

# Are carbon emissions priced during corporate restructuring announcements?

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## Abstract

We investigate the impact of carbon emissions on the market reaction to announcements of corporate restructuring activities. Using a sample of US firms, we find that investors discount the value of corporate restructuring announcements when firms have higher levels of carbon emissions. Our results indicate that emissions are negatively associated with both Cumulative Abnormal Returns (CAR) and Cumulative Total Returns (CTR) around announcements. This effect is more pronounced for firms with higher risk of bankruptcy, lower financial constraints and lower growth opportunities. Overall, our results highlight the growing implications of firm-level carbon emissions for corporate market valuations.

**Keywords:** Carbon emissions, Corporate restructuring, Market reaction, ESG

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# 1 Introduction

Firms engage in corporate restructuring to enhance productivity, reduce cost and enhance performance (Singh, 1993). Strategies that may be employed include downsizing, upsizing, or alternating the complementary feature of assets, employees and technology (Cascio, 2021). It may also take the form of portfolio reconfiguration through the sale of some business lines or changes in organisational structure through the disposal or acquisition of assets (Bowman and Singh, 1993). Similar to acquisitions and divestment, corporate restructuring may occur as a result of corporate performance, economic cycles, civil unrest, managerial optimism, and disruptive technology in an industry (Cascio, 2021). Theoretically, corporations may also restructure to realign strategically with changing times (Eckbo and Thorburn, 2008). Ultimately, the goal of restructuring is to increase the likelihood of future profitability (Singh, 1993; Eckbo and Thorburn, 2008; Cascio, 2021).

Despite the potential operational, financial and economic benefits that it brings, corporate restructuring may also have unintended consequences (Brockner et al., 1993; Reilly et al., 1993). One area of concern relates to the potential implications corporate restructuring may have for firms' sustainability. All over the world, governments and other stakeholders are beginning to require more action from companies in terms of their contributory efforts to reducing climate change. In the United States for example, the Wall Street Journal has recently reported that the US Governments, through the Securities and Exchanges Commission (SEC), is proposing more stringent requirements for publicly traded companies to report on greenhouse emissions and potential risks to climate.<sup>1</sup>

In spite of the growing prominence of the need for firms to take action to help reduce climate change, it remains unclear whether a firm's level of contribution to climate change is factored into the pricing of its securities during times of corporate restructuring. This is due to two competing views. On the one hand, firms that emit more greenhouse gases are

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<sup>1</sup><https://www.wsj.com/articles/sec-to-float-mandatory-disclosure-of-climate-change-risks-emissions-11647874814>

likely to have stock returns discounted by the market during announcements of corporate restructuring activities, leading to a negative effect of emissions on returns around corporate restructuring announcements. On the other hand, corporate restructuring activities may be the outcome of pressure from investors, with the view to increasing productivity and value-creation ([Morin, 2000](#); [Desender et al., 2016](#)). Hence, firm emissions are likely not to have an impact on stock returns during corporate restructuring announcements.

Thus, whether or not firms level of emissions affect the wealth effects of corporate restructuring announcements remains an open empirical question. In this paper, we address this question by using a sample of US firms to investigate how emissions affect returns during corporate restructuring announcements. We focus on short-term returns using Cumulative Abnormal Returns (CAR) and Cumulative Total Returns (CTR) during an 11 day window around announcements of corporate restructuring activities. We find that firms with higher amounts of emissions experience a decrease in both CAR and CTR. This supports the view that markets discount the value of corporate restructuring announcements in firms with higher levels of carbon emissions. In sub-sample analysis, we find this effect to be prominent for firms with high risk of bankruptcy, financially unconstrained firms and firms with low growth opportunities. In further analysis, we also demonstrate that the information content inferred from firm carbon emissions is distinct from firms' environmental score.

Our paper contributes to the literature on how carbon emissions affect firm value by focusing on corporate restructuring which is a specific approach by which firms may aim to increase their value. Prior studies document a negative impact of carbon emissions on firm market value ([Chapple et al., 2013](#); [Matsumura et al., 2014](#); [Clarkson et al., 2015](#); [Griffin et al., 2017](#); [Choi and Luo, 2021](#)). We extend this literature by showing that carbon emissions also negatively affect the market reaction to firms' intention to restructure and reorganise. Our findings also complement the limited literature on firm corporate performance and firm carbon performance ([Lewandowski, 2017](#)). We demonstrate that it pays to be green when announcing a corporate restructuring activity. We also complement the embryonic argument

on carbon premium ([Oestreich and Tsiakas, 2015](#); [Azar et al., 2021](#)), which states that the stock prices of clean corporations benefit during value relevant corporate events.

The rest of the paper is organised as follows. We review prior literature and develop our hypotheses in Section 2. In Section 3, we discuss our research design. We present our main results in Section 4 and conduct additional analyses and robustness checks in Section 5. Section 6 concludes.

## 2 Hypotheses development

Corporate restructuring announcements carry some information content and affect stock returns, and by extension, shareholder wealth. Since the purpose of corporate restructuring is primarily to enhance productivity, reduce cost and enhance efficiency, it mostly should lead to positive reaction from investors. Hence, although restructuring activities like asset write downs and closing plants could be charged against a firm’s earnings, there will still be a positive reaction if the relevant charge against the firms earnings is lower than the present value of expected future cash flows from the process ([Poon et al., 2001](#)). Indeed, several prior studies document a positive market reaction to corporate restructuring announcements ([Brickley and Van Drunen, 1990](#); [Francis et al., 1996](#); [Bunsis, 1997](#)). A few studies, however, also find a negative reaction to restructuring announcements [Poon et al. \(2001\)](#). Thus, investors react to corporate restructuring announcements based on the their expectations of how such restructuring activity might lead to improvements in firms’ future performance ([Jaggi et al., 2009](#)).

Over the last decade, interest in climate change risk has led to a growing body of research that investigates its potential firm-level implications. These studies have focused on the impact of firms’ exposure to climate change risk (using a variety of measures) on capital structure ([Nguyen and Phan, 2020](#); [Adasi Manu et al., 2022](#)), dividend policy ([Balachandran and Nguyen, 2018](#)), bond returns ([Huynh and Xia, 2021](#)) and cost of debt ([Javadi and](#)

Masum, 2021). An aspect of this literature most relevant to our study focuses on the implications of carbon risk on firm returns and market value (Chapple et al., 2013; Matsumura et al., 2014; Garcia-Blandon et al., 2020; Choi and Luo, 2021; Basse Mama and Mandaroux, 2022). For example, Matsumura et al. (2014) use a sample of SP 500 firms that voluntarily disclosed carbon emissions data between 2006 and 2008 and find that an additional thousand tons of carbon emissions is associated with a decrease in market value by about \$212,000. Basse Mama and Mandaroux (2022) examine a sample of US firms and find a concave relationship between firms' emissions and market valuations. At lower levels, emissions appear to have a positive impact on market valuations since they may be considered as essential for the production process. Above a threshold, emissions have a negative impact on valuations especially in light of both regulatory and transition risk.

The above arguments may point to some contrasting findings in the literature. We rely on this literature to infer that the relationship between firms' carbon emissions and the market valuation of their restructuring may be unclear. On the one hand, given the regulatory, climate and transition risk associated with increased carbon issues and the growing call to action by policy makers and some institutional investors, corporate restructuring, however well intended, may be associated with lower returns at announcement if carbon emissions of the firms involved are high. On the other hand, and as mentioned earlier, corporate restructuring are intended to achieve cost reductions, revenue enhancements and improved efficiency. As such, when restructuring announcements are made in line with market expectations, it is possible that that carbon emissions will have no impact on excess firm returns around such announcements, especially as it is considered as a non-financial metric. We state our first hypothesis in alternative form as we expect that markets will discount the value of corporate restructuring announcements when firms have higher levels of carbon emissions.

**Hypothesis 1:** *Higher firm carbon emissions are associated with negative returns around corporate restructuring announcements.*

Firms may escape the adverse consequences of carbon emissions and poor environmental

practice by filing for bankruptcy (Boomhower, 2019). Because bankruptcy may absolve corporations from wrong doings, insolvent actors could pursue high risk policies that are hazardous to public health and environmental safety. As a result, such category of firms may emit higher levels of carbon than their comparable peers. Put together, firms' carbon emissions may vary in their impact on returns around corporate restructuring announcements based on the level of bankruptcy risk associated with the firm.

**Hypothesis 2:** *The negative impact of carbon emissions on returns around corporate restructuring announcements is more pronounced for firms with higher risk of bankruptcy.*

Firm growth opportunities constitute a portion of firm value that reflects the value of future projects (Miller and Modigliani, 1961). Several previous studies find that firm growth opportunities affect financing decisions (Gaver and Gaver, 1993; Goyal et al., 2002; Johnson, 2003; Billett et al., 2007). More importantly, some other studies document an impact of growth opportunities on the market reaction to corporate financing and investment decisions (Goergen and Renneboog, 2004; Burton et al., 2000). It is therefore possible that the impact of firm-level emissions on the market valuation of restructuring announcements may vary amongst firms with different levels of growth opportunities. Since restructuring also allows firms to maximise their full potential for growth, it can be expected that the cost-benefit pendulum may tilt in favour of the pursuit of growth. This would imply an insignificant impact of carbon emissions on the market reaction to corporate restructuring announcements for firms with higher growth opportunities. However, for firms with lower growth opportunities, increased carbon emissions may negatively affect returns around corporate restructuring announcements. This leads us to our third hypothesis, which focuses on firm growth opportunities.

**Hypothesis 3:** *The negative impact of carbon emissions on returns around corporate restructuring announcements is more pronounced for firms with low growth opportunities*

Decreasing carbon emissions can increase cost to firms because of the investments required

to adopt more climate friendly technologies. [Nguyen and Phan \(2020\)](#) argue that reducing carbon emissions can be particularly challenging for some firms, especially in periods of economic downturns. They find that following the adoption of the Kyoto protocol, which increased climate risk for firms in the Australia, firms use of leverage falls. Their findings are consistent with the view that increases in carbon emissions may reduce firms' access to capital markets as a result of an increase in cost of debt ([Javadi and Masum, 2021](#); [Lemma et al., 2021](#)). To that extent, we expect no significant effect of carbon emissions on returns around corporate restructuring announcements for firms with higher financial constraints. This is because, by virtue of their higher contribution and exposure to carbon risk, financially constrained firms are unable to access funds to make the needed corrective investments. However, for firms that are financially unconstrained and with more access to capital markets, we expect the negative effect of carbon emissions on their restructuring announcements to be more pronounced.

**Hypothesis 4:** *The negative impact of carbon emissions on returns around corporate restructuring announcements is more pronounced for firms that are not financially constrained.*

## 3 Research design

### 3.1 Data and sample

To test our hypotheses, we collect data on corporate restructuring announcements for US firms from Capital IQ in the Wharton Research Data Service (WRDS) database between 2010 and 2020. We then collect firm level financial data from Compustat. We obtain data on firm carbon emissions from Refinitiv Eikon. Merging all three datasets yields a total of 489 corporate restructuring announcements by 207 firms.

## 3.2 Variables

### 3.2.1 Market valuation of corporate restructuring announcements measures

We estimate the market valuation of corporate restructuring announcements using Cumulative Abnormal Returns (CAR) and Cumulative Total Returns (CTR). We employ an event study methodology to compute both CAR and CTR. For CAR, we adopt the market model to first determine the abnormal return for each day of an 11-day window (-5,+5) around the announcement. The abnormal returns is defined in the following equation:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i RM_t) \quad (1)$$

Where  $AR_{it}$  refers to the abnormal returns of firm  $i$  on a day  $t$ .  $R_{it}$  is defined as the actual return of firm  $i$  on day  $t$ .  $RM_t$  is the return on the S&P 500 index on day  $t$ .  $\beta_i$  is the estimated coefficient of the relationship between a firm's returns and the returns on the S&P 500 index during a 100 trading day period prior to the start of the event window. We then calculate the CAR for each firm for the period [-5, +5] around the announcement as follows:

$$CAR = \sum_{t=-5}^{t+5} (AR_{it}) \quad (2)$$

We compute the CTR by summing up the returns for each firm during the event window [-5, +5]:

$$CTR = \sum_{t=-5}^{t+5} (R_{it}) \quad (3)$$

### 3.2.2 Carbon emissions

We measure carbon emissions as the ratio of firms' carbon emissions in tonnes to firm total assets ([Safiullah et al., 2021](#); [Garel and Petit-Romec, 2022](#)). We scale by total assets to



reflect the carbon emissions of firms relative to their size.

### 3.2.3 Control variables

We control for a number of firm-level variables. Specifically, we include Leverage, which we measure as the ratio of total debt to total assets. We also control for firm size (Size), which we measure as the natural logarithm of total assets. We include cash holdings (Cash Holdings), computed as the ratio of cash to total assets. We further control for profitability (ROA) which is computed as Earnings before Interest, Tax, Depreciation, and Amortization (EBITDA) divided by total assets. Finally we control for Tobins Q (Q), measured as the market value of equity plus debt, divided by total assets.

### 3.2.4 Model specification

To test the impact of carbon emissions on the market valuation of corporate restructuring announcements, we estimate the following multivariate regression model by Ordinary Least Squares (OLS):

$$Y_{i,t} = \alpha + \beta EmissionsLevel_{it} + \gamma' X_{it} + \delta' YearDummy_t + v' IndustryDummy_j + \varepsilon \quad (4)$$

Where Emissions Level is a firm's carbon emission at announcement scaled by total asset.  $X_{it}$  is a vector of firm level characteristics that affect market valuation of announcements. We include Leverage, Size, Cash Holdings, ROA, and Q ratio.  $\delta$  and  $v$  represent year and industry dummies respectively.

## 3.3 Summary statistics

Table 1 reports the summary statistics of the variables used in this study. On average, firms generate CARs of 0.5% during corporate restructuring announcements. The average CTR generated over the period [-5 to +5] is 1%. This implies that there are positive wealth effects

attributable to corporate restructuring announcements.

**Insert Table 1 here**

The average CAR value reported in this study is similar to those reported in other announcement studies (Zhou et al., 2020; Dandapani et al., 2020; Tunyi, 2021). The average firm in our sample emits 6million tonnes of carbon. However, Figure 1 indicates that the mean firm carbon emission has been on a decline since 2005. This suggests that corporate behaviour towards the environment may be improving. This may be a motivation to discount the value of firms with higher than average levels of carbon emissions.

**Insert Figure 1 here**

## 4 Empirical results

### 4.1 Carbon emissions and market valuation of corporate restructuring announcements

Table 2 reports the results of the regression analysis that evaluates the relationship between carbon emissions and the market valuation of corporate restructuring announcements. In all columns we include both industry and year dummies. Columns 1 & 3 report the results for CAR and CTR respectively, where we use a parsimonious model, without the control variables. We observe negative and statistically significant coefficients of our predictor variable. Columns 2 & 4 report the result with the introduction of relevant control variables. Coefficient estimates of our predictor variable continue to remain negative and statistically significant. The introduction of the control variables also appears to magnify the impact of carbon emission on market valuation of corporate restructuring announcements. The results across all four columns confirm the view that carbon emissions negatively affect firm value

(Griffin et al., 2017; Choi and Luo, 2021). Thus, corporations with higher carbon emissions at announcements of restructuring activities see their market value discounted. A potential explanation of our finding is that the market discounts a firm’s future cash flows based on the level of its carbon emission. The discount in share prices may be due to the inherent risk of firms’ environmental practices. The results contradict the view that firms with high carbon emissions earn higher returns than comparable firms with low carbon emissions (Bolton and Kacperczyk, 2021). Our results also show that the risks associated with high emissions is priced negatively. Some of the risks inherent in high emissions level include reputational damage, litigation, asset fire sales, and regulatory compliance risk (Matsumura et al., 2014; Nikolaou et al., 2015; Jung et al., 2018; Herbohn et al., 2019).

Insert Table 2 here

## 4.2 Carbon emissions, bankruptcy risk and market valuation of corporate restructuring

Market responses to corporate restructuring announcements may also be sensitive to firms’ likelihood of bankruptcy. (Dellisanti and Wagner, 2018; Javadi and Masum, 2021). Corporations may evade the adverse consequences of their environmental practice through bankruptcy (Boomhower, 2019). To this effect, we examine whether the market values corporate restructuring announcements differently based on firms’ risk of bankruptcy. To explore the link between bankruptcy risk and market valuation of corporate announcements, we calculate the Z score for each firm following Altman (1968). We compute Z score as:

$$Z = 1.2\beta_1 + 1.4\beta_2 + 3.3\beta_3 + 0.6\beta_4 + 0.999\beta_5 \quad (5)$$

where  $\beta_1$  is working capital divided by total assets.  $\beta_2$  is retained earnings deflated by total assets.  $\beta_3$  is earnings before interest and taxes deflated by total assets.  $\beta_4$  refers to the market

value of equity deflated by total assets.  $\beta_5$  is annual sales deflated by total assets.

We categorise firms with Z scores below or equal to 1.81 as having a high likelihood of bankruptcy and those with greater than 1.81 as having a low likelihood of bankruptcy. We then re estimate out baseline regressions with control variables for each sub-sample.

We present the results in Table 3. The results suggest that the negative impact of carbon emission on market valuation of corporate restructuring is only present in firms with high risk of bankruptcy. We interpret this result to mean that carbon emissions exacerbate bankruptcy risk. The market prices carbon emission levels negatively for firms with higher likelihood of bankruptcy because the inherent risk associated with bad environmental practice increases the cost of equity. Furthermore, since firms with higher bankruptcy risk can circumvent the negative impact of poor environmental practices by filing for bankruptcy, such firms are penalised more than others by the market.

**Insert Table 3 here**

### **4.3 Growth opportunities, carbon emission, and market valuation of corporate restructuring**

In Table 4, we evaluate how the market’s perception of carbon emissions during corporate restructuring announcements varies between firms with high and low growth opportunities. To calculate a firm’s future growth opportunity, we follow Lang et al. (1996) and calculate the ratio of capital expenditures, net of depreciation, to total assets. Firms with values above the sample median are regarded as having high growth opportunities whilst those below the median are considered as those with low growth opportunities.

**Insert Table 4 here**

The results indicate that the market’s valuation of firms’ carbon emission levels during

corporate restructuring announcements is negative among firms with low growth opportunities. This implies that firms with low growth opportunities experience lower returns because they do not have as many growth options to exercise which may mitigate the environmental risk inherent in their carbon emissions level. However, the relationship between carbon emission and market valuation of corporate restructuring for firms with high growth opportunities is insignificant. This is worrying and indicates that there are no discounts to firm value for high growth firms with high emission levels. Empirical evidence suggests that carbon emission reduction can improve corporate innovation (Huang and Yang, 2021). Therefore, investors and market participants may be passing up an opportunity to encourage corporate innovation.

#### 4.4 Financial constraints, carbon emission, and market valuation of corporate restructuring

Next, we examine the effect of carbon emissions on market valuation of restructuring announcements based on firms' level of financial constraints. Financially constrained firms may struggle to generate finance to drive investment in carbon efficient infrastructures and services (Lemma et al., 2021). To measure financial constraints, we calculate the modified KZ index as specified by Baker et al. (2003). The KZ index is specified using the following equation:

$$KZIndex = -1.002 * CashFlow - 39.368 * Dividends - 1.315 * Cash + 3.139 * Leverage \quad (6)$$

Where Cash Flow refers to earnings before interest, tax, depreciation and amortization (EBITDA). Dividend is the cash equivalent of profit distributed to shareholders. Cash is a firm's cash holdings in a year. Leverage refers to total liabilities. All variables are scaled by total assets.

We then split firms into financially constrained and financially unconstrained sub-samples

based on the whether their KZ index lies above or below the sample median. Following this, we re-estimate our baseline regressions for each sub-sample and present the results in Table 5. The results suggest that the market negatively perceives carbon emissions for the set of financially unconstrained firms when valuing corporate restructuring announcements. This is because financially unconstrained firms can easily access capital for investment in green technology (Javadi and Masum, 2021). Such firms are penalised for passing up the opportunity of drawing on available finances for investment in assets that reduce their carbon footprint. For financially constrained firms, the impact of carbon emission on market valuation of corporate restructuring announcement is insignificant. The market recognises that this category of firms do not have access to finances that will drive investment in green technologies. In general, these findings complement the view that financial constraints limit the extent to which firms can engage with their environmental performance (Guérin and Suntheim, 2021). In untabulated results, we also employ an alternative measure of financial constraints based on Almeida and Campello (2007). We find consistent results with those reported in Table 5.

**Insert Table 5 here**

## **5 Additional analyses and robustness checks**

In this section we conduct additional analyses and also carry out some robustness checks.

### **5.1 Environmental score and market valuation of corporate restructuring**

Similar to previous studies that evaluate corporate environmental practice through the lenses of Rifinitiv scores (Albuquerque et al., 2020; Gangi et al., 2022), we examine if the signals inferred from firms’ carbon emission levels are distinct from third party corporate environ-

mental scores like the Rifinitiv environmental score. We present these results in Table 6. The results indicate that the information deduced from a firm’s carbon emission level is unique and cannot be inferred from the Rifinitiv corporate environmental score. This is particularly insightful because a number of investment managers rely on these third-party ratings for information on a firms’ environmental practices. The results suggest that such measures may not be all-encompassing.

**Insert Table 6 here**

## 5.2 Using Buy-Hold Abnormal Returns (BHAR)

We employ an alternative dependent variable using BHAR. This allows us to capture the magnitude of the returns through the lenses of an investment strategy. The BHAR approach evaluates the difference between firms with corporate restructuring announcements and matched portfolios based on similar characteristics (Kothari and Warner, 2007). We compute BHAR as:

$$BHAR = \prod_{t=1}^T (1 + R_{it}) - \prod_{t=1}^T (1 + E(R_{it})) \quad (7)$$

We then re-estimate our baseline model and present the results in Table 7. Similar to the results in Table 2, we find that the coefficient estimates of our predictor variable are negative and statistically significant. Thus, our findings are not necessarily driven by the choice of our measure of the market reaction.

**Insert Table 7 here**

## 5.3 Using log of emissions

Finally, because our measure of carbon emissions may be subject to measurement error, we specify our model using the natural log of a firm’s carbon emissions level. Despite the

additional approach, our results are unchanged. The market perception of carbon emission levels is negative during corporate restructuring announcements. Using the three return-generating models, we find a consistent relationship between carbon emissions and market valuation of corporate restructuring announcements.

**Insert Table 8 here**

## 6 Conclusion

In this study, we evaluate the market’s perception of firms’ carbon emission levels during corporate restructuring announcements. The results suggest that the market views high carbon emission levels negatively during corporate restructuring announcements. We find that this effect is more pronounced among firms with high likelihood of bankruptcy, financially unconstrained and low growth opportunities.

For firms with high risk of bankruptcy, the market prices high carbon emissions level negatively because such firms can circumvent the penalties of poor environmental practices by filing for bankruptcy ([Boomhower, 2019](#)). For financially unconstrained firms, the market reacts negatively to their carbon emissions level because they have the capacity to access finances for funding green investments from the capital market ([Javadi and Masum, 2021](#); [Lemma et al., 2021](#)). The results also reveal that the relationship between carbon emissions and market valuation of corporate restructuring announcement is negative for the set of firms with low growth opportunities and insignificant for firms with high growth opportunities. One explanation for the negative relationship is that firms with fewer growth opportunities have lesser chances of reducing the implied environmental risk they possess due to their carbon emissions level. The insignificant relationship between carbon emissions and market valuation of corporate restructuring announcement implies the market is passing up an opportunity to pressure the innovative capacity of such firms as regards their environmental



practice ([Huang and Yang, 2021](#)).

The signals inferred from a firm's carbon emissions level is different from aggregate corporate environmental measures. The results from this study joins the call by government, academics and wider society requiring firms to pay attention to their environmental practices. In particular, the findings indicate that corporate behaviour towards the environment is an important factor when valuing a firm relative to its corporate activities. In addition, the value relevance of this practice differs with firm characteristics such as bankruptcy likelihood, financial constraints, and growth opportunities.

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**Table 1: Summary statistics**

This table presents summary statistics of the variables used in the study. All variables are defined in [Appendix A](#).

	N	Mean	SD	Min	P25	P75	Max
Cumulative Abnormal Return	489	0.005	0.069	-0.623	-0.026	0.033	0.317
Cumulative Total Return	489	0.010	0.071	-0.578	-0.026	0.045	0.353
Emissions Level	489	3.273	2.051	-3.668	2.420	4.423	8.013
Emissions in Tonnes	489	6m	16m	1k	313k	3m	13m
Log Emissions	489	13.896	1.950	7.222	12.654	15.184	18.750
Environmental Score	90	51.116	21.685	8.065	37.698	67.104	87.088
Leverage	436	0.242	0.144	0.000	0.139	0.346	0.694
Size	489	10.623	1.761	6.235	9.189	11.803	14.780
Cash Holdings	477	0.078	0.065	0.000	0.029	0.104	0.362
ROA	472	0.122	0.091	-1.163	0.080	0.163	0.342
Q	421	1.391	0.851	0.046	0.861	1.686	6.971

6



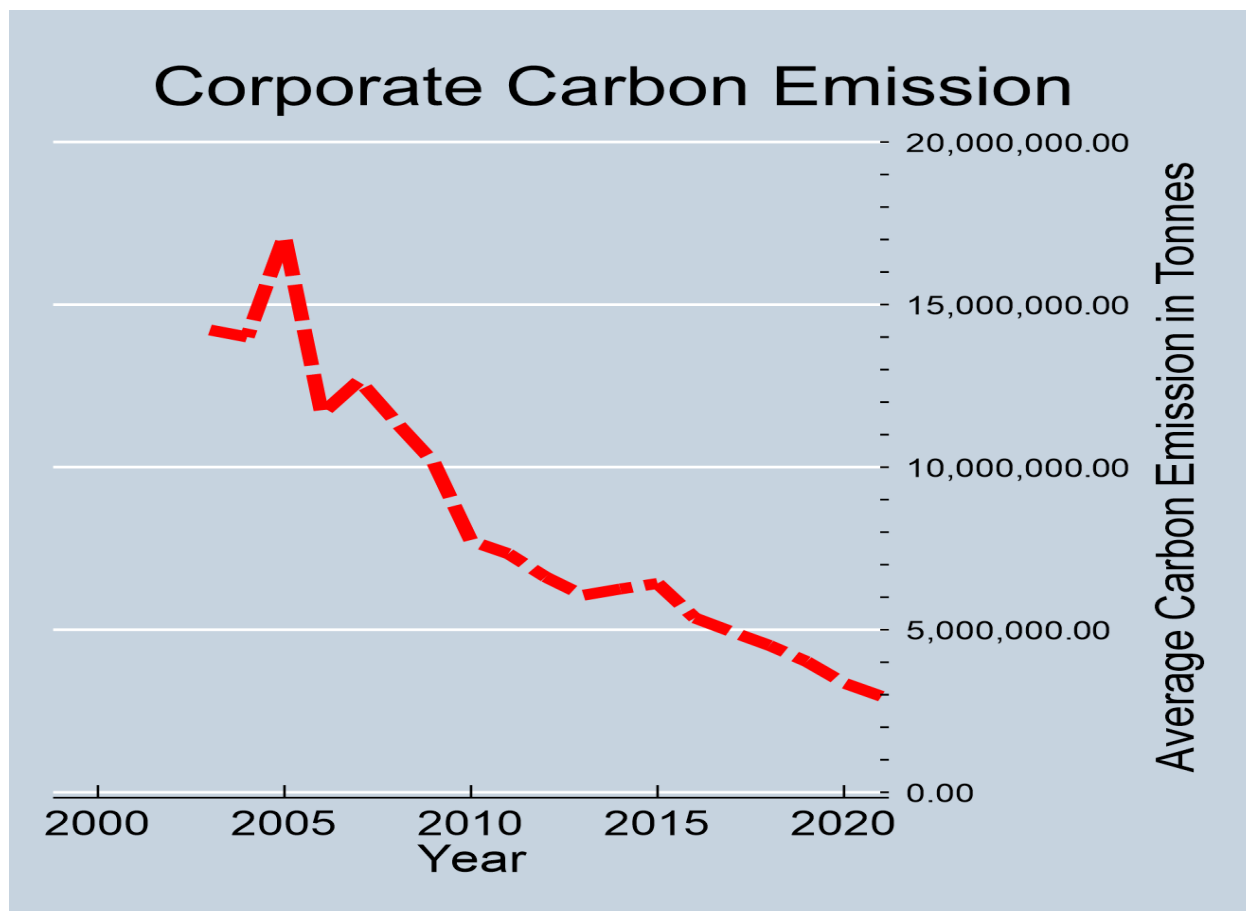


Figure 1: *The figure reports the average carbon emission by firms in the S&P 1500 from the period 2000 to 2021.*

**Table 2: Emissions and market valuation of restructuring announcements**

This table presents the regression results of the relationship between carbon emissions and market valuation of corporate restructuring announcements. The dependent variables are CAR, the 11-day (-5,+5) market model Cumulative Abnormal Return and CTR the 11-day (-5,+5) Cumulative Total Return around the restructuring announcement. Emissions Level is the amount of firms' emissions in tones divided by total assets. Leverage is total debt divided by total assets. Size is the natural log of total assets. Cash Holdings is the ratio of cash to total assets. ROA is Earnings before Interest, Tax, Depreciation, and Amortization (EBITDA) divided by total assets. Q is the market value of equity plus total debt divided by total assets. T statistics are reported in parentheses. \*\*\*, \*\*, \* indicate statistical significance at 1%, 5%, and 10% levels respectively.

Variables	CAR		CTR	
	(1)	(2)	(3)	(4)
Emissions Level	-0.010** (-2.06)	-0.016** (-1.99)	-0.013*** (-2.65)	-0.018*** (-3.14)
Leverage		-0.001 (-0.03)		0.017 (0.44)
Size		-0.012* (-1.75)		-0.010* (-1.82)
Cash Holdings		0.001 (0.01)		0.091 (1.03)
ROA		0.021 (0.72)		0.060 (1.25)
Q		-0.002 (-0.20)		0.007 (0.87)
Constant	0.087 (1.37)	0.245** (2.52)	0.088 (1.30)	0.202* (1.95)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	489	410	489	410
Adjusted $R^2$	0.330	0.340	0.273	0.252

**Table 3: Bankruptcy risk, emissions and market valuation of corporate restructuring**

This table presents regression results of the impact of carbon emissions level on market reaction to corporate restructuring announcements based on a firm's likelihood of bankruptcy. The dependent variables are CAR, the 11-day (-5,+5) market model Cumulative Abnormal Return and CTR the 11-day (-5,+5) Cumulative Total Return around the restructuring announcement. Emissions Level is the amount of firms' emissions in tones divided by total assets. Leverage is total debt divided by total assets. Size is the natural log of total assets. Cash Holdings is the ratio of cash to total assets. ROA is Earnings before Interest, Tax, Depreciation, and Amortization(EBITDA) divided by total assets. Q is the market value of equity plus total debt divided by total assets. T statistics are reported in parentheses. \*\*\*, \*\* and \* indicate statistical significance at 1%, 5%, and 10% levels respectively.

Variables	CAR		CTR	
	High Risk	Low Risk	High Risk	Low Risk
Emissions Level	-0.017*** (-2.95)	0.058 (0.63)	-0.022*** (-3.56)	0.055 (0.52)
Leverage	0.013 (0.29)	0.221 (0.73)	0.022 (0.48)	0.412 (1.18)
Size	-0.019*** (-3.09)	0.003 (0.03)	-0.017*** (-2.74)	-0.047 (-0.38)
Cash Holdings	-0.050 (-0.57)	-0.475 (-0.58)	0.002 (0.02)	0.203 (0.22)
ROA	-0.153 (-1.40)	0.116 (1.33)	-0.141 (-1.23)	0.205** (2.04)
Q	0.001 (0.13)	0.031 (0.30)	0.006 (0.61)	0.039 (0.34)
Constant	0.318*** (3.68)	-0.309 (-0.19)	0.331*** (3.66)	0.063 (0.03)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	328	82	328	82
Adjusted $R^2$	0.161	0.554	0.137	0.341

**Table 4: Growth opportunities, emissions and market valuation of corporate restructuring**

This table reports the results of the relationship between carbon emissions and market valuation of corporate restructuring announcements based the degree of a firm's growth opportunities. The dependent variables are CAR, the 11-day (-5,+5) market model Cumulative Abnormal Return and CTR the 11-day (-5,+5) Cumulative Total Return around the restructuring announcement. Emissions Level is the amount of firms' emissions in tones divided by total assets. Leverage is total debt divided by total assets. Size is the natural log of total assets. Cash Holdings is the ratio of cash to total assets. ROA is Earnings before Interest, Tax, Depreciation, and Amortization(EBITDA) divided by total assets. Q is the market value of equity plus total debt divided by total assets. T statistics are reported in parentheses. \*\*\*, \*\* and \* indicate statistical significance at 1%, 5% and 10% levels respectively.

Variables	CAR		CTR	
	Low Growth	High Growth	Low Growth	High Growth
Emissions Level	-0.023** (-2.16)	0.001 (0.20)	-0.025** (-2.05)	-0.004 (-0.60)
Leverage	0.051 (0.60)	-0.051 (-1.03)	0.051 (0.53)	-0.025 (-0.47)
Size	-0.025** (-2.49)	-0.000 (-0.04)	-0.023** (-2.00)	-0.001 (-0.18)
Cash Holdings	-0.078 (-0.52)	0.083 (0.70)	-0.049 (-0.29)	0.089 (0.71)
ROA	0.120 (0.47)	0.016 (0.37)	0.309 (1.07)	0.056 (1.30)
Q	0.008 (0.35)	-0.014 (-1.22)	0.003 (0.13)	-0.002 (-0.19)
Constant	0.477*** (3.41)	0.023 (0.20)	0.416*** (2.67)	0.026 (0.22)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	197	213	197	213
Adjusted $R^2$	0.436	0.219	0.350	-0.043

**Table 5: Financial constraints, emissions and market valuation of corporate restructuring**

The Table reports the results of the relationship between carbon emissions and market valuation of corporate restructuring announcements based on the severity of a firm's financial constraint. The dependent variables are CAR, the 11-day (-5,+5) market model Cumulative Abnormal Return and CTR the 11-day (-5,+5) Cumulative Total Return around the restructuring announcement. Emissions Level is the amount of firms' emissions in tones divided by total assets. Leverage is total debt divided by total assets. Size is the natural log of total assets. Cash Holdings is the ratio of cash to total assets. ROA is Earnings before Interest, Tax, Depreciation, and Amortization(EBITDA) divided by total assets. Q is the market value of equity plus total debt divided by total assets. T statistics are reported in parentheses. \*\*\*, \*\* and \* indicate statistical significance at 1%, 5%, and 10% levels respectively.

Variables	CAR		CTR	
	Constrained	Unconstrained	Constrained	Unconstrained
Emissions Level	-0.000 (-0.04)	-0.030*** (-2.78)	-0.001 (-0.14)	-0.022* (-1.96)
Leverage	0.011 (0.22)	-0.036 (-0.54)	-0.011 (-0.20)	0.016 (0.23)
Size	-0.021** (-2.37)	-0.011 (-1.13)	-0.032*** (-3.23)	-0.006 (-0.63)
Cash Holdings	0.190** (2.25)	-0.345* (-1.79)	0.148 (1.58)	-0.065 (-0.32)
ROA	0.024 (0.63)	0.024 (0.13)	0.083* (1.95)	-0.069 (-0.35)
Q	-0.010 (-1.19)	-0.001 (-0.03)	-0.004 (-0.45)	0.008 (0.47)
Constant	0.209* (1.80)	0.363** (2.22)	0.335** (2.60)	0.194 (1.13)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	210	200	210	200
Adjusted $R^2$	0.086	0.426	0.166	0.308

**Table 6: Environmental score and market valuation of corporate restructuring**

This table reports the results of the relationship between Refinitiv Environmental Score and market valuation of corporate restructuring announcements. The dependent variables are CAR, the 11-day (-5,+5) market model Cumulative Abnormal Return and CTR the 11-day (-5,+5) Cumulative Total Return around the restructuring announcement. Environmental Score is the environmental score of each firm obtained from Refinitiv. Leverage is total debt divided by total assets. Size is the natural log of total assets. Cash Holdings is the ratio of cash to total assets. ROA is Earnings before Interest, Tax, Depreciation, and Amortization (EBITDA) divided by total assets. Q is the market value of equity plus total debt divided by total assets. T statistics are reported in parentheses. \*\*\*, \*\* and \* indicate statistical significance at 1%,5% and 10% levels respectively.

Variables	CAR		CTR		BHAR	
	(1)	(2)	(3)	(4)	(5)	(6)
Environmental Score	-0.001 (-1.21)	-0.001 (-0.45)	-0.000 (-0.25)	0.000 (0.20)	-0.001 (-1.20)	-0.001 (-0.45)
Leverage		-0.137 (-0.48)		-0.248 (-0.86)		-0.120 (-0.41)
Size		-0.002 (-0.03)		0.014 (0.16)		-0.013 (-0.15)
Cash Holdings		-0.480 (-0.97)		-0.157 (-0.31)		-0.503 (-1.00)
ROA		0.071 (0.10)		-0.491 (-0.67)		0.056 (0.08)
Q		-0.128 (-1.16)		-0.070 (-0.62)		-0.139 (-1.24)
Constant	0.146 (1.33)	0.283 (0.36)	0.057 (0.49)	0.032 (0.04)	0.145 (1.28)	0.385 (0.48)
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
N	90	84	90	84	90	84
Adjusted $R^2$	0.464	0.524	0.347	0.445	0.360	0.435

**Table 7: Using Buy-Hold Abnormal Returns (BHAR)**

This table presents the results of the relationship between carbon emissions and market valuation of corporate restructuring announcements calculated through the buy and hold abnormal return (BHAR) method. Emissions Level is the amount of firms' emissions in tones divided by total assets. Leverage is total debt divided by total assets. Size is the natural log of total assets. Cash Holdings is the ratio of cash to total assets. ROA is Earnings before Interest, Tax, Depreciation, and Amortization (EBITDA) divided by total assets. Q is the market value of equity plus total debt divided by total assets. T statistics are reported in parentheses. \*\*\*, \*\*, \* indicate statistical significance at 1%, 5%, and 10% levels respectively.

Dependent Variable: BHAR								
Variables	Baseline		Bankruptcy Risk		Growth Opportunities		Financial Constraints	
	No controls	Controls	High Risk	Low Risk	Low Growth	High Growth	Constrained	Unconstrained
Emissions Level	-0.010** (-2.08)	-0.016*** (-2.97)	-0.017*** (-2.93)	0.063 (0.69)	-0.023** (-2.06)	0.001 (0.14)	-0.000 (-0.01)	-0.030*** (-2.77)
Leverage		-0.002 (-0.06)	0.011 (0.25)	0.235 (0.79)	0.054 (0.61)	-0.046 (-0.92)	0.007 (0.13)	-0.036 (-0.53)
Size		-0.012** (-2.15)	-0.018*** (-2.94)	0.004 (0.04)	-0.025** (-2.42)	0.000 (0.03)	-0.023** (-2.47)	-0.011 (-1.14)
Cash Holdings		0.009 (0.11)	-0.042 (-0.47)	-0.413 (-0.52)	-0.071 (-0.46)	0.078 (0.65)	0.198** (2.26)	-0.336* (-1.73)
ROA		0.022 (0.48)	-0.150 (-1.34)	0.120 (1.41)	0.099 (0.38)	0.018 (0.42)	0.028 (0.69)	0.014 (0.07)
Q		-0.001 (-0.16)	0.001 (0.16)	0.033 (0.34)	0.008 (0.37)	-0.012 (-1.03)	-0.012 (-1.30)	0.000 (0.02)
Constant	0.080 (1.25)	0.234** (2.37)	0.314*** (3.55)	-0.367 (-0.23)	0.469*** (3.29)	0.009 (0.08)	0.229* (1.91)	0.356** (2.16)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	489	410	328	82	197	213	210	200
Adjusted $R^2$	0.265	0.268	0.158	0.452	0.337	0.231	0.082	0.351

**Table 8: Using log values of emissions**

This table presents the regression analyses that evaluates the relationship between carbon emissions and market valuation of corporate restructuring announcements. The dependent variables are CAR, the 11-day (-5,+5) market model Cumulative Abnormal Return, CTR, the 11-day (-5,+5) Cumulative Total Return and BHAR, the Buy-Hold Abnormal Returns around the restructuring announcement. Log Emissions natural log of firms' emissions levels. Leverage is total debt divided by total assets. Size is the natural log of total assets. Cash Holdings is the ratio of cash to total assets. ROA is Earnings before Interest, Tax, Depreciation, and Amortization (EBITDA) divided by total assets. Q is the market value of equity plus total debt divided by total assets. T statistics are reported in parentheses. \*\*\*, \*\* and \* indicate statistical significance at 1%, 5%, and 10% levels respectively.

	CAR		CTR		BHAR	
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Log Emissions	-0.009*** (-2.64)	-0.016*** (-2.96)	-0.013*** (-3.46)	-0.018*** (-3.14)	-0.009*** (-2.59)	-0.016*** (-2.97)
Leverage		-0.001 (-0.04)		0.017 (0.44)		-0.002 (-0.06)
Size		0.004 (0.60)		0.008 (1.09)		0.005 (0.69)
Cash Holdings		0.001 (0.01)		0.091 (1.03)		0.009 (0.11)
ROA		0.021 (0.47)		0.059 (1.25)		0.022 (0.48)
Q		-0.002 (-0.24)		0.007 (0.87)		-0.001 (-0.16)
Constant	0.183*** (2.27)	0.245*** (2.53)	0.223*** (2.59)	0.202** (1.95)	0.174*** (2.13)	0.234*** (2.37)
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
N	489	410	489	410	489	410
Adjusted $R^2$	0.335	0.340	0.282	0.252	0.270	0.268



# Appendices

## A Variable definitions

Variable	Definition
CAR	The sum of market model abnormal returns during an 11 day event (-5, +5) window around a firm's restructuring announcement
CTR	The sum of actual returns during an 11 day event window (-5,+5) around a firm's restructuring announcement
Emissions Level	Emissions in Tonnes divided by Total Assets
Log Emissions	Natural Logarithm of Emissions Level
Leverage	Total Debt divided by Total Assets
Size	Natural Logarithm of Total Assets
Cash Holdings	Cash divided by Total Assets
ROA	Earnings before Interest, Tax, Depreciation, and Amortization (EBITDA) divided by Total Assets
Q	Market Value of Equity plus Total Debt divided by Total Assets.