWN***
	(1)	**(2)**	***(3)***	**(4)**
CEO_ID	2.969	4.251***†	2.413	3.242**†
	(1.550)	(3.724)	(1.151)	(2.548)
MTB	1.812	4.923***	0.674	4.126***
	(1.588)	(5.053)	(0.630)	(4.063)
LEV	1.460	3.951	3.077	11.252**
	(0.264)	(0.686)	(0.581)	(2.018)
CASH	26.223***	-0.369	39.334***	9.001
	(3.261)	(-0.042)	(5.080)	(1.091)
SIZE	13.283***	13.324***	13.351***	13.115***
	(14.760)	(19.583)	(14.892)	(18.052)
PPENT	10.783*	13.021**	10.833*	8.618
	(1.789)	(2.254)	(1.834)	(1.321)
AGE	1.967	2.220*	1.984*	0.872
	(1.580)	(1.858)	(1.685)	(0.705)
ROA	18.050	19.193	34.037***	26.860**
	(1.543)	(1.552)	(2.955)	(2.034)
INTERCEPT	-92.353***	-109.788***	-96.780***	-105.479***
	(-11.689)	(-18.862)	(-12.668)	(-13.171)
Observations	2,707	2,700	2,707	2,700
Adjusted R^2	0.444	0.314	0.405	0.314
IND. FE	Yes	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes	Yes

This table reports the results of examining the role of different firms' characteristics in explaining the relationship between inside debt and environmental emissions. We study sensitivity to institutional ownership as measured by institutional ownership concentration. Models 1 and 3 report the findings for high institutional ownership, and models 2 and 4 report the findings for low institutional ownership. See Appendix B for definitions of the variables. All models include industry and year fixed effects. Robust t-statistics corrected for clustering at the firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. † denotes statistical significance of the difference at the 5% significance level or better.

Table 14. Relationship between inside debt compensation and environmental emissions: Role of socially responsible institutional investors

VARIABLES	**RES_USE_SCORE**		**EMI_SCORE**	
	HIGH SRI INV	***LOW SRI INV***	***HIGH SRI INV***	***LOW SRI INV***
	(1)	**(2)**	**(4)**	***(3)***
CEO_ID	2.326*	4.398***†	0.959	4.463***†
	(1.839)	(4.544)	(0.704)	(4.223)
MTB	3.889***	3.029***	3.188***	2.272**
	(3.701)	(3.181)	(3.151)	(2.559)
LEV	3.748	3.538	8.867*	7.256*
	(0.721)	(0.791)	(1.756)	(1.692)
CASH	17.222**	11.778*	26.883***	20.237***
	(1.995)	(1.838)	(3.286)	(3.130)
SIZE	13.252***	11.074***	12.600***	10.661***
	(20.028)	(15.352)	(19.413)	(14.299)
PPENT	16.994***	3.566	14.855***	-1.968
	(2.947)	(0.828)	(2.662)	(-0.434)
AGE	2.289*	3.685***	1.801	1.855**
	(1.900)	(4.032)	(1.629)	(2.049)
ROA	20.444*	-10.135	26.739**	1.724
	(1.774)	(-0.989)	(2.287)	(0.172)
INTERCEPT	-108.946***	-77.549***	-109.343***	-69.727***
	(-20.516)	(-9.140)	(-20.858)	(-8.068)
Observations	3,491	3,498	3,491	3,498
Adjusted R^2	0.373	0.280	0.342	0.25
IND. FE	Yes	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes	Yes

This table reports the results of examining the role of different firms' characteristics in explaining the relationship between inside debt and environmental emissions. We study socially responsible institutional ownership as measured by the number of shares held by socially responsible investors scaled by the total number of shares outstanding. Models 1 and 3 report the findings for high socially responsible institutional ownership, and models 2 and 4 report the findings for low socially responsible institutional ownership. See Appendix B for definitions of the variables. All models include industry and year fixed effects. Robust t-statistics corrected for clustering at the firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. † denotes statistical significance of the difference at the 5% significance level or better.