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August 7, 2025

National Bureau of Economic Research
PhD Student Workshop on Climate Finance
1050 Massachusetts Avenue
Cambridge, MA 02138

Dear Selection Committee,

I am writing to apply for the NBER Dissertation-Writer Workshop on Climate Finance, scheduled for October 9, 2025. I am a third year PhD student in the Department of Economic Sciences at the Indian Institute of Technology Kanpur.

My research focuses on the intersection of climate risk and financial markets in emerging economies. My current work examines how corporate environmental performance affects financial market outcomes, with a particular focus on the relationship between greenhouse gas emissions and the idiosyncratic volatility of Indian firms. This relationship appears to be moderated by environmental governance quality and the strength of firms' financial buffers.

Broadly, I am interested in how environmental performance, sustainability disclosures, and regulatory frameworks influence financial outcomes and market risk. In my future research, I plan to examine the effects of mandatory climate disclosure regulations on market transparency and explore how the quality of these disclosures shapes investor decisions in emerging markets. I expect to complete my PhD by 2027.

This research is supervised by Dr. Wasim Ahmad, who is familiar with my work and can serve as a reference. Thank you for your consideration.

Sincerely,
Ushmeet Kaur

Ushmeet Kaur

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Education

PhD, Dept. of Economics Sciences, IIT Kanpur 2023-
Thesis title: Essays in Climate Finance: Firm- level Dynamics
Advisor Name: Dr. Wasim Ahmad

M.Sc. Financial Economics, Gokhale Institute of Politics & Economics 2021

B.A.(H) Economics, Hansraj College, Delhi University 2019

Research Interests

Fields*:* Climate finance, ESG and Firm Performance, Climate Risk Disclosure

Research in Progress

Greenhouse Gas Emissions and Idiosyncratic Volatility: Evidence from Indian Firms

Abstract: This study examines the association between corporate greenhouse gas (GHG) emissions and firm-specific stock price volatility for 86 Indian companies over the period 2014-2023. Using idiosyncratic volatility as our dependent variable, we find that companies with higher GHG emissions relative to revenue (GHG intensity) exhibit significantly elevated levels of firm-specific risk. This relationship suggests that investors in emerging markets price environmental inefficiency as a source of non-diversifiable, company-specific uncertainty. Our results show significant heterogeneity across firm characteristics and time periods. The emissions-volatility relationship is statistically significant for smaller firms, highly leveraged companies, and during the pre-COVID period, while the effect disappears for larger firms, low-debt firms, and the post-COVID era. Interestingly, we also observe that green revenue exposure and cash holdings can moderate this relationship. Moreover, we present new evidence that corporate environmental governance, particularly the presence of energy efficiency policies and environmental management teams, alters market perception of environmental performance.

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Greenhouse Gas Emissions and Idiosyncratic Volatility: Evidence from Indian Firms

Ushmeet Kaur

Abstract

This study examines the association between corporate greenhouse gas (GHG) emissions and firm-specific stock volatility for 86 Indian companies over the period 2014-2023. Using idiosyncratic volatility as our dependent variable, we find that companies with higher GHG emissions relative to revenue (GHG intensity) exhibit elevated levels of firm-specific risk. This relationship suggests that investors in emerging markets price environmental inefficiency as a source of non-diversifiable, company-specific uncertainty. The effect is marginally significant: a one-standard-deviation rise in emissions intensity results in an 8.3 basis point increase in volatility. Our results show significant heterogeneity across firm characteristics and time periods. The emissions-volatility relationship is statistically significant for smaller firms, highly leveraged companies, and during the pre-COVID period, while the effect disappears for larger firms, low-debt firms, and the post-COVID era. Interestingly, we also observe that green revenue exposure and cash holdings can moderate this relationship. This implies environmental risk will interact with other firm-level factors in multifaceted ways. Moreover, we present new evidence that corporate environmental governance, particularly the presence of energy efficiency policies and environmental management teams, alters market perception of environmental performance. This generates accountability mechanisms that transform emissions from a negligible factor to a major source of risk for particular firms. These results contribute to the emerging literature on climate finance and provide valuable information on how environmental performance influences financial risk for emerging market firms. This has significant implications for corporate environmental policy and investor decisions.

1 Introduction

Integrating environmental considerations in financial decision-making has emerged as one of the most significant innovations in contemporary finance. As climate change increasingly threatens economic stability and corporate performance (Stern, 2007; Battiston et al., 2017; Bolton & Kacperczyk, 2021), investors are paying unprecedented attention to how environmental issues impact risks and returns for firms. This shift is particularly pronounced in emerging economies, where increasing industrial growth, evolving regulations, and heightened environmental consciousness provide a distinct framework for examining the financial implications of corporate environmental performance.

India is the world's third-largest emitter of greenhouse gases, after China and the United States (Global Carbon Project, 2023). As a leading emerging economy, India provides an ideal case study to examine these linkages. India's rapid economic development, coupled with tighter environmental controls and more advanced investors, provides a setting in which the economic consequences of environmental performance are emerging. However, the connection between corporate environmental performance and particular financial risks in emerging economies remains less understood (Rajesh, 2020), making this a key area of knowledge gap regarding climate finance. This paper attempts to bridge this gap by investigating the relationship between corporate GHG emissions and stock return volatility for Indian firms. Idiosyncratic volatility, defined as the firm-specific component of stock return variation that cannot be explained by common market factors (Ang et al., 2006; Fu, 2009), is an appropriate measure of firm-specific risk here.

In contrast to systematic measures of risk, idiosyncratic volatility captures how the market perceives company-specific uncertainty and, therefore, is a good measure to gauge the impact of environmental performance on firm-level perceived risks. Our study enriches the literature in a number of important ways. First, we offer the first comprehensive analysis of the GHG emissions-volatility link in India, providing new empirical insights into how environmental performance influences firm-specific risk in a large emerging economy. Second, we demonstrate considerable heterogeneity in this link for various firm attributes, time horizons, and environmental governance regimes, providing nuanced findings on when environmental performance is financially significant. Third, we discover new drivers of influence—like green revenue exposure, cash holdings, and environmental governance arrangements—that profoundly alter the emissions-volatility nexus, drawing on more recent work on ESG performance and idiosyncratic volatility (Albuquerque et al., 2019; Chava, 2014). Above all, we show that environmental governance arrangements are connected to accountability mechanisms that change the way that markets perceive carbon performance. We discover that the presence of energy efficiency policies and specialized environmental management teams considerably influences the connection between emissions and volatility. This implies that the environmental commitments of firms influence market expectations, and when these commitments are not realized, they result in higher firm-specific risk.

With a panel sample of 86 Indian companies from the period 2014 to 2023, we obtain that companies with greater GHG emissions intensity also face considerably higher idiosyncratic volatility. The association has a marginally but statistically significant impact, as a one-standard-deviation rise in emissions intensity is associated with an 8.3 basis point increase in monthly idiosyncratic volatility. The impact is especially pronounced in lower-sized and more financially leveraged firms and suggests that constraints in terms of resources can exacerbate environmental exposures.

Our temporal analysis indicates that the emissions-volatility link was statistically significant pre-COVID-19 but only became so during the pandemic. This is likely a function of shifting investor priorities and underscores the dominating role of health and economic considerations (Baker et al., 2020; Ramelli & Wagner, 2020). This result provides essential information about how market conditions influence the perceived importance of environmental hazards. The remainder of this paper is structured as follows. Section 2 presents a review of the literature and Section 3 formulates our hypotheses. Section 4 reports our data, sample construction, and methodology. Section 5 reports our core empirical findings, and Section

6 presents heterogeneity and moderating analyses. Section 7 reports robustness checks and alternative specifications. Section 8 concludes with theory, practice, and policy implications.

2 Literature Review and Hypotheses

2.1 Theoretical Foundations: Idiosyncratic Volatility and Asset Pricing

The theoretical foundation for examining idiosyncratic volatility as a determinant of cross-sectional stock returns stems from Ang et al. (2006), who document a robust negative relationship between idiosyncratic volatility and future stock returns. They demonstrate a very strong negative relationship between idiosyncratic volatility and future stock returns. Employing the Fama-French three-factor model residuals, they determine that high idiosyncratic volatility stocks return very low average returns, with the quintile that has the highest returns earning just -0.02% per month. This idiosyncratic volatility puzzle cannot be explained by traditional risk factors including size, book-to-market, momentum, liquidity, or exposure to aggregate volatility risk, establishing idiosyncratic volatility as an important cross-sectional pricing factor.

Ang et al. (2006) also examine aggregate volatility risk using VIX innovations and find that sensitive stocks have low average returns, consistent with negative volatility risk premiums. They estimate the price of volatility risk to be roughly -1% annually. This provides a theoretical explanation for why firm-specific characteristics that increase idiosyncratic volatility should reduce returns.

Peterson and Smedema (2014) advance this knowledge by decomposing idiosyncratic volatility into realized and expected components, uncovering various pricing phenomena. They demonstrate that realized idiosyncratic volatility is strongly negatively related to mispricing returns, whereas expected idiosyncratic volatility is positively related, capturing rational risk compensation. Their findings attribute the negative impact of realized volatility to behavioral influences. The impacts are stronger with high market sentiment and for low-information stocks.

2.2 Environmental Performance and Financial Risk

2.2.1 Carbon Emissions and Volatility

We extend the idiosyncratic volatility framework based on recent studies to investigate how environmental performance influences firm-specific risk.

Perera et al. (2021) provide seminal evidence from US S&P 500 companies between 2009 and 2019. They point to a crucial distinction between disclosure of carbon emissions and true emissions performance. The authors document that firms disclosing carbon emissions experience significantly lower IdVol compared to their non-disclosing counterparts, suggesting that transparency mitigates investor uncertainty. However, contrary to expectations that environmentally proactive firms are perceived as less risky, the study finds a statistically significant negative relationship between carbon emissions intensity(CEI) and IdVol. This

counterintuitive result is interpreted through the lens of managerial opportunism theory, suggesting that attempts to reduce CEI may signal agency conflicts or resource misallocation, leading to increased volatility. Their quantile regression estimation reveals that the adverse effect of emissions intensity is heterogeneous across the volatility range, with more intensive effects for more volatile companies.

An analysis by industry reveals that this relationship is significant for high-carbon industries, where shareholders are most dubious about environmental initiatives. The study identifies R&D spending as a key factor, showing that environmental investments involve technological uncertainty, leading to higher firm-specific risk. Interestingly, Perera et al. (2021) observe a strong change following the Paris Agreement in 2015. Polluting companies experienced escalating volatility as markets priced carbon cut plans. Nevertheless, concentration on large-cap US companies with well-developed institutional structures and environmental disclosure mandates makes the findings less relevant to emerging markets that have alternate regulations, governance, and investor sophistication.

2.2.2 Climate Policy and Energy Uncertainty

Drawing on emissions performance literature, Ren et al. (2021) examine climate policy uncertainty's effect on idiosyncratic volatility, using 2,555 Chinese non-financial firm observations from 2009 to 2019. Their empirical findings indicate that policy uncertainty significantly enhances firms' idiosyncratic volatility, with differing effects depending on the characteristics of firms. State-owned firms, firms with dispersed equity, and small firms are more exposed to climate policy uncertainty.

Siddiqui et al. (2024) build upon this uncertainty framework by examining energy-related uncertainty in Chinese firms from 2007 to 2022. Employing the Energy-Related Uncertainty Index (EUI), they observe that a one-unit rise in energy-related uncertainty is associated with a 5.1% increase in idiosyncratic volatility among all firms. There are significant differences; energy firms experience a 6.4% increase, and non-energy firms have a 3.7% increase.

Their findings suggest that state-owned companies, highly concentrated ownership firms, and small firms are more exposed to energy uncertainties, highlighting the influence of firm attributes in the determination of environmental risk effects.

2.2.3 ESG Performance and Risk Mitigation

The general ESG literature provides context to environmental risk effects by identifying intricate relationships between sustainability performance and firm-specific risk.

Becchetti et al. (2015) discuss the relationship between corporate social responsibility (CSR) and idiosyncratic volatility. They demonstrate that aggregate CSR is positively related to idiosyncratic volatility but negatively related to stakeholder-specific risk factors. They consider that CSR constrains flexibility in responding to productivity shocks since it can decrease stakeholder well-being, rendering earnings more unpredictable and reducing exposure to stakeholder conflict risks.

This twofold effect suggests that environmental and social habits may enhance operational limitations while providing risk mitigation advantages. This contrast can account for inconclusive findings in various studies. The authors identify stakeholder risk as an im-

portant variable, insisting on recognizing when and why CSR practices have an impact on firm-specific volatility. They underscore the necessity of focusing on individual governance mechanisms rather than general sustainability measures.

In comparison, Kim and Kang (2023) demonstrate that intense ESG performance significantly reduces firm-level idiosyncratic volatility in Korean firms, particularly during the COVID-19 pandemic. According to their research, high ESG performance is most effective in ESG-sensitive industries. This indicates that ESG practice risk mitigating benefits rely on industry-specific pressures and regulations.

The contrasting results between Becchetti et al. (2015) and Kim and Kang (2023) underlie the necessity to examine individual components of ESG performance and the interactions among them with firm and industry characteristics. Although aggregate measures of ESG may uncover conflicting impacts, an intensively examined study of governance mechanisms can yield more uniform connections to firm-specific risk.

Roy et al. (2022) offer sector-specific insights examining clean energy stocks in the time of the pandemic. They observe a positive relationship between idiosyncratic volatility and returns during normal times that disappears during the pandemic. In general, they find that macroeconomic factors comprise the primary drivers of clean energy stock volatility, but firm-specific factors matter more in times of crisis, which suggests that environmental factors interact differently with market conditions over time.

2.3 Theoretical Mechanisms and Market Dynamics

2.3.1 Investor Preferences and Sustainable Investing

Pástor et al. (2021) develop an equilibrium model of sustainable investing. The model clarifies the influence of environmental factors on firm-specific risk. It reveals that environmental characteristics significantly influence asset pricing by means of investors' ESG preferences and hedging benefits of green assets. It determines that green firms require less expected return due to investor demand and hedging incentives, whereas brown firms require more returns to compensate for exposure to climate risk.

The ESG factor of the model picks up on unanticipated shifts in environmental tastes and can sometimes make green stocks outperform with lower initial returns. This suggests that the relationship between emissions and volatility can vary over periods, particularly during periods of higher climate consciousness. Second, differences in investor preferences for ESG drive sustainable investment trends and result in differences of opinion regarding emission-related risk, which can increase idiosyncratic volatility for high-emitting firms.

2.3.2 Investor Revolution and Market Segmentation

Eccles and Klimenko (2019) point to a transformation in capital markets. Institutional investors, in particular large asset managers and pension funds, cannot afford to disregard ESG factors. When these investors grow too big to ignore systemic risks such as climate change, ESG performance has moved from a secondary issue to a priority.

This shift suggests that investors are internalizing emissions-related risks, potentially generating increased idiosyncratic volatility for high-emission companies as a result of repu-

tational risk, policy risk, and shifting investor attitudes.

Luo and Balvers (2017) estimate the impact of investor boycotts of problematic companies. They demonstrate that market segmentation generates a boycott risk factor, under which unconstrained investors demand compensation for assuming the excess supply of boycotted stocks. Although their model applies to "sin stocks," it can explain ESG-driven divestment impacts on carbon-intensive companies that could elevate idiosyncratic volatility from reduced analyst following, liquidity problems, and heightened regulatory uncertainty.

2.4 Research Gaps and Our Contribution

Our present literature identifies a number of significant gaps that limit our knowledge concerning environmental risk pricing in financial markets. The first is the emphasis placed on developed markets, particularly the US, which leaves a knowledge gap regarding environmental risk dynamics for emerging economies. Research such as Perera et al. (2021) is focused only on S&P 500 companies, whereas emerging market research comes largely from China (Ren et al., 2021; Siddiqui et al., 2024), and thus there is less research on other major emerging economies such as India that is increasingly important for understanding global environmental policy.

Second, existing literature is not adequately addressing the issue of environmental governance structures. Although Perera et al. (2021) discuss disclosure versus performance and Kim and Kang (2023) examine composite ESG scores, there is insufficient evidence on what certain governance structures—such as environmental management teams, energy efficiency policies, and board oversight—really do in terms of affecting the emissions-risk relationship. This is an important shortcoming because governance mechanisms are the levers firms employ to address environmental risks.

Third, the period considered in previous studies is of critical limitation. The majority of studies end prior to 2020 (Perera et al., 2009–2019; Ren et al., 2009–2019). Those that cover the time of the COVID-19 pandemic look only at specific industries, such as clean energy (Roy et al., 2022), without presenting a wider cross-sector perspective. This period limitation is particularly problematic since the pandemic drastically altered investor agendas, regulatory attention, and market forces related to environmental threats.

Fourth, although theoretical frameworks like Pástor et al. (2021) predict heterogeneous effects depending on the characteristics of firms, empirical findings regarding how environmental risks interact with certain firm-level factors are still dispersed and sometimes conflicting. Studies tend to analyze individual characteristics without having overall frameworks to cater to multifaceted interactions.

Moreover, conflicting results regarding ESG impacts on volatility (positive in Becchetti et al., 2015; negative in Kim and Kang, 2023) indicate that the connection might largely rely on certain governance mechanisms, institutional environments, and measurement methods that existing research fails to study properly.

Our research will address these significant gaps through four key contributions. First, we provide the first extensive analysis of how greenhouse gas emissions and idiosyncratic volatility are related in the Indian market. This provides critical evidence from an emerging economy with specific institutional features, regulation, and sophistication of investors in contrast to other studies conducted in the US and China.

Second, we advance the environmental governance literature by concentrating on targeted governance mechanisms rather than general measures. Our research into environmental management teams, energy efficiency policies, and board-level monitoring provides close-up views of how companies can manage environmental risk internally—beyond disclosure and performance and delving into actual solutions to governance.

Third, our period spanning 2014–2023 specifically isolates the effect of the COVID-19 era on green risk pricing. This generates novel evidence about how the crisis altered the emissions-volatility link for various types of companies and horizons, uncovering crucial structural shifts in green risk pricing that earlier research fails to examine.

Fourth, we provide a full analysis of firm-level differences in environmental risk impacts and analyze, in parallel, the effects of size, leverage, cash balances, and green revenue exposure on the relationship between emissions and volatility. This multi-dimensional analysis reveals complex interactions that may be missed by one-factor studies and offers a fuller understanding of when and why environmental performance affects firm-specific risk.

Our results show, for the first time, how environmental regulation institutes accountability structures that turn carbon performance from a marginal consideration into an important driver of firm-specific risk in emerging economies. This is of significance to corporate environmental strategies, investor decisions, and policy regulation in developing economies.

3 Hypotheses

Hypothesis 1 (H1): Companies with a higher level of greenhouse gas intensity exhibit higher idiosyncratic volatility in stock returns

Greenhouse gas emissions are an essential component of environmental performance since they are directly associated with climate change and increasing regulatory attention.

Regulatory Risk: Companies with high emissions are exposed to more carbon pricing, emissions trading, and environmental rules. Stroebel and Wurgler (2021) reveal that regulatory risk has been identified by finance professionals and policymakers as the most urgent climate threat. According to their survey, over the next five years, firms will face higher financial risks from regulatory actions than physical climate occurrences, with the respondents naming regulatory risk as the primary climate concern for companies.

Transition Risk: As the economies transition towards low carbon economies, companies highly dependent on carbon are exposed to increasing threats from obsolescence, shifts in consumer choice, and shifts in capital allocation. Ma, Feng, Chen, and Zhang (2024) present evidence that carbon pricing induces volatility spillovers to stock prices. This illustrates how transition risk impacts individual stock volatility through carbon market forces.

Operational Risk: High GHG emissions can be a reflection of operational inefficiencies, inefficient use of resources, and low investment in advanced technology. Xu, Liu, and Dou (2022) find that environmental performance contains information about operational efficiency that is relevant for understanding firm-specific risk patterns.

Reputational Risk: With increasing environmental consciousness, companies with high emissions are subjected to increased scrutiny from stakeholders such as customers, employees, investors, and regulators. Guastella et al. (2022) examine reputational risk as a climate

transition risk, where the gap between climate communication and performance can jeopardize the reputation of a company and influence investor behavior.

Information Asymmetry: Environmental performance can shed light on management quality, operational competence, and future cash flow. Poorly performing firms in terms of the environment can experience higher information gaps with investors, resulting in higher volatility as markets have difficulty valuing these companies accurately.

Hypothesis 2 (H2): Green revenue exposure and cash holdings moderate the positive relationship between greenhouse gas emissions intensity and idiosyncratic volatility

This hypothesis recognizes that companies have different ways of dealing with environmental risks. Green revenue exposure provides operational diversification that can offset risks associated with emissions. Cash buffers provide companies with financing flexibility to deal with environmental issues and make investments in improvements when needed. These two factors should mitigate the perceived risk associated with high emissions intensity.

Hypothesis 3 (H3): Firms exhibit a positive relationship between GHG emissions intensity and idiosyncratic volatility

Environmental governance structures function as commitment devices that create both internal accountability (through organizational processes and expectations) and external accountability (through stakeholder monitoring and market scrutiny). When firms establish energy efficiency policies or dedicate resources to environmental management teams, they signal environmental commitment and create performance benchmarks against which they will be evaluated. This heightened accountability means that high emissions intensity represents not just poor environmental performance, but a failure to meet explicit commitments, thereby amplifying market perceptions of management credibility risk and operational effectiveness. Consequently, emissions intensity becomes a more salient risk factor for firms with environmental governance structures than for firms without such commitments, where environmental performance may be viewed as less material to firm value.

4 Data and Methodology

4.1 Sample Construction and Market Context

Our analysis focuses on Indian firms during a key period for understanding the growth of climate finance in emerging markets. The time frame from 2014 to 2023 includes important changes in both Indian and global environmental policies and reporting standards.

In India, this period covers the launch of the National Action Plan on Climate Change (NAPCC), the introduction of mandatory Business Responsibility Reporting (BRR), and the later adoption of the Business Responsibility and Sustainability Reporting (BRSR) framework. These regulatory changes significantly improved the availability and quality of environmental data from Indian companies and increased market awareness of environmental issues.

Globally, this time frame aligns with the Paris Agreement (2015), the creation of the Task Force on Climate-related Financial Disclosures (TCFD), and the growing focus of institutional investors on environmental, social, and governance (ESG) factors. These changes

shaped how firms around the world started to include environmental risks in their financial reports and strategic plans.

After carefully checking for data availability and quality, our final sample consists of 86 companies that reported GHG emissions data consistently from 2014 to 2023.

To ensure the quality of our data and the strength of our analysis, we applied several data cleaning methods. We removed clear outliers that seemed to come from data entry mistakes or reporting inconsistencies. We also winsorized selected variables at the 1st and 99th percentiles to reduce the impact of extreme values while keeping the core data relationships intact.

All data were collected from Refinitiv. All financial figures are reported in Indian rupees to ensure consistency and avoid issues with currency conversion.

Our final sample includes 860 firm-year observations for the main analysis, forming a balanced panel. The sample includes firms from various industries, such as manufacturing, energy, materials, technology, and services, representing a good cross-section of the broader Indian economy.

4.2 Variable Construction

4.2.1 Dependent Variable: Idiosyncratic Volatility

Our main variable of interest is idiosyncratic volatility, which captures the portion of a firm's risk that is unique to that company and not driven by broader market movements. To measure this, we start by collecting daily closing stock prices for each firm using data from the Refinitiv database. We then compute daily stock returns by taking the natural logarithm of the ratio of each day's closing price to the previous day's closing price.

Following Ang et al. (2006), we employ the Carhart four-factor model (Carhart, 1997), which extends the Fama-French three-factor model by incorporating a momentum factor, to isolate idiosyncratic risk from systematic factors.

The Carhart model specification is:

$$(R_{it} - r_{ft}) = \alpha_{it} + \beta_{ER}(R_{Mt} - r_{ft}) + \beta_{SMB}(SMB_t) + \beta_{HML}(HML_t) + \beta_{MOM}(MOM_t) + \varepsilon_{it}$$

Where:

- R_{it} is the daily return on stock i at time t
- r_{ft} is the risk-free rate (91-day Treasury bill rate)
- R_{Mt} is the market return (Nifty 500 index return)
- SMB_t represents the size factor (small minus big)
- HML_t represents the value factor (high minus low book-to-market)
- MOM_t represents the momentum factor (winners minus losers)
- ε_{it} is the residual term

We obtain the factor portfolios (SMB, HML, and MOM) from IIM Ahmedabad's website. The size factor (SMB) represents the return difference between small and large market capitalization portfolios. The value factor (HML) represents the return difference between high and low book-to-market portfolios. The momentum factor (MOM) represents the return difference between winner and loser portfolios based on past 11-month returns.

We then calculate annual averages of these monthly values to obtain our main dependent variable. For each firm-month, we run a regression of daily excess returns on the four Carhart factors using daily data within that month. The standard deviation of the obtained residuals ε_{im}, denoted $\sigma_{\varepsilon_{im}}$, captures the monthly idiosyncratic volatility and is expressed in percentage terms:

$$\text{IdVol}_{im} = \sigma_{\varepsilon_{im}} = \sqrt{\text{Var}(\varepsilon_{im})}$$

We then compute annual averages of these monthly values to construct our main dependent variable, denoted IdVol_{it}, as follows:

$$\text{IdVol}_{it} = \frac{1}{12} \sum_{m=1}^{12} \text{IdVol}_{im}$$

4.2.2 Main Independent Variable: GHG Intensity

Our key independent variable is Greenhouse Gas Emissions Intensity (GHG Intensity). We calculate this by dividing a company's total greenhouse gas emissions (in tonnes) by its annual revenue (in million rupees). In simple terms, this tells us how much pollution a firm generates for every unit of economic output it produces.

We use revenue instead of assets to scale emissions for a few important reasons. Revenue gives a more accurate sense of how efficiently a company runs its operations and is more closely tied to profitability—something that's often linked to stock market performance. On the other hand, asset values can be influenced by accounting rules or revaluations that don't really reflect how environmentally responsible a company is.

The emissions data we use includes all major categories:

- *Scope 1*: Direct emissions from things the company owns or controls (like factory smokestacks or company vehicles),
- *Scope 2*: Emissions from the electricity or energy the company buys,
- *Scope 3*: Other indirect emissions, such as those from suppliers, customers, or product use.

We include several control variables based on prior literature on the determinants of idiosyncratic volatility:

Leverage: The ratio of total debt to total assets, winsorized at the 1st and 99th percentiles. This variable captures financial leverage, which prior research has consistently linked to higher volatility through increased financial risk.

Labor Intensity: Labor expenses divided by total revenue, measuring labor intensity relative to firm size. This variable captures operational characteristics that may affect volatility through their impact on operational leverage and cost structure flexibility.

EBITDA Margin: EBITDA divided by total revenue, winsorized at the 1st and 99th percentiles. This variable captures operating profitability and efficiency, with more profitable firms generally exhibiting lower volatility due to more stable cash flows.

Size: The natural logarithm of total assets, included to control for firm size. Larger firms typically exhibit lower volatility due to better diversification and more stable operations.

4.3 Empirical Methodology

Our main empirical specification employs a two-way fixed effects model:

$$\text{IdVol}_{it} = \alpha + \beta_1 \times \text{GHG_Intensity}_{it} + \beta_2 \times \text{Controls}_{it} + \lambda_i + \gamma_t + \varepsilon_{it}$$

Where:

- IdVol_{it} measures idiosyncratic stock volatility for firm i in year t
- $\text{GHG_Intensity}_{it}$ captures greenhouse gas emissions intensity
- Controls_{it} includes the firm-level control variables described above
- λ_i represents firm fixed effects
- γ_t denotes year fixed effects
- ε_{it} is the error term

We estimate our model using ordinary least squares (OLS) with robust standard errors clustered at the firm level. Clustering accounts for potential heteroskedasticity and correlations in the error terms within firms over time, helping to ensure more reliable inference.

To control for unobserved, time-invariant characteristics that may influence both a firm's environmental performance and its idiosyncratic volatility, we include firm fixed effects. This allows us to isolate the effect of changes within a firm over time, rather than differences across firms.

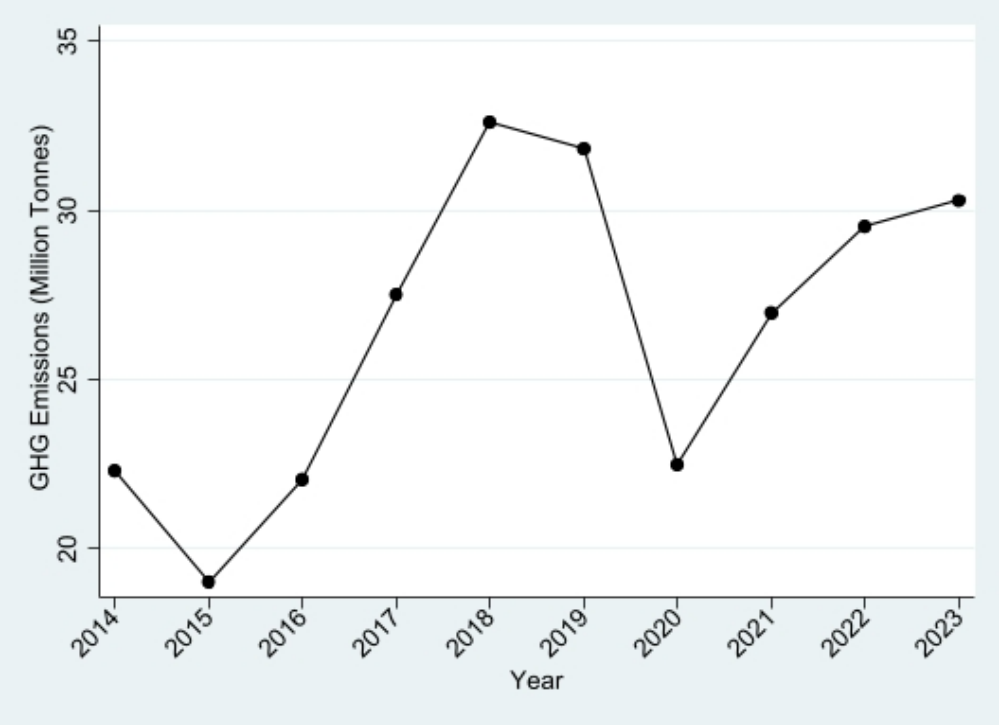
We also include year fixed effects to account for macroeconomic shocks, policy changes, and market-wide events that affect all firms in a given year. This is particularly important given our sample period includes major disruptions such as the COVID-19 pandemic and several regulatory reforms impacting Indian firms.

4.4 Sample Characteristics and Descriptive Statistics

Our final sample exhibits considerable variation across firms and time in both environmental performance and financial characteristics. Table 1 presents descriptive statistics for our main variables.

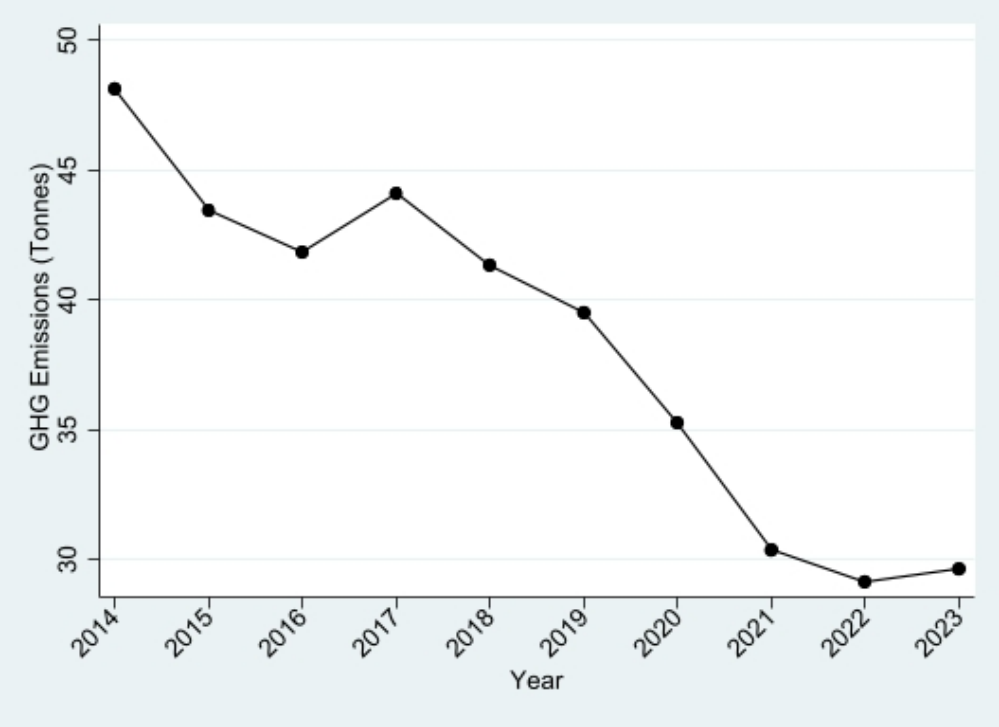
Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Idiosyncratic Volatility (Idvol)	1.483	0.505	0.653	4.665
GHG Intensity	38.196	48.345	0.084	259.126
Leverage	0.269	0.240	0.000	0.991
Labor Intensity	0.128	0.120	0.004	0.618
EBITDA Margin	0.236	0.161	-0.128	0.889
Size	27.122	1.525	24.113	31.923
Cash to Assets	0.048	0.051	0.000	0.389



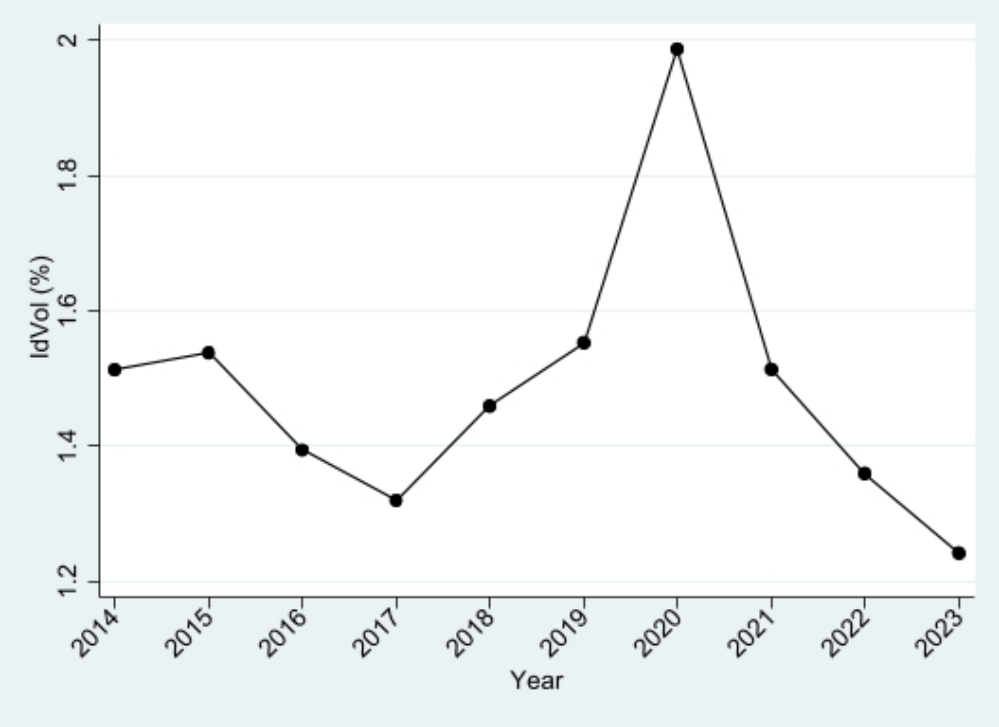
There's quite a bit of variation in greenhouse gas (GHG) emissions across the firms and over time. Emissions peaked around 2018–2019, which probably reflects the strong industrial activity leading up to the pandemic. Then in 2020, as expected, emissions dropped sharply—likely a result of COVID-related shutdowns and the broader slowdown in India's economy. In contrast, GHG intensity (emissions per unit of revenue) shows a clearer trend: a steady decline from 2013 through 2021. This is broadly in line with India's updated climate goals, including its target to cut emissions intensity by 45% from 2005 levels by 2030 (India's Nationally Determined Contributions, 2022). The data suggest that, over time, many firms have started producing more with less environmental cost.

When we look at idiosyncratic volatility, we see a noticeable spike in 2020—again likely tied to pandemic-driven uncertainty. After that, it gradually declines through 2023. This trend helps explain why we find a significant relationship between environmental performance and volatility in the pre-COVID period, but not during the pandemic itself. In those years,



market-wide uncertainty seemed to drown out firm-level differences, including environmental practices.

Interestingly, both emissions intensity and volatility appear to stabilize in the years following COVID. This might point to a shift—where efficiency and environmental responsibility have become more standard across firms, rather than being standout characteristics. That could help explain why environmental governance seems to matter more in recent years when it comes to differentiating firm performance.



The average idiosyncratic volatility in our sample is 1.483%, with a standard deviation of 0.505%. GHG intensity is even more varied, averaging 38.2 tonnes per million rupees of revenue, with a standard deviation of 48.3. That wide spread is useful for our purposes, since it gives us enough within-firm variation to study how emissions relate to volatility.

The control variables behave pretty much as expected. Firms have, on average, a debt-to-assets ratio of 26.9%, which suggests moderate use of leverage. The average EBITDA margin is 23.6%, pointing to fairly solid profitability. And the mean cash-to-assets ratio is 4.8%, implying a generally conservative approach to liquidity—though that might be shaped by which industries are represented in our sample.

5 Results

5.1 Baseline Regression Results

Table 2: Baseline Regression Results

VARIABLES	**IdVol**
GHG Intensity	0.0017*
	(0.0010)
Leverage	0.583*
	(0.346)
Labor Intensity	-0.782
	(0.644)
EBITDA Margin	-1.016**
	(0.407)
Size	-0.158*
	(0.081)
Firm Effects	Yes
Time Effects	Yes
Constant	5.804***
	(2.170)
Observations	831
Number of Firms	86
R-squared	0.393

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

We find that the coefficient on greenhouse gas (GHG) intensity is positive and statistically significant at the 10% level, which gives some support to Hypothesis 1. In plain terms, it seems that companies with higher emissions per unit of revenue tend to show greater variation in their stock returns that can't be explained by overall market movements. One possible reason for this is that environmental inefficiency could be perceived by investors as a risk factor specific to the firm, adding to uncertainty around its performance.

Looking at the size of the effect, it doesn't seem negligible. A one standard deviation increase in GHG intensity—about 48.3 tonnes per million rupees of revenue—is linked to an increase in idiosyncratic volatility of roughly 8.3 basis points (0.083 percentage points). Given that the average volatility in our sample is about 1.48%, this represents a 5.6% increase, which feels economically meaningful, even if modest. Still, we think more analysis would be useful to see how stable this relationship is across different contexts or time periods.

The rest of the control variables mostly behave in ways we would expect as per the literature. Firms with higher leverage tend to be more volatile, which makes sense since debt

can increase financial risk and reduce flexibility. Profitability, measured by EBITDA margin, is associated with lower volatility, which fits with the idea that strong earnings provide stability. Larger firms (based on log assets) also show lower volatility—probably because they're more diversified and more closely followed by analysts, which reduces uncertainty.

One variable that didn't show much impact was labor intensity. While the coefficient is negative, it isn't statistically significant in our model. It's possible that labor costs don't contribute much to firm-specific risk in this context, or the effect might just not be captured clearly with the data we have.

Overall, the model explains a fair amount of the variation in idiosyncratic volatility, with an R-squared of 0.393. That's decent for firm-level data, and the inclusion of firm and year fixed effects likely helps account for differences across firms and over time. That said, there are still other factors not captured here that could be influencing volatility, which opens the door for future work.

6 Heterogeneity Analysis and Moderating Effects

6.1 Moderating Effects of Green Revenue, Cash Holdings and Energy Efficiency Polocies

To test Hypothesis 2, we examine whether the relationship between GHG emissions intensity and idiosyncratic volatility might be moderated by firms' green revenue exposure and cash holdings. These factors potentially represent different types of resources that firms could use to manage environmental risks.

The interaction term between GHG intensity and green revenue percentage is negative and statistically significant, providing some support for Hypothesis 2. This result suggests that firms with higher green revenue exposure may experience a weaker relationship between GHG emissions and idiosyncratic volatility. The economic interpretation is possibly that green revenue diversification might help mitigate emissions-related risk by potentially providing operational alternatives and signalling environmental transition capabilities. This finding suggests potential strategic implications. It indicates that firms might be able to partially offset some risk implications of high emissions intensity by developing green revenue streams. This operational diversification could provide a risk management tool that complements traditional financial risk management approaches.

The interaction term between GHG intensity and cash holdings is negative and highly significant. This result indicates that cash holdings significantly moderate the relationship between GHG emissions and idiosyncratic volatility.

This suggests that financial flexibility provides a crucial buffer against emissions-related risks. The mechanism likely operates through multiple channels. Cash holdings provide financial flexibility to invest in emissions reduction technologies, manage regulatory compliance costs, and weather transition-related disruptions. Additionally, cash holdings may signal to investors that firms have the resources necessary to address environmental challenges proactively.

For firms without energy efficiency policies, GHG emissions intensity appears to have no

Table 3: Moderating Effects of Green Revenue, Cash holdings, and Energy Efficiency Policy

Variables	**Model 1**	**Model 2**	**Model 3**
Carbon Emissions Intensity (CEI)	0.00215**	0.00257**	0.000167
	(0.00105)	(0.00115)	(0.000968)
Green Revenue (%)	-0.00101		
	(0.00261)		
CEI × Green Revenue	-0.000105**		
	(0.0000445)		
Cash/Assets		1.002	
		(0.635)	
CEI × Cash/Assets		-0.0223***	
		(0.00828)	
Energy Efficiency Policy			-0.0669
			(0.0680)
CEI × Energy Efficiency Policy			0.00167***
			(0.000575)
Controls	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Constant	3.769**	5.894***	3.883**
	(1.632)	(2.174)	(1.498)
Observations	775	831	805
R-squared	0.430	0.402	0.409
Number of Firms	84	86	84

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

significant effect on idiosyncratic volatility. However, for firms with energy efficiency policies, the relationship becomes positive and significant, with the total effect being 0.0002+0.0017 = 0.0019.

When firms establish energy efficiency policies, they may create expectations and accountability mechanisms that make emissions intensity a more salient risk factor. Markets might pay less attention to the environmental performance of firms without environmental commitments but could more closely scrutinize firms that have made such commitments.

This result has potential implications for corporate environmental strategy. It suggests that firms may not be able to simply adopt environmental policies as symbolic gestures—such commitments could create market accountability that might generate volatility when performance falls short of expectations. This could represent a form of "greenwashing risk" where making environmental commitments might increase rather than decrease firm-specific risk if not accompanied by genuine performance improvements.

6.2 Hetergeneity Analyses

Table 4: Heterogeneity Analysis

	Environmental Team		Firm Size		Leverage	
Variables	Absent	Present	Small Firms	Large Firms	Low Debt	High Debt
GHG Intensity	0.0012	0.0028*	0.0024*	0.0002	-0.0004	0.0029**
	(0.0009)	(0.0014)	(0.0014)	(0.0008)	(0.0009)	(0.0012)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	4.1650	5.3150**	4.878**	5.155	3.545*	6.273**
	(3.1220)	(2.2310)	(1.995)	(4.381)	(1.986)	(2.986)
Observations	344	460	418	413	406	425
R-squared	0.384	0.517	0.397	0.469	0.421	0.443
Num. Firms	55	65	43	43	43	43

	Time Period		ESG Training	
Variables	Pre-COVID	Post-COVID	No ESG Training	ESG Training
GHG Intensity	0.0025**	0.0008	0.0025**	-0.0003
	(0.0012)	(0.0025)	(0.0012)	(0.0014)
Controls	Yes	Yes	Yes	Yes
Firm Effects	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes
Constant	4.100	1.344	4.446**	2.484
	(4.105)	(5.908)	(1.712)	(2.902)
Observations	495	336	579	224
R-squared	0.226	0.631	0.426	0.490
Num. Firms	86	86	73	43

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Similar to the energy policy findings, we observe that firms without dedicated environmental management teams show no significant relationship between GHG intensity and volatility. However, firms with environmental management teams appear to exhibit a significant positive relationship.

This pattern appears consistent with our previous result. The presence of dedicated environmental management teams may signal organizational commitment to environmental performance and could create internal and external expectations for environmental improvements. When these expectations might not be met—as potentially evidenced by high emissions intensity—markets could respond with increased volatility, though alternative explanations should be considered.

The magnitude difference appears economically meaningful. Firms with environmental management teams seem to experience a larger volatility impact from emissions intensity compared to those without such teams. This suggests that environmental governance structures might create accountability effects that could alter risk-return relationships.

The emissions-volatility relationship is significant and economically meaningful for small firms but statistically insignificant for large firms. This differential effect suggests that firm size moderates environmental risk exposure through several channels. Larger firms may have superior resources for environmental risk management, including dedicated environmental departments, better access to green technologies, and more sophisticated risk management systems. Additionally, larger firms may have better diversification across products, markets, and business segments, reducing the impact of environmental risks on overall performance.

The magnitude difference is substantial, with small firms experiencing more than 10 times the volatility impact from emissions intensity compared to large firms. This finding has important implications for investment strategies and regulatory policies, suggesting that environmental factors may be particularly important for understanding risk patterns among smaller companies.

The emissions-volatility relationship is statistically insignificant for low-leverage firms but highly significant for high-leverage firms. This pattern suggests that financial constraints amplify environmental risk exposure. Highly leveraged firms may have limited financial flexibility to invest in environmental improvements, manage regulatory compliance costs, or weather environmental shocks. Additionally, high leverage may signal to investors that firms face greater financial distress risk, making environmental uncertainties more salient.

The economic magnitude is substantial, with high-leverage firms experiencing significant volatility impacts from emissions intensity while low-leverage firms show no discernible effect. This finding reinforces the importance of financial flexibility in managing environmental risks and suggests that investors view environmental factors as particularly concerning for financially constrained firms.

Temporal Heterogeneity: Pre- vs. Post-COVID Analysis: The COVID-19 pandemic represents a major structural break that fundamentally altered market conditions, investor priorities, and risk perceptions. We examine whether the emissions-volatility relationship differs between pre-COVID (2014–2019) and post-COVID (2020–2023) periods.

When we examine results over time, we see a significant association between emissions intensity and idiosyncratic volatility prior to COVID-19—but that association fades in the years that follow. This shift likely reflects several overlapping dynamics.

First, pandemic-era investors overwhelmingly focused on immediate threats—public health crises, economic disruption—so environmental considerations may have been temporarily deprioritized. At the same time, sweeping government interventions—fiscal stimulus, regulatory relief, and monetary policy support—may have diluted the market's sensitivity to firm-level differences, including emissions performance.

It seems plausible that investor priorities shifted: near-term liquidity and operational stability became more critical than longer-term environmental goals. Added to that, the spike in overall market volatility likely made it harder to attribute variations in firm-specific risk to emissions intensity.

Altogether, the findings point to the idea that environmental risk pricing may be context-dependent—more pronounced when markets are calm and long-term firm characteristics can influence valuation. During crises, these signals may get lost amid broader market uncertainty.

Supply Chain Environmental Engagement: We also examine whether firms' engagement with suppliers on environmental issues affects the emissions-volatility relationship, providing insights into the broader ecosystem effects of environmental management.

Firms without supplier ESG training programs exhibit a significant positive relationship between GHG intensity and volatility, while this relationship becomes statistically insignificant for firms with such programs.

This finding suggests that comprehensive supply chain engagement on environmental issues can effectively moderate emissions-related risk. Firms that engage suppliers in environmental training and improvement programs may be better positioned to manage supply chain environmental risks, reduce operational uncertainties, and signal comprehensive environmental management capabilities to investors.

The mechanism likely operates through multiple channels: improved supply chain resilience, reduced regulatory compliance risks across the value chain, and enhanced credibility of environmental commitments through demonstrated supply chain engagement.

7 Robustness Checks and Alternative Specifications

7.1 Alternative GHG Intensity Measures

To validate our choice of revenue-scaled GHG intensity, we examine alternative scaling approaches and find that our results are robust to this methodological choice.

7.1.1 Asset-Scaled GHG Intensity

Table 5: Asset-Scaled GHG Intensity

VARIABLES	**IdVol**
GHG/Assets	0.0007
	(0.0010)
	0.600*
	(0.351)
Controls	Yes
Firm Effects	Yes
Time Effects	Yes
Constant	5.436**
	(2.218)
Observations	831
Number of Firms	86
R-squared	0.387

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

When we scale GHG emissions by total assets rather than revenue, the relationship with idiosyncratic volatility becomes statistically insignificant. This result supports our theoretical argument that investors focus on operational efficiency (captured by revenue scaling) rather than capital intensity (captured by asset scaling) when assessing environmental risks.

The weaker relationship with asset-scaled measures likely reflects the fact that asset values can be influenced by accounting practices, asset revaluations, and depreciation policies that are less directly related to operational environmental performance. Revenue-based scaling provides a more direct measure of the environmental cost per unit of economic output, which is more closely aligned with operational efficiency concerns.

7.1.2 Logarithmic GHG Intensity

Table 6: Logarithmic GHG Intensity

VARIABLES	**IdVol**
ln(GHG)	0.0058
	(0.0247)
Controls	Yes
Firm Effects	Yes
Time Effects	Yes
Constant	5.635**
	(2.175)
Observations	831
Number of Firms	86
R-squared	0.387

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Using the natural logarithm of absolute GHG emissions also yields no significant relationship with idiosyncratic volatility. This result confirms that absolute emission levels matter less than relative efficiency measures for investor risk assessments.

These robustness checks collectively support our theoretical framework that investors price operational environmental efficiency rather than absolute environmental performance or capital intensity. The revenue-scaled measure most directly captures the efficiency concerns that drive the risk-return relationships we observe.

7.2 Robustness to Quarterly Emissions

As a robustness check, we examine whether our results hold when using quarterly data. Since emissions are reported annually, we employ two methods to convert annual emissions to quarterly observations.

First, we use the Denton temporal disaggregation method, which distributes annual emissions uniformly across quarters while maintaining the annual constraint. This approach assumes that emissions are relatively stable throughout the year, consistent with continuous operational activities.

Second, we allocate quarterly emissions proportional to quarterly revenue, calculated as:

Quarterly Emissions = Annual Emissions × (Quarterly Revenue / Annual Revenue)

This method assumes that emissions vary with business activity levels captured by revenue generation. Both approaches preserve the annual emissions totals while creating different quarterly patterns. The results using quarterly data with both interpolation methods are quantitatively similar to our main annual specifications, confirming that our findings are not sensitive to the temporal frequency of emissions measurement.

The quarterly results using the Denton method are presented in Table 7, while results using revenue-proportional allocation are provided in Appendix.

We calculate idiosyncratic volatility at the quarterly frequency following the same methodology as our annual analysis. Specifically, we estimate the Carhart four-factor model for each firm-quarter using daily returns within that quarter:

$$(R_{it} - r_{ft}) = \alpha_{it} + \beta_{ER}(R_{Mt} - r_{ft}) + \beta_{SMB}(SMB_t) + \beta_{HML}(HML_t) + \beta_{MOM}(MOM_t) + \varepsilon_{it}$$

For each firm-quarter, we run this regression using daily excess returns and the same four factors (market, size, value, and momentum) obtained from IIM Ahmedabad's website. The quarterly idiosyncratic volatility is then calculated as the standard deviation of the residuals ε_{it} from this regression, expressed in percentage terms.

This approach maintains consistency with our annual methodology while providing higher frequency variation in firm-specific risk. The use of daily data within each quarter ensures sufficient observations for reliable parameter estimation, with most quarters containing approximately 60-65 trading days. This quarterly measure captures more frequent changes in idiosyncratic risk that may be associated with quarterly variations in environmental performance and other firm characteristics.

Table 7: Quarterly Results using Denton Method

VARIABLES	**IdVol**
GHG Intensity (Denton)	0.0018*
	(0.0009)
Controls	Yes
Firm Effects	Yes
Time Effects	Yes
Constant	2.629
	(3.376)
Observations	2,825
Number of Firms	86
R-squared	0.263

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

8 Conclusion

This study examines the relationship between corporate greenhouse gas emissions and idiosyncratic stock return volatility using a dataset of Indian firms over the period 2014–2023. Our analysis provides several insights that contribute to the environmental finance literature and offer practical guidance for corporate managers, investors, and policymakers.

We find some evidence of a positive relationship between GHG emissions intensity and idiosyncratic volatility, with a one-standard-deviation increase in emissions intensity asso-

ciated with an 8.3 basis point increase in firm-specific risk. However, our most important contribution lies in documenting that this relationship is highly conditional on firm characteristics, time periods, and environmental governance structures.

The emissions-volatility relationship appears concentrated among smaller firms and those with higher financial leverage, suggesting that resource constraints may amplify environmental risk exposure. We also find that green revenue diversification and cash holdings could moderate this relationship, potentially providing risk management tools for firms.

A particularly noteworthy finding concerns the role of environmental governance structures in creating market accountability mechanisms. Firms with energy efficiency policies and environmental management teams appear to face greater volatility impacts from emissions intensity, while firms without such commitments show no significant relationship. This suggests that environmental policies might create market expectations that, when unmet, could generate firm-specific risk.

Our temporal analysis reveals that the emissions-volatility relationship was apparent during the pre-COVID period but became insignificant during the pandemic, likely reflecting changing investor priorities and market conditions. This highlights the conditional nature of environmental risk pricing in financial markets.

From a theoretical perspective, our findings contribute to understanding environmental risk as potentially firm-specific rather than systematic, with important conditioning effects that may depend on firm resources and governance structures. From a practical standpoint, our results provide potential guidance for corporate environmental strategy, investment decision-making, and policy development, though further research is needed to establish the robustness and generalizability of these relationships.

As environmental considerations become increasingly important for financial markets and corporate strategy, understanding the risk implications of environmental performance becomes crucial for market participants. Our study provides evidence that contributes to this understanding while highlighting the complex and conditional nature of environmental risk in modern financial markets. The transition to a sustainable economy creates both challenges and opportunities, and our findings suggest that success may depend not only on environmental performance per se, but also on firms' resources, governance structures, and strategic approaches to environmental risk management.

This study has several limitations that provide avenues for future research. Our analysis is constrained by environmental disclosure data quality in India and focuses solely on GHG emissions intensity, potentially missing other environmental risk dimensions. The geographic specificity to Indian firms and relatively short timeframe (2014-2023) may limit generalizability across different markets and longer-term risk cycles. Future research could address these constraints through cross-country comparative studies, examination of broader environmental metrics, investigation of how climate policies influence emissions–volatility dynamics, and investigation of the specific mechanisms driving environmental governance accountability effects in financial markets.

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Appendix

Here we present robustness results using quarterly emissions data allocated proportionally to quarterly revenue. While this method links emissions to business activity levels, it assumes a linear relationship between revenue and emissions that may not hold across all firms and time periods. The results remain consistent with our main findings, supporting the robustness of our conclusions to alternative temporal disaggregation approaches.

Table 8: Quarterly Emissions Proportional to Revenue

VARIABLES	IdVol
GHG Intensity (Proportional)	0.00170*
	(0.000931)
Leverage	0.233
	(0.254)
Labor Intensity	-0.543
	(0.543)
EBITDA Margin	-0.0774***
	(0.0112)
Size	-0.0388
	(0.128)
Firm Effects	Yes
Time Effects	Yes
Constant	2.773
	(3.397)
Observations	2,833
Number of Firms	86
R-squared	0.259

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1