"This is a preliminary draft. Please do not circulate."

Executive Equity-based Compensation, Risk, and Environmental Performance

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Abstract

We examine the relationship between stock-based pay and greenhouse gas emissions. We surmise that equity-based compensation reduces risk aversion among chief executives, who then engage in projects that expose firms to greater climate risk. Hence, we find that an increase of one standard deviation in managerial equity-based compensation is accompanied by a 3.4% jump in emissions, which is tantamount to 9 million additional metric tons of greenhouse gases per year for the average firm.

Keywords: Equity-based compensation, greenhouse gas emissions, firm risk.

JEL: D22, G34, M12, M14, O13, O16, Q53, Q54

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1. Introduction

"Though we are not now that strength which in old days moved earth and heaven, that which we are, we are:" the sum product of the carrots and sticks that surround us. We have borrowed, and adapted, a line from Tennyson to point out that our behavior is driven by the social cues at hand.[1] The lines that follow in that poem spur the reader towards virtue, heroism, and the desire to defy fate against all odds. But the poet is doing more than inspiring the reader. As we read those lines, values are being embedded into the social fabric. What are the carrots and sticks conveyed to chief executives? How do those cues reach CEOs? One characteristic way in which managers have been incentivized is with remuneration in the form of stock and options. As such, executives are compelled "to strive, to seek, to find" better yields on behalf of the shareholders. In this paper, we explore the consequences of such an activity in terms of corporate environmental performance.

In representing shareholders, a corporate board structures executive compensation to align the behavior of management with the interests of stockholders (Jensen and Meckling, 1976). As such, a portion of executive pay takes the form of stock and option grants. Not only does

[1] See "Ulysses" in *Poems*, by Alfred, Lord Tennyson (1842).

equity-based pay curb the desire to usurp wealth from shareholders through perquisites, but it also instigates a higher risk tolerance on the part of management (Harikumar, 1996; Low, 2009). While incentivized to accept projects with a higher degree of uncertainty, CEOs will expose the firm to different sources of risk. Given that carbon emissions bear an equity premium (Bolton and Kacperczyk, 2021), exposure to climate risk becomes a suitable avenue by which corporate leadership may search for higher yields.

Our analysis of over a thousand firms between 2006 and 2023 confirms such an assertion. We find that an increase of one standard deviation in equity-based pay (i.e., 8.4%) is associated with 3.4% higher greenhouse gas emissions. In essence, corporate environmental performance becomes collateral in the process affecting executive decision-making through cues embedded in the method of managerial compensation. The main result in this study is robust to the implementation of different specifications. Moreover, the effect of equity-based pay on emissions is more evident among firms within industries that have high variability in their environmental performance. Thus, it is likely that the structure of the compensation package facilitates decisions that lead to higher emissions. In addition, we uncover evidence that the effect at hand is stronger for those firms in low carbon intensity industries. The finding connotes that equity-based pay drives emissions only where there are opportunities to seek climate risk exposure. However, we have found that engaging in projects that increase emissions on the part of incentivized managers does not pay. Firms that compensate their CEOs with a high share of stock-based pay and that emit high volumes of greenhouse gasses have lower valuations.

This paper adds to our understanding of the ramifications of executive compensation, and particularly stock-based pay. Moreover, our findings reveal that there are outcomes that go beyond the intended effects of managerial pay schemes. Another contribution is towards the determinants

of corporate environmental performance. In that sense, this paper goes beyond firm and managerial characteristics to consider how financial performance incentives translate into environmental performance outcomes. Additionally, this paper highlights how the interests of shareholders could come into conflict with the aims of a broader segment of society, thus pitting the actions of management against stakeholders on behalf of ownership.

The remainder of this article is organized in the following manner. Section 2 highlights the relevant literature and presents our rationale for this study. Section 3 describes the sample, data, and methods utilized throughout the paper. Section 4 details the results of our analysis, and section 5 offers concluding remarks.

2. Literature Review

2.1 Greenhouse gas emissions and risk

Exposure to climate change risk may take many forms, including increased regulatory attention, disruptive environmental activism, and loss of reputation (Berrone and Gomez-Mejia, 2009). Investors have taken notice of climate risk exposure, regardless of how it may present itself. For example, Seltzer et al. (2021) find that firms with poor environmental performance experience higher yield spreads. Ilhan et al. (2021) note that option premiums are higher for firms with higher carbon emissions. Bolton and Kacperczyk (2021) encounter an equity premium associated with carbon emissions. In essence, there is mounting evidence that pollution has become a risky activity for which shareholders and creditors demand compensation, and for which the cost of hedging is higher.

2.2 Equity-based compensation and risk-taking behavior

Businesses that organize themselves into the corporate form enjoy the benefit of limited liability through the separation of ownership and management. In turn, limited liability affords the ability to transfer ownership and raise capital easily. However, the partition between principal and agent engenders a conflict of interest (Jensen and Smith Jr., 1985). Equity-based compensation has been a quintessential solution to the agency problem (Jensen and Meckling, 1976; Guay, 1999; Ang et al., 2000). By awarding compensation in the form of stock and options, the incentives of management may become aligned with those of shareholders. Specifically, management is induced to take on more risk through positive net present value projects that would have otherwise been neglected (Low, 2009).

However, some argue (e.g., Meulbroek, 2001; Hall, 2003) that equity-based compensation is inefficient in that it precludes portfolio diversification among managers. Therefore, management views the value of stock-based pay as less than its face value. Indeed, Ofek and Yermack (2000) report that managers who already own a larger proportion of their firm's equity tend to sell nearly all the shares allocated to them through options. Yet management does not entirely dispose of its own stake for various reasons. For example, market imperfections, such as taxation and information asymmetry, as well as takeover defense are compelling reasons to hold on to stock awards. To the extent that managers are unable to diversify those holdings derived from compensation schemes, there is a higher tolerance for risk beyond that which is induced by the outright ownership of the firm's shares.

In sum, equity-based compensation is conducive to higher risk tolerance on the part of management. For instance, Boulton et al. (2014) document a positive correlation between said form of compensation and the likelihood of acquiring other firms. Similarly, equity-based

compensation encourages earnings management (Harris et al., 2019). Additionally, John and John (1993) develop a theoretical framework in which compensation schemes meant to homogenize the interests of shareholders and executives bring about agency conflict with respect to bondholders through asset substitution. Critically, Bolton et al. (2006) present a model in which equity-based compensation could generate short-termism in the face of heterogenous expectations. Bebchuk and Fried (2010) concur so long as executives are not prevented from selling their shares shortly after they are awarded. An executive's modified behavior towards riskier endeavors, resulting from the structure of the compensation package, is of interest to us in the context of corporate environmental performance.

2.3 Executive compensation and environmental outcomes

There is a growing literature that examines how managerial compensation, and adjacent topics (e.g., corporate governance), affect the environmental conduct of the firm. For example, Walls et al. (2012) find an inverse relationship between CEO salary and environmental performance, as quantified by the KLD index. The authors allude to risk aversion promoted by fixed compensation, which favors a status quo that is detrimental to environmental performance, as an explanation for such a result. Interestingly, Walls et al. conclude that the disposition of the board is the most relevant issue driving corporate environmental performance. Walls et al.'s analysis is thorough, yet their interpretation of the result pertaining to salary is untested.

Another relevant contribution comes from Haque and Ntim (2020), who examine the relationship between total executive compensation and greenhouse gas emissions. The authors find no evidence that total compensation affects emissions, even though it does predict the incidence of corporate environmental initiatives. Haque and Ntim's findings could be construed

as poignant evidence of greenwashing being contingent on managerial compensation. However, the authors do not consider the components of executive compensation, such as equity-based pay, in their analysis.

One more contribution, which is closer to our own, is that of Berrone and Gomez-Mejia (2009). The authors assess how environmental performance affects executive compensation, and in turn, how abatement activities can impact both total pay and long-term (i.e., equity-based) compensation. The authors find evidence suggesting that long-term compensation increases the efficacy of corporate pollution policies that prevent the effluence of toxic chemicals. Berrone and Gomez-Mejia contextualize the relationship between equity-based compensation and environmental performance as one in which risk comes from the adoption of technologies that could help the environment at the expense of financial performance. The context in our own study is rather different from Berrone and Gomez-Mejia's contribution in several aspects. First, we study greenhouse gas emissions instead of the generation of toxic chemicals. Second, our sample, described below, is more extensive. Third, we conceptualize risk differently, particularly if management favors short-term gains. Specifically, we propose that equity-based compensation incentivizes management to adopt projects with climate risk exposure that bear higher returns.

This paper explores how equity-based compensation affects corporate environmental performance in terms of greenhouse gas emissions. Considering how such compensation drives executives to select riskier projects, we hypothesize that such a form of compensation affects the environmental performance of firms in such a way that that emissions are higher because of the greater risk that those projects entail.

3. Sample, Data, and Methods

The main specification in this study encompasses 5,426 firm-year observations spread across a span of 18 years (2006 to 2023). There are 1,014 firms in the sample, which represent over 61 industries based on two-digit SIC codes. Financial characteristics have been obtained through the CRSP-Compustat merged dataset, while executive compensation has been observed through Compustat's ExecuComp file. Firms' environmental performance has been gathered through Bloomberg's ES Scores. The variables described below have been winsorized at the extreme 1% of their annual distributions.

The dependent variable is the natural logarithm of a firm's scope 1 greenhouse gas emissions.[2] The independent variable is the share of a CEO's compensation package which has a value derived from the firm's stock. Specifically, equity-based compensation is calculated as salary and bonus pay subtracted from total compensation, and then divided by total compensation. The control variables in the analysis of greenhouse gas emissions follow Bolton and Kacperczyk (2021), and include firm size, book-to-market ratio, return on equity, debt-to-equity ratio, capital expenditures, and the natural logarithm of net property, plant, and equipment. Details on the computation of each variable can be found in the appendix. Table 1 provides summary statistics for each of the variables in the study.

>>> Insert table 1 around here <<<

Though preliminary in nature, the correlations in panel B of table 1 point to some noteworthy associations. Greenhouse gas emissions appear to be noticeably correlated with a

[2] According to the U.S. Environmental Protection Agency, scope 1 emissions are those greenhouse gas emissions that are directly attributable, either by ownership or control, to an organization.

firm's size (ρ = 0.37), capital expenditures (ρ = 0.57), and net fixed assets (ρ = 0.77). Equity-based compensation seems to be significantly related to firm size (ρ = 0.33). Yet we leave it to the ensuing multivariate analysis to discern the true relationship between said variables.

We examine the impact of equity-based compensation on corporate emissions through a fixed effects estimation with robust standard errors. The specification contains industry (two-digit SIC code) and year fixed effects.

4. Results

4.1 Main results

Table 2 presents regressions of firm's scope 1 emissions on stock-based executive pay and control variables. Column 1 shows a specification comprised only of equity-based compensation (β = 2.23, t = 10.68, p = 0.000) as well as year and industry fixed effects. Column 2 displays the key result in this paper, as it incorporates the control variables listed above (β = 0.40, t = 2.37, p = 0.018). Column 3 presents a more stringent test of the relationship at hand in that year and industry dummies are interacted, consuming 571 degrees of freedom as opposed to the 78 taken up in the standard model (β = 0.39, t = 2.05, p = 0.04). Regardless of the specification, the coefficient of stock-based pay is positive and significant at 95% confidence or better. The equity-based compensation coefficient in column 2 implies that an increase of one standard deviation in such a component of CEO pay yields an increase in greenhouse gas emissions of 3.4%.[3] That is, an 8% increase in stock-based compensation is expected to augment the average firm's annual emissions by nearly nine million metric tons.[4]

[3] $e^{0.4024 \times 0.0835} - 1 = 0.0342$

[4] $0.0835 \times (e^{4.7017} - 1) = 9.1127$

>>> Insert table 2 around here <<<

There are other observations to be made about greenhouse gas emissions based on the results in table 2. First, the scale of a firm's operations matters. According to column 2, increases in size ($\beta = 0.15$, $t = 4.93$, $t = 0.000$), capital expenditures ($\beta = 3.13$, $t = 4.00$, $t = 0.000$), and net fixed assets ($\beta = 0.70$, $t = 22.73$, $t = 0.000$) tend to increase emissions.[5] Second, there are other aspects of a firm's finances that are linked to emissions. The lack of growth prospects, which is implied by an increasing book-to-market ratio ($\beta = 0.27$, $t = 5.37$, $p = 0.000$), and more debt ($\beta = 0.02$, $t = 2.39$, $p = 0.017$), relative to contributed capital, signify worsening environmental performance. Together, the coefficients corresponding to the book-to-market and debt-to-equity ratios suggest that the same risk-shifting impetus affecting CEOs through the structure of their compensation package is at play in other spheres of corporate finance.

4.2 Robustness tests

The results above suggest that equity-based compensation is linked to worsening environmental performance in the form of higher scope 1 emissions. The tests that follow seek to corroborate such a result in various ways. First, we modify the main specification to include additional variables related to corporate governance. Since equity-based pay is driven by governance considerations, the inclusion of such variables alleviates concerns that the independent variable is proxying for an unobserved factor related to corporate governance. Therefore, total compensation, CEO tenure, the share of independent directors, and CEO duality

[5] In corporate finance, firm size is typically conveyed through either the book value of assets or by market capitalization. In an unreported result, the equity-based compensation coefficient is robust to controlling for size proxied by capitalization ($\beta = 0.59$, $t = 3.43$, $p = 0.001$). However, the sign of the capitalization-based size coefficient is negative ($\beta = -0.08$, $t = -3.11$, $p = 0.002$) in that specification. We opt to use the asset-based measure of size throughout the paper as it conveys a notion of a firm's physical size, given that we believe said measure to be more closely related to environmental performance.

are added as controls, resulting in the model shown in column 1 of table 3 below. Even after adding governance-related controls, the coefficient for equity-based compensation remains positive at 95% confidence ($\beta = 0.48$, $t = 2.11$, $p = 0.035$). Therefore, the key finding in this study is unlikely to be driven by an unobserved factor associated with corporate governance.

>>> Insert table 3 around here <<<

Another concern could be with how the independent variable itself is constructed. In column 2 of table 3, equity-based compensation is replaced with the natural logarithm of one plus CEOs total equity-based pay. Though this study focuses on the structure of the executive compensation package, it is reassuring to note that the level of equity-based pay is also positively related to greenhouse gas emissions, though with admittedly smaller effect ($\beta = 0.05$, $t = 1.86$, $p = 0.063$).

Yet another issue could be the timing of decisions that affect a firm's environmental performance. The specification used above utilizes concurrent predictors for scope 1 emissions. Yet if environmental performance is more dependent on the selection of projects (e.g., capital expenditure decisions, innovation, supply chain disposition, etc.) more than the ongoing operations of the firm, then a model featuring lagged predictors might be more suitable. In columns 3 and 4 of table 3, the relationship between emissions and equity-based compensation (and controls) is examined at various lags. At either a single ($\beta = 0.35$, $t = 2.08$, $p = 0.037$) or three-year lag (0.33, $t = 2.19$, $p = 0.029$), the coefficient for equity-based pay remains positively associated with environmental performance.

Omitted variable bias is addressed in the main specification using industry and year fixed effects, as well as robust standard errors. While we believe that such a specification is a sensible way to deal with possible endogeneity, the potential bias in the equity-based compensation

coefficient could emanate from any other dimension that is uncorrelated with the fixed effects factors. One way to demonstrate resilience to omitted variable bias is to dispose of the fixed effects and instead implement a change regression with robust standard errors. In column 5 of table 3, we show that the change in equity-based pay affects the change scope 1 emissions ($\beta = 0.01$, $t = 1.74$, $p = 0.082$), albeit with a smaller effect size than catalogued above.

The reader may be skeptical as to whether equity-based compensation could really be a determinant of greenhouse gas emissions. The following test is an attempt to assuage such a concern by demonstrating the agency engendered by the composition of an executive's compensation package. We divide the sample into industries that have above and below-average variability in greenhouse gas emissions.[6] Also, we dichotomize firms into above- and below-average equity-based pay. If the composition of CEO compensation indeed influences choices that drive emissions, then we would expect stronger evidence among those firms that operate in industries where there is a wide breadth of environmental outcomes. In column 6 of table 3, the interaction term between belonging to an industry with high variability in emissions and having a CEO whose compensation leans towards stock-based pay is positive at 95% confidence ($\beta = 0.31$, $t = 2.59$, $p = 0.010$). Therefore, we conclude that the relationship between emissions and stock-based pay is not mechanical, but one that affects executive choices. Moreover, such a relationship is more evident where there is greater latitude to be had in terms of environmental performance.

4.3 Cross-sectional variation

There is ample evidence that the share of equity-based pay is associated with increased greenhouse gas emissions. We propose that equity-based compensation steers the actions of

[6] Based on each firm's two-digit SIC code.

management towards higher emissions for the purpose of earning higher returns through exposure to greater risk. Yet the context in which such a relationship unfolds matters. The industry setting ought to moderate the dynamic between equity-based pay and emissions given the environmental performance of the overall segment. That is because it would be difficult to seek projects which long climate risk if a firm operates in an industry that is already thoroughly exposed to it. We test that assertion by dividing the sample into high and low carbon intensity industries following the designations in Kouloukoui et al. (2021).[7] Then, we interact the industry designation indicator with the dummy for above-average stock-based pay. The expectation is to find a heterogeneous effect driven by the environmental performance of the industry in which a firm is situated. Indeed, table 4 shows that the effect of equity-based compensation on emissions is more pronounced among firms in low-emissions industries ($\beta = 0.32$, $t = 1.94$, $p = 0.053$). As such, equity-based pay exacerbates corporate environmental performance only when there are opportunities by which to gain exposure to climate change risk.

>>> Insert table 4 around here <<<

4.4 Economic implications

If the carbon premiums documented by Bolton and Kacperczyik (2021), Seltzer et al. (2021), and Ilhan et al. (2021) are to be construed as compensation for climate change risk, then it behooves us to inquire about the economic fortunes of firms who engage in emissions-intensive activities prompted by the structure of the executive compensation contract. Table 5 displays a fixed effects regression of firms' value, quantified by Tobin's Q, on an interaction between above-

[7] Industries with high carbon intensity are those with a two-digit SIC code between 10 and 14 (mining), 44 (water transportation), and 28 (chemicals and allied products). Please note that the industry designation coefficient in the regression shown in table 4 has been subsumed by the industry fixed effects.

average equity-based compensation and an indicator for firms with above-average emissions. Firms with high equity-based pay as well as emissions tend to have lower valuations ($\beta = -0.35$, $t = -3.03$, $p = 0.002$). The takeaway from such a result is that any gains made from gaining exposure to climate risk are not enough to surmount the cost of capital charge imposed by investors. While equity-based compensation may be an effective way to promote risk-taking behavior, it fosters societal inefficiency in that it degrades environmental performance without creating economic value.

>>> Insert table 5 around here <<<

5. Conclusion

In this study, we have uncovered a relationship between greenhouse gas emissions and equity-based compensation. We argue that the structure of executive pay schemes matters because of the incentives connoted to corporate leadership. Through equity-based compensation, CEOs are encouraged to take on more risk, thus exposing their firm to climate risk. Yet the impetus for greater risk is not fruitful, as firms that emphasize stock-based pay and have high emissions exhibit lower valuations. Such a pattern of results reveals two profound implications from our work. First, equity-based compensation may induce executives to take actions that put their firms at odds with societal interests, such as deterring climate change. We believe that the tension between shareholders and societal stakeholders caused by equity-based pay has not been sufficiently studied. Second, stock-based compensation drives executives towards riskier endeavors. But is that efficient? In the case of environmental performance, the evidence suggests that there is no economic benefit commensurate with the aggravation of environmental performance.

Our findings bear implications for several stakeholders of corporations. First, this work calls for greater attention to the design of executive compensation plans. Though we cannot say whether greater exposure to climate risk is intended, the rise of board-level environmental committees and the corporate discourse regarding the environment suggests that at least some on the board would be opposed to such exposure. Second, the results herein could inform environmental regulators of alternative ways to gauge the environmental impact of corporate policies and exercise their oversight more judiciously. Third, environmental activists, from the largest institutional holders to atomistic retail investors, could attempt to guide the actions of companies by influencing executive pay. Dictating managerial incentives could be a more efficient way to affect corporate environmental performance than attempting to impose arbitrary goals that have little relation to financial objectives.

References

Ang, J. S., Cole, R. A., & Lin, J. W. (2000). Agency Costs and Ownership Structure. *The Journal of Finance 55(1)*, 81-106.

Bebhcuk, L. A., & Fried, J. M. (2010). How to Tie Equity Compensation to Long-Term Results. *Journal of Applied Corporate Finance 22(1)*, 99-106.

Berrone, P., & Gomez-Mejia, L. R. (2009). Environmental Performance and Executive Compenation: An Integrated Agency-Institutional Perspective. *The Academy of Management Journal 52(1)*, 103-126.

Bolton, P., & Kacperczyk, M. (2021). Do investors care about carbon risk? *Journal of Financial Economics 142(2)*, 517-549.

Bolton, P., Scheinkman, J., & Xiong, W. (2006). Executive Compensation and Short-Termist Behaviour in Speculative Markets. *The Review of Economic Studies 73(3)*, 577-610.

Boulton, T. J., Braga-Alves, M. V., & Schlingemann, F. P. (2014). Does Equity-Based Compensation Make CEOs more Acquisitive? *The Journal of Financial Research 37(3)*, 267-293.

Guay, W. R. (1999). The sensitivity of CEO wealth ot equity risk: an analysis of the magnitude and determinants. *Journal of Financial Economics 53*, 43-71.

Hall, B. J. (2003, July). *Siz Challenges in Designing Equity-Based Pay.* Retrieved from National Bureau of Economic Research: http://www.nber.org/papers/w9887

Haque, F., & Ntim, C. G. (2020). Executive Compensation, Sustainable Compensation Policy, Carbon Performance and Market Value. *British Journal of Management 31*, 525-546.

Harikumar, T. (1996). Leverage, Risk-shifting Incentive, and Stock-based Compensation. *The Journal of Financial Research 19(3)*, 417-428.

Harris, O., Karl, J. B., & Lawrence, E. (2019). CEO compensationa and earnings management: Does gender really mmatters? *Journal of Business Research 98*, 1-14.

Ilhan, E., Sautner, Z., & Vilkov, G. (2021). Carbon Tail Risk. *The Review of Financial Studies 34(3)*, 1540-1571.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics 3(4)*, 305-360.

Jensen, M. C., & Smith Jr, .. C. (1985). Stockholder, Manager, and Creditor Interests: Applications of Agency Theory. In E. I. Altman, & M. G. Subrahmanyam, *Recent Advances in Corporate Finance* (pp. 93-132). Homewood, Illinois: Richard D. Irwin.

John, T. A., & John, K. (1993). Top-Management Compensation and Capital Structure. *Teh Journal of Finance 48(3)*, 949-974.

Kouloukoui, D., de Marcellis-Warin, N., Armellini, F., Warin, T., & Andrade Torres, E. (2021). Factors influencing the perception of exposure to climate risks: Evidence from the world's largest carbon intensive industries. *Journal of Cleaner Production 306*, 127160.

Low, A. (2009). Managerial risk-taking behavior and equity-based compensation. *Journal of Financial Economics 92(3)*, 470-490.

Meulbroek, L. K. (2001). The Efficiency of Equity-Linked Compensation: Understanding the Full Cost of Awarding Executive Stock Options. *Financial Management 30(2)*, 5-44.

Ofek, E., & Yermack, D. (2000). Taking Stock: Equity-Based Compensation and the Evolution of Managerial Ownership. *The Journal of Finance 53(3)*, 1367-1384.

Seltzer, L., Starks, L., & Zhu, Q. (2021, May 7). *Climate Regulatory Risks and Corporate Control.* Retrieved from Nanyan Business School Research Paper No. 20-05: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3563271#

Walls, J. L., Beffone, P., & Phan, P. H. (2012). Corporate Goverrnance and Environmental Perforemance: Is There Really a Link? *Strategic Management Journal 33(8)*, 885-913.

Table 1: Summary Statistics

This table provides summary statistics for a sample of 5,426 firm-year observations between 2006 and 2023.

Panel A: Descriptives

	Mean	Within-group Stdev	5th Percentile	95th Percentile
Greenhouse gas emissions	4.7017	0.3311	0.4688	9.7208
Equity-based compensation	0.8481	0.0835	0.6360	0.9498
Size	9.5014	0.2633	7.2296	12.3373
Book-to-market	0.4472	0.1909	0.1488	1.1774
ROE	0.1566	0.3895	-0.2806	0.6630
Debt-to-equity	1.1489	2.1706	0.0003	4.7502
Capital expenditures	0.3921	0.0149	0.0008	0.1112
PP&E	7.6327	0.3142	4.8007	10.5072
Tobin's Q	1.8112	0.6938	0.3154	4.7953

Panel B: Spearman correlations

		1	2	3	4	5	6	7	8
1	Greenhouse gas emissions								
2	Equity-based compensation	0.0035							
3	Size	0.3657	0.3261						
4	Book-to-market	0.1309	-0.2239	0.1484					
5	ROE	-0.0058	0.1545	0.0183	-0.4580				
6	Debt-to-equity	0.2151	-0.0294	0.1642	-0.0484	0.1798			
7	Capital expenditures	0.5725	-0.0829	-0.1027	-0.0433	0.0453	0.0716		
8	PP&E	0.7717	0.1679	0.6976	0.1046	0.0014	0.2569	0.5027	
9	Tobin's Q	-0.1807	0.1968	-0.2854	-0.8436	0.4002	-0.1292	0.0979	-0.1773

Table 2: The Relationship Between Corporate Greenhouse Gas Emissions and Equity-based Compensation

This table shows several fixed effects regressions of firms' emissions. Robust standard errors are shown in parentheses. +, *, **, and *** correspond to p-values of 0.1, 0.05, 0.01, and 0.001, respectively.

	Greenhouse Gas Emissions		
	(1)	(2)	(3)
Equity-based compensation	2.2335***	0.4024*	0.3883*
	(0.2092)	*(0.1695)*	*(0.1892)*
Size		0.1516***	0.1606***
		(0.0308)	*(0.0343)*
Book-to-market		0.2654***	0.3044***
		(0.0494)	*(0.0549)*
ROE		-0.0163	-0.0121
		(0.0355)	*(0.0415)*
Debt-to-equity		0.0153*	0.0187**
		(0.0064)	*(0.0071)*
Capital expenditures		3.1337***	3.8060***
		(0.7828)	*(0.9358)*
PP&E		0.6973***	0.6911***
		(0.0307)	*(0.0342)*
Constant	2.7024***	-2.6592***	-2.7478***
	(0.1804)	*(0.1966)*	*(0.2124)*
Industry fixed effects	Yes	Yes	No
Year fixed effects	Yes	Yes	No
Industry-year fixed effects	No	No	Yes
Observations	5,736	5,426	5,229
R-square	0.0309	0.473	0.476

Table 3: Robustness Tests

This table shows several regressions of firms' emissions. Robust standard errors are shown in parentheses. $^{+}$, *, **, and *** correspond to p-values of 0.1, 0.05, 0.01, and 0.001, respectively.

	(1) Expanded specification	(2) Independent variable as level	(3) Lagged (1) predictors	(4) Lagged (3) predictors	(5) Difference regression	(6) High variability in emissions cross-section
Equity-based compensation	0.4792*		0.3529*	0.3333*	0.0062^{+}	
	(0.2273)		(0.1694)	(0.1522)	(0.0036)	
Equity-based compensation (level)		0.0454^{+}				
		(0.0244)				
High equity-based pay × Industry with high variability in emissions						0.3128**
						(0.1208)
Size	0.1286***	0.1462***	0.1621***	0.1773***	390.9471	0.1551***
	(0.0339)	(0.0315)	(0.0331)	(0.0360)	(313.1459)	(0.0306)
Book-to-market	0.3091***	0.2608***	0.3035***	0.2121***	233.4898*	0.2696***
	(0.0524)	(0.0495)	(0.0531)	(0.0639)	(105.5892)	(0.0495)
ROE	-0.0263	-0.0165	-0.0032	0.0349	110.7236	-0.0172
	(0.0377)	(0.0355)	(0.0389)	(0.0554)	(137.1240)	(0.0360)
Debt-to-equity	0.0127^{+}	0.0155*	0.0156*	0.0125	-27.9762	0.0154*
	(0.0068)	(0.0064)	(0.0074)	(0.0091)	(25.9058)	(0.0064)
Capital expenditures	3.8035***	3.1138***	3.2038***	3.9645***	61.3341	3.2794***
	(0.8014)	(0.7818)	(0.7775)	(0.8173)	(3,370.8765)	(0.8044)
PP&E	0.733***	0.696***	0.687***	0.642***	301.301^{+}	0.696***
	(0.0322)	(0.0306)	(0.0329)	(0.0352)	(169.8904)	(0.0309)
Total compensation	-0.089^{+}					
	(0.0466)					
CEO tenure	0.034					
	(0.0300)					
Board independence	1.088***					
	(0.2109)					
Dual CEO	0.422***					
	(0.0540)					
High equity-based pay						0.032
						(0.0617)
Industry with high emissions variability						-0.332**
						(0.1201)
Constant	-3.353***	-2.660***	-2.611***	-2.277***	-167.683***	-2.363***
	(0.3107)	(0.2132)	(0.2027)	(0.2057)	(39.7167)	(0.1559)
Industry fixed effects	Yes	Yes	Yes	Yes	No	Yes
Year fixed effects	Yes	Yes	Yes	Yes	No	Yes
Observations	5,024	5,433	5,138	4,465	4,307	5,234
Within R-square	0.486	0.473	0.478	0.480	0.00309	0.476

Table 4: Heterogeneity Between Industries

This table shows a fixed effects regression of firms' emissions. Robust standard errors are shown in parentheses. $^{+}$, *, **, and *** correspond to p-values of 0.1, 0.05, 0.01, and 0.001, respectively.

	Greenhouse Gas Emissions
High equity-based pay	-0.0871
	(0.1510)
High equity-based pay × Low emissions industry	0.3215^{+}
	(0.1659)
Size	0.1513***
	(0.0305)
Book-to-market	0.2587***
	(0.0489)
ROE	-0.0155
	(0.0354)
Debt-to-equity	0.0152*
	(0.0064)
Capital expenditures	3.0643***
	(0.7852)
PP&E	0.7016***
	(0.0307)
Constant	-2.5031***
	(0.1620)
Industry fixed effects	Yes
Year fixed effects	Yes
Observations	5,428
Within R-square	0.474

Table 5: Equity-based pay, emissions, and firm value

This table shows a fixed effects regression of firms' Tobin's Q. Robust standard errors are shown in parentheses. $^{+}$, *, **, and *** correspond to p-values of 0.1, 0.05, 0.01, and 0.001, respectively.

	Tobin's Q
High equity-based compensation	0.3434***
	(0.0784)
High emissions	0.1572
	(0.1218)
High equity-based pay × High emissions	-0.3456**
	(0.1139)
Size	-0.0668***
	(0.0187)
Debt-to-equity	-0.0291***
	(0.0087)
R&D intensity	6.7907***
	(0.5262)
Intangibility	-0.1606
	(0.1316)
Constant	2.1413***
	(0.1886)
Industry fixed effects	Yes
Year fixed effects	Yes
Observations	5,433
Within R-square	0.0854

Appendix

Table A1: Variable definitions

Variable	Type	Description	Source
Greenhouse gas emissions	Dependent	The natural logarithm of one plus a firm's scope 1 emissions (in millions of metric tons).	Bloomberg
Equity-based compensation	Independent	The ratio of a CEO's total compensation, less salary and bonus, to total compensation	ExecuComp (SALARY, BONUS, TDC1)
Size	Control	The natural logarithm of one plus a firm's total assets (in millions of US dollars).	Compustat (AT)
Book-to-market	Control	The ratio of a firm's book value of equity to market value of equity.	Compustat (SEQ, PRCC_C, CSHO)
ROE	Control	The ratio of a firm's income before extraordinary items to owner's equity.	Compustat (IB, SEQ)
Debt-to-equity	Control	The ratio of a firm's book value of debt to book value of equity.	Compustat (DLC, DLTT, SEQ)
Capital expenditures	Control	A firm's capital expenditures per dollar of assets.	Compustat (CAPX, AT)
PP&E	Control	The natural logarithm of one plus a firm's property, plant, and equipment (net of depreciation, in millions of US dollars).	Compustat (PPENT)
Tobin's Q	Dependent	The ratio of the market value of assets and book value of liabilities to book value of assets.	Compustat (PRCC_C, CSHO, DLC, DLTT, AT)
R&D intensity	Control	The ratio of R&D expenditures to total revenue. Missing R&D values have been replaced with zero.	Compustat (XRD, REVT)
Tangibility	Control	One minus the ratio of net fixed assets to total assets.	Compustat (PPENT, AT)