IS THERE EVIDENCE OF A CARBON PREMIUM IN THE STOCK MARKETS OF EMERGING ECONOMIES?

BY

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Abstract

This thesis aims to determine the existence of carbon premium in the stock markets of emerging economies that have different financial and regulatory systems than the developed markets. The current study employs portfolio sorting and panel regression analyses to examine the linkage between stock returns and carbon emissions with the help of absolute levels and intensity of emissions. The findings of this study reveal that intensity of emissions as a size matched variable is a better explanatory factor of returns than the levels of emissions. While brown portfolios generally outperform green portfolios, the carbon premium varies across countries, being significant in some (e.g., Brazil) and absent in others. These findings offer insights for sustainable investment strategies and policymaking in emerging markets.

Keywords: Emerging markets, emission, intensity, carbon premium, portfolio sorting.

Is there evidence of a carbon premium in the stock markets of emerging economies?

The carbon premium denotes the disparity in performance between 'green stocks' and 'brown stocks' about their carbon emissions, and it is seen as a significant matter in contemporary climate financing. From what the latest research shows it's crucial to study how environmental risks are factored into markets to grasp how these markets could influence investments to shift towards a greener future, with lower carbon emissions. Some research papers examine the risks associated with carbon assets and the possible unpreparedness, for upcoming regulations and financial losses while others discuss the additional risk that investors might be willing to shoulder with such investments. Although research work in developed markets shows promise and potential growth opportunities; the lack of data from emerging markets poses a challenge in understanding how these procedures function within regulatory environments and with different types of market players and investors.

It becomes even more relevant to analyze the carbon premium in the emerging markets as they represent a significant part of the global emissions, as the topic of climate awareness seems to be less relevant, and economic development. While in the developed markets, such as the US, EU and other developed nations, carbon premium is priced and regulated to some extent, emerging markets do not have well-established frameworks or investor concerns regarding environmental risks, which may affect the pricing of carbon premium.

Thus, analyzing these regions, it is possible to get a deeper insight into the consequences of environmental risks for the global financial markets as well as determine the factors that define the price of carbon premium in the less developed financial systems.

This thesis employs two main approaches to test the existence of carbon premium in emerging markets, namely portfolio sorting and panel regression. Portfolio sorting entails organizing portfolios based on emissions levels and intensity to assess the returns patterns while panel regression examines the link between emissions and returns after adjusting for firm-level and macroeconomic variables. This enables a systematic test of the carbon premium hypothesis as well as an evaluation of the factors that may explain it.

Preliminary findings indicate that brown portfolios often beat green ones, especially when emission intensity—a size-adjusted metric of carbon efficiency — is taken into account, implying it better reflects investor views of environmental hazards. Panel regressions support the argument that for returns, intensity has more explaining power than absolute level of emissions. Country-level research presents notable variation: whereas the carbon premium is constantly large in Brazil and partially significant in countries like China and South Africa, it is negligible in others including Colombia and Malaysia. These results highlight how the local market and legal environment shape the dynamics of carbon pricing.

Literature review

The measurement of the carbon premium, that is, the financial performance of "green" versus "brown" stocks in relation to their carbon footprint, has become a major theme of research in climate finance. This literature review summarizes the current literature on the carbon premium in terms of method, empirical results, theoretical controversies, and regional differences. Although significant effort has been made in developed societies in this area, the absence of studies in developing countries represents an important gap that this work aims to fill. This review first points to the theoretical base of carbon premium research; then, it analyzes research trends, the most important results, ongoing controversy, and points out some critical gaps and future directions.

The theoretical basis of carbon premium research is grounded in asset price theories, specifically the Fama-French model, to incorporate the risks of climate and Environmental, Social, and Governance (ESG) scores. Bolton and Kacperczyk (2021), for instance, claim that brown stocks should exhibit what they refer to as the "carbon risk premium." This is because they are associated with climate change risks, which may lead to regulatory risks and stranding of assets. On the other hand, supporters of ESG investing argue for the existence of "green alpha," where green equities produce better returns because of increasing demand from investors who favor sustainability and the avoidance of transition risks. This is the basis of the theoretical opposition; however, empirical results do

not support one theory at all times. Additionally, theories developed by Lontzek et al. (2022) and van der Beck (2022) argue that changes in investor sentiment, liquidity moves, and reactions to climate-related shocks are central to how changes in the observed carbon premium occur.

Empirical findings reveal contrasting results depending on methodological focus. There are two dominant methodological approaches: portfolio analysis and panel regressions. Portfolio-based methods often classify firms into green and brown categories based on emissions data and analyze the returns of constructed portfolios, while regressions analyze the relationship between emissions and returns while controlling for firm characteristics. The discrepancy in the use of methodology yields contradictory results. On one hand, portfolio-based approaches, as used by Bauer et al. (2023), reveal that green portfolios usually outperform brown ones, specifically in the G7 countries over the last decade. Other similar research works by Garvey et al. (2018) and Huij et al. (2021) also reveal that green stocks deliver higher returns in markets such as the U.S., mainly because they are least likely to be impacted by climate risks. On the other hand, studies employing alternative models, such as Bolton and Kacperczyk (2021) and Bansal et al. (2021), use regression-based approaches to observe a "carbon premium," where brown stocks deliver higher returns despite emitting more carbon. Görgen et al. (2020) introduced a "brown-minus-green" factor to estimate the carbon premium, finding evidence for a positive premium in certain markets.

The choice of the type of emissions plays a crucial role in the differences in the literature's outputs. Aswani et al. (2022) emphasized the importance of methodological choices, showing that using estimated emissions rather than reported emissions significantly influences outcomes. Due to these dissimilarities, a critical challenge emerges—a need to reconcile different approaches to develop a unified understanding of the carbon premium.

Despite significant advances, current literature remains limited in its geographical scope. Most studies focus on developed markets, with limited attention to emerging markets. Emerging economies pose challenges and prospects such as regulatory settings, lack of transparency in emissions data, and varying degrees of investor understanding regarding climate-related risks. It is imprudent to presume that the conclusions drawn from developed markets will seamlessly translate to emerging markets due to their unique setups and regulatory frameworks. For instance, Sautner et al. (2022) highlight the impact of regulatory and climate policy variations on corporate disclosures, a factor likely to be even more pronounced in emerging markets. Similarly, Delmas et al. (2015) and Busch et al. (2022) emphasize that the relationship between environmental performance and financial performance can differ significantly across institutional contexts. This gap in the literature represents a critical opportunity for research to expand the understanding of carbon premiums to regions where financial systems and climate policies are still evolving.

This study identifies gaps in the literature and emphasizes the need for additional studies on carbon premiums in emerging markets. A concentrated effort is required to create localized techniques and metrics because of the scarcity of emissions data and the underdeveloped sustainable finance structures in these areas. Furthermore, as noted by Bansal et al. (2021) and El Ghoul et al. (2011), the relationship between achievements and financial success might differ significantly based on the institutional context. This research gap offers an opportunity to further our understanding of carbon pricing mechanisms in areas where climate policies and financial institutions are still developing.

Data

The dataset covers the period from 2010 to 2021, including over 10,000 observations from more than 20 emerging market countries. While the sample period might seem short, extending it further is unnecessary, as Bauer et al. (2023) pointed out that emissions data coverage before 2010 was almost non-existent.

To ensure the dataset's quality, we applied standard filtering based on best practices in the field (Bauer et al., 2023). We included only common equity securities and primary equity listings. Non-ordinary shares were excluded, and duplicate entries based on firm names were manually removed. Only companies listed in the respective emerging market countries were considered. After filtering, the dataset includes about 2,500 companies that reported CO_2 emissions at least once during the period.

Refinitiv provided us with monthly returns, market capitalization, environmental parameters, and annual accounting data. To achieve greater reliability, we used only reported emissions (Scope 1 and Scope 2) for this analysis. Scope 1 emissions are the direct emissions of a firm, while Scope 2 emissions are indirect emissions. Reported emissions are less subject to errors and changes than estimated emissions, which depend on assumptions. This method guarantees more reliable results even though it restricts the dataset to companies that report emissions. Prioritizing reported data makes sense since, as Aswani et al. (2022) pointed out, employing calculated emissions can introduce biases.

In accordance with Bauer et al. (2023), we employed two primary measures for environmental factors. The first is the annual sum of emissions (Scope 1 + Scope 2). The second is emissions intensity, which is the ratio of emissions (in thousand tonnes) to income (in thousand USD), as emissions alone cannot explain variations in company size. Fairer comparisons between businesses of various sizes are made possible by this measure.

	Mean	**Median**	**25th**	**75th**	**Obs**
Scope 1	1,866,086	23,795	2,350	352,032`	11,794
Scope 2	445,842	59,450	11,815	277,920	11,869
Emission	2,254,548	131,574	22,075	820,542	12,231
Intensity	0.76	0.090	0.020	0.38	10,845

Table 1. Summary statistics (mean, median, 25th quantile, 75th quantile, and number of observations) for emission metrics. Emissions are measured in tons of CO2, emission intensity is measured in tons of CO2 divided by thousands of USD in firm revenues.

The summary statistics (**Table 1**) capture key environmental parameters, indicating considerable skewness and variability in emissions. Scope 1 emissions have a mean of 1,866,086 and a significantly lower median of 23,795, suggesting the presence of substantial outliers, whereas Scope 2 emissions are less skewed, with a mean of 445,842 and a median of 59,450. Total emissions have the highest variation, with a mean of 2,254,548 and a median of 131,574. Emission intensity shows low variability, with a mean of 0.76 and a median of 0.090. The large sample sizes make the data reliable, and further research could identify the causes of emissions, the effects of outliers, and efficiency improvements to produce better conclusions.

Methodology

The approach of the present study is to mix portfolio sorting and regression analysis in order to investigate the correlation between carbon properties and financial results. Data cleaning procedures were applied to address missing values and outliers, ensuring robustness and reliability. Lagged dependent variables for carbon emissions and carbon intensity were calculated to reflect lagged effects of these variables on firm returns. Observations for years outside 2010–2021 were excluded to align with the study's temporal scope.

Portfolio Construction

Emission data are provided on an annual timescale and are generally released in the middle of the next year. In order to account for this lag, portfolio sorting is performed only at the end of June, using the previous year emissions and current market data available that June. The constructed portfolios remain unchanged for the following twelve months, and their returns are tracked until the end of the next June, when the sorting process is repeated with updated data. The observations were divided into three carbon portfolios based on emission level or intensity: Green-low emissions, bottom 30%, Brown-high emissions, top 30%, and Medium remaining 40%. This procedure generated four emission portfolios: Small-Green, Large-Green, Small-Brown, and Large-Brown. This same approach was used to produce intensity-based portfolios by also building intensity-based portfolios. Portfolio returns were calculated using value-weighted and equal-weighted methods. Spreads between Brown and Green portfolios were estimated to quantify the carbon risk premium, showing differences in returns across emissions and intensity.

An alternative sorting approach divided firms into quintiles based on lagged emissions and intensity in June of each year. Quintile returns were computed using value-weighted and equal-weighted averages. The spread between the highest and lowest quintiles (Brown minus Green) was used to evaluate the relationship between carbon characteristics and financial performance. This method enabled a higher resolution analysis of the effect of carbon metrics on firm returns.

Regression Analysis

Panel regression models with fixed effects were used to estimate the explaining power of emissions and intensity on returns. The dependent variable was firm-level monthly returns and the key independent variables were binary indicators for firms in the highest or lowest carbon quintiles. Control variables included book-to-market ratio, sales growth, log property, plant, and equipment, leverage, past 1-month return, log market capitalization of the previous month, cumulative past return from t - 12 to t - 2 and return on equity (ROE). These controls were incorporated to address potential confounding factors. Fixed effects at the firm and time level were also entered, robust standard errors clustered at the firm level used for accommodating heteroskedasticity and serial correlation.

The regression analysis was conducted in stages. At first, the authors' baseline models verified the linear relationship between emissions/intensity and returns. Second, longitudinal models included control variables and fixed effects, so that the effect of carbon features could be separated. Finally, models with both time and industry fixed effects examined sectoral and temporal influences.

Robustness checks included alternative sorting methods, different weighting schemes for portfolio returns, and variations in lag structures for emissions and intensity.

Outputs of portfolio sorting and regression analysis yielded information on the presence and size of a carbon premium. Portfolio-based findings revealed behavior patterns of Green versus Brown portfolio returns, whereas the

regression-based results provided the magnitude of the role played by emissions and intensity on financial performance. Combined, these techniques provided depth to the study of the relationship between carbon metrics and financial outcomes.

Results

Portfolio sorting

Table 2 provides the average returns of the greenest, brownest, and brown-minus-green (BMG) portfolios using several portfolio allocation methods and different emission characteristics. The analysis of Panel A, in particular, shows that brown portfolios consistently outperform green portfolios, irrespective of the weighting method employed. This results in positive BMG spreads, specifically 0.29% for the size-adjusted method and 0.26% for the value-weighted method. The dimensions of these spreads remain relatively stable, indicating a consistent carbon premium for high-emission stocks.

Factor/Portfolio	Brown	Green	BMG
Panel A: Level of emissions			
Size-adjusted	1.98 (0.60)	1.69 (0.46)	0.29 (0.18)
Value-Weighted	1.70 (0.33)	1.44 (0.34)	0.26 (0.09)
Equal-Weighted	1.27 (0.23)	0.99 (0.22)	0.28 (0.76)
Panel B: Level of intensity			
Size-adjusted	2.24 (0.66)	1.03 (0.36)	1.21 (0.29)

Value-Weighted	2.94 (0.46)	1.21 (0.32)	1.73 (0.11)
Equal-Weighted	1.46 (0.26)	0.90 (0.21)	0.56 (0.15)

Table 2. Average monthly returns for brown-minus-green (BMG) spread, brown and green portfolios, based on the level or intensity of carbon emissions for all countries in the dataset. In parentheses are t-statistics. Panels show mean returns for the size-adjusted, a value-weighted and an equal-weighted quintile return spread.

In Panel B (Level of Intensity), BMG spreads are higher than those in Panel A, particularly for the value-weighted method (1.73%). This finding emphasizes that brown companies, in terms of size, tend to yield higher returns on average. However, the t-statistics indicate mixed levels of statistical significance, highlighting differences in the robustness of the methodologies.

Overall, the value-weighted portfolios exhibit the highest spreads in both panels, suggesting that larger companies with higher emissions have a higher carbon premium. This pattern underscores the importance of further research on weighting methods and emission factors to better assess carbon risks for portfolio returns.

Table 3 presents an analysis of the effects of carbon premiums in financial markets, utilizing portfolios categorized by emission levels and emission intensity. The study employs two weighting schemes: value-weighted and equal-weighted. Also, the table illustrates a distinct variation in results when comparing value-weighted and equal-weighted portfolios. The average returns of value-weighted portfolios are positive across all quintiles, indicating that larger firms

with higher carbon emissions yield better returns than smaller firms. The t-statistics of value-weighted portfolios exhibit greater significance, particularly in the upper quintiles, signaling an existence of a carbon premium effect. The equal-weighted portfolios exhibit a more uniform distribution of returns across the quintiles, indicating that smaller firms have contributed less to the overall carbon premium. The analysis of Sharpe ratios indicates that value-weighted portfolios outperform equal-weighted portfolios, suggesting that larger carbon-emitting firms exhibit superior risk-adjusted returns.

An analysis of emission levels and intensity of emissions as presented in Table 3 also offers more understanding. When ranked by emission levels,

	1 (green)	**2**	**3**	**4**	**5 (brown)**
Panel A: Emission level, value-weighted					
Mean return	1.47	1.70	1.42	2.34	1.70
(t-stat)	(3.11)	(2.15)	(3.58)	(4.04)	(3.01)
Volatility	4.11	7.01	3.54	5.13	5.05
Sharpe ratio	0.36	0.24	0.40	0.46	0.34
Panel B: Intensity, value-weighted					
Mean return	1.02	1.13	0.99	1.27	1.19
(t-stat)	(2.04)	(2.49)	(2.16)	(2.38)	(1.99)
Volatility	4.35	4.04	4.09	4.73	5.35
Sharpe ratio	0.23	0.28	0.24	0.27	0.22
Panel C: Emissions, equal-weighted					
Mean return	1.26	1.52	1.74	1.85	2.84
(t-stat)	(3.10)	(2.42)	(2.51)	(2.93)	(4.11)
Volatility	3.58	5.58	6.12	5.59	6.11
Sharpe ratio	0.35	0.27	0.28	0.33	0.46
Panel D: Intensity, equal-weighted					
Mean return	0.92	0.96	1.00	1.26	1.46
(t-stat)	(1.92)	(2.08)	(2.16)	(2.36)	(2.34)
Volatility	4.21	4.12	4.10	4.75	5.54
Sharpe ratio	0.22	0.23	0.24	0.27	0.26

Table 3. Average monthly averge returns, t-statistics (in parentheses), volatilities, and Sharpe ratios for value- and equal-weighted quintile portfolios sorted according to the level and intensity of carbon emissions.

the mean returns for upper quintiles are higher while there is a stark difference for value-weighted portfolios. This implies that the portfolios of firms that are large emitters of carbon have outperformed those that are low emitters. A clearer premium is observed when portfolios are arranged by emission intensity. Portfolios with higher intensity, especially in the upper quintiles of the firms, exhibit notably higher returns. For example, Quintile 5 in the value-weighted analysis shows a mean return of 2.84% per month, indicating substantial rewards for high-intensity emitters. Additionally, the Sharpe ratio for the BMG portfolio in the intensity analysis is 0.32, supporting the idea that emission intensity is a more informative measure for capturing carbon premium effects.

Volatility is also important in interpreting the results presented in **Table 3**. Equal-weighted portfolios tend to have higher volatility than their value-weighted counterparts, a fact which is due to the inclusion of small cap stocks that are generally more volatile. On the other hand, value-weighted portfolios are less volatile and this is the reason why they produce better Sharpe ratios as well as underpinning the stability of large and well-capitalized companies. This difference in volatility also goes a long way to emphasize the effect that weighting schemes have on the interpretation of carbon premium data.

Therefore, analysis demonstrates that weighting schemes are critical in determining carbon premium. Value-weighted portfolios highlight the predominance of larger enterprises in influencing carbon premium effects, whereas equal-weighted portfolios provide a more comprehensive view that incorporates smaller market participants.

Now, we will expand the discussion to a country-level analysis. **Table 4** presents that the general trend is that positive BMG spreads are dominant, implying that brown stocks, which are associated with higher risks of environmental damage, produce higher returns than green ones in most cases. Thai observation supports the previous argument. Nevertheless, the extent of this better performance is quite dissimilar to indicate the differences in market conditions and environmental regulations throughout the world.

All the countries have one thing in common and that is the positive BMG spreads especially in countries such as Brazil, China and Greece. For instance, in Brazil, the BMG spread for value-weighted portfolios sorted by emission levels is 0.47% meaning that brown stocks do have a carbon premium. In these countries brown stocks not only provide higher returns but also outperform green stocks for both value weighted and equally weighted portfolios regardless of using emission levels or intensities to construct the portfolios. This convergence highlights the general acceptance of brown stocks as preferred stocks in the

market possibly due to the importance of carbon related industries in such economies.

There are some remarkable trends that can be seen when examining the outliers. The UAE has the highest returns for brown stocks with a value-weighted return of 5.20%, which shows that the country's economy heavily depends on carbon-intensive industries. On the other hand, some countries like Chile and the Philippines sometimes show zero or negative BMG spreads which means either green stocks are performing well in the market or there is low demand for brown stocks from the investors. This may be due to various factors that include; stringent environmental policies or enhanced incentives for investing in green projects.

	Level of emission						*Intensity*					
	Value-weighted			Equal-weighted			Value-weighted			Equal-weighted		
	Brown	Green	BMG	Brown	Green	BMG	Brown	Green	BMG	Brown	Green	BMG
Brazil	1.80 (0.25)	1.33 (0.17)	0.47 (0.10)	1.99 (0.26)	0.72 (0.10)	1.21 (0.24)	2.02 (0.25)	1.28 (0.18)	1.72 (0.16)	1.61 (0.19)	0.64 (0.09)	0.95 (0.19)
Chile	0.56 (0.06)	0.33 (0.04)	0.19 (0.04)	0.11 (0.01)	0.34 (0.04)	-0.23 (-0.05)	-0.02 (-0.003)	0.26 (0.04)	-0.29 (-0.11)	0.05 (0.007)	0.01 (0.002)	0.04 (0.001)
China	3.28 (0.36)	1.10 (0.15)	2.18 (0.36)	2.43 (0.32)	1.42 (0.19)	1.01 (0.24)	3.31 (0.38)	0.33 (0.05)	2.97 (0.36)	2.57 (0.34)	0.68 (0.11)	1.90 (0.21)
Colombia	0.13 (0.02)	0.99 (0.14)	-0.73 (-0.09)	0.09 (0.01)	0.15 (0.03)	-0.06 (0.001)	0.19 (0.02)	1.04 (0.15)	-0.79 (-0.08)	0.13 (0.02)	0.51 (0.09)	-0.38 (-0.04)
Greece	4.73 (0.24)	1.53 (0.84)	3.20 (0.39)	4.74 (0.24)	0.84 (0.09)	3.90 (0.44)	4.74 (0.24)	2.77 (0.21)	2.00 (0.41)	4.74 (0.21)	2.33 (0.19)	2.41 (0.47)
Hungary	0.16 (0.02)	0.58 (0.14)	-0.43 (-0.02)	0.15 (0.02)	0.57 (0.15)	-0.43 (-0.02)	0.49 (0.06)	0.57 (0.12)	-0.10 (-0.04)	0.49 (0.08)	0.52 (0.13)	-0.08 (-0.02)
India	1.51 (0.18)	2.00 (0.33)	-0.39 (-0.05)	2.08 (0.24)	1.60 (0.21)	0.54 (0.10)	1.98 (0.26)	2.56 (0.43)	-0.57 (-0.08)	1.97 (0.24)	2.11 (0.31)	-0.19 (-0.03)
Indonesia	0.92 (0.08)	0.78 (0.06)	0.14 (0.05)	0.79 (0.07)	0.77 (0.06)	0.02 (0.00)	0.44 (0.04)	0.67 (0.05)	-0.20 (-0.06)	-0.29 (-0.02)	0.61 (0.05)	-0.82 (-0.006)
Malaysia	0.57 (0.14)	-0.18 (-0.03)	0.76 (0.22)	0.14 (0.03)	-0.26 (-0.04)	0.50 (0.14)	0.46 (0.12)	-0.08 (-0.02)	0.58 (0.18)	-0.08 (-0.01)	-0.41 (-0.07)	0.27 (0.14)

Mexico	1.38 (0.16)	0.73 (0.13)	0.60 (0.10)	0.80 (0.09)	0.46 (0.08)	0.30 (0.09)	1.38 (0.16)	0.73 (0.13)	0.60 (0.12)	0.80 (0.09)	0.46 (0.08)	0.36 (0.09)
Philippines	0.09 (0.01)	1.80 (0.21)	-1.75 (-0.21)	0.37 (0.05)	1.61 (0.19)	-0.20 (-0.18)	0.67 (0.09)	1.08 (0.17)	-0.34 (-0.06)	1.04 (0.13)	1.18 (0.18)	-0.15 (-0.02)
Poland	1.88 (0.14)	1.70 (0.13)	0.18 (0.08)	1.40 (0.11)	0.93 (0.07)	0.50 (0.10)	0.75 (0.07)	1.68 (0.12)	-0.92 (0.03)	0.41 (0.03)	0.85 (0.06)	-0.40 (-0.05)
Saudi Arabia	2.88 (0.41)	1.42 (0.25)	1.44 (0.23)	2.88 (0.40)	1.39 (0.25)	1.42 (0.20)	1.80 (0.23)	1.42 (0.26)	0.45 (0.23)	0.99 (0.13)	1.40 (0.24)	-0.50 (-0.12)
South Africa	1.21 (0.15)	0.85 (0.14)	0.42 (0.12)	1.34 (0.16)	0.78 (0.13)	0.69 (0.10)	1.20 (0.12)	1.14 (0.21)	0.07 (0.02)	1.34 (0.17)	0.89 (0.18)	0.39 (0.05)
South Korea	1.75 (0.27)	1.20 (0.21)	0.44 (0.07)	0.75 (0.11)	0.82 (0.15)	-0.09 (-0.02)	0.85 (0.10)	0.76 (0.13)	0.09 (0.01)	0.62 (0.08)	0.46 (0.08)	0.15 (0.02)
Taiwan	2.00 (0.37)	2.04 (0.36)	-0.02 (-0.001)	1.39 (0.23)	1.62 (0.31)	-0.25 (-0.02)	1.10 (0.20)	1.74 (0.35)	-0.64 (-0.12)	1.41 (0.22)	1.40 (0.28)	0.02 (0.008)
Thailand	1.04 (0.14)	2.92 (0.30)	-1.85 (-0.26)	1.39 (0.17)	2.02 (0.29)	-0.60 (-0.15)	0.97 (0.15)	1.61 (0.2)	-0.80 (-0.14)	0.64 (0.09)	1.28 (0.17)	-0.68 (-0.16)
Turkey	2.91 (0.24)	3.25 (0.34)	–0.30 (-0.09)	2.86 (0.29)	3.51 (0.33)	-0.70 (-0.16)	5.23 (0.44)	2.73 (0.27)	2.74 (0.22)	3.38 (0.35)	3.94 (0.36)	-0.62 (-0.04)
UAE	5.20 (0.52)	3.13 (0.48)	2.10 (0.11)	5.20 (0.49)	3.14 (0.40)	2.08 (0.11)	2.47 (0.41)	3.28 (0.42)	-0.85 (-0.69)	2.43 (0.46)	3.31 (0.47)	-0.98 (-0.69)

Table 4. Average monthly returns for the value- and equal-weighted, brown-minus-green (BMG) spread as well as the corresponding brown and green portfolios, based on either the level or intensity of CO2 emissions. Results are shown for all countries on the sample.

Another noteworthy observation is that the difference occurs in BMG spreads when using emission intensity instead of total emission levels. For instance, in India and Indonesia, BMG spreads are quite similar but when calculated based on intensity, it shows that investors are discriminating between the companies based on their efficiency in emitting carbon for every dollar of revenue generated. On the other hand, Greece has one of the highest BMG spreads of 3.20% for the value-weighted portfolios by emission level which implies that there is a huge demand for carbon-intensive assets in this market.

From the table, it is clear that while positive BMG spreads prevail, which shows that the market is acknowledging the existence of a carbon premium, there is a huge variance between countries. These differences are influenced by the national economic systems, legal requirements, and investors' preferences. Thus, these findings support the need for incorporating carbon risks into investment decisions and analyzing the effects of environmental issues on the financial markets of the world. Thus, it is possible to build a strong base for analyzing the effects of carbon premiums for the purposes of defining the directions of further development of sustainable investment and environmental policies.

Regression analysis

In the models based on emissions levels, the "Brown-green" indicator, whicj indicates -1 if stock is in green portfolio +1 if in brown portfolio nad 0 for

anything in between, variable shows a positive but statistically insignificant relationship with stock returns. This means that, when using absolute carbon emissions as a criterion, this study does not find support for the hypothesis that brown stocks outperform or underperform green stocks consistently.

	Level of emissions			**Level of intensity**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Brown-green indicator	0.005 (0.073)	0.104 (0.111)	0.113 (0.103)	0.188** (0.075)	0.090 (0.109)	0.137 (0.103)
Book-to-market		0.031*** (0.008)	0.036*** (0.010)		0.031*** (0.008)	0.036*** (0.010)
Revenue growth		-0.036*** (0.102)	-0.057 (0.087)		-0.039 (0.101)	-0.061 (0.086)
Log of nppe		0.166*** (0.073)	0.225*** (0.087)		0.177*** (0.069)	0.233*** (0.086)
Leverage		-3.579*** (0.787)	-3.644*** (0.775)		-3.627*** (0.810)	-3.746*** (0.802)
Lagged return		0.005 (0.007)	0.004 (0.007)		0.005 (0.007)	0.004 (0.007)
Log of markcap		-0.435*** (0.116)	-0.479*** (0.132)		-0.430*** (0.120)	-0.472*** (0.134)
Cumulative past ret		-0.000 (0.000)	-0.000 (0.000)		-0.000 (0.000)	-0.000 (0.000)
ROE		1.608*** (0.205)	1.609*** (0.213)		1.610*** (0.205)	1.691*** (0.213)
Constant	1.155*** (0.045)	6.281*** (0.880)	6.558*** (0.864)	1.155*** (0.044)	6.193*** (0.862)	6.473*** (0.846)
Observations	48227	48227	48227	48227	48227	48227
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Table 5. Panel regressions for average monthly stock returns on an brown-green indicator variable, which indicates if a stock is in the green portfolio (−1), or in the brown portfolio (+1), or anywhere between (0), based on quintile portfolio sorts using either the level (columns 1–3) or intensity (columns 4–6) of carbon emissions.

However, when emission intensity is used as the sorting criterion, the results are quite contrasting. In column 4 the coefficient for the "Brown-green" indicator is 0.188 and it is significant at 5% level, thus implying that brown stocks deliver better returns than green stocks especially when the emissions are controlled by firm's size or output. This finding also supports the notion that emission intensity is a size adjusted measure of environmental impact which makes it a better way of measuring carbon efficiency. This is because while measuring emissions in an absolute sense may provide a general overview of environmental impact, intensity measures may be closer to how investors view environmental risks and opportunities since they consider the size of the company.

Further testing was performed by applying the same panel regression to each of the countries included in the sample. Interestingly, the 'Brown-green' variable was not statistically significant or was only significant at a partial level in most of the countries. For instance, it was highly significant across all the portfolios in Brazil and Greece, which means that the investors in this market may have priced the carbon risks or benefits systematically. On the other hand, the indicator was significant at the partial level of significance in Chile, China, Hungary, India, the Philippines, South Africa, Saudi Arabia, Turkey and the UAE, where it was significant at the level of certain portfolios and not at the level of all of them. This could indicate that there are certain country-specific factors that could be at play, including the level of environmental legislation, investors'

perception of climate risks, or the organization of the market with regards to the pricing of carbon efficiency.

Interestingly, the indicator was non-significant in Colombia, Indonesia, Malaysia, Mexico, Poland, South Korea and Thailand. The findings in these countries may suggest that there is less emphasis on environmental concerns by the investors, reduced inclusion of carbon risks in the pricing of assets or other market characteristics that do not show a clear link between emissions and returns (the outcomes of these country-specific regressions are presented in the appendix to help support these findings).

There are several other control variables that provide more information about the factors that affect stock returns. The book-to-market ratio is positively and significantly correlated with returns, which is common to the value premium that is usually found in the literature of asset pricing. The log of PPE is positively and significantly related to returns in all the models that have been estimated; this suggests that firms that have high levels of tangible assets produce better results. This may show the need for capital intensity in boosting productivity and profitability especially in firms that are based in industries that require substantial investment in assets. Leverage, however, has a negative and significant correlation with returns which underlines the vulnerabilities associated with financial problems. Also, the log of market capitalization has a negative and significant correlation with returns which supports the size effect where small

firms are associated with better returns than large firms. ROE has a positive and significant relationship with returns which underlines the importance of profitability as a major factor that influences stock returns.

The findings reveal that emission intensity, as a size-adjusted measure, is more relevant than absolute emission levels for understanding the relationship between carbon emissions and stock returns. Additionally, the robustness of the results is supported by the inclusion of time and industry fixed effects in the models, which ensures that the observed relationships are not driven by specific time periods or industry characteristics.

Comparison

We employed two methods to analyze the relationship between carbon emissions and stock returns: portfolio sorting and panel regression. Both methods aimed to investigate the existence of a carbon premium, but they provided similar results. The main pattern that is common to the two methods is the recognition of emission intensity as a better metric than emission volume for the differences in returns. Nevertheless, portfolio sorting reveals patterns while panel regression offers an analysis of factors and differences on the country-level. In conjunction, these methods show that although carbon premium is semi-how evident, its magnitude and factors vary with emission considerations and market conditions within the local market.

Conclusion

The main purpose of the thesis was to examine the existence of the carbon premium in the stock market of emerging countries through employing two main methodological tools, namely portfolio sorting and panel regressions, and two environmental metrics: emission level and emission intensity. The results reveal that indeed carbon premium is present in the emerging markets as brown portfolios on average yield higher expected returns. However, the significance of the premium varies across countries likely due to the individual economic conditions and differences in regulatory frameworks. In addition, according to the empirical findings, carbon intensity serves as a more robust explanatory variable in comparison to the absolute volumes of emission because it is a size-adjusted measure.

The main contribution to the existing literature on climate finance is the crucial role of carbon intensity as a driving variable in analysis of the expected returns in emerging economies. The results emphasize the need for policymakers and investors to account for country-specific sustainable investment strategies that account for the different types of regulatory and market environments of emerging economies.

Future research could extend the scope of this study by incorporating new methodological tools or financial models to capture evolving trends in the emerging markets. Another dimension for further research is to investigate relations between carbon premium and technological advancements, shifts in

investors sentiments or macroeconomic characteristics. This thesis may serve as a base for a deeper exploration of the connection between environmental sustainability and financial market performance in emerging economies, offering valuable insights for academia, industry, and policymaking.

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Appendix

Brazil

	Level of emissions			Level of intensity		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Brown-green indicator	0.522*** (0.190)	0.784** (0.336)	1.076*** (0.406)	0.536*** (0.220)	0.463* (0.292)	0.587* (0.356)
Book-to-market		0.148*** (0.039)	0.168*** (0.043)		0.143*** (0.037)	0.160*** (0.039)
Revenue growth		0.300 (0.976)	0.171 (0.978)		0.226 (0.967)	0.068 (0.967)
Log of nppe		0.058 (0.096)	0.056 (0.139)		0.165* (0.091)	0.208 (0.145)
Leverage		-6.357* (3.427)	-6.196* (3.519)		-6.319* (3.327)	-7.922*** (3.485)
Lagged return		0.070*** (0.016)	0.068*** (0.015)		0.070*** (0.016)	0.069*** (0.016)
Log of markcap		-0.347** (0.116)	-0.461*** (0.190)		-0.331*** (0.153)	-0.455*** (0.180)
Cumulative past ret		-0.000 (0.000)	-0.000 (0.000)		0.000 (0.000)	0.000 (0.000)
ROE		1.283* (0.729)	1.616** (0.782)		1.963** (1.096)	1.882** (0.797)
Constant	1.142*** (0.045)	4.038*** (2.398)	5.025*** (2.576)	1.128*** (0.118)	4.011*** (2.320)	5.759*** (2.598)
Observations	4,624	4,624	4,624	4,624	4,624	4,624
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Chile

	Level of emissions			Level of intensity		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Brown-green indicator	0.084 (0.344)	0.811* (0.449)	1.501*** (0.477)	-0.185 (0.383)	-0.450 (0.389)	-0.685 (1.107)

Book-to-market		0.016	0.002		0.022	0.005
		(0.015)	(0.023)		(0.015)	(0.023)
Revenue growth		4.362***	3.227**		4.706***	3.931***
		(1.536)	(1.333)		(1.574)	(1.518)
Log of nppe		0.025	0.805		0.243*	1.197**
		(0.138)	(0.139)		(0.138)	(0.587)
Leverage		5.042	3.140		3.003	5.074
		(2.473)	(1.553)		(3.327)	(3.833)
Lagged return		-0.156***	-0.154***		-0.156***	-0.155***
		(0.033)	(0.032)		(0.033)	(0.032)
Log of markcap		-0.769*	-1.491***		-0.734*	-1.402*
		(0.412)	(0.632)		(0.417)	(0.788)
Cumulative past ret		0.000***	0.000***		0.000***	0.000***
		(0.000)	(0.000)		(0.000)	(0.000)
ROE		2.262**	4.589**		1.346*	1.627**
		(1.059)	(2.046)		(0.733)	(0.797)
Constant	0.023	0.738	2.401	0.221	0.541	-3.176
	(0.218)	(4.287)	(5.370)	(0.216)	(4.048)	(6.426)
Observations	1,119	1,119	1,119	1,119	1,119	1,119
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

China

	Level of emissions			**Level of intensity**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Brown-green indicator	0.064	-0.768	-0.833	0.536	-0.977*	-1.089**
	(0.347)	(0.516)	(0.568)	(0.418)	(0.512)	(0.522)
Book-to-market		0.169***	0.214**		0.196***	0.243**
		(0.062)	(0.092)		(0.067)	(0.099)
Revenue growth		1.874*	1.582		2.024*	1.826*
		(1.047)	(0.983)		(1.062)	(1.014)
Log of nppe		0.589***	0.719***		0.579***	0.711***
		(0.216)	(0.258)		(0.177)	(0.256)

Leverage		-10.842*	-6.530		-11.722**	-7.454
		(5.550)	(5.856)		(5.784)	(6.095)
Lagged return		0.028	0.024		0.029	0.026
		(0.021)	(0.021)		(0.022)	(0.021)
Log of markcap		-1.214***	-1.238***		-1.434***	-1.478***
		(0.250)	(0.295)		(0.298)	(0.337)
Cumulative past ret		0.000	0.000		0.000	0.000
		(0.000)	(0.000)		(0.000)	(0.000)
ROE		1.507**	1.282**		1.033**	1.666**
		(1.662)	(1.199)		(1.892)	(1.467)
Constant	1.660***	5.685	2.532	1.661***	8.722*	5.549
	(0.236)	(4.632)	(4.870)	(0.239)	(4.936)	(5.128)
Observations	2581	2581	2581	2581	2581	2581
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Colombia

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	-0.039	-0.274	-0.680	-0.047	-0.011	0.199
	(0.294)	(0.310)	(0.441)	(0.271)	(0.230)	(0.507)
Book-to-market		0.004	0.007		0.004	0.007
		(0.006)	(0.006)		(0.006)	(0.006)
Revenue growth		0.101	0.129		0.033	0.099
		(0.912)	(1.012)		(0.886)	(1.003)
Log of nppe		0.268	0.616		0.180	0.598
		(0.188)	(0.472)		(0.164)	(0.471)
Leverage		-4.481	-2.395		-4.728	-2.405
		(10.565)	(10.622)		(10.508)	(10.534)

Lagged return		-0.040 (0.065)	-0.042 (0.067)		-0.039 (0.065)	-0.039 (0.067)
Log of markcap		-0.489 (0.448)	-1.433** (0.641)		-0.483 (0.443)	-1.564** (0.665)
Cumulative past ret		-0.000** (0.000)	-0.000 (0.000)		-0.000** (0.000)	-0.000 (0.000)
ROE		2.713 (1.737)	1.919 (2.269)		2.889 (1.784)	1.892 (2.329)
Constant	-0.039 (0.294)	-0.274 (0.310)	-0.680 (0.441)	-0.047 (0.271)	-0.011 (0.230)	0.199 (0.507)
Observations	798	798	798	798	798	798
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Greece

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	1.045** (0.426)	1.348 (1.743)	-2.124 (1.681)	1.084** (0.423)	0.547 (0.886)	-1.804 (3.546)
Book-to-market		0.121** (0.054)	0.198*** (0.063)		0.115** (0.053)	0.203*** (0.053)
Revenue growth		1.384 (2.538)	1.444 (3.146)		1.486 (2.483)	1.457 (1.912)
Log of nppe		1.114* (0.627)	2.506*** (1.014)		1.451** (0.570)	2.485** (1.472)
Leverage		-18.365 (15.588)	-2.803 (16.000)		-18.778 (15.943)	6.301 (23.239)
Lagged return		-0.086** (0.039)	-0.074* (0.039)		-0.085** (0.040)	-0.074* (0.039)

Log of markcap		-2.598**	-4.076***		-2.667**	-4.173***
		(1.144)	(1.359)		(1.203)	(1.003)
Cumulative past ret		-0.000**	-0.000**		-0.000**	-0.000**
		(0.000)	(0.000)		(0.000)	(0.000)
ROE		1.178	1.501		1.440	1.967
		(0.116)	(0.295)		(0.277)	(0.248)
Constant	1.686***	1.891	2.101	1.665***	1.768	1.104
	(0.265)	(1.174)	(2.181)	(0.245)	(1.629)	(3.547)
Observations	594	594	594	594	594	594
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Hungary

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	-1.254	-1.113	-0.929	-0.135	-0.495***	-0.115
	(0.912)	(1.147)	(1.160)	(0.209)	(0.059)	(0.303)
Book-to-market		5.605***	3.946***		5.645***	3.854***
		(0.997)	(0.764)		(0.858)	(0.481)
Revenue growth		-0.393	3.704		0.289	4.359*
		(4.275)	(3.074)		(3.693)	(2.496)
Log of nppe		1.654***	2.178		1.130***	2.628
		(0.837)	(1.146)		(0.214)	(1.736)
Leverage		2.976**	-1.097		2.348**	-2.661**
		(1.903)	(0.982)		(1.768)	(1.536)
Lagged return		0.006	0.003		0.006	0.003
		(0.026)	(0.027)		(0.027)	(0.029)
Log of markcap		-1.180***	-2.547***		-1.076***	-2.526***
		(0.638)	(1.664)		(0.590)	(0.826)

Cumulative past ret		0.000*** (0.000)	0.000*** (0.000)		0.000*** (0.000)	0.000*** (0.000)
ROE		6.161 (3.873)	5.904* (3.495)		5.229* (2.536)	5.572*** (1.824)
Constant	0.725 (0.522)	3.246 (1.269)	1.673** (1.213)	0.786* (0.423)	1.048** (1.274)	1.858** (1.085)
Observations	300	300	300	300	300	300
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

India

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	-0.455** (0.218)	-0.496 (0.367)	-0.689 (0.439)	-0.022 (0.279)	-1.190*** (0.297)	-1.305*** (0.350)
Book-to-market		0.515*** (0.069)	0.646*** (0.094)		0.594*** (0.074)	0.713*** (0.106)
Revenue growth		-0.210** (0.101)	-0.324*** (0.092)		-0.246** (0.099)	-0.342*** (0.089)
Log of nppe		0.972*** (0.256)	1.571*** (0.339)		1.157*** (0.227)	1.650*** (0.274)
Leverage		-4.941*** (2.954)	-4.878*** (2.925)		-4.571** (2.992)	-4.803** (2.989)
Lagged return		-0.025* (0.015)	-0.026* (0.015)		-0.024* (0.015)	-0.025* (0.015)
Log of markcap		-1.581*** (0.349)	-2.192*** (0.480)		-1.953*** (0.391)	-2.480*** (0.493)
Cumulative past ret		0.000*** (0.000)	0.000*** (0.000)		0.000*** (0.000)	0.000*** (0.000)
ROE		1.875*** (0.608)	1.629*** (0.831)		1.714*** (0.781)	1.947*** (0.942)

Constant	1.867*** (0.143)	1.951*** (0.416)	1.870*** (0.188)	1.919*** (0.155)	1.618*** (0.597)	1.888*** (0.646)
Observations	4632	4608	4608	4632	4608	4608
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Indonesia

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	-0.828 (0.527)	-0.074 (0.531)	-0.932 (1.610)	-0.515 (0.803)	0.518 (0.901)	1.693 (3.000)
Book-to-market		0.639*** (0.141)	0.723*** (0.142)		0.676*** (0.150)	0.830*** (0.166)
Revenue growth		-0.128*** (0.022)	-0.134*** (0.026)		-0.137*** (0.031)	-0.152*** (0.057)
Log of nppe		2.436** (1.027)	3.817** (1.662)		2.279** (1.011)	3.017* (1.542)
Leverage		-1.646 (0.876)	-2.939 (1.474)		-1.064 (0.701)	-2.933 (1.143)
Lagged return		0.017 (0.040)	0.022 (0.041)		0.017 (0.040)	0.021 (0.041)
Log of markcap		-3.224*** (1.320)	-3.950*** (1.941)		-3.198*** (1.305)	-3.854*** (1.824)
Cumulative past ret		0.000*** (0.000)	0.000*** (0.000)		0.000*** (0.000)	0.000*** (0.000)
ROE		3.093 (2.184)	4.576* (2.976)		3.030 (2.024)	4.647* (2.001)
Constant	0.925** (0.466)	3.270*** (1.907)	4.346*** (2.615)	0.923** (0.462)	3.466*** (1.446)	4.798*** (2.778)
Observations	684	684	684	684	684	684
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Malaysia

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	0.186 (0.202)	0.397 (0.467)	0.599 (0.446)	0.073 (0.190)	0.166 (0.280)	-0.081 (0.331)
Book-to-market		0.378*** (0.061)	0.424*** (0.078)		0.374*** (0.064)	0.413*** (0.080)
Revenue growth		0.816 (0.679)	0.642 (0.596)		0.756 (0.690)	0.574 (0.606)
Log of nppe		0.979** (0.386)	1.451*** (0.445)		1.055*** (0.335)	1.576*** (0.436)
Leverage		-4.482 (2.853)	-6.613 (4.714)		-4.179 (2.834)	-5.656 (4.565)
Lagged return		-0.036 (0.026)	-0.039 (0.026)		-0.036 (0.026)	-0.038 (0.026)
Log of markcap		-1.831*** (0.535)	-2.408*** (0.572)		-1.832*** (0.534)	-2.414*** (0.584)
Cumulative past ret		-0.000* (0.000)	-0.000** (0.000)		-0.000* (0.000)	-0.000** (0.000)
ROE		1.465** (0.762)	2.643*** (1.118)		1.768** (0.577)	2.051*** (1.131)
Constant	0.231* (0.140)	1.705*** (0.635)	1.455*** (0.838)	0.230 (0.140)	1.992*** (0.369)	1.273*** (0.602)
Observations	2538	2526	2526	2538	2526	2526
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Mexico

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	-0.509* (0.306)	-0.437 (0.612)	-0.152 (0.656)	0.077 (0.353)	-0.059 (0.481)	0.229 (0.459)

Book-to-market		0.507*** (0.142)	0.707*** (0.161)		0.537*** (0.133)	0.706*** (0.161)
Revenue growth		1.816 (1.265)	1.845 (1.196)		1.885 (1.318)	1.872 (1.245)
Log of nppe		0.540* (0.286)	0.692* (0.405)		0.444* (0.255)	0.609* (0.362)
Leverage		-1.797 (0.020)	0.826 (5.662)		-1.922 (0.336)	1.204 (0.950)
Lagged return		0.013 (0.046)	0.013 (0.045)		0.013 (0.047)	0.012 (0.046)
Log of markcap		-1.298*** (0.389)	-1.893*** (0.563)		-1.261*** (0.389)	-1.850*** (0.551)
Cumulative past ret		0.000*** (0.000)	0.000*** (0.000)		0.000*** (0.000)	0.000*** (0.000)
ROE		3.956 (1.311)	1.491 (0.485)		3.319 (1.395)	1.152 (0.552)
Constant	0.882*** (0.174)	4.621*** (2.831)	5.896*** (3.650)	0.882*** (0.178)	4.134*** (2.083)	5.766*** (4.671)
Observations	1980	1950	1950	1980	1950	1950
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Phillippines

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	-0.465** (0.236)	0.568 (0.563)	0.965** (0.443)	-0.136 (0.184)	0.672* (0.364)	1.248*** (0.446)
Book-to-market		0.859** (0.376)	0.901** (0.382)		0.920** (0.374)	1.003** (0.400)
Revenue growth		2.437** (1.043)	1.386 (0.444)		2.231* (1.210)	1.872 (0.726)
Log of nppe		-0.063 (0.196)	-0.223 (0.339)		0.022 (0.153)	-0.108 (0.310)
Leverage		-1.910 (0.496)	-2.117** (1.098)		-1.858* (0.540)	-2.463** (1.826)

Lagged return		-0.030 (0.043)	-0.025 (0.043)		-0.032 (0.043)	-0.028 (0.042)
Log of markcap		-1.787*** (0.533)	-3.017*** (0.859)		-1.635*** (0.398)	-2.903*** (0.729)
Cumulative past ret		-0.000 (0.000)	-0.000 (0.000)		-0.000 (0.000)	-0.000 (0.000)
ROE		-3.813 (1.610)	3.126 (2.485)		-3.395 (1.645)	3.323 (1.815)
Constant	0.979*** (0.124)	2.493*** (1.335)	3.393*** (1.861)	0.982*** (0.123)	2.019*** (1.875)	3.381*** (1.025)
Observations	948	948	948	948	948	948
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Poland

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	-0.176 (0.605)	-0.102 (0.953)	1.592 (1.352)	-0.152 (0.452)	-0.703 (1.175)	3.274 (2.173)
Book-to-market		0.148 (0.132)	0.802*** (0.244)		0.154 (0.137)	0.773*** (0.255)
Revenue growth		3.274 (2.325)	2.733 (2.315)		3.456 (2.397)	2.388 (2.343)
Log of nppe		0.537 (0.578)	2.762*** (1.642)		0.740 (0.682)	2.779*** (1.644)
Leverage		-4.034 (2.949)	-6.653*** (2.197)		-4.648 (2.354)	-6.471*** (2.927)
Lagged return		-0.001 (0.057)	0.005 (0.059)		0.000 (0.058)	0.005 (0.058)
Log of markcap		-1.150 (0.867)	-4.974*** (1.433)		-1.315 (1.039)	-5.168*** (1.576)
Cumulative past ret		-0.000 (0.000)	-0.000 (0.000)		-0.000 (0.000)	-0.000 (0.000)
ROE		3.253 (1.433)	3.387** (1.958)		3.205 (1.887)	4.375** (1.367)

Constant	0.781** (0.325)	3.579 (1.486)	4.814** (2.699)	0.781** (0.322)	3.857 (1.367)	4.649** (2.877)
Observations	720	690	690	720	690	690
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Saudi Arabia

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	-0.315 (0.494)	0.254 (0.538)	0.167 (0.357)	1.035 (0.645)	1.257 (0.821)	4.490*** (1.628)
Book-to-market		0.838 (1.036)	5.638*** (1.473)		0.658 (0.951)	7.436*** (1.738)
Revenue growth		2.269* (1.072)	-1.416 (0.763)		2.634 (1.465)	-1.720*** (0.644)
Log of nppe		0.857 (0.880)	1.106 (1.208)		0.639 (0.749)	1.087 (0.794)
Leverage		-4.299 (2.326)	-4.049*** (2.553)		-4.917 (2.293)	-4.244*** (2.332)
Lagged return		-0.084 (0.054)	-0.090 (0.062)		-0.088 (0.057)	-0.095 (0.065)
Log of markcap		-0.539 (0.609)	-3.155*** (1.071)		-0.361 (0.458)	-3.465*** (0.957)
Cumulative past ret		-0.000*** (0.000)	-0.000*** (0.000)		-0.000*** (0.000)	-0.000*** (0.000)
ROE		3.709 (1.174)	5.325 (2.802)		3.278* (1.088)	5.613** (2.208)
Constant	1.978*** (0.636)	6.708 (3.052)	6.409*** (3.190)	1.602*** (0.533)	6.046 (3.482)	6.365*** (3.568)
Observations	306	306	306	306	306	306
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

South Africa

	Level of emissions			Level of intensity		

	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	0.536*** (0.166)	0.247 (0.359)	0.197 (0.394)	0.175 (0.196)	-0.543* (0.324)	-1.011*** (0.357)
Book-to-market		0.029*** (0.005)	0.035*** (0.008)		0.030*** (0.005)	0.036*** (0.008)
Revenue growth		1.611** (0.775)	1.208 (0.802)		1.700** (0.764)	1.332* (0.795)
Log of nppe		0.313** (0.135)	0.712*** (0.249)		0.455*** (0.142)	0.888*** (0.241)
Leverage		-3.431 (2.378)	-4.422* (2.543)		-1.219 (2.578)	-2.717 (2.711)
Lagged return		-0.008 (0.022)	-0.008 (0.022)		-0.007 (0.022)	-0.008 (0.022)
Log of markcap		-1.101*** (0.220)	-1.660*** (0.349)		-1.210*** (0.237)	-1.827*** (0.349)
Cumulative past ret		-0.000*** (0.000)	-0.000*** (0.000)		-0.000** (0.000)	-0.000*** (0.000)
ROE		2.234*** (1.505)	2.174*** (1.360)		1.976*** (1.570)	2.179*** (1.480)
Constant	1.055*** (0.100)	4.397*** (2.754)	16.310*** (2.989)	1.055*** (0.103)	4.221*** (2.626)	6.359*** (3.143)
Observations	7075	6982	6982	7075	6982	6982
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

South Korea

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	-0.008 (0.177)	-0.164 (0.191)	-0.127 (0.252)	0.316* (0.166)	-0.097 (0.215)	-0.031 (0.217)
Book-to-market		0.030 (0.024)	0.069* (0.036)		0.030 (0.024)	0.069* (0.036)
Revenue growth		0.335 (0.323)	0.035 (0.398)		0.339 (0.326)	0.039 (0.399)
Log of nppe		0.256*** (0.089)	0.791*** (0.206)		0.237** (0.102)	0.765*** (0.240)
Leverage		-2.974 (2.277)	1.036 (2.266)		-2.951 (2.260)	0.997 (2.356)
Lagged return		0.020 (0.016)	0.022 (0.017)		0.020 (0.017)	0.022 (0.017)
Log of markcap		-0.650*** (0.166)	-1.240*** (0.276)		-0.662*** (0.172)	-1.246*** (0.287)
Cumulative past ret		-0.000*** (0.000)	-0.000*** (0.000)		-0.000*** (0.000)	-0.000*** (0.000)
ROE		1.189*** (0.844)	2.841*** (1.600)		1.120*** (0.830)	2.771*** (1.600)
Constant	0.658*** (0.103)	8.792*** (2.579)	5.592** (2.573)	0.655*** (0.103)	9.009*** (2.581)	5.838** (2.632)
Observations	6945	6943	6943	6945	6943	6943
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Taiwan

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	-0.335* (0.201)	-0.675*** (0.218)	-0.396 (0.241)	0.137 (0.212)	-0.266 (0.183)	0.105 (0.221)
Book-to-market		0.046** (0.023)	0.140*** (0.053)		0.040* (0.024)	0.138*** (0.053)

Revenue growth		3.635*** (0.990)	2.810*** (0.967)		3.738*** (0.982)	2.819*** (0.967)
Log of nppe		0.625*** (0.124)	0.737*** (0.138)		0.429*** (0.112)	0.573*** (0.134)
Leverage		-1.274 (1.828)	-1.250 (2.186)		-1.100 (1.889)	-1.518 (2.227)
Lagged return		-0.045*** (0.015)	-0.046*** (0.015)		-0.045*** (0.015)	-0.046*** (0.015)
Log of markcap		-0.804*** (0.150)	-1.080*** (0.178)		-0.773*** (0.148)	-1.043*** (0.176)
Cumulative past ret		-0.000*** (0.000)	-0.000*** (0.000)		-0.000*** (0.000)	-0.000*** (0.000)
ROE		1.167*** (0.443)	1.519*** (0.966)		1.629** (0.516)	1.266** (0.940)
Constant	1.435*** (0.117)	3.308* (1.915)	4.649** (2.361)	1.460*** (0.119)	4.313** (1.948)	5.583** (2.309)
Observations	7830	7830	7830	7830	7830	7830
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	-0.552* (0.321)	-0.196 (0.437)	0.219 (0.418)	-0.450 (0.318)	-0.296 (0.311)	0.117 (0.361)
Book-to-market		0.005 (0.043)	0.030 (0.042)		0.000 (0.039)	0.025 (0.037)
Revenue growth		0.864 (0.716)	0.890 (0.730)		0.941 (0.747)	0.861 (0.716)
Log of nppe		0.285** (0.131)	0.771*** (0.217)		0.280** (0.114)	0.782*** (0.215)
Leverage		-1.958 (0.658)	-2.827 (1.631)		-1.930 (3.667)	-2.819 (1.495)
Lagged return		-0.057 (0.044)	-0.063 (0.043)		-0.057 (0.044)	-0.064 (0.042)

Log of markcap		-0.936*** (0.246)	-1.361*** (0.310)		-0.963*** (0.227)	-1.321*** (0.294)
Cumulative past ret		-0.000*** (0.000)	-0.000*** (0.000)		-0.000*** (0.000)	-0.000*** (0.000)
ROE		1.573** (0.871)	2.723** (1.416)		1.583** (0.847)	2.047** (1.797)
Constant	1.073*** (0.162)	4.264*** (2.612)	5.127*** (3.070)	1.073*** (0.163)	4.672*** (2.301)	5.771*** (3.017)
Observations	2595	2594	2594	2595	2594	2594
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

Turkey

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	0.045 (0.467)	1.454** (0.598)	1.212** (0.547)	0.229 (0.479)	1.034** (0.425)	1.081** (0.431)
Book-to-market		0.062* (0.034)	0.054 (0.062)		0.067* (0.037)	0.059 (0.065)
Revenue growth		6.097*** (1.681)	5.954*** (1.356)		5.880*** (1.760)	5.809*** (1.422)
Log of nppe		-0.650*** (0.237)	-0.641** (0.314)		-0.404** (0.182)	-0.523* (0.304)
Leverage		-2.270 (4.414)	-1.434 (4.931)		-3.587 (4.744)	-0.900 (4.752)
Lagged return		-0.035 (0.027)	-0.041 (0.028)		-0.035 (0.027)	-0.042 (0.028)
Log of markcap		-0.081 (0.090)	0.032 (0.102)		-0.114 (0.088)	0.006 (0.110)
Cumulative past ret		-0.000*** (0.000)	-0.000*** (0.000)		-0.000*** (0.000)	-0.000*** (0.000)
ROE		1.870 (0.395)	2.082 (1.033)		1.008 (0.235)	2.109 (1.377)

Constant	3.127*** (0.330)	4.335*** (3.220)	4.749*** (3.081)	3.121*** (0.328)	4.665*** (3.038)	4.630*** (2.846)
Observations	1700	1700	1700	1700	1700	1700
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes

UAE

	Level of emissions			Level of intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Brown-green indicator	0.256 (1.341)	4.478*** (1.602)	3.463 (2.592)	0.164 (1.204)	1.015 (1.375)	1.760 (1.515)
Book-to-market		2.560*** (0.712)	2.923** (1.579)		1.470*** (0.400)	1.936*** (0.099)
Revenue growth		-2.858*** (1.496)	-3.025 (1.442)		-2.715*** (0.217)	3.078 (1.176)
Log of nppe		1.768** (0.465)	1.819*** (0.385)		1.097* (0.156)	1.210* (0.804)
Leverage		-1.022** (0.662)	-2.493*** (1.885)		-1.578 (0.993)	-2.912*** (1.467)
Lagged return		-0.184* (0.100)	-0.104 (0.101)		-0.198** (0.098)	-0.102 (0.101)
Log of markcap		-1.040** (0.768)	-1.709*** (0.166)		-1.416* (0.805)	-1.258*** (0.585)
Cumulative past ret		-0.000*** (0.000)	-0.000*** (0.000)		-0.000*** (0.000)	-0.000*** (0.000)
ROE		-1.484*** (0.977)	1.541*** (0.593)		-0.743 (0.144)	1.846*** (0.866)
Constant	1.533** (0.685)	2.507** (1.252)	6.591*** (1.861)	1.516*** (0.551)	2.414 (1.953)	6.795*** (1.550)
Observations	143	143	143	143	143	143
Time FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	No	Yes	No	No	Yes