# Does the Carbon Premium Reflect Risk or Outperformance?*

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## Abstract

Prior research documents a carbon premium in realized returns, assuming they proxy for expected returns and thus the cost of capital. We find that the carbon premium partially reflects unexpected returns and thus outperformance. Companies with higher scope 1, 2, or 3 emissions enjoy superior earnings surprises and announcement returns; earnings announcements explain 20-40% of the annual premium. We find similar results for emissions changes but not intensities, consistent with earlier evidence on realized returns. Our results suggest that the carbon premium, where it exists, partially arises from an unpriced externality rather than the market pricing in carbon transition risk.

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Whether carbon transition risk is priced in financial markets has first-order implications for the likelihood and speed of a shift to a low-carbon economy. If stocks exposed to transition risk (as proxied by high carbon emissions) are heavily discounted, then companies have strong incentives to cut their emissions, investors will engage with companies to lower their emissions, and emitters will have difficulty raising capital. In contrast, if markets insufficiently price in transition risk, then companies may not reduce their emissions nor investors pressure firms to do so.

An influential paper by Bolton and Kacperczyk (2021a, "BK") finds that U.S. companies with high levels of and changes in carbon emissions have high realized stock returns. These results are consistent with such firms facing a high cost of equity and thus markets pricing in transition risk. Aswani, Raghunandan, and Rajgopal (2024a) show that this carbon premium becomes insignificant when studying either carbon intensities (emissions scaled by sales), or disclosed rather than estimated emissions. Bolton and Kacperczyk (2024) respond that absolute emissions are the relevant measure of transition risk because it is they that determine climate impact; Aswani, Raghunandan, and Rajgopal (2024b) disagree. Separately, Bolton and Kacperczyk (2023) show that a carbon premium exists in many other countries around the world.

Regardless of whether levels, changes, or intensities are the appropriate measure, and whether estimated emissions are reliable, these results assume that realized returns are a good proxy for expected returns and thus the cost of capital. In addition to BK, 36 papers published in the *Journal of Finance*, *Journal of Financial Economics*, *Review of Financial Studies*, *Review of Finance*, *Journal of Financial and Quantitative Analysis*, *Management Science*, and *Annual Review of Financial Economics* since 2020 refer to the BK results as documenting higher "expected returns", a "risk premium", "carbon risk[s]", "climate risk[s]", or that "risk is priced". Sixteen of these were accepted after Aswani, Raghunandan, and Rajgopal (2024a), perhaps because the authors believe

that absolute emissions are the relevant measure, which highlights the importance of understanding the source of the carbon premium in absolute emissions.

However, a large literature on environmental, social, and governance ("ESG") investing uses realized abnormal returns as a measure of *un*expected returns and thus outperformance rather than risk. For example, Gompers, Ishii, and Metrick (2003) document high returns to well-governed companies, Fornell et al. (2006) and Fornell, Morgeson, and Hult (2016) to firms with high customer satisfaction, Edmans (2011, 2012) and Boustanifar and Kang (2022) to stocks with high employee satisfaction, and Lins, Servaes and Tamayo (2017) to high-trust businesses in the financial crisis. Similarly, practitioners interpret the high alpha to certain ESG strategies as evidence that ESG is good for firm value and underpriced by the market, rather than bad for firm value and exposing companies to excessive risk. ESG skeptics highlight how some ESG strategies are associated with negative alpha, rather than claiming that the positive alpha to other ESG strategies is evidence that ESG is risky.

A standard way to disentangle outperformance from risk is to study future earnings surprises. La Porta et al. (1997) find that value companies systematically beat analyst expectations. In an ESG context, Core, Guay, and Rusticus (2006) show that well-governed firms do not deliver positive earnings surprises; Giroud and Mueller (2006) find that they do in non-competitive industries. Edmans (2011) documents positive earnings surprises for companies with high employee satisfaction, Edmans et al. (2024) find similar results in non-U.S. countries with flexible labor markets, and Fornell et al. (2016) uncover analogous findings for stocks with high customer satisfaction.

This paper studies the relationship between carbon emissions and earnings surprises to help understand the source of the carbon premium. We find that carbon emissions have a remarkably

similar association with earnings surprises as they do with stock returns. Both the level of and change in emissions are positively related to earnings surprises, just as BK find with realized returns. A one standard deviation increase in the level of scope 1, scope 2, or scope 3 emissions is associated with an increase in the one-year earnings surprise that is approximately twice its sample median and significant at the 1% level. In contrast, carbon intensities are unrelated to earnings surprises, as are emissions levels and changes when focusing on disclosed emissions only, consistent with Aswani, Raghunandan, and Rajgopal (2024a). These results suggest that the carbon premium, where it exists, at least partly results from outperformance. They are robust to using the econometric model of Hou, van Dijk, and Zhang (2012) to forecast earnings in place of analyst estimates, and the fraction of forecasts that miss on the same side (Chiang et al., 2019) as an alternative measure of earnings surprises.

We find similar results when relating carbon emissions to three-day earnings announcement returns over a market model. A one standard deviation increase in scope 1 emissions levels (changes) is associated with a 0.17% (0.37%) higher announcement return, controlling for a long list of other determinants of stock returns used in BK. Analogous figures are 0.29% (0.35%) for scope 2 emission levels (changes) and 0.47% (0.50%) for scope 3 emission levels (changes). The four quarterly earnings announcements per year account for 20-40% of the carbon premium. These results are robust to controlling for the earnings announcement beta of Savor and Wilson (2016), calculating earnings announcement returns over the Fama-French six-factor model, using a five-day window, and winsorizing announcement returns.

Finally, we extend the analysis to other corporate events through which a company's investment (or non-investment) in emissions reduction may manifest in cash flow-relevant news: earnings calls, earnings guidance, dividend announcements, and buyback announcements. We find

that the change in emissions (under all three scopes) is positively and significantly related to the announcement returns to these additional events. For the level of emissions, all coefficients are positive but only those for scope 2 emissions are statistically significant. Combining these events with earnings announcements accounts for up to 50% of the annual carbon premium.

Taken together, our results suggest that the carbon premium does not fully result from the market pricing in carbon transition risk, casting doubt on whether market forces alone can bring about the shift to a low-carbon economy. This may be because companies and investors view carbon emissions as an externality that harms society but not the polluting firms, even in the long term. Thus, some firms choose not to invest in lowering their emissions, and enjoy higher earnings and stock returns as a result. While it is frequently claimed that "climate risk is investment risk" (e.g. Fink, 2020), the risk to society may not be fully borne by investors. Our results are consistent with Gasparini (2024), who finds a positive link between analyst EPS forecasts and carbon emissions, suggesting that analysts believe that firms do not suffer negative consequences from high emissions. These findings highlight the role of government intervention to achieve the carbon transition, and the trade-off that investors face between fiduciary duty and net-zero alignment in the absence of such action (see also Gosling and MacNeil, 2023).

Our results are related to three strands of existing literature. One is the robustness of the association between carbon emissions and realized returns. In addition to the papers already cited, Zhang (2025) finds that no carbon premium exists when studying lagged measures of emissions available to investors rather than contemporaneous measures. She also finds that the link between emissions and returns disappears after controlling for sales growth, but does not explore earnings or earnings surprises. In contrast, Lioui and Misra (2024) use Fama and MacBeth (1973) cross-sectional regressions to estimate carbon factors, and find that these factors command a significant

premium.[1] Our paper takes no position on the correct measure of carbon emissions; instead, our contribution is to study earnings surprises given that realized returns may stem from either outperformance or risk. Due to the difficulty of interpreting realized stock returns, Halling, Yu, and Zechner (2021) and Kim and Pouget (2023) study the link between environmental performance and bond yields, which are a good proxy for expected bond returns.

A second is on the theoretical link between carbon emissions and expected returns. Edmans (2023) points out that textbook corporate finance recommends modelling any risk as principally affecting expected cash flows. The discount rate does not change if the risk is idiosyncratic, for example if government action is unrelated to economic conditions and instead driven by factors such as successful global coordination. Moreover, the carbon premium could be negative (i.e. emitting companies bear lower systematic risk) if government action is more likely in an economic upswing where production and thus pollution is higher (Giglio, Kelly, and Stroebel, 2021), or if government inaction leads to a climate disaster which causes the market to collapse but brown stocks to outperform (Baker, Hollifield, and Osambela, 2022). In contrast, Pastor, Stambaugh, and Taylor (2021) show that the carbon premium is positive if government action is prompted by a welfare-reducing climate disaster, or if investors dislike holding brown stocks and demand a higher expected return to do so. The theoretical ambiguity on the link between emissions and systematic risk is consistent with our finding that the carbon premium may result at least in part from outperformance rather than risk.

A third is on the distinction between expected and realized returns in an ESG context. Pastor, Stambaugh, and Taylor (2022) find high realized returns to *green* stocks, as defined by MSCI's environmental scores. Carbon emissions are one of 13 characteristics that enter these scores; others

[1] Van Binsbergen and Brogger (2024) advocate measuring carbon emissions through emissions futures because they are more forward-looking than actual emissions, although they do not study the relationship with stock returns.

include raw material sourcing, toxic waste, and opportunities in clean tech, green building, and renewable energy. These dimensions are more likely to be internalized by the company, potentially explaining the opposite sign to the carbon premium. The authors decompose the source of the "greenium", guided by the model of Pastor, Stambaugh, and Taylor (2021). They find that it arises from unexpected increases in environmental concerns, rather than high expected returns. Green stocks also enjoyed positive earnings surprises, although these surprises only explain a small proportion of the high realized returns.

## 1. Data and Methodology

We obtain data on carbon emissions between 2005 and 2023 from Trucost. Trucost adheres to the Greenhouse Gas Protocol and thus classifies emissions into three categories. Scope 1 emissions arise directly from operations owned or controlled by a company, such as a factory or vehicle. Scope 2 emissions come from the production of purchased heat, electricity, and steam consumed by a company. Scope 3 emissions stem from operations not directly owned or controlled by the company. They can occur upstream from purchased goods or services, or downstream as customers use a company's products. Following BK, we focus on upstream scope 3 emissions since the available time-series for downstream scope 3 emissions is much shorter.

Trucost obtains data from a variety of public sources such as company annual reports, company websites and environmental data providers such as the Carbon Disclosure Project. If a company does not voluntarily disclose its emissions, then Trucost estimates them based on a proprietary model. BK run their results separately for disclosed and estimated emissions, but do not state how they conduct their classification. Trucost's "data source" variable does not neatly flag data as either "disclosed" or "estimated" but takes 29 different values, which can be grouped into: (i) estimated

emissions for firms that do not disclose, (ii) directly disclosed total emissions, and (iii) total emissions figures derived through other firm-level emissions disclosures. Following Aswani, Raghunandan and Rajgopal (2024a), we classify (ii) and (iii) as disclosed, and (i) as estimated if it contains the keyword "estimate".[2]

Following prior literature, we calculate level, growth and intensity measures for carbon emissions under all three scopes. The level of emissions is the natural logarithm of carbon dioxide equivalent ($CO_2e$) emissions in tons. The change in emissions is the annual percentage growth in $CO_2e$ emissions. Emissions intensity is the level of emissions scaled by the company's revenues (in million US dollars), divided by 100. Following BK, the last two measures are winsorized at the 2.5% level.

We obtain stock returns and market equity from CRSP, book equity from COMPUSTAT, and analyst forecasts from I/B/E/S. We calculate three measures of earnings surprises. *AFE1* is the one-year earnings surprise (also known as "analyst forecast error") and calculated as the actual earnings per share (EPS) for the fiscal year ending in year *t* minus the median analyst forecast, scaled by the year-end stock price as in Teoh and Wong (2002), Richardson, Teoh, and Wysocki (2004), Core, Guay, and Rusticus (2006), and Edmans (2011). The analyst consensus forecast is taken eight months prior to the end of the forecast period, i.e. four months after the prior fiscal year-end, to ensure that analysts observe prior earnings when making their forecasts. *AFE2* is the two-year earnings surprise and calculated in an analogous manner, with the consensus forecast taken 20 months prior to the end of the forecast period. As in Teoh and Wong (2002), we winsorize earnings surprises with an absolute value exceeding 10% of the stock price. *LTG* is the long-term

[2] Aswani, Raghunandan, and Rajgopal (2024a) use this classification because Trucost also provides another variable, the weighted average disclosure score. Observations in category (i) have a mean score of less than 1 out of 100 while observations in categories (ii) and (iii) have mean scores close to 95.

growth surprise and equal to the actual five-year EPS growth taken from I/B/E/S minus the median growth forecast from 56 months earlier.

To measure earnings announcement returns, we calculate *CAR*, the three-day (-1, +1) cumulative abnormal returns in excess of a market model estimated over (-300, -46). Table 1 presents summary statistics for our carbon emissions, earnings surprises, and earnings announcement return metrics, as well as control variables to be described later.

## 2. Results

### *2.1. The Carbon Premium*

As a preliminary first step, we replicate the carbon premium initially documented by BK for their sample period of 2005-2017, and then extend it to our sample period of 2005-23. This is because BK found that the carbon premium is sensitive to the sample period and we wish to verify that the carbon premium indeed exists in our sample.

We estimate the following cross-sectional regression model using pooled ordinary least squares ("OLS"):

$$Return_{it} = b_0 + b_1 Emissions_{it} + b_2 Controls1_{it-j} + \gamma_{year} + \delta_{ind} + \varepsilon_{it} \qquad (1)$$

The dependent variable, $Return_{it}$, is the stock return for firm $i$ in month $t$. The independent variable of interest, $Emissions_{it}$, is the level of, change in, or intensity of one of the three scopes. $Controls1_{it-j}$ is the vector of controls used in BK: log market equity (*SIZE*), book-to-market ratio (*BM*), momentum returns over the past year (*MOM*), return on equity (*ROE*), capital expenditure scaled by assets (*IA*), market beta calculated over the prior year (*BETA*), standard deviation of

monthly returns over the past year (*VOL*), book debt divided by book assets (*LEV)*, Herfindahl index of the business segments of a company based on segment revenues (*HHI*), log property, plant and equipment (*PPE*), dollar change in annual revenues scaled by market capitalization (*SALESGR*), and dollar change in annual earnings per share scaled by stock price (*EPSGR*). In all of our regressions, we include year ($\gamma_{year}$) and Fama-French 48 industry ($\delta_{ind}$) fixed effects and cluster standard errors by firm and year. The intercept and coefficients for the control variables are not reported for brevity.

Table 2 illustrates the results. For BK's original sample of 2005-17, we replicate their findings of a positive and significant carbon premium for the level of and changes in emissions, but not for emissions intensity. For example, a one standard deviation in respectively the level of and change in scope 1 emissions leads to a 12-bps and 28-bps increase in monthly returns. The analogous figures are 19 bps and 23 bps for scope 2 emissions, and 26 bps and 31 bps for scope 3 emissions; all are very close to those reported by BK. For our sample of 2005-23, we find that the carbon premium is even higher. For example, a one standard deviation increase in the level of scope 1, 2, and 3 emissions increases monthly returns by 30, 39, and 41 bps (3.6%, 4.7%, and 4.9% annualized), respectively. Similarly, a one standard deviation increase in the change in scope 1, 2, and 3 emissions increases monthly returns by 35, 37, and 47 bps (4.2%, 4.4%, and 5.6% annualized), respectively.

### *2.2. Earnings Surprises*

We study the relationship between emissions and earnings surprises by estimating the following cross-sectional regression model using pooled OLS for 2005-23:

$$Surprise_{it} = b_0 + b_1 Emissions_{it} + b_2 Controls2_{it-j} + \gamma_{year} + \delta_{ind} + \varepsilon_{it} \qquad (2)$$

The dependent variable, $Surprise_{it}$, is one of the three measures of earnings surprises described earlier for firm *i* and quarter *t*. $Controls2_{it-j}$ is one of two sets of controls. One set of controls is firm size and the book-to-market ratio, as in Teoh and Wong (2002), Richardson, Teoh, and Wysocki (2004), Core, Guay, and Rusticus (2006), Edmans (2011), and Giroud and Mueller (2011), measured either one, two or five years prior to the end of the forecast period depending on the surprise metric used. Some papers add additional controls depending on their research question. For example, Core, Guay, and Rusticus (2006) study whether the link between governance and stock returns is due to outperformance or risk, and so control additionally for governance; Giroud and Mueller (2011) control for governance interacted with industry competition. Our research question is to explore the source of the carbon premium documented by BK. BK study stock returns and thus choose control variables that have previously been found to be linked to stock returns. These controls may not be as relevant when investigating earnings surprises, but we nevertheless check for robustness using a second set of controls. This is the full list of controls in BK (*Controls1*) excluding *SALESGR* and *EPSGR*, because they are "bad controls" when earnings surprises are the independent variable: a channel through which carbon emissions may manifest in earnings surprises. (In Table OA1, we verify that our results are robust to including these controls).

Table 3 presents the results for the full sample, which contains both disclosed and estimated emissions. Panel A considers the level of emissions. When controlling for *SIZE* and *BM* in columns (1), (3), and (5), all three measures of carbon emissions are positively and significantly associated with all three measures of earnings surprises (*AFE1*, *AFE2*, and *LTG*). Eight of the nine coefficients are significant at the 5% level or better, with the ninth significant at 10%. A one

standard deviation increase in the level of scope 1 emissions increases *AFE1* by 0.0020 which is twice the median value of this variable; these numbers are 0.0019 and 0.0023 for scopes 2 and 3. Turning to the other earnings surprise measures, a one standard deviation increase in emission levels (changes) is associated with a 0.0038-0.0058 (0.0051-0.0086) increase in *AFE2* depending on the scope used; these figures are 2.20%-7.38% and 1.15%-2.83% for *LTG*. Columns (2), (4), and (6) add the full set of controls. All nine coefficients increase, and all are now significant at the 5% level or better.

Panel B shows similar results for changes in emissions. Out of the 18 regressions (three measures of emissions, three measures of earnings surprises, and two sets of controls), 15 coefficients are significant at the 1% level, two at 5%, and the remaining one at 10%. In contrast, Panel C finds no positive relationship between scaled emissions and earnings surprises in any specification, and a significantly negative relationship in three. These results are consistent with BK and Aswani, Raghunandan, and Rajgopal (2024a) who document a carbon premium for emission levels and changes, but not intensities.

We next estimate model (2) for estimated and disclosed emissions separately. Table 4 presents the results for estimated emissions. Panel A demonstrates that all three measures of emission levels are significantly associated with all three measures of earnings surprises with both sets of controls, with 17 coefficients significant at the 5% level or better and one at the 10% level. Compared to the full sample results of Table 2, coefficient estimates are markedly higher for scopes 1 and 2 and similar for scope 3. Panel B finds similar results for emission changes, with all 18 coefficients significant at the 1% level; Panel C reports only one significant coefficient (negative, at 10%) for emission intensities.

Table 5 illustrates the results for disclosed emissions. Out of the 36 regressions using both the level and change in emissions, we only find seven positive coefficients that are significant at the 5% level or better and five at the 10% level; the remaining 24 are insignificant. There are no significantly positive coefficients when studying emissions intensities. These results are consistent with Aswani, Raghunandan, and Rajgopal (2024a), who show that the carbon premium is driven by estimated rather than disclosed emissions.

We now explore the robustness of these results to alternative definitions of earnings surprises. Hou, van Dijk, and Zhang (2012) propose using an econometric model to forecast earnings, rather than using analyst forecasts. We follow their paper by estimating pooled cross-sectional regressions of one- or two-year ahead earnings on total assets, dividends, a dummy variable that equals 1 for dividend payers, a dummy variable that equals 1 for firms with negative earnings, and accruals (earnings before extraordinary items and discontinued operations minus operating cash flows), for each of the past ten years. Continuous variables are winsorized at 1%. For each firm *i* and year *t*, we compute one- or two-year ahead earnings forecasts by multiplying the independent variables as of year *t* with the coefficients from the pooled cross-sectional regression estimated using the previous ten years of data. We define the one-year (*MBFE1*) or two-year (*MBFE2*) earnings surprise as the actual earnings minus the model-based forecast scaled by year-end market equity. We winsorize earnings surprises with an absolute value exceeding 10% of the market value of equity.

A second alternative measure of earnings surprises is the fraction of forecasts that miss on the same side (*FOM*) from Chiang et al. (2019). *FOM* is defined as the number of forecasts strictly below actual earnings, minus the number of forecasts strictly above actual earnings, divided by the total number of analyst forecasts. We include the latest forecast made at least 8 months before the

earnings announcement date. As in Chiang et al. (2019), we focus on forecasts for fiscal year-end earnings and require that the earnings announcements fall between 15 to 90 calendar days following the fiscal period-end date.

Table OA2 presents the results. Column (1) relates *MBFE1*, the model-based forecast error for one-year earnings, to carbon emissions controlling for *SIZE* and *BM*. For both levels and changes, all three scopes are positive and significant at the 1% level, but intensities are not. Tables OA3 and OA4 show that this result is driven by estimated rather than disclosed emissions. Column (2) includes the full set of controls and finds similar results. Columns (3) and (4) consider *MBFE2*, the two-year earnings surprise, and demonstrate the same statistical significance and somewhat higher coefficients.

Columns (5) and (6) consider the *FOM* measure of Chiang et al. (2019). Controlling for *SIZE* and *BM*, earnings surprises are positively related to the level of scope 3 emissions and the change in emissions under all three scopes. With the full set of controls, all three scopes are significant under both levels and changes. Again, these results are driven by estimated rather than disclosed emissions.

Overall, the results in Tables 3-5 and Tables OA2-OA4 suggest that, where the carbon premium exists (i.e. for estimated levels and changes in emissions), it is at least partially the result of outperformance that manifests itself in superior earnings surprises. This result is robust to different earnings surprise measures.

### *2.3. Earnings Announcement Returns*

We study the stock price consequences of these earnings surprises by estimating the following cross-sectional regression model using pooled OLS:

$$CAR_{it} = b_0 + b_1 Emissions_{it} + b_2 Controls2_{it-j} + \gamma_{year} + \delta_{ind} + \varepsilon_{it} \quad (3)$$

The dependent variable, $CAR_{it}$, is the three-day abnormal announcement return over the market model of firm *i* during quarter *t*. We regress *CAR* on level, change and intensity metrics associated with the three scopes. As before, *Controls2* is either *SIZE* and *BM* or the full set of controls in BK excluding *SALESGR* and *EPSGR*, as they are channels through which emissions may manifest in superior announcement returns. Table OA5 shows that the results are robust to including these controls.

Table 6 presents the results. The full-sample results in columns (1) and (2), for both sets of controls, show that *CAR* is positively associated with both the level of and change in all three emissions measures, with 10 out of the 12 coefficients significant at the 1% level and the remaining two at the 5% level; there is no positive relationship with emissions intensities. A one standard deviation increase in the level of emissions is associated with a higher *CAR* of 17, 29, and 47 basis points for scopes 1, 2, and 3, respectively. With four quarterly earnings announcements per year, earnings surprises account for 0.7-1.9 percentage points of the annual carbon premium. As reported earlier, a one standard deviation increase in the level of scope 1, scope 2, and scope 3 emissions leads to an annualized increase in stock returns of 3.6%, 4.7%, and 4.9%, respectively. Thus, earnings announcements account for about 20-40% of the carbon premium. Moving to the change in emissions, a one standard deviation increase in the change in scope 1, 2, and 3 emissions is respectively associated with a 37, 35, and 50 basis point increase in *CAR*, i.e. 1.5-2.0 percentage

points per year, compared to an annual carbon premium of 4.2%, 4.4%, and 5.6%. Thus, we find that earnings surprises account for 30-35% of the carbon premium based on changes.[3]

Columns (3)-(4) and (5)-(6) repeat the results for estimated and disclosed emissions, respectively. They demonstrate that the significantly positive relation between emission levels/changes and announcement returns is confined to estimated emissions, and the coefficients tend to be higher than in the full sample.[4] These results are again consistent with earlier work which attributes the carbon premium to estimated emissions. Taken together, these findings suggest that a significant portion of the carbon premium is driven by outperformance during earnings announcements that is imputed into stock prices.

We now perform a series of robustness tests on the earnings announcement results. Savor and Wilson (2016) argue that earnings announcement returns may result from risk. Specifically, announcements provide information about the earnings of not only the announcing firm but also the economy, which they conjecture is a systematic risk. They create an earnings announcement factor: the return on a portfolio that is long firms expected to report their earnings in a given week and short all other firms. They regress individual stock returns on this factor to estimate earnings announcement betas, which they relate to the cross-section of equity returns. In Table 7, we control

[3] These findings are also inconsistent with the explanation that the higher returns to emitting companies result from a sin stock premium: emitting companies are excessively divested, reducing their stock price and increasing their future returns. Instead, we find that the higher returns are partially due to greater earnings. BK already rejected the sin stock explanation on different grounds: they only find significant divestment for scope 1 emissions intensities, for which there is no relationship with stock returns.

[4] Table A.11 of BK finds that that the level of disclosed Scope 1 emissions is positively related to stock returns and significant at the 10% level, but changes and intensities are unrelated. However, Table OA.3 of Aswani, Raghunandan, and Rajgopal (2024) finds that this result only exists when using Trucost industry definitions (not GICS, SIC, or Fama-French 48 industries) and counting only category (ii) of Trucost's "data source variable" (emissions directly disclosed to the CDP or in environmental/CSR reports) as "disclosed" emissions, omitting category (iii) (total emissions figures derived through other firm-level emissions disclosures). In unreported results, we find that Scope 1 levels (but not changes or intensities) are positively related to earnings announcement returns and significant at the 10% level when using Trucost industry definitions and under the more conservative definition of disclosure. Thus, even in the specification in which BK obtain a carbon premium for disclosed emissions, the premium is at least partly driven by outperformance.

for the earnings announcement beta, *EABETA*. It is significant in all specifications, yet all results continue to hold. The earnings surprise results of Tables 3-5 are also inconsistent with a purely risk-based explanation.[5]

BK also consider the possibility that emitting firms have received positive shocks. For robustness, they omit the 1-day return to earnings announcements and find that the carbon premium remains. However, they only consider a 1-day return, in contrast to the common (-1, +1) window for event studies; they also do not investigate the relationship between emissions and earnings surprises. We study a short announcement window to ensure that the realized returns are attributable to earnings announcements rather than other news. It is, therefore, possible that earnings surprises account for even more than 20-40% of the carbon premium given the existence of post-earnings announcement drift (Bernard and Thomas, 1989). In Table 8, we expand the return window to (-2, +2), both to verify the robustness of our results and investigate whether earnings announcement returns account for a larger fraction of the carbon premium with a wider window. We find that the results remain robust, and earnings announcement returns explain a greater proportion of the carbon premium: 25-45% of the carbon premium based on levels and 35-40% based on changes. Table OA6 shows that earnings announcement returns explain up to 45% of the carbon premium based on both levels and changes when calculated over (-1, +5); Table OA7 finds that they explain up to 55% (50%) for levels (changes) over (-1, +10).

We next investigate robustness to the benchmark asset pricing model used to calculate earnings announcement returns. We use the market model, which is standard for event studies as

[5] Engelberg, McLean, and Pontiff (2018) study a broad set of 97 anomalies (abnormal realized returns), taken from McLean and Pontiff (2016), which do not include the carbon premium as it had not yet been discovered. They show that anomaly returns are six times higher on earnings announcement days, also suggesting that they result from outperformance rather than risk. They acknowledge that high earnings announcement returns do not conclusively rule out risk, since betas could change on earnings announcement days, and thus conduct other tests to exclude this explanation.

the benchmark should make little difference over a short window. Nevertheless, in Table 9, we use the Fama and French (2018) six-factor model as the benchmark which controls for market, size, value, momentum, profitability, and investment factors, and all results remain robust. In Table 10, we consider one final robustness check, which winsorizes announcement returns at the 1% level to ensure that the results are not driven by outliers. The inferences again remain unchanged.

While Tables 7-10 add robustness checks one-by-one, in Table OA8 we combine all four robustness tests together: we control for the earnings announcement beta, expand the event-study window to (-2, +2), use the Fama-French six-factor model as the benchmark, and winsorize announcement returns. Out of 24 tests (two sets of controls, full sample and estimated emissions, three scopes of emissions, and the level of and change in emissions), 22 are significant at the 5% level or better. In sum, the level of and change in all three scopes of total and estimated emissions are positively and significantly related to earnings announcement returns, but emission intensities and disclosed emissions are not.

### *2.4. Other News Items*

We finally extend the analysis beyond earnings announcements to other news items that may affect stock prices through the cash flow channel. We obtain news releases from Capital IQ's Key Developments database, also used in Edmans et al. (2018) and Cohn, Gurun, and Moussawi (2020). We focus exclusively on the events that are most likely to be associated with the release of cash flow news associated with a company's investment in emissions reduction: earnings calls, earnings guidance, dividend announcements, and buyback announcements.[6] For example, a company that

[6] Our earnings calls events are: earnings calls, guidance/update calls, shareholder/analyst calls, and analyst/investor days. Our earnings guidance events are: corporate guidance-lowered, corporate guidance – raised, and corporate guidance – new / confirmed. Our dividend events are: dividend reaffirmations, dividend increases, dividend decreases,

does not invest in emissions reduction may have higher earnings, which could lead to positive earnings guidance, dividend increases, and/or share buybacks. In contrast, we exclude events, such as mergers and acquisitions and debt issuance, that are unlikely to be linked to the cash flow implications of emissions-related expenditures.

We obtain 57,683 such events for the companies in our sample. Since some of the events overlap with each other, and occasionally with the (-1, +1) earnings announcement window studied in Table 6, we consider 1-day CARs on the announcement date to remove any overlaps. If part of the reaction to such events occurs on the day before or after the announcement date, this restriction will lead us to underestimating the proportion of the carbon premium that can be explained by them. We also exclude any news events that occur within the (-1, +1) earnings announcement window to ensure that we are only capturing incremental explanatory power. As in Table 6, we relate the announcement returns to emissions levels, changes, and intensities under the three scopes.

Table 11 illustrates the results. Panel A relates the level of emissions to the 1-day CARs to these additional events. While all coefficients for both total and estimated emissions are positive, they are only significant for scope 2 (in all specifications). In contrast, Panel B shows that the change in all three scopes of emissions is positively and significantly related to event-study returns in all specifications. Combining these additional events with earnings announcements in Table 12, events in aggregate account for up to 50% of the annual carbon premium, compared to 20-40% from earnings announcements alone. Table OA9 shows that the results remain robust to the Fama-French six-factor model.

Consistent with prior results, there is no link between disclosed emissions or emissions intensities and the returns to these additional events. These results provide further evidence that

dividend cancellations, and dividend initiations. Our buyback events are: buyback transaction announcements and buyback transaction cancellations.

the carbon premium, where it exists, results from the release of cash flow-relevant news rather than priced risk.

## 3. Discussion

Our results have shown that companies with higher levels of and changes in estimated emissions enjoy positive earnings surprises and earnings announcement returns; in addition, companies with higher changes in estimated emissions experience superior announcement returns to other corporate events. There are three potential reasons for this association. First, some companies may focus entirely on shareholder value and view carbon emissions as an externality that they can "get away with", even in the long term, due to doubts about government action. Such firms do not spend money on reducing their emissions, thus delivering higher earnings (or more positive other corporate events) than the market anticipated. Investors respond positively to these higher earnings because they also view government action as unlikely. This is consistent with the infamous claim by HSBC's Stuart Kirk that, while climate change is a serious risk to society, it is not yet a serious risk to investors.[7]

Under the same interpretation, low-emission companies are sacrificing shareholder value to curb their carbon emissions. They announce earnings that are lower than expected and investors respond negatively to these lower earnings, perhaps because they signal that these companies are not maximizing shareholder value. Such a sacrifice may either be due to an agency problem (executives pursuing social goals without shareholder approval) or shareholders' objective function containing both shareholder value and carbon emissions.

[7] "Why Investors Need Not Worry About Climate Risk", speech at the *Financial Times* Live Moral Money Summit Europe conference, May 2022.

A second explanation is short-termism. Some companies think that they can "get away with" high carbon emissions and underinvest in emissions reduction compared to the level that would maximize long-term shareholder value. Investors are similarly myopic and respond positively to higher earnings, and other events, not recognizing that the company will suffer in the long term. In contrast to the first channel, under this explanation, high-emission companies are not creating long-term shareholder value but taking advantage of market myopia; similarly, low-emission companies are not sacrificing long-term shareholder value. However, it remains the case that the higher returns to high-emissions companies do not result from the market fully pricing in carbon transition risk, as argued by prior literature.

Third, our results may be driven by an omitted variable. It may be that high carbon emissions do not cause higher earnings surprises, but that some companies receive a positive shock to demand, which causes them to produce more. This increases emissions levels and changes but not intensities since revenues also rise. These demand shocks generate favorable earnings surprises that investors welcome because they do not believe that the accompanying high emissions will lead to future costs. Under this interpretation, it remains the case that the carbon premium does not represent only carbon transition risk.

That our results only arise for estimated and not disclosed emissions may be due to the endogeneity of the disclosure decision, which Bolton and Kacperczyk (2021b) offer as an explanation for why they find a lower carbon premium for disclosed emissions. Assume that firm A has received a positive shock to demand, which increases both revenues and emissions, and leads to positive earnings surprises. Since reported emissions would be high, the firm chooses not to disclose its emissions; indeed Bolton and Kacperczyk (2021b) find that companies are significantly less likely to disclose high emissions. Since estimated emissions are strongly

correlated with revenues[8], estimated emissions will be high[9], leading to a positive link between estimated emissions and earnings surprises. Now consider firm B, which also enjoys a positive demand shock, but this increased output does not lead to higher emissions, either because it is in a sector (e.g. services) where revenues can increase without emissions doing so, because it invests in reducing its emissions, or because it enjoys a negative shock to emissions. Since its emissions do not rise, it is willing to disclose them. Because positive demand shocks do not lead to high disclosed emissions, there is no link between disclosed emissions and earnings surprises.

Similar logic applies if disclosure is an irreversible decision, i.e. once a firm has decided to disclose, it cannot stop doing so. A company whose output is largely decoupled from emissions is more likely to disclose since it can grow its business without having to disclose ever-increasing emissions. Demand shocks will be uncorrelated with disclosed emissions for such firms, also explaining the absence of a link.

Regardless of the reason for the association between emissions and earnings surprises, the implications for investors are similar. By buying firms with high levels of or changes in total or estimated emissions, they earn higher returns that are at least partially due to outperformance. Indeed, buying emitting companies just before earnings announcements and selling just after would lead to abnormal returns with negligible exposure to transition risk (due to a three-day window). Conversely, responsible investing strategies that screen out high emitting companies sacrifice returns, in contrast to common claims that investors can "do well by doing good." The survey of Krueger, Sautner, and Starks (2020) finds that improving investor returns is a major motivation for why investors incorporate climate risks into the investment process, and the survey

[8] Aswani et al. (2024a) document a 0.699 correlation between log scope 1 emissions and log sales, compared to a 0.525 correlation with log market cap and a 0.463 correlation with log assets.

[9] Even though estimated emissions are also high, the company may still choose not to disclose emissions due to the cost of doing so (Bolton and Kacperczyk, 2021b).

of Edmans, Gosling, and Jenter (2025) finds that investors believe that high emitters deliver lower returns. Our evidence suggests that avoiding firms exposed to transition risk can actually decrease investment returns.

## 4. Conclusion

Prior literature uncovered that the level of and change in carbon emissions is associated with significantly higher realized returns, but carbon intensities are not. While it interpreted realized returns as expected returns, they instead may at least partially result from outperformance. We study the relationship between carbon emissions and earnings surprises to shed light on whether the carbon premium results from outperformance or risk. We find remarkably similar results to the prior literature – the level of and change in all three scopes of carbon emissions is significantly associated with both higher earnings surprises and higher earnings announcement returns, but carbon intensities are not. The four earnings announcements each year account for 20-40% of the carbon premium in both levels and changes. When adding in corporate events related to earnings calls, earnings guidance, dividend announcements, and buyback announcements, we can explain up to 50% of the carbon premium. These results are robust to alternative measures of earnings surprises and ways to calculate earnings announcement returns.

Our results imply a more skeptical view of financial markets' ability to accelerate the carbon transition than suggested by prior literature. Financial markets may not be fully pricing in carbon transition risk, potentially because of doubts about the likelihood of government action. As a result, emissions may be an unpriced externality that harms wider society but not the emitting company; emitting firms are able to enjoy superior earnings surprises, earnings announcement returns, and realized returns because they do not fully bear the consequences of their polluting activity. These

findings highlight the need for additional government action, beyond what the market already anticipates, to address climate change.

**Table 1: Summary Statistics**

This table presents summary statistics for the emission measures, earnings surprises, earnings announcement returns and stock characteristics. *Level* is calculated as the natural logarithm of carbon dioxide equivalent ($CO_2e$) emissions measured in tons. *Change* is calculated as the annual percentage growth in $CO_2e$ emissions winsorized at the 2.5% level. *Intensity* is calculated as the ratio of tons of $CO_2e$ emissions to the company's revenues (in million US dollars) divided by 100, also winsorized at the 2.5% level. *AFE1* (*AFE2*) is the one-year (two-year) earnings surprise measured as the actual EPS minus the I/B/E/S median analyst forecast 8 (20) months prior to the end of the forecast period, scaled by the stock price. *LTG* is the long-term growth surprise measured as the actual five-year annualized EPS growth rate minus the I/B/E/S median analyst long-term growth forecast from 56 months earlier. *CAR(-1, +1)* is the three-day cumulative abnormal return to quarterly announcements relative to a market model in which the coefficients are estimated over (-300, -46). *CAR(-2, +2)* is the five-day cumulative abnormal return to quarterly announcements relative to a market model in which the coefficients are estimated over (-300, -46). *SIZE* is the natural logarithm of market capitalization. *BM* is the book value of equity divided by market value of equity. *MOM* is the cumulative stock return over the prior one-year period. *ROE* is return on equity defined as net income divided by book value of equity. *IA* is capital expenditures divided by book value of assets. *BETA* is the market beta calculated over the prior year using daily data. *VOL* is the monthly stock return volatility calculated over the past 12 months. *LEV* is the book value of leverage defined as the book value of debt divided by the book value of assets. *HHI* is the Herfindahl concentration index of firms with respect to different business segments based on each segment's revenues. *PPE* is the natural logarithm of plant, property & equipment. *SALESGR* is the dollar change in annual revenues normalized by market capitalization. *EPSGR* is the dollar change in annual earnings per share normalized by stock price. *EABETA* is the earnings announcement beta calculated as the slope coefficient from a regression of a stock's weekly excess returns on the long-short equal-weighted announcement portfolio return (announcers minus non-announcers) over the past 52 weeks. *BM*, *LEV*, and *IA* are winsorized at the 2.5% level and *MOM*, *VOL*, *SALESGR*, and *EPSGR* are winsorized at the 0.5% level. The sample period is from 2005 to 2023.

| | Mean | Median | StDev | Min | P25 | P75 | Max |
|---|---|---|---|---|---|---|---|
| Scope 1 Level | 11.595 | 11.398 | 2.762 | 2.310 | 9.710 | 13.284 | 19.736 |
| Scope 2 Level | 11.665 | 11.646 | 2.047 | 4.234 | 10.388 | 13.128 | 17.165 |
| Scope 3 Level | 13.497 | 13.548 | 1.829 | 6.238 | 12.318 | 14.724 | 19.031 |
| Scope 1 Change | 0.036 | 0.012 | 0.308 | -0.855 | -0.081 | 0.115 | 1.023 |
| Scope 2 Change | 0.042 | 0.012 | 0.306 | -0.858 | -0.085 | 0.126 | 1.126 |
| Scope 3 Change | 0.039 | 0.023 | 0.236 | -0.843 | -0.072 | 0.121 | 1.076 |
| Scope 1 Intensity | 0.864 | 0.129 | 1.536 | 0.005 | 0.034 | 0.469 | 4.784 |
| Scope 2 Intensity | 0.285 | 0.172 | 0.299 | 0.010 | 0.080 | 0.386 | 1.131 |
| Scope 3 Intensity | 1.402 | 0.958 | 1.172 | 0.228 | 0.518 | 2.011 | 4.112 |
| *AFE1* | -0.001 | 0.001 | 0.034 | -0.100 | -0.007 | 0.007 | 0.100 |
| *AFE2* | -0.006 | -0.001 | 0.042 | -0.100 | -0.020 | 0.009 | 0.100 |
| *LTG* | -0.042 | -0.025 | 0.242 | -1.518 | -0.119 | 0.046 | 5.941 |
| *CAR(-1, +1)* | 0.210 | 0.131 | 8.594 | -76.23 | -3.618 | 3.963 | 360.102 |
| *CAR(-2, +2)* | 0.263 | 0.150 | 9.481 | -77.211 | -4.036 | 4.394 | 318.96 |
| *SIZE* | 9.338 | 9.337 | 1.571 | 3.134 | 8.251 | 10.380 | 14.606 |
| *BM* | 0.500 | 0.374 | 0.449 | -0.233 | 0.208 | 0.697 | 2.738 |
| *MOM* | 0.128 | 0.110 | 0.361 | -0.897 | -0.066 | 0.295 | 4.091 |
| *ROE* | 0.110 | 0.132 | 0.433 | -2.586 | 0.062 | 0.224 | 1.085 |
| *IA* | 0.047 | 0.033 | 0.046 | 0.000 | 0.015 | 0.063 | 0.208 |
| *BETA* | 1.090 | 1.045 | 0.449 | -0.428 | 0.802 | 1.320 | 3.671 |
| *VOL* | 0.089 | 0.076 | 0.054 | 0.024 | 0.054 | 0.107 | 0.734 |
| *LEV* | 0.257 | 0.242 | 0.173 | 0.000 | 0.242 | 0.356 | 0.722 |
| *HHI* | 0.677 | 0.667 | 0.299 | 0.085 | 0.392 | 1.000 | 1.000 |
| *PPE* | 7.615 | 7.611 | 1.853 | -4.423 | 6.370 | 8.906 | 12.467 |
| *SALESGR* | 0.008 | 0.021 | 0.371 | -6.095 | -0.006 | 0.058 | 2.851 |
| *EPSGR* | -0.006 | 0.004 | 0.269 | -5.413 | -0.012 | 0.004 | 3.942 |
| *EABETA* | 0.463 | 0.362 | 0.540 | -4.371 | 0.137 | 0.678 | 8.785 |

**Table 2: Monthly Stock Returns**

This table presents results from regressions of monthly stock returns on emissions. We present results for the full sample, estimated emissions only, and disclosed emissions only. All regressions control for *SIZE*, *BM*, *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, *PPE*, *SALESGR* and *EPSGR* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | 2005-2017 | | | 2005-2023 | | |
|---|---|---|---|---|---|---|
| | Full Sample | Estimated | Disclosed | Full Sample | Estimated | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.044 | 0.088*** | -0.022 | 0.110*** | 0.164*** | 0.018 |
| | (1.69) | (4.42) | (-0.57) | (3.21) | (3.76) | (0.32) |
| | 138,158 | 98,202 | 39,956 | 257,840 | 180,179 | 77,661 |
| Scope 2 | 0.092** | 0.095** | 0.029 | 0.189*** | 0.214*** | 0.054 |
| | (2.70) | (2.86) | (0.40) | (3.48) | (3.32) | (1.08) |
| | 138,217 | 102,944 | 35,273 | 257,947 | 186,839 | 71,108 |
| Scope 3 | 0.140*** | 0.141*** | 0.287 | 0.224*** | 0.225*** | 0.273* |
| | (5.01) | (4.98) | (1.71) | (4.18) | (4.19) | (1.92) |
| | 138,229 | 136,990 | 1,239 | 257,959 | 256,492 | 1,467 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 0.910*** | 1.637*** | 0.137 | 1.138*** | 2.026*** | 0.118 |
| | (4.52) | (5.96) | (1.07) | (10.18) | (10.17) | (1.41) |
| | 119,843 | 80,300 | 39,543 | 237,342 | 160,152 | 77,190 |
| Scope 2 | 0.745*** | 1.557*** | -0.061 | 1.202*** | 2.001*** | 0.136 |
| | (3.73) | (6.48) | (-0.32) | (7.49) | (10.55) | (1.10) |
| | 119,855 | 84,823 | 35,032 | 237,390 | 166,579 | 70,811 |
| Scope 3 | 1.293*** | 1.300*** | -0.086 | 1.992*** | 1.995*** | 0.703 |
| | (3.42) | (3.44) | (-0.04) | (6.69) | (6.72) | (0.40) |
| | 119,891 | 118,652 | 1,239 | 237,426 | 235,959 | 1,467 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.002 | 0.050 | -0.060 | -0.021 | -0.039 | -0.045 |
| | (-0.05) | (0.61) | (-1.17) | (-0.37) | (-0.37) | (-0.76) |
| | 138,229 | 98,202 | 40,027 | 257,959 | 180,179 | 77,780 |
| Scope 2 | 0.074 | 0.124 | -0.159 | 0.042 | 0.102 | -0.198 |
| | (0.36) | (0.41) | (-0.76) | (0.26) | (0.37) | (-1.55) |
| | 138,229 | 102,944 | 35,285 | 257,959 | 186,839 | 71,120 |
| Scope 3 | 0.077 | 0.078 | 0.020 | -0.000 | 0.000 | -0.070 |
| | (1.53) | (1.54) | (0.11) | (-0.00) | (0.00) | (-0.36) |
| | 138,229 | 136,990 | 1,239 | 257,959 | 256,492 | 1,467 |

**Table 3: Earnings Surprises (Full Sample)**

This table presents results from regressions of earnings surprises on emissions for the full sample. *AFE1* (*AFE2*) is the one-year (two-year) earnings surprise measured as the actual EPS minus the I/B/E/S median analyst forecast 8 (20) months prior to the end of the forecast period, scaled by the stock price. *LTG* is the long-term growth surprise measured as the actual five-year annualized EPS growth rate minus the I/B/E/S median analyst long-term growth forecast from 56 months earlier. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. All coefficients are multiplied by 1,000. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | *AFE1* | *AFE1* | *AFE2* | *AFE2* | *LTG* | *LTG* |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.707** | 0.958*** | 1.382*** | 1.778*** | 12.412*** | 13.315*** |
| | (2.45) | (3.51) | (3.24) | (4.18) | (4.22) | (3.59) |
| | 23,076 | 19,719 | 22,186 | 18,895 | 4,577 | 3,799 |
| Scope 2 | 0.933* | 1.407** | 2.116*** | 2.835*** | 10.766*** | 10.796*** |
| | (1.93) | (2.81) | (3.74) | (4.58) | (3.27) | (3.16) |
| | 23,079 | 19,728 | 22,189 | 18,904 | 4,576 | 3,803 |
| Scope 3 | 1.236** | 1.705** | 3.175*** | 4.244*** | 40.347*** | 46.720*** |
| | (2.10) | (2.71) | (3.96) | (4.47) | (6.17) | (7.51) |
| | 23,091 | 19,729 | 22,200 | 18,905 | 4,581 | 3,803 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 9.582*** | 9.867*** | 16.627*** | 17.150*** | 37.384** | 36.307* |
| | (5.56) | (5.62) | (6.32) | (6.58) | (2.14) | (2.05) |
| | 21,588 | 18,469 | 20,910 | 17,780 | 4,511 | 3,742 |
| Scope 2 | 10.499*** | 10.831*** | 18.090*** | 18.461*** | 38.955*** | 42.793*** |
| | (4.90) | (4.90) | (6.55) | (6.82) | (3.02) | (2.98) |
| | 21,586 | 18,473 | 20,908 | 17,785 | 4,510 | 3,746 |
| Scope 3 | 20.248*** | 20.808** | 36.374*** | 36.743*** | 120.046*** | 124.908*** |
| | (5.91) | (6.05) | (6.63) | (7.21) | (4.45) | (4.06) |
| | 21,599 | 18,476 | 20,921 | 17,787 | 4,515 | 3,746 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.101 | -0.164 | -0.436 | -0.367 | -7.864 | -9.163 |
| | (-0.19) | (-0.30) | (-0.49) | (-0.43) | (-1.32) | (-1.30) |
| | 23,091 | 19,729 | 22,200 | 18,905 | 4,581 | 3,803 |
| Scope 2 | -0.251 | 0.781 | -1.561 | -0.294 | -69.230*** | -75.916*** |
| | (-0.16) | (0.45) | (-0.74) | (-0.15) | (-4.42) | (-3.88) |
| | 23,091 | 19,729 | 22,200 | 18,905 | 4,581 | 3,803 |
| Scope 3 | -0.801* | -0.731 | -0.752 | -0.501 | -5.441 | -7.379 |
| | (-1.90) | (-1.36) | (-1.20) | (-0.71) | (-0.85) | (-1.21) |
| | 23,091 | 19,729 | 22,200 | 18,905 | 4,581 | 3,803 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table 4: Earnings Surprises (Estimated Emissions)**

This table presents results from regressions of earnings surprises on emissions for the sample of estimated emissions only. *AFE1* (*AFE2*) is the one-year (two-year) earnings surprise measured as the actual EPS minus the I/B/E/S median analyst forecast 8 (20) months prior to the end of the forecast period, scaled by the stock price. *LTG* is the long-term growth surprise measured as the actual five-year annualized EPS growth rate minus the I/B/E/S median analyst long-term growth forecast from 56 months earlier. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI,* and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. All coefficients are multiplied by 1,000. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively**.**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | *AFE1* | *AFE1* | *AFE2* | *AFE2* | *LTG* | *LTG* |
| *Panel A: Level* | | | | | | |
| Scope 1 | 1.219** | 1.559*** | 2.533*** | 3.177*** | 46.340*** | 43.881*** |
| | (2.35) | (3.05) | (3.73) | (4.24) | (5.87) | (4.32) |
| | 15,295 | 13,415 | 14,520 | 12,691 | 1,808 | 1,587 |
| Scope 2 | 1.502** | 1.992*** | 2.986*** | 3.874*** | 32.216*** | 32.623*** |
| | (2.17) | (2.96) | (3.69) | (3.89) | (4.22) | (3.94) |
| | 15,945 | 13,947 | 15,150 | 13,213 | 1,946 | 1,697 |
| Scope 3 | 1.226* | 1.703** | 3.158*** | 4.247*** | 40.468*** | 46.948*** |
| | (1.82) | (2.70) | (3.95) | (4.46) | (6.14) | (7.43) |
| | 22,928 | 19,607 | 22,036 | 18,782 | 4,511 | 3,753 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 16.510*** | 17.554*** | 29.846*** | 30.271*** | 95.063*** | 108.791*** |
| | (5.95) | (6.58) | (9.09) | (9.80) | (2.89) | (3.60) |
| | 13,857 | 12,192 | 13,271 | 11,598 | 1,748 | 1,533 |
| Scope 2 | 16.986*** | 18.150*** | 29.666*** | 30.552*** | 111.650*** | 131.658*** |
| | (5.25) | (5.58) | (6.36) | (6.71) | (3.48) | (3.91) |
| | 14,493 | 12,711 | 13,890 | 12,111 | 1,885 | 1,643 |
| Scope 3 | 20.315*** | 20.807*** | 36.444*** | 36.737*** | 120.210*** | 123.470*** |
| | (5.95) | (6.06) | (6.63) | (7.21) | (4.47) | (4.07) |
| | 21,436 | 18,354 | 20,757 | 17,664 | 4,445 | 3,696 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | 0.661 | 0.819 | 1.520 | 1.736 | -0.594 | -8.982 |
| | (0.86) | (1.03) | (1.25) | (1.42) | (-0.04) | (-0.46) |
| | 15,295 | 13,415 | 14,520 | 12,691 | 1,808 | 1,587 |
| Scope 2 | 0.165 | 0.948 | 1.623 | 2.458 | -12.507 | -75.757 |
| | (0.06) | (0.34) | (0.50) | (0.65) | (-0.23) | (-1.21) |
| | 15,945 | 13,947 | 15,150 | 13,213 | 1,946 | 1,697 |
| Scope 3 | -0.826* | -0.753 | -0.792 | -0.529 | -5.769 | -7.586 |
| | (-1.94) | (-1.38) | (-1.24) | (-0.74) | (-0.89) | (-1.21) |
| | 22,928 | 19,607 | 22,036 | 18,782 | 4,511 | 3,753 |
| Controls | *SIZE*, *BM* | All | *SIZE*, *BM* | All | *SIZE*, *BM* | All |

**Table 5: Earnings Surprises (Disclosed Emissions)**

This table presents results from regressions of earnings surprises on emissions for the sample of disclosed emissions only. *AFE1* (*AFE2*) is the one-year (two-year) earnings surprise measured as the actual EPS minus the I/B/E/S median analyst forecast 8 (20) months prior to the end of the forecast period, scaled by the stock price. *LTG* is the long-term growth surprise measured as the actual five-year annualized EPS growth rate minus the I/B/E/S median analyst long-term growth forecast from 56 months earlier. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. All coefficients are multiplied by 1,000. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | *AFE1* | *AFE1* | *AFE2* | *AFE2* | *LTG* | *LTG* |
| *Panel A: Level* | | | | | | |
| Scope 1 | -0.170 | -0.053 | -0.086 | 0.666 | 5.893** | 14.712*** |
| | (-0.67) | (-0.12) | (-0.18) | (1.09) | (2.12) | (3.44) |
| | 7,781 | 6,304 | 7,666 | 6,204 | 2,769 | 2,212 |
| Scope 2 | 0.044 | 0.515 | 0.988 | 2.464*** | 0.702 | 9.547** |
| | (0.13) | (1.08) | (1.65) | (4.39) | (0.15) | (2.53) |
| | 7,134 | 5,781 | 7,039 | 5,691 | 2,630 | 2,106 |
| Scope 3 | 4.169 | 12.985 | 5.846 | 23.542* | 248.440 | 365.275* |
| | (0.77) | (1.16) | (0.71) | (2.13) | (1.32) | (2.41) |
| | 159 | 120 | 160 | 121 | 62 | 42 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 1.450 | 1.088 | 2.886 | 3.999 | 11.726 | 4.374 |
| | (1.38) | (0.96) | (1.19) | (1.60) | (0.74) | (0.24) |
| | 7,731 | 6,277 | 7,639 | 6,182 | 2,763 | 2,209 |
| Scope 2 | 2.164** | 1.774 | 4.642*** | 4.810*** | 5.929 | 2.586 |
| | (2.29) | (1.66) | (4.02) | (3.60) | (0.36) | (0.14) |
| | 7,093 | 5,762 | 7,018 | 5,674 | 2,625 | 2,103 |
| Scope 3 | 21.920 | 43.275* | 32.099* | 47.769* | 280.988 | 225.658 |
| | (1.32) | (1.97) | (1.94) | (1.85) | (1.62) | (1.18) |
| | 159 | 120 | 160 | 121 | 62 | 42 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -1.031** | -1.033** | -2.860*** | -2.810*** | -11.703 | -7.464 |
| | (-2.14) | (-2.46) | (-3.00) | (-3.04) | (-1.53) | (-0.95) |
| | 7,796 | 6,314 | 7,680 | 6,214 | 2,773 | 2,216 |
| Scope 2 | -2.339* | -0.715 | -6.590*** | -3.320 | -88.005*** | -69.102*** |
| | (-1.74) | (-0.42) | (-2.90) | (-1.48) | (-4.92) | (-3.98) |
| | 7,146 | 5,782 | 7,050 | 5,692 | 2,535 | 2,106 |
| Scope 3 | 0.813 | 4.463 | -2.687 | 9.050 | 2.407 | 221.500 |
| | (0.36) | (0.71) | (-0.71) | (1.37) | (0.02) | (0.93) |
| | 159 | 120 | 161 | 121 | 62 | 42 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table 6: Earnings Announcement Returns (Baseline)**

This table presents results from regressions of earnings announcement returns on emissions. Announcement returns are defined as the three-day (-1, +1) cumulative abnormal returns to quarterly announcements relative to a market model in which coefficients are estimated over (-300, -46). We present results for the full sample, estimated emissions only, and disclosed emissions only. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full Sample | Full Sample | Estimated | Estimated | Disclosed | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.064** | 0.058** | 0.133*** | 0.134** | -0.026 | -0.037 |
| | (2.50) | (2.19) | (3.17) | (2.83) | (-0.82) | (-1.05) |
| | 80,052 | 80,052 | 54,957 | 54,957 | 25,095 | 25,095 |
| Scope 2 | 0.124*** | 0.142*** | 0.210*** | 0.236*** | -0.031 | -0.029 |
| | (5.30) | (4.57) | (4.18) | (3.86) | (-1.10) | (-0.64) |
| | 80,088 | 80,088 | 57,067 | 57,067 | 23,021 | 23,021 |
| Scope 3 | 0.212*** | 0.256*** | 0.212*** | 0.255*** | 0.474 | 1.878 |
| | (6.61) | (5.63) | (6.58) | (5.56) | (0.61) | (1.11) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 1.173*** | 1.186*** | 2.226*** | 2.254*** | -0.009 | -0.009 |
| | (8.11) | (8.15) | (8.54) | (8.74) | (-0.06) | (-0.06) |
| | 74,270 | 74,270 | 49,312 | 49,312 | 24,958 | 24,958 |
| Scope 2 | 1.119*** | 1.138*** | 1.975*** | 2.007*** | 0.094 | 0.099 |
| | (6.09) | (6.31) | (6.90) | (7.05) | (0.79) | (0.82) |
| | 74,286 | 74,286 | 51,355 | 51,355 | 22,931 | 22,931 |
| Scope 3 | 2.067*** | 2.107*** | 2.063*** | 2.102*** | 6.868* | 7.501* |
| | (7.67) | (7.98) | (7.66) | (7.96) | (2.06) | (2.01) |
| | 74,298 | 74,298 | 73,809 | 73,809 | 489 | 489 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.090* | -0.092* | -0.160** | -0.165** | -0.076 | -0.081 |
| | (-1.95) | (-1.92) | (-2.22) | (-2.33) | (-1.43) | (-1.37) |
| | 80,092 | 80,092 | 54,957 | 54,957 | 25,135 | 25,135 |
| Scope 2 | -0.360*** | -0.330** | -0.712** | -0.723** | -0.329 | -0.318 |
| | (-2.80) | (-2.35) | (-2.67) | (-2.66) | (-1.68) | (-1.60) |
| | 80,092 | 80,092 | 57,067 | 57,067 | 23,025 | 23,025 |
| Scope 3 | -0.030 | -0.042 | -0.032 | -0.045 | -0.311 | -0.415 |
| | (-0.63) | (-0.95) | (-0.69) | (-1.02) | (-0.42) | (-0.37) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table 7: Earnings Announcement Returns (Controlling for Announcement Beta)**

This table presents results from regressions of earnings announcement returns on emissions. Announcement returns are defined as the three-day (-1, +1) cumulative abnormal returns to quarterly announcements relative to a market model in which coefficients are estimated over (-300, -46). We present results for the full sample, estimated emissions only, and disclosed emissions only. Columns (1), (3), and (5) control for *SIZE*, *BM* and *EABETA* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full Sample | Full Sample | Estimated | Estimated | Disclosed | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.068** | 0.062** | 0.140*** | 0.140** | -0.025 | -0.031 |
| | (2.80) | (2.36) | (3.20) | (2.82) | (-0.80) | (-0.90) |
| | 80,052 | 80,052 | 54,957 | 54,957 | 25,095 | 25,095 |
| Scope 2 | 0.124*** | 0.141*** | 0.212*** | 0.235*** | -0.031 | -0.024 |
| | (5.39) | (4.42) | (4.18) | (3.76) | (-0.95) | (-0.48) |
| | 80,088 | 80,088 | 57,067 | 57,067 | 23,021 | 23,021 |
| Scope 3 | 0.222*** | 0.261*** | 0.221*** | 0.260*** | 0.244 | 1.829 |
| | (6.45) | (5.35) | (6.42) | (5.28) | (0.34) | (1.10) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 1.168*** | 1.199*** | 2.221*** | 2.272*** | -0.002 | 0.004 |
| | (7.96) | (7.94) | (8.30) | (8.35) | (-0.01) | (0.02) |
| | 74,270 | 74,270 | 49,312 | 49,312 | 24,958 | 24,958 |
| Scope 2 | 1.105*** | 1.136*** | 1.958*** | 2.006*** | 0.092 | 0.099 |
| | (5.86) | (6.02) | (6.71) | (6.79) | (0.75) | (0.80) |
| | 74,286 | 74,286 | 51,355 | 51,355 | 22,931 | 22,931 |
| Scope 3 | 2.045*** | 2.107*** | 2.040*** | 2.102*** | 7.538** | 7.452* |
| | (7.40) | (7.56) | (7.38) | (7.54) | (2.26) | (2.09) |
| | 74,298 | 74,298 | 73,809 | 73,809 | 489 | 489 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.094* | -0.092* | -0.162** | -0.161** | -0.085 | -0.084 |
| | (-2.08) | (-1.96) | (-2.25) | (-2.25) | (-1.53) | (-1.41) |
| | 80,092 | 80,092 | 54,957 | 54,957 | 25,135 | 25,135 |
| Scope 2 | -0.403*** | -0.355** | -0.811*** | -0.807*** | -0.335 | -0.305 |
| | (-3.06) | (-2.54) | (-3.25) | (-3.13) | (-1.69) | (-1.57) |
| | 80,092 | 80,092 | 57,067 | 57,067 | 23,025 | 23,025 |
| Scope 3 | -0.031 | -0.046 | -0.036 | -0.049 | -0.524 | -0.465 |
| | (-0.67) | (-1.05) | (-0.73) | (-1.13) | (-0.63) | (-0.40) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table 8: Earnings Announcement Returns (-2, +2)**

This table presents results from regressions of earnings announcement returns on emissions. Announcement returns are defined as the five-day (-2, +2) cumulative abnormal returns to quarterly announcements relative to a market model in which coefficients are estimated over (-300, -46). We present results for the full sample, estimated emissions only, and disclosed emissions only. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full Sample | Full Sample | Estimated | Estimated | Disclosed | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.077** | 0.070** | 0.162*** | 0.170*** | -0.036 | -0.051 |
| | (2.13) | (2.10) | (2.95) | (2.92) | (-1.23) | (-1.68) |
| | 80,052 | 80,052 | 54,957 | 54,957 | 25,095 | 25,095 |
| Scope 2 | 0.157*** | 0.181*** | 0.246*** | 0.281*** | -0.009 | 0.000 |
| | (3.92) | (4.21) | (3.56) | (3.58) | (-0.28) | (0.01) |
| | 80,088 | 80,088 | 57,067 | 57,067 | 23,021 | 23,021 |
| Scope 3 | 0.248*** | 0.300*** | 0.248*** | 0.300*** | 0.530 | 2.141 |
| | (4.63) | (4.79) | (4.63) | (4.75) | (0.76) | (1.21) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 1.325*** | 1.347*** | 2.556*** | 2.560*** | -0.042 | -0.039 |
| | (8.33) | (8.43) | (8.72) | (8.84) | (-0.29) | (-0.26) |
| | 74,270 | 74,270 | 49,312 | 49,312 | 24,958 | 24,958 |
| Scope 2 | 1.300*** | 1.326*** | 2.315*** | 2.356*** | 0.072 | 0.079 |
| | (6.69) | (6.93) | (6.89) | (7.09) | (0.60) | (0.64) |
| | 74,286 | 74,286 | 51,355 | 51,355 | 22,931 | 22,931 |
| Scope 3 | 2.319*** | 2.372*** | 2.316*** | 2.369*** | 7.321* | 7.851* |
| | (8.86) | (9.11) | (8.84) | (9.09) | (2.04) | (2.01) |
| | 74,298 | 74,298 | 73,809 | 73,809 | 489 | 489 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.083* | -0.085* | -0.115 | -0.120 | -0.130** | -0.136** |
| | (-1.73) | (-1.84) | (-1.38) | (-1.47) | (-2.26) | (-2.16) |
| | 80,092 | 80,092 | 54,957 | 54,957 | 25,135 | 25,135 |
| Scope 2 | -0.386** | -0.367** | -0.828*** | -0.861*** | -0.386* | -0.369 |
| | (-2.73) | (-2.56) | (-2.95) | (-3.17) | (-1.80) | (-1.64) |
| | 80,092 | 80,092 | 57,067 | 57,067 | 23,025 | 23,025 |
| Scope 3 | -0.072 | -0.089 | -0.075 | -0.092* | 0.008 | 0.071 |
| | (-1.23) | (-1.68) | (-1.29) | (-1.76) | (0.01) | (0.08) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table 9: Earnings Announcement Returns (FF6 Model)**

This table presents results from regressions of earnings announcement returns on emissions. Announcement returns are defined as the three-day (-1, +1) cumulative abnormal returns to quarterly announcements relative to the Fama-French six-factor model in which coefficients are estimated over (-300, -46). We present results for the full sample, estimated emissions only, and disclosed emissions only. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full Sample | Full Sample | Estimated | Estimated | Disclosed | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.048* | 0.051* | 0.112** | 0.122** | -0.035 | -0.027 |
| | (1.79) | (1.75) | (2.71) | (2.42) | (-1.25) | (-0.79) |
| | 80,052 | 80,052 | 54,957 | 54,957 | 25,095 | 25,095 |
| Scope 2 | 0.107*** | 0.135*** | 0.188*** | 0.222*** | -0.047* | -0.025 |
| | (4.19) | (3.95) | (3.87) | (3.52) | (-1.93) | (-0.51) |
| | 80,088 | 80,088 | 57,067 | 57,067 | 23,021 | 23,021 |
| Scope 3 | 0.182*** | 0.238*** | 0.181*** | 0.237*** | 0.582 | 2.256 |
| | (4.77) | (4.34) | (4.75) | (4.29) | (0.81) | (1.47) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 1.233*** | 1.238*** | 2.305*** | 2.322*** | 0.029 | 0.034 |
| | (8.63) | (8.55) | (9.75) | (9.77) | (0.19) | (0.23) |
| | 74,270 | 74,270 | 49,312 | 49,312 | 24,958 | 24,958 |
| Scope 2 | 1.143*** | 1.152*** | 2.002*** | 2.023*** | 0.100 | 0.104 |
| | (7.38) | (7.40) | (7.64) | (7.66) | (0.99) | (1.01) |
| | 74,286 | 74,286 | 51,355 | 51,355 | 22,931 | 22,931 |
| Scope 3 | 2.183*** | 2.208*** | 2.179*** | 2.202*** | 7.082** | 7.595* |
| | (9.00) | (8.99) | (8.98) | (8.97) | (2.23) | (2.12) |
| | 74,286 | 74,286 | 73,809 | 73,809 | 489 | 489 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.086* | -0.087 | -0.143* | -0.147* | -0.079 | -0.074 |
| | (-1.75) | (-1.66) | (-1.89) | (-1.90) | (-1.34) | (-1.14) |
| | 80,092 | 80,092 | 54,957 | 54,957 | 25,135 | 25,135 |
| Scope 2 | -0.375** | -0.343* | -0.690** | -0.707** | -0.363 | -0.314 |
| | (-2.53) | (-2.09) | (-2.37) | (-2.29) | (-1.71) | (-1.34) |
| | 80,092 | 80,092 | 57,067 | 57,067 | 23,025 | 23,025 |
| Scope 3 | -0.038 | -0.043 | -0.040 | -0.046 | -0.004 | 0.048 |
| | (-0.79) | (-0.92) | (-0.85) | (-0.99) | (-0.01) | (0.06) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table 10: Earnings Announcement Returns (Winsorized)**

This table presents results from regressions of earnings announcement returns on emissions. Announcement returns are defined as the three-day (-1, +1) cumulative abnormal returns to quarterly announcements relative to a market model in which coefficients are estimated over (-300, -46). Announcement returns are winsorized at the 1% level. We present results for the full sample, estimated emissions only, and disclosed emissions only. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full Sample | Full Sample | Estimated | Estimated | Disclosed | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.052** | 0.056** | 0.114*** | 0.122*** | -0.029 | -0.028 |
| | (2.39) | (2.61) | (3.16) | (3.31) | (-1.21) | (-1.14) |
| | 80,052 | 80,052 | 54,957 | 54,957 | 25,095 | 25,095 |
| Scope 2 | 0.096*** | 0.121*** | 0.173*** | 0.202 | -0.040 | -0.027 |
| | (4.80) | (5.10) | (3.93) | (4.17) | (-1.38) | (-0.65) |
| | 80,088 | 80,088 | 57,067 | 57,067 | 23,021 | 23,021 |
| Scope 3 | 0.180*** | 0.231*** | 0.179*** | 0.230*** | 0.474 | 1.878 |
| | (6.05) | (6.80) | (6.03) | (6.70) | (0.61) | (1.11) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 1.098*** | 1.115*** | 2.026*** | 2.059*** | 0.046 | 0.052 |
| | (8.43) | (8.39) | (9.20) | (9.37) | (0.36) | (0.42) |
| | 74,270 | 74,270 | 49,312 | 49,312 | 24,958 | 24,958 |
| Scope 2 | 1.063*** | 1.084*** | 1.816*** | 1.851*** | 0.146 | 0.155 |
| | (6.67) | (6.91) | (7.44) | (7.60) | (1.22) | (1.29) |
| | 74,286 | 74,286 | 51,355 | 51,355 | 22,931 | 24,958 |
| Scope 3 | 1.927*** | 1.970*** | 1.922*** | 1.965*** | 6.868* | 7.501* |
| | (8.48) | (8.85) | (8.47) | (8.83) | (2.06) | (2.01) |
| | 74,286 | 74,286 | 73,809 | 73,809 | 489 | 489 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.084** | -0.080** | -0.117** | -0.117** | -0.097** | -0.097** |
| | (-2.61) | (-2.50) | (-2.16) | (-2.20) | (-2.33) | (-2.13) |
| | 80,092 | 80,092 | 54,957 | 54,957 | 25,135 | 25,135 |
| Scope 2 | -0.368*** | -0.323** | -0.629** | -0.625** | -0.347* | -0.316 |
| | (-2.91) | (-2.34) | (-2.52) | (-2.43) | (-1.84) | (-1.64) |
| | 80,092 | 80,092 | 57,067 | 57,067 | 23,025 | 23,025 |
| Scope 3 | -0.025 | -0.033 | -0.027 | -0.035 | -0.311 | -0.415 |
| | (-0.57) | (-0.77) | (-0.63) | (-0.83) | (-0.42) | (-0.37) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table 11: Other Event Announcement Returns**

This table presents results from regressions of announcement returns to earnings calls, earnings guidance, dividends, and buybacks on emissions. Announcement returns are defined as 1-day abnormal returns relative to a market model in which coefficients are estimated over (-300, -46). We present results for the full sample, estimated emissions only, and disclosed emissions only. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full Sample | Full Sample | Estimated | Estimated | Disclosed | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.007 | 0.011 | 0.032 | 0.043 | -0.025 | -0.038* |
| | (0.48) | (0.60) | (1.22) | (1.30) | (-1.72) | (-1.91) |
| | 57,668 | 57,668 | 34,633 | 34,633 | 23,035 | 23,035 |
| Scope 2 | 0.030* | 0.045** | 0.059** | 0.078** | 0.000 | 0.006 |
| | (2.06) | (2.44) | (2.40) | (2.69) | (0.00) | (0.21) |
| | 57,674 | 57,674 | 36,688 | 36,688 | 20,986 | 20,986 |
| Scope 3 | 0.028 | 0.043 | 0.028 | 0.045 | -0.006 | -0.011 |
| | (1.43) | (1.31) | (1.45) | (1.31) | (-0.06) | (-0.05) |
| | 57,683 | 57,683 | 57,140 | 57,140 | 543 | 543 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 0.165*** | 0.167*** | 0.344*** | 0.346*** | 0.004 | 0.008 |
| | (3.40) | (3.89) | (5.00) | (5.80) | (0.06) | (0.15) |
| | 54,375 | 54,375 | 31,438 | 31,438 | 22,937 | 22,937 |
| Scope 2 | 0.145** | 0.149** | 0.286** | 0.291** | 0.030 | 0.031 |
| | (2.13) | (2.32) | (2.60) | (2.85) | (0.36) | (0.38) |
| | 54,364 | 54,364 | 33,433 | 33,433 | 20,931 | 20,931 |
| Scope 3 | 0.385*** | 0.394*** | 0.386*** | 0.395*** | 0.155 | -0.081 |
| | (4.01) | (4.54) | (4.01) | (4.53) | (0.21) | (-0.11) |
| | 54,383 | 54,383 | 53,840 | 53,840 | 543 | 543 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.018 | -0.016 | -0.019 | -0.022 | -0.036** | -0.033* |
| | (-0.87) | (-0.78) | (-0.49) | (-0.55) | (-2.24) | (-2.07) |
| | 57,683 | 57,683 | 34,633 | 34,633 | 23,050 | 23,050 |
| Scope 2 | -0.057 | -0.044 | 0.007 | 0.079 | -0.090 | -0.085 |
| | (-0.91) | (-0.80) | (0.28) | (0.34) | (-1.24) | (-1.21) |
| | 57,683 | 57,683 | 36,688 | 36,688 | 20,995 | 20,995 |
| Scope 3 | -0.024 | -0.024 | -0.021 | -0.024 | -0.359 | -0.495 |
| | (-1.03) | (-1.04) | (-1.01) | (-1.03) | (-1.18) | (-1.64) |
| | 57,683 | 57,683 | 57,140 | 57,140 | 543 | 543 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table 12: Earnings and Other Event Announcement Returns**

This table presents results from regressions of earnings announcement returns and announcement returns to earnings calls, earnings guidance, dividends, and buybacks on emissions. Earnings announcement returns are defined as the three-day (-1, +1) cumulative abnormal return to quarterly announcements and event announcement returns are defined as 1-day abnormal returns both relative to a market model in which coefficients are estimated over (-300, -46). We present results for the full sample, estimated emissions only, and disclosed emissions only. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI,* and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full Sample | Full Sample | Estimated | Estimated | Disclosed | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.041** | 0.042** | 0.095*** | 0.103*** | -0.026 | -0.038** |
| | (2.40) | (2.21) | (3.12) | (2.88) | (-1.54) | (-2.19) |
| | 137,720 | 137,720 | 89,590 | 89,590 | 48,130 | 48,130 |
| Scope 2 | 0.085*** | 0.105*** | 0.153*** | 0.179*** | -0.021 | -0.018 |
| | (4.64) | (4.25) | (4.11) | (3.86) | (-1.43) | (-0.73) |
| | 137,762 | 137,762 | 93,755 | 93,755 | 44,007 | 44,007 |
| Scope 3 | 0.143*** | 0.181*** | 0.143*** | 0.181*** | 0.190 | 1.012 |
| | (5.47) | (4.68) | (5.47) | (4.65) | (0.53) | (1.22) |
| | 137,775 | 137,775 | 136,743 | 136,743 | 1,032 | 1,032 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 0.779*** | 0.787*** | 1.587*** | 1.601*** | -0.003 | -0.002 |
| | (8.26) | (8.33) | (9.43) | (9.61) | (-0.03) | (-0.02) |
| | 128,645 | 128,645 | 80,750 | 80,750 | 47,895 | 47,895 |
| Scope 2 | 0.717*** | 0.729*** | 1.373*** | 1.390*** | 0.061 | 0.063 |
| | (5.94) | (6.24) | (7.38) | (7.63) | (0.70) | (0.74) |
| | 128,650 | 128,650 | 84,788 | 84,788 | 43,862 | 43,862 |
| Scope 3 | 1.444*** | 1.470*** | 1.442*** | 1.468*** | 3.343 | 3.567 |
| | (8.35) | (8.90) | (8.33) | (8.88) | (1.77) | (1.54) |
| | 128,681 | 128,681 | 127,649 | 127,649 | 1,032 | 1,032 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.060** | -0.061** | -0.099*** | -0.104*** | -0.055* | -0.058* |
| | (-2.55) | (-2.44) | (-3.06) | (-3.15) | (-1.85) | (-1.76) |
| | 137,775 | 137,775 | 89,590 | 89,590 | 48,185 | 48,185 |
| Scope 2 | -0.228** | -0.206** | -0.401** | -0.412** | -0.219** | -0.217** |
| | (-2.83) | (-2.36) | (-2.22) | (-2.21) | (-2.29) | (-2.15) |
| | 137,775 | 137,775 | 93,755 | 93,755 | 44,020 | 44,020 |
| Scope 3 | -0.021 | -0.030 | -0.023 | -0.032 | -0.326 | -0.379 |
| | (-0.85) | (-1.29) | (-0.93) | (-1.38) | (-0.61) | (-0.53) |
| | 137,775 | 137,775 | 136,743 | 136,743 | 1,032 | 1,032 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

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**Online Appendix for "Does the Carbon Premium Reflect Risk or Outperformance?"**

## Table OA1: Earnings Surprises (Controlling for *SALESGR* and *EPSGR*)

This table presents results from regressions of earnings surprises on emissions for the full sample. *AFE1* (*AFE2*) is the one-year (two-year) earnings surprise measured as the actual EPS minus the I/B/E/S median analyst forecast 8 (20) months prior to the end of the forecast period, scaled by the stock price. *LTG* is the long-term growth surprise measured as the actual five-year annualized EPS growth rate minus the I/B/E/S median analyst long-term growth forecast from 56 months earlier. All regressions control for *SIZE*, *BM*, *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, *PPE*, *SALESGR,* and *EPSGR* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. All coefficients are multiplied by 1,000. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | *AFE1* | *AFE2* | *LTG* |
|---|---|---|---|
| *Panel A: Level* | | | |
| Scope 1 | 0.983*** | 1.623*** | -0.092 |
| | (3.94) | (3.49) | (-0.21) |
| | 19,692 | 13,391 | 6,301 |
| Scope 2 | 1.439*** | 2.059*** | 0.476 |
| | (2.98) | (3.12) | (1.06) |
| | 19,701 | 13,923 | 5,778 |
| Scope 3 | 1.761*** | 1.759*** | 13.780 |
| | (2.97) | (2.96) | (1.24) |
| | 19,702 | 19,580 | 120 |
| *Panel B: Change* | | | |
| Scope 1 | 9.776*** | 17.508*** | 0.908 |
| | (5.58) | (6.57) | (0.80) |
| | 18,446 | 12,172 | 6,274 |
| Scope 2 | 10.707*** | 18.161*** | 1.587 |
| | (4.92) | (5.57) | (1.52) |
| | 18,450 | 12,691 | 5,759 |
| Scope 3 | 20.769*** | 20.768*** | 42.062* |
| | (6.06) | (6.07) | (1.95) |
| | 18,453 | 18,331 | 120 |
| *Panel C: Intensity* | | | |
| Scope 1 | -0.108 | 0.757 | -1.159** |
| | (-0.20) | (0.99) | (-2.84) |
| | 19,702 | 13,391 | 6,311 |
| Scope 2 | 0.727 | 0.839 | -0.845 |
| | (0.42) | (0.30) | (-0.52) |
| | 19,702 | 13,923 | 5,779 |
| Scope 3 | -0.734 | -0.756 | 5.468 |
| | (-1.45) | (-1.37) | (0.87) |
| | 19,702 | 19,580 | 120 |

**Table OA2: Alternative Measures of Earnings Surprises (Full Sample)**

This table presents results from regressions of alternative measures of earnings surprises on emissions for the full sample. *MBFE1* (*MBFE2*) is the one-year (two-year) earnings surprise measured as the actual earnings minus the forecast based on a cross-sectional earnings model, scaled by the market value of equity. *FOM* is the fraction of misses on the same side defined as the number of misses strictly below actual earnings, minus the number of misses strictly above actual earnings, divided by the total number of analyst forecasts. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. All coefficients are multiplied by 1,000. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | *MBFE1* | *MBFE1* | *MBFE2* | *MBFE2* | *FOM* | *FOM* |
| *Panel A: Level* | | | | | | |
| Scope 1 | 2.427*** | 3.332*** | 3.586*** | 4.503*** | 6.126 | 16.095** |
| | (4.79) | (6.00) | (5.68) | (7.99) | (1.36) | (2.78) |
| | 24,489 | 20,992 | 23,889 | 20,443 | 22,873 | 19,529 |
| Scope 2 | 3.539*** | 4.713*** | 5.415*** | 6.613*** | 8.461 | 25.432*** |
| | (4.77) | (6.01) | (5.91) | (7.37) | (1.42) | (3.35) |
| | 24,492 | 21,001 | 23,892 | 20,452 | 22,876 | 19,538 |
| Scope 3 | 5.184*** | 7.489*** | 7.790*** | 10.049*** | 27.277*** | 49.633*** |
| | (6.34) | (8.03) | (8.13) | (9.59) | (3.33) | (4.83) |
| | 24,504 | 21,002 | 23,903 | 20,453 | 22,888 | 19,539 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 14.932*** | 14.865*** | 17.313*** | 18.250*** | 231.817*** | 240.421*** |
| | (6.78) | (6.63) | (7.33) | (7.69) | (8.46) | (9.76) |
| | 22,752 | 19,538 | 22,333 | 19,085 | 21,378 | 18,277 |
| Scope 2 | 18.984*** | 18.823*** | 20.076*** | 21.206*** | 229.574*** | 237.714*** |
| | (8.20) | (8.16) | (9.84) | (10.84) | (10.45) | (11.11) |
| | 22,750 | 19,542 | 22,331 | 19,090 | 21,376 | 18,281 |
| Scope 3 | 37.835*** | 37.239*** | 39.325*** | 40.157*** | 461.678*** | 484.340*** |
| | (9.07) | (8.43) | (8.20) | (8.90) | (10.89) | (10.66) |
| | 22,763 | 19,545 | 22,344 | 19,092 | 21,389 | 18,284 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | 0.126 | -0.056 | -0.837 | -0.838 | -9.243 | -6.533 |
| | (0.16) | (-0.07) | (-0.86) | (-0.83) | (-0.86) | (-0.61) |
| | 24,504 | 21,002 | 23,903 | 20,453 | 22,888 | 19,539 |
| Scope 2 | -2.931 | -4.397* | -3.497 | -4.351 | -98.999*** | -56.389* |
| | (-1.12) | (-2.08) | (-0.98) | (-1.31) | (-3.08) | (-1.71) |
| | 24,504 | 21,002 | 23,903 | 20,453 | 22,888 | 19,539 |
| Scope 3 | 0.137 | -0.029 | 0.259 | 0.209 | -11.236 | -9.252 |
| | (0.23) | (-0.04) | (0.30) | (0.23) | (-1.12) | (-0.80) |
| | 24,504 | 21,002 | 23,903 | 20,453 | 22,888 | 19,539 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table OA3: Alternative Measures of Earnings Surprises (Estimated Emissions)**

This table presents results from regressions of alternative measures of earnings surprises on emissions for the sample of estimated emissions only. *MBFE1* (*MBFE2*) is the one-year (two-year) earnings surprise measured as the actual earnings minus the forecast based on a cross-sectional earnings model, scaled by the market value of equity. *FOM* is the fraction of misses on the same side defined as the number of misses strictly below actual earnings, minus the number of misses strictly above actual earnings, divided by the total number of analyst forecasts. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. All coefficients are multiplied by 1,000. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | *MBFE1* | *MBFE1* | *MBFE2* | *MBFE2* | *FOM* | *FOM* |
| *Panel A: Level* | | | | | | |
| Scope 1 | 3.977*** | 5.640*** | 5.941*** | 7.387*** | 12.458* | 29.905*** |
| | (6.00) | (7.95) | (7.23) | (9.52) | (1.97) | (4.35) |
| | 16,588 | 14,607 | 16,071 | 14,135 | 15,214 | 13,342 |
| Scope 2 | 5.111*** | 6.994*** | 7.648*** | 9.570*** | 13.311 | 33.933*** |
| | (5.75) | (6.75) | (7.04) | (8.18) | (1.49) | (3.32) |
| | 17,267 | 15,165 | 16,732 | 14,683 | 15,837 | 13,853 |
| Scope 3 | 5.184*** | 7.493*** | 7.780*** | 10.065*** | 26.898*** | 49.043*** |
| | (6.33) | (8.02) | (8.15) | (9.58) | (3.29) | (4.70) |
| | 24,333 | 20,881 | 23,732 | 20,331 | 22,729 | 19,421 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 25.391*** | 25.981*** | 29.732*** | 31.275*** | 391.061*** | 412.459*** |
| | (8.36) | (8.75) | (9.70) | (10.25) | (9.49) | (10.53) |
| | 14,908 | 13,185 | 14,549 | 12,805 | 13,769 | 12,116 |
| Scope 2 | 29.729*** | 30.274*** | 31.454*** | 33.703*** | 366.018*** | 386.866*** |
| | (9.22) | (8.70) | (8.83) | (10.03) | (10.82) | (11.39) |
| | 15,572 | 13,728 | 15,196 | 13,340 | 14,381 | 12,615 |
| Scope 3 | 37.888*** | 37.275*** | 39.320*** | 40.204*** | 462.576*** | 483.576*** |
| | (9.07) | (8.44) | (8.19) | (8.91) | (11.05) | (10.70) |
| | 22,592 | 19,424 | 22,173 | 18,970 | 21,230 | 18,166 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | 1.574* | 1.712** | 1.100 | 1.055 | -7.849 | 2.698 |
| | (1.93) | (2.31) | (0.88) | (0.80) | (-0.64) | (0.21) |
| | 16,588 | 14,607 | 16,071 | 14,135 | 15,214 | 13,342 |
| Scope 2 | 1.884 | 1.029 | 2.369 | 2.686 | -204.327*** | -143.074** |
| | (0.54) | (0.33) | (0.56) | (0.58) | (-3.84) | (-2.44) |
| | 17,268 | 15,165 | 16,732 | 14,683 | 15,837 | 13,853 |
| Scope 3 | 0.132 | -0.023 | 0.252 | 0.248 | -12.663 | -11.052 |
| | (0.21) | (-0.03) | (0.30) | (0.27) | (-1.25) | (-0.93) |
| | 24,333 | 20,881 | 23,732 | 20,331 | 22,729 | 19,421 |
| Controls | *SIZE*, *BM* | All | *SIZE*, *BM* | All | *SIZE*, *BM* | All |

**Table OA4: Alternative Measures of Earnings Surprises (Disclosed Emissions)**

This table presents results from regressions of alternative measures of earnings surprises on emissions for the sample of disclosed emissions only. *MBFE1* (*MBFE2*) is the one-year (two-year) earnings surprise measured as the actual earnings minus the forecast based on a cross-sectional earnings model, scaled by the market value of equity. *FOM* is the fraction of misses on the same side defined as the number of misses strictly below actual earnings, minus the number of misses strictly above actual earnings, divided by the total number of analyst forecasts. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. All coefficients are multiplied by 1,000. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | *MBFE1* | *MBFE1* | *MBFE2* | *MBFE2* | *FOM* | *FOM* |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.341 | 0.519 | 0.357 | 1.279 | -3.892 | 8.953 |
| | (0.61) | (0.71) | (0.45) | (1.61) | (-0.47) | (0.65) |
| | 7,901 | 6,385 | 7,818 | 6,308 | 7,659 | 6,187 |
| Scope 2 | 1.187* | 1.635*** | 2.290*** | 3.269*** | -2.291 | 18.991* |
| | (1.92) | (3.23) | (2.68) | (4.09) | (-0.30) | (1.93) |
| | 7,225 | 5,836 | 7,160 | 5,769 | 7,039 | 5,685 |
| Scope 3 | 2.831 | 4.211 | -0.053 | 22.399 | 32.291 | 531.394*** |
| | (0.47) | (0.30) | (-0.01) | (1.24) | (0.18) | (3.14) |
| | 171 | 121 | 171 | 122 | 159 | 118 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 2.926 | 2.290 | 2.216 | 3.128 | 69.460* | 67.661** |
| | (1.59) | (1.33) | (0.95) | (1.22) | (2.06) | (2.27) |
| | 7,844 | 6,353 | 7,784 | 6,280 | 7,609 | 6,161 |
| Scope 2 | 6.290*** | 5.158*** | 5.489*** | 4.713*** | 78.240*** | 72.334*** |
| | (3.34) | (3.29) | (4.56) | (4.02) | (4.23) | (4.01) |
| | 7,178 | 5,814 | 7,135 | 5,750 | 6,995 | 5,666 |
| Scope 3 | 2.941 | 3.430 | 42.485* | 47.866 | 465.636 | 1,409.02 |
| | (1.70) | (1.14) | (2.13) | (1.30) | (0.74) | (1.58) |
| | 171 | 121 | 171 | 122 | 159 | 118 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -1.074 | -1.386 | -2.782* | -2.237* | -15.003 | -12.573 |
| | (-1.13) | (-1.54) | (-2.08) | (-1.93) | (-1.04) | (-0.86) |
| | 7,916 | 6,395 | 7,832 | 6,318 | 7,674 | 6,197 |
| Scope 2 | -5.660** | -5.273** | -6.852 | -5.209 | -71.913* | -24.149 |
| | (-2.16) | (-2.31) | (-1.51) | (-1.34) | (-2.06) | (-0.66) |
| | 7,236 | 5,837 | 7,171 | 5,770 | 7,051 | 5,686 |
| Scope 3 | -0.111 | -2.236 | 5.931 | 3.022 | 59.661 | 205.952*** |
| | (-0.01) | (-0.22) | (0.60) | (0.21) | (0.70) | (3.84) |
| | 171 | 121 | 171 | 122 | 159 | 118 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table OA5: Earnings Announcement Returns (Controlling for *SALESGR* and *EPSGR*)**

This table presents results from regressions of earnings announcement returns on emissions. Announcement returns are defined as the three-day (-1, +1) cumulative abnormal returns to quarterly announcements relative to a market model in which coefficients are estimated over (-300, -46). We present results for the full sample, estimated emissions only, and disclosed emissions only. All regressions control for *SIZE*, *BM*, *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, *PPE*, *SALESGR,* and *EPSGR* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | Full Sample | Estimated | Disclosed |
|---|---|---|---|
| *Panel A: Level* | | | |
| Scope 1 | 0.058** | 0.133** | -0.035 |
| | (2.14) | (2.79) | (-1.02) |
| | 80,052 | 54,957 | 25,095 |
| Scope 2 | 0.143*** | 0.235*** | -0.028 |
| | (4.54) | (3.81) | (-0.61) |
| | 80,088 | 57,067 | 23,021 |
| Scope 3 | 0.256*** | 0.255*** | 2.064 |
| | (5.68) | (5.60) | (1.15) |
| | 80,092 | 79,603 | 489 |
| *Panel B: Change* | | | |
| Scope 1 | 1.187*** | 2.254*** | -0.014 |
| | (8.15) | (8.73) | (-0.09) |
| | 74,270 | 49,312 | 24,958 |
| Scope 2 | 1.136*** | 2.000*** | 0.095 |
| | (6.33) | (7.08) | (0.81) |
| | 74,286 | 51,355 | 22,931 |
| Scope 3 | 2.108*** | 2.102*** | 7.586* |
| | (8.03) | (8.01) | (2.01) |
| | 74,298 | 73,809 | 489 |
| *Panel C: Intensity* | | | |
| Scope 1 | -0.091* | -0.164** | -0.084 |
| | (-1.93) | (-2.35) | (1.45) |
| | 80,092 | 54,957 | 25,135 |
| Scope 2 | -0.329** | -0.723** | -0.332 |
| | (-2.34) | (-2.66) | (-1.65) |
| | 80,092 | 57,067 | 23,025 |
| Scope 3 | -0.042 | -0.045 | -0.377 |
| | (-0.95) | (-1.02) | (-0.34) |
| | 80,092 | 79,603 | 489 |

**Table OA6: Earnings Announcement Returns (-1, +5)**

This table presents results from regressions of earnings announcement returns on emissions. Announcement returns are defined as the seven-day (-1, +5) cumulative abnormal returns to quarterly announcements relative to a market model in which coefficients are estimated over (-300, -46). We present results for the full sample, estimated emissions only, and disclosed emissions only. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full Sample | Full Sample | Estimated | Estimated | Disclosed | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.061 | 0.062* | 0.123** | 0.136** | -0.003 | -0.15 |
| | (1.29) | (1.74) | (2.14) | (2.74) | (-0.08) | (-0.34) |
| | 80,049 | 80,049 | 54,954 | 54,954 | 25,095 | 25,095 |
| Scope 2 | 0.143** | 0.175*** | 0.225*** | 0.266*** | 0.011 | 0.015 |
| | (2.74) | (3.84) | (2.95) | (3.54) | (0.19) | (0.21) |
| | 80,085 | 80,085 | 57,064 | 57,064 | 23,021 | 23,021 |
| Scope 3 | 0.235*** | 0.303*** | 0.235*** | 0.302*** | 0.602 | 1.969 |
| | (3.34) | (4.92) | (3.34) | (4.87) | (0.77) | (0.99) |
| | 80,089 | 80,089 | 79,600 | 79,600 | 489 | 489 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 1.448*** | 1.463*** | 2.715*** | 2.738*** | 0.047 | 0.056 |
| | (6.26) | (6.40) | (7.08) | (7.30) | (0.41) | (0.49) |
| | 74,268 | 74,268 | 49,310 | 49,310 | 24,958 | 24,958 |
| Scope 2 | 1.320*** | 1.342*** | 2.456*** | 2.488*** | -0.055 | -0.043 |
| | (4.75) | (4.94) | (5.64) | (5.92) | (-0.36) | (-0.28) |
| | 74,268 | 74,268 | 51,353 | 51,353 | 22,931 | 22,931 |
| Scope 3 | 2.562*** | 2.612*** | 2.562*** | 2.611*** | 6.843 | 7.973* |
| | (6.43) | (6.66) | (6.41) | (6.64) | (1.64) | (1.78) |
| | 74,296 | 74,296 | 73,807 | 73,807 | 489 | 489 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.115* | -0.114* | -0.144 | -0.150* | -0.161* | -0.165* |
| | (-1.97) | (-1.96) | (-1.68) | (-1.79) | (-1.98) | (-1.81) |
| | 80,089 | 80,089 | 54,954 | 54,954 | 25,135 | 25,135 |
| Scope 2 | -0.435** | -0.405** | -0.698* | -0.730* | -0.535* | -0.505* |
| | (-2.65) | (-2.58) | (-1.94) | (-2.04) | (-2.06) | (-1.96) |
| | 80,089 | 80,089 | 57,064 | 57,064 | 23,025 | 23,025 |
| Scope 3 | -0.054 | -0.063 | -0.056 | -0.065 | -0.378 | -0.608 |
| | (-0.99) | (-1.14) | (-1.05) | (-1.20) | (-0.60) | (-0.51) |
| | 80,089 | 80,089 | 79,600 | 79,600 | 489 | 489 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table OA7: Earnings Announcement Returns (-1, +10)**

This table presents results from regressions of earnings announcement returns on emissions. Announcement returns are defined as the twelve-day (-1, +10) cumulative abnormal returns to quarterly announcements relative to a market model in which coefficients are estimated over (-300, -46). We present results for the full sample, estimated emissions only, and disclosed emissions only. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full Sample | Full Sample | Estimated | Estimated | Disclosed | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.081 | 0.092* | 0.147* | 0.171** | 0.001 | -0.005 |
| | (1.29) | (2.06) | (1.74) | (2.85) | (0.02) | (-0.12) |
| | 80,044 | 80,044 | 54,949 | 54,949 | 25,095 | 25,095 |
| Scope 2 | 0.159** | 0.196*** | 0.238** | 0.284*** | 0.019 | 0.031 |
| | (2.18) | (3.37) | (2.41) | (3.35) | (0.23) | (0.37) |
| | 80,080 | 80,080 | 57,059 | 57,059 | 23,021 | 23,021 |
| Scope 3 | 0.280** | 0.362*** | 0.280** | 0.361*** | 0.311 | 1.267 |
| | (2.63) | (4.24) | (2.62) | (4.21) | (0.34) | (0.62) |
| | 80,084 | 80,084 | 79,595 | 79,595 | 489 | 489 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 1.600*** | 1.636*** | 2.881*** | 2.932*** | 0.199 | 0.218 |
| | (5.85) | (5.87) | (6.24) | (6.35) | (1.05) | (1.18) |
| | 74,263 | 74,263 | 49,305 | 49,305 | 24,958 | 24,958 |
| Scope 2 | 1.385*** | 1.424*** | 2.501*** | 2.552*** | 0.041 | 0.061 |
| | (5.10) | (5.27) | (6.07) | (6.23) | (0.28) | (0.42) |
| | 74,279 | 74,279 | 51,348 | 51,348 | 22,931 | 22,931 |
| Scope 3 | 2.656*** | 2.738*** | 2.658*** | 2.739*** | 6.619 | 7.596 |
| | (6.30) | (6.27) | (6.31) | (6.28) | (1.74) | (1.64) |
| | 74,291 | 74,291 | 73,802 | 73,802 | 489 | 489 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.124* | -0.109 | -0.138 | -0.126 | -0.224** | -0.223** |
| | (-1.91) | (-1.65) | (-1.35) | (-1.32) | (-2.78) | (-2.31) |
| | 80,084 | 80,084 | 54,949 | 54,949 | 25,135 | 25,135 |
| Scope 2 | -0.603*** | -0.545** | -0.990** | -0.961** | -0.729*** | -0.679** |
| | (-3.26) | (-2.77) | (-2.31) | (-2.24) | (-2.95) | (-2.64) |
| | 80,084 | 80,084 | 57,059 | 57,059 | 23,025 | 23,025 |
| Scope 3 | -0.048 | -0.066 | -0.051 | -0.069 | -0.396 | -0.843 |
| | (-0.67) | (-0.95) | (-0.70) | (-0.99) | (-0.69) | (-1.00) |
| | 80,084 | 80,084 | 79,595 | 79,595 | 489 | 489 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table OA8: Earnings Announcement Returns (All Robustness Combined)**

This table presents results from regressions of earnings announcement returns on emissions. Announcement returns are defined as the five-day (-2, +2) cumulative abnormal returns to quarterly announcements relative to the Fama-French six-factor model in which coefficients are estimated over (-300, -46). Announcement returns are winsorized at the 1% level. We present results for the full sample, estimated emissions only, and disclosed emissions only. Columns (1), (3), and (5) control for *SIZE*, *BM* and *EABETA* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full Sample | Full Sample | Estimated | Estimated | Disclosed | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.035 | 0.051* | 0.097** | 0.120** | -0.054** | -0.025 |
| | (1.44) | (1.86) | (2.47) | (2.37) | (-2.63) | (-1.18) |
| | 80,052 | 80,052 | 54,957 | 54,957 | 25,095 | 25,095 |
| Scope 2 | 0.086*** | 0.126*** | 0.155*** | 0.200*** | -0.055* | -0.002 |
| | (4.17) | (4.23) | (3.57) | (3.47) | (-1.76) | (-0.05) |
| | 80,088 | 80,088 | 57,067 | 57,067 | 23,021 | 23,021 |
| Scope 3 | 0.166*** | 0.240*** | 0.166*** | 0.239*** | 0.280 | 2.579 |
| | (4.62) | (4.59) | (4.63) | (4.55) | (0.44) | (1.61) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 1.248*** | 1.265*** | 2.358*** | 2.390*** | 0.009 | 0.028 |
| | (8.57) | (8.55) | (9.53) | (9.55) | (0.07) | (0.21) |
| | 74,270 | 74,270 | 49,312 | 49,312 | 24,958 | 24,958 |
| Scope 2 | 1.205*** | 1.221*** | 2.060*** | 2.087*** | 0.162 | 0.175 |
| | (7.67) | (7.61) | (7.51) | (7.54) | (1.47) | (1.52) |
| | 74,286 | 74,286 | 51,355 | 51,355 | 22,931 | 22,931 |
| Scope 3 | 2.235*** | 2.271*** | 2.231*** | 2.267*** | 8.519** | 7.696** |
| | (9.78) | (9.59) | (9.75) | (9.56) | (2.68) | (2.29) |
| | 74,298 | 74,298 | 73,809 | 73,809 | 489 | 489 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.086* | -0.077* | -0.100 | -0.095 | -0.145** | -0.128* |
| | (-1.94) | (-1.75) | (-1.24) | (-1.14) | (-2.36) | (-2.02) |
| | 80,092 | 80,092 | 54,957 | 54,957 | 25,135 | 25,135 |
| Scope 2 | -0.455** | -0.395* | -0.838** | -0.830** | -0.411 | -0.297 |
| | (-2.36) | (-2.02) | (-2.84) | (-2.77) | (-1.66) | (-1.13) |
| | 80,092 | 80,092 | 57,067 | 57,067 | 23,025 | 23,025 |
| Scope 3 | -0.051 | -0.052 | -0.054 | -0.055 | -0.020 | 0.512 |
| | (-1.08) | (-1.17) | (-1.14) | (-1.25) | (-0.04) | (0.68) |
| | 80,092 | 80,092 | 79,603 | 79,603 | 489 | 489 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |

**Table OA9: Earnings and Other Earnings-Related Announcement Returns (FF6 Model)**

This table presents results from regressions of earnings announcement returns and announcement returns to other earnings-related corporate events on emissions. Earnings announcement returns are defined as the three-day (-1, +1) cumulative abnormal return to quarterly announcements and other announcement returns are defined as 1-day abnormal returns both relative to the Fama-French six-factor model in which coefficients are estimated over (-300, -46). We present results for the full sample, estimated emissions only, and disclosed emissions only. Columns (1), (3), and (5) control for *SIZE* and *BM* whereas columns (2), (4), and (6) also control for *MOM*, *ROE*, *IA*, *BETA*, *VOL*, *LEV*, *HHI*, and *PPE* as defined in Table 1. All regressions include industry and year fixed effects. The intercept terms and coefficients of the control variables are not reported for brevity. *t*-statistics with standard errors clustered at the firm and year level are in parentheses, and the number of observations is below the *t*-statistic. ***,**, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Full Sample | Full Sample | Estimated | Estimated | Disclosed | Disclosed |
| *Panel A: Level* | | | | | | |
| Scope 1 | 0.031* | 0.037* | 0.080** | 0.093** | -0.032* | -0.033* |
| | (1.75) | (1.88) | (2.81) | (2.64) | (-2.04) | (-1.81) |
| | 137,720 | 137,720 | 89,590 | 89,590 | 48,130 | 48,130 |
| Scope 2 | 0.074*** | 0.098*** | 0.137*** | 0.168*** | -0.031** | -0.017 |
| | (3.95) | (3.84) | (3.89) | (3.59) | (-2.21) | (-0.69) |
| | 137,762 | 137,762 | 93,755 | 93,755 | 44,007 | 44,007 |
| Scope 3 | 0.125*** | 0.171*** | 0.125*** | 0.171*** | 0.268 | 1.261 |
| | (4.09) | (3.78) | (4.08) | (3.75) | (0.81) | (1.65) |
| | 137,775 | 137,775 | 136,743 | 136,743 | 1,032 | 1,032 |
| *Panel B: Change* | | | | | | |
| Scope 1 | 0.803*** | 0.807*** | 1.628*** | 1.636*** | 0.006 | 0.011 |
| | (8.22) | (8.16) | (10.35) | (10.27) | (0.06) | (0.11) |
| | 128,645 | 128,645 | 80,750 | 80,750 | 47,895 | 47,895 |
| Scope 2 | 0.719*** | 0.727*** | 1.371*** | 1.386*** | 0.057 | 0.060 |
| | (7.08) | (7.17) | (7.95) | (8.03) | (0.81) | (0.87) |
| | 128,650 | 128,650 | 84,788 | 84,788 | 43,862 | 43,862 |
| Scope 3 | 1.501*** | 1.518*** | 1.499*** | 1.516*** | 3.695* | 3.923* |
| | (9.56) | (9.67) | (9.55) | (9.65) | (2.07) | (1.80) |
| | 128,681 | 128,681 | 127,649 | 127,649 | 1,032 | 1,032 |
| *Panel C: Intensity* | | | | | | |
| Scope 1 | -0.059** | -0.058** | -0.092** | -0.095** | -0.058* | -0.054 |
| | (-2.30) | (-2.14) | (-2.59) | (-2.54) | (-1.79) | (-1.51) |
| | 137,775 | 137,775 | 89,590 | 89,590 | 48,185 | 48,185 |
| Scope 2 | -0.240** | -0.214* | -0.387* | -0.394* | -0.249** | -0.221* |
| | (-2.52) | (-2.06) | (-2.02) | (-1.93) | (-2.29) | (-1.81) |
| | 137,775 | 137,775 | 93,755 | 93,755 | 44,020 | 44,020 |
| Scope 3 | -0.019 | -0.023 | -0.021 | -0.025 | -0148 | -0.105 |
| | (-0.69) | (-0.83) | (-0.76) | (-0.91) | (-0.36) | (-0.19) |
| | 137,775 | 137,775 | 136,743 | 136,743 | 1,032 | 1,032 |
| Controls | *SIZE, BM* | All | *SIZE, BM* | All | *SIZE, BM* | All |