Market Shifts Under European Green Deal News: Green vs. Brown Stocks and Bonds

June 30, 2025

Abstract

The European Green Deal (EGD) stands out as the largest global largest initiative currently in motion to achieve net zero emissions by 2050. Monitoring its implementation is thus of foremost importance for global investors, particularly those focused on green investments. In this article, we examine the impact of announcements from the European Commission regarding the EGD on the corporate bond and stock markets. Using the event study methodology, we assess whether various categories of Green Deal-related News (`GDN`) trigger significant short-term market reactions, particularly in terms of cumulative abnormal returns (CARs). We find that `GDN` generally results in negative CARs across multiple stock portfolios and sorting criteria. The response of bond portfolios is different. In addition to the event study, we employ regression models to analyze the relationship between returns on corporate bond and stock portfolios and `GDN`. Within the stock market, the estimated relationship between portfolio returns and `GDN` is invariably negative, though significance is evident only for specific portfolios, particularly those with higher exposure to brown assets. By contrast, within the bond market, the response of portfolios is rarely significant. Building on the event study and regression analysis, we develop trading strategies based on `GDN`. On non-event days, the strategy follows a buy-and-hold approach, investing in a portfolio of risky assets. However, on event days, the portfolio is liquidated, and the proceeds are allocated to risk-free bonds. We evaluate the performance of this strategy against a traditional buy-and-hold portfolio. While the `GDN`-based strategy, accounting for a conservative 1% transaction cost, generally proves unprofitable, we observe that strategies anticipating the timing of `GDN` events can yield positive returns. Importantly, our findings highlight a clear dichotomy between the bond and stock markets in their sensitivity to `GDN`.

JEL classification: F15, F36, F44, F62, G15

Keywords: European Green Deal, Green Deal News, Climate Exposure, Stock Returns

The EU's Green Deal is large on ambition, but in many places frustratingly vague on detail.

The Economist, Dec 14th 2019

1 Introduction

Climate change stands as one of the paramount global societal challenges, necessitating coordinated, global solutions involving every nation on Earth. The European Green Deal (EGD), endorsed by all 27 EU member states in December 2019, serves as a comprehensive policy framework. It guides legislators, policymakers, and regulators in the endeavor to transform the EU into the world's first climate-neutral continent by 2050. The EGD represents a multifaceted approach, encompassing: (i) the transformation of the economy and society, (ii) the pursuit of sustainability in all aspects of transportation, (iii) leadership in the third industrial revolution, (iv) the transition to a cleaner energy system, (v) the renovation of buildings to promote greener lifestyles, (vi) collaboration with nature to safeguard the planet and human health, (vii), the rise of global climate action, among other initiatives.

The EGD holds the power to reshape both the production and consumption sides of the economy. The financial system assumes a pivotal role in reallocating financial resources toward greener activities and sectors. The EGD wields the potential to significantly influence the behavior of portfolio investors across the EU through its multifaceted approach to sustainability and climate action. By laying out a comprehensive strategy for achieving climate neutrality by 2050, the EGD serves as a roadmap that directly impacts the investment landscape. Portfolio investors are increasingly recognizing the risks associated with carbon-intensive assets and the importance of integrating environmental, social, and governance (ESG) factors into their decision-making processes. As the EGD advances the transition to a low-carbon and sustainable economy, it sends clear signals to investors about the direction of policy and regulation. Investors are likely to respond by reevaluating their portfolios and allocating capital toward green and sustainable assets and sectors. For instance, they may consider investing in traditionally carbon-intensive (termed *brown*) sectors only if the expected return is sufficiently high to offset the increased transition risks associated with such investments. This shift may encompass divestment from high-carbon industries, increased investments in renewable energy, clean technology, or ESG-aligned companies, and a heightened focus on assessing climate-related risks and opportunities. Moreover, the EGD's emphasis on sustainability reporting and disclosure requirements can empower investors with enhanced ESG data, enabling more informed investment choices. In essence, the EGD acts as a catalyst, aligning investor behavior with the imperative of combating climate change and fostering sustainability, thereby driving a fundamental transformation in portfolio investment strategies within the EU.

It is worth noting that the impact of the EGD on the behavior of portfolio investors remains largely unexplored within academic circles, prompting our investigation to address this gap. Our research seeks to answer several pivotal questions:

RQ1. Do European Green Deal News (`GDNs`) influence the valuation of diversified portfolios of EU bonds and stocks?

RQ2. Do the valuation effects of `GDN` vary across different sectors?

RQ3. Do `GDNs` exert positive or negative effects on the valuation of green portfolios of EU bonds and stocks?

RQ4. Do `GDNs` trigger positive or negative effects on the valuation of brown portfolios of EU bonds and stocks?

RQ5. Do portfolio returns respond differently to `GDNs` in the EU bond and stock markets?

RQ6. Do the valuation effects of `GDNs` vary in the long -and short-run?

The contribution to knowledge is six-fold. First, our study makes a pioneering contribution by recognizing and addressing the dearth of research into the impact of the EGD on portfolio investor behavior. This sets a foundation for understanding the crucial link between sustainability policy and portfolio investment and management. Second, by investigating the influence of `GDN` on diversified portfolios of EU stocks, our research quantifies the effects of sustainability policies on investment decisions. We provide concrete evidence of how policy developments shape financial markets. Third, our study sheds light on differences in the influence of `GDN` across various sectors. This sector-specific analysis shows that sustainability policies have different effects across industries, offering valuable insights for both researchers and practitioners. Fourth, this research contributes to practice by examining how `GDN` influences the valuation of green and brown (less sustainable) sectors. These findings inform investors on how sustainability policies can affect the value of their investments, which guides their investment strategies. Fifth, by examining how large and small stocks respond differently to `GDNs`, we aim to offer practical guidance for investors. Our study aims to develop tailored investment strategies that account for the varying sensitivities of different-sized stocks to sustainability policy changes. Sixth, we scrutinize 1,600 corporate bonds, grouped into five ESG-based portfolios. Similar to our stock analysis, we assess how bond portfolios respond to `GDNs`, perform regression analyses on the bond portfolios, and integrate these portfolios into investment strategies.

Our research findings have the potential to inform policymakers and regulators about the real-world impact of climate and sustainability policies on financial markets, thereby guiding the formulation of effective policy actions to support green and sustainable finance and climate goals. Overall, our study contributes to both academic knowledge and practice by addressing pertinent questions at the intersection of sustainability and finance. It offers insights that bridge the gap between theoretical knowledge and practical implications, making it relevant for academia, financial professionals, and policymakers alike.

The research design encompasses three key components: the Event Study Methodology, Regression Analysis and the Design of Trading Strategies.

Event Study Methodology. The initial stepping stone involves employing an event study methodology. This methodology is employed to evaluate whether `GDNs` have the potential to induce abnormal (positive or negative) returns on diversified portfolios of EU *stock*. Furthermore, it extends to sector-specific portfolios and portfolios structured around carbon intensity and ESG-based criteria, as well as considerations related to the size of stocks. This approach allows us evaluate the influence of `GDNs` across different dimensions of portfolio composition. The event study methodology yields the following results. We find that `GDNs` generally result in negative CARs for the majority of stock portfolios constructed using five different sorting criteria. However, in instances where news is associated with sustainability, renewable energy, or agriculture, specific portfolios exhibit positive returns. Importantly, this pattern is consistent across all five sorting criteria. In contrast, the results for *bond* portfolios associated with higher ESG ratings indicate relatively stable or positive CARs in the pre-event window. This suggests that investors display confidence in these bonds ahead of `GDN` announcements, likely due to the perceived alignment of these firms with emerging sustainability policies. As the event date approaches, however, a significant shift occurs.

CARs begin to decline, particularly for bonds linked to lower ESG ratings or those categorized as high-polluting. The results indicate that *bond* portfolios associated with higher ESG ratings exhibit relatively stable or positive CARs in the pre-event window. Overall, the event study provides valuable insights into the disparate responses of CARs to GDN announcements in the bond and stock markets. A key takeaway from this analysis is that stock portfolios appear to be more sensitive to GDNs than bond portfolios, which underscores the heterogeneous dynamics at play in these two asset classes.

Regression Analysis. The second stepping stone involves regression analysis that aims to gain a deeper understanding of the relationship between GDNs and returns on *stock* portfolios. In this part, we evaluate the marginal effect of GDNs on the returns of both diversified and sector-specific portfolios. Additionally, this analysis extends to portfolios constructed based on CO2 intensity, ESG performance, size & CO2 intensity, and size & ESG performance. The estimated marginal effect consistently demonstrates a negative impact of GDNs, which persists across all portfolio sorts, deciles, or GDN categories. Furthermore, while the marginal effect maintains a negative sign, the significance of the coefficient estimate varies notably across different portfolio sorts and deciles. First, the consistent negative impact highlights the growing investor sensitivity to climate-related news. High-emission firms are particularly penalized, reflecting concerns about regulatory risks and the potential financial burden of transitioning to a low-carbon economy. Firms with strong ESG credentials are not immune to the effects of GDNs, as they may face high expectations from investors regarding their sustainability performance. In parallel, our analysis of *bond* portfolios reveals additional insights into the market's response to GDNs. The regression results indicate that bond portfolios also reflect a negative, albeit insignificant marginal effect when subjected to GDNs. This shift underscores the growing investor caution regarding long-term risks associated with sustainability policies. Conversely, lower ESG-rated bonds demonstrate a more severe decline in returns, reflecting a heightened awareness of the potential regulatory impacts and market penalties associated with carbon-intensive investments. It is important to emphasize that bond portfolios with strong ESG ratings exhibit negative CARs, though the magnitude of these effects is smaller compared to those observed in portfolios with lower ESG ratings.

The negative CARs associated with `GDNs` possibly reflect increased investor apprehension regarding regulatory risks and the shift towards a low-carbon economy. Nevertheless, these impacts remain statistically insignificant.

Design of Investment Strategies. The final stepping stone involves the design of investment strategies, a crucial practical application of the research findings. Informed by the outcomes derived from the event study methodology and regression analysis, these investment strategies are tailored to leverage the empirical insights generated by the study. They offer guidance to investors seeking to navigate the complex interplay between sustainability policies, as represented by GDNs, and their investment decisions. These strategies aim to optimize the allocation of financial resources in response to GDNs. Informed by the event study methodology and regression analysis, we construct a diverse set of portfolios using the aforementioned sorting criteria. Specifically, on the event day, investors are advised to sell portfolios of stocks and acquire risk-free bonds. After the event has settled, investors should then buy portfolios of stocks and liquidate their bond holdings. This strategy typically results in a positive return.

The rest of this article is organized as follows. In Section 2, we survey the related literature. In Section 3, we outline the methodology and describe the data. In Section 4, we analyze the results. Finally, in Section 5, we conclude.

2 Related literature

This paper is intended as a contribution to the most recent and growing literature that focuses on the short term impact of climate change policy-related events on stock market prices. For the sake of brevity, we discuss only a subset of papers that are closely related to ours, especially in terms of employed empirical strategies (i.e., standard event study methodologies). In this respect, our work comes very close to Ramiah et al. (2013), Donadelli et al. (2021), Borghesi et al. (2022) and Barnett (2023) who employ well-established event study techniques to examine movements in stock returns around key/influential climate-change policy-related events.

Ramiah et al. (2013) examine the impact of 19 environmental regulation announcements on stocks listed on the Australian Stock Exchange over the period from 2005 to 2011. The study shows the absence of significant abnormal returns following the introduction of green policies in the electricity industry, a sector known for its high carbon intensity. The authors conclude that major polluters are do not exhibit significant short-run impacts in response to more stringent green policies. Out of the 19 announcements considered, only 12 are found to exert a significant influence on Australian stock returns. Notably, only announcements made by Australian government related to more stringent carbon pollution rules are found to have a negative impact on a relatively large number of sectors (e.g., beverages, construction and materials, financial services, non-life insurance, and banks). The oil&gas sector – recognized to be one of the dirtiest sectors – exhibits negative and statistically significant CARs only following one specific event, i.e., "*The Australian government's green paper is released, outlining intended emission trading design - the Carbon Pollution Reduction Scheme*". Conversely, a less stringent carbon policy (i.e., "*Senate rejects the Carbon Pollution Reduction Scheme bill*") is instead found to have a positive impact on various sectors (i.e., industrial engineering, industrial mining, banks, electrical equipment, food producers, and general industrials). Other announcements display a mixed impact, influencing some sectors positively while affecting others negatively.

Taken together, the event-by-event analysis conducted by Ramiah et al. (2013) yields mixed evidence regarding the impact of climate change-related policy news on stock market returns. It is evident that different announcements exert varying effects on returns, and similar announcements do not uniformly influence different sectors. Our work closely aligns with their as we focus mainly on green policy announcements (i.e., GDNs). However, in line with recent studies, we capitalize on the entirety of climate policy-related events provided by the European Commission collectively, rather than examining one event at a time. These green policy-related events are categorized into sub-groups where each sub-category has more than one single event.

In contrast, Borghesi et al. (2022) rely on the Environmental Pillar Score developed by Thomson Reuters to construct two distinct portfolios (green and brown) using firms listed on the STOXX All Europe 100 Index. Their classification deems a firm as green (brown) if their rating is A or A+ (A- or below). They investigate the behavior of brown and green portfolio returns around official green policy-related announcements retrieved from the OECD Green Recovery Database. The announcements made by major European governments in 2020, specifying the resources allocated for new green policy plans, generate positive CARs both in the green and brown sectors. However, the positive sentiment effect is more pronounced among more sustainable stocks. Following the OECD Green Recovery Database, Borghesi et al. (2022) classify Green policy-related announcements in seven categories (i) "Adaptation", (ii) "Air Pollution", (iii) "Biodiversity", (iv) "Climate Mitigation", (v) "Other", (vi) "Waste Recycling", (vii) "Water". It emerges that positive CARs are mainly due to announcements on climate change mitigation-related policies, which account for a large fraction of the total funds allocated for the green transition. Broadly, this classification confirms Ramiah et al. (2013) who observe that different categories of green policy-related announcements do not influence green and brown sectors homogeneously.

Our empirical analysis differs from Borghesi et al. (2022) in several respects. First, we move beyond announcements made by single European governments and focus exclusively on the official news released by the European Commission on the Green Deal since its inception. This approach allows us to capture events that influence the mood of a broader range of individuals and investors across EU economies, as national-level green policy news may not significantly impact behavior due to factors like rational inattention, information costs, or limited media coverage. Second, we build a larger variety of "green" and "brown" portfolios by classifying stocks following different criteria, including climate change exposure, C02 emission and ESG scores. This enables a clearer distinction between green and brown stocks. To the best of our knowledge, no prior study bas tested such a divererse range of green and brown portfolios. Third, our analysis covers 622 European listed firms, which represent 70% of the total European market capitalization, rather than being limited to the 100 firms included in the STOXX All Europe 100 Index.

Donadelli et al. (2021) provide event-study evidence, which demonstrates a strong exposure of fossil fuel firms to announcements about changes in climate policy. They capture sectoral returns using the Fama-French value-weighted returns data for the 17 industry portfolios. For the event dates, they rely on Barnett (2023) and on the UNFCCC, and focus only on those events that are associated with stricter climate policies (a total of 83 events over the period 1988–2018). Overall, they find that CARs of the oil sector are considerably lower than the cumulative market returns or the cumulative average return across the other sectors at the end of the event window.

Barnett (2023) performs an event study in the spirit of Koijen et al. (2016) to estimate the impact of changes in the likelihood of a future climate transition event on US stock returns. He relies on a major fossil fuel and alternative energy events, IPCC and UNFCCC official meetings and related events, US presidential election results, other major global and national climate policies, and US energy policies from non-partisan government, academic, and non-profit informational websites to capture climate transition risk. Using the 49 sector portfolio available at https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html and a standard event study, he finds that there is a significant decrease in the return of high-climate transition risk firms (i.e., dirty/brown firms) around climate transition-related events.

Along similar lines, Bauer et al. (2023) conducted an event-study analysis of market responses to climate policy announcements, focusing on the Inflation Reduction Act (IRA). Their findings reveal significant quantitative impacts: after the "brown" event on July 14, the SP Global Clean Energy index saw negative abnormal returns of approximately -3% to -5%, which rebounded to +4% to +6% after the IRA announcement on July 27. Conversely, the SP 500 Integrated Oil Gas index experienced positive abnormal returns of +2% to +4% post-brown event but fell by -5% to -7% following the IRA announcement. Portfolios that were long on brown stocks and short on green stocks saw returns increase by 3% to 7% following the brown event. However, these portfolios then experienced a decline in returns of 4% to 10% after the IRA announcement. Sector-specific responses highlighted that industries expected to benefit from the IRA, such as electrical equipment producers and utilities, saw positive returns of +4% to +8%, while oil and coal firms experienced declines of -6% to -10%. Firm-level analyses revealed green firms with lower carbon emissions and higher environmental scores faced losses of -2% to -4% after initial policy uncertainty but gained +3% to +6% post-IRA, whereas high-emission firms benefited initially but lost -5% to -8% following the IRA. Overall, the study suggests that despite the significant nature of the IRA, the market response was orderly and manageable, with limited risk of severe financial dislocation, and underscores the need for more granular assessments of climate policy transition risks at the firm level. Donadelli et al. (2021), Barnett (2023), Bauer et al. (2023), and our study collectively contribute to understanding the financial impacts of climate policy, but they differ markedly in their focus and scope. Donadelli et al. (2021) and Barnett (2023) concentrate on the effects of climate frameworks established by the IPCC and UNFCCC on U.S. stock market returns, assessing how these global climate policies influence investments in the U.S. market. (Bauer et al., 2023) narrows its focus to the Inflation Reduction Act (IRA), evaluating its financial effects on various U.S. industries and sectors, with particular attention to the contrasting impacts on green and brown industries. In contrast, study investigates the impact of the European Green Deal (EGD) on European stock markets. Unlike Donadelli et al. (2021), Barnett (2023), or Bauer et al. (2023), which predominantly focus on the oil and fossil fuel sectors—commonly perceived as highly exposed to transition risks—we analyze a broader range of portfolios constructed based on diverse criteria of greenness and brownness. Our approach encompasses a variety of sectors rather than concentrating solely on the fossil fuel industry, and we examine the implications of climate policy on European stocks rather than U.S. equities. Gupta and Goldar (2005) explore the response of stock markets to environmental performance in India. Conducting an event study, they examine the impact of environmental ratings on large pulp and paper, auto, and chlor-alkali firms. Their findings reveal that the market penalizes environmentally unfriendly behavior, with announcements of poor environmental performance leading to negative abnormal returns of up to 30%. They find a positive association between abnormal returns and the level of a firm's environmental performance. This study underscores the role capital markets play in environmental management, particularly in developing countries with weaker environmental monitoring and enforcement. These findings support the argument for institutionalizing public disclosure programs as a complement to traditional regulatory approaches in developing countries. Gupta and Goldar (2005) focus on India, a developing economy, highlighting how environmental performance affects stock prices in a context with less stringent regulatory enforcement. Our research, while focused on European stock markets, contributes to the broader understanding of how market reactions to environmental policies can vary across different economic contexts across developed and developing economies, including regulatory environments, market maturity levels, and investor behavior. Moreover, while Gupta and Goldar (2005) evaluate the impact of environmental ratings on sectors such as pulp and paper, automobiles, and chlor alkali, our studies, while broader in scope, also examines sector-specific reactions to climate policy announcements. Hengge et al. (2023) explore the impact of carbon policy on stock returns using data from over 2,000 European firms from 2011 to 2021. The study finds that regulatory events leading to higher carbon prices result in negative returns for firms with high emission intensities. This effect is even more pronounced for companies in sectors not covered by the EU Emissions Trading System (ETS). By analyzing the surprise component of carbon policy changes, the research shows that tighter carbon regulations raise the cost of capital for emission-intensive firms, highlighting the financial market's pricing of transition risk associated with the shift towards a low-carbon economy. The findings underscore the effectiveness of carbon pricing policies in influencing investor behavior and increasing financial pressures on high-emission firms. Our research diverges from Hengge et al. (2023) primarily in the focus and scope of the analysis. While Hengge et al. (2023) concentrate on the EU Emissions Trading System (ETS) and its impact on stock returns by analyzing regulatory events and their effects on firms with varying carbon intensities, our study extends the analysis to a broader range of climate policy-related events across multiple European countries. Hengge et al. (2023) emphasize the direct financial impact of carbon pricing on firms, particularly those in the ETS, and reveal that higher carbon prices lead to negative returns for emission-intensive firms. In contrast, our research investigates a wider array of climate policy announcements, including those from the European Commission, and employs a more comprehensive portfolio classification based on various criteria such as climate change exposure, CO2 emissions, and ESG scores.

3 Data and methodology

3.1 Data

European Green Deal News (GDNs). The European Green Deal represents the European Union's ambitious and multifaceted commitment to addressing the urgent challenges of sustainability, environmental conservation, and climate change. Table 1 provides a comprehensive chronicle of pivotal events and policy developments related to the European Green Deal initiative, which spans the period from December 2019 to June 2024. Our European Green Deal events are represented by press releases provided by the European Commission. GDNs are regularly updated and posted on the following European Commission web page: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en. Table 1 serves as a historical record, which offers valuable insights into the EU's proactive stance on mitigating environmental degradation and fostering a more sustainable future. Each entry in the table is accompanied by a date (see 'Date' column), pinpointing the precise moment when significant actions, strategies, or announcements were made. The 'Event' column succinctly describes the essence of each development, encompassing a wide spectrum of initiatives, from the presentation of the European Green Deal and its investment plan to the proposal of a Circular Economy Action Plan, strategies for renewable energy, climate targets, etc. Entries are categorized into Sustainability, Renewable Energy, Gas, Agriculture, Emissions categories (see 'Categories' column), which allows readers to discern the primary focus of each milestone.

We inquire about the potential impact of these events on investor decision-making in the EU stock market. The news related to the European Green Deal, as presented in Table 1, have the potential to exert a substantial influence on stock market investors in a number of ways. Firstly, these news are indicative of a regulatory environment that is increasingly favoring companies, which are committed to improving their environmental, social, and governance (ESG) profiles. Investors recognize that companies aligning with these objectives are likely to be viewed favorably by regulators, thereby mitigating regulatory risks. Conversely, companies not adapting to sustainability goals may face compliance challenges, fines, and potentially significant financial setbacks. Secondly, these news provide valuable insights into sectoral performance dynamics. To make informed decisions, investors must monitor these developments to identify sectors that are likely to thrive under the evolving regulatory landscape. For instance, the push for renewable energy, emphasized in the offshore wind capacity expansion, can be expected to benefit companies in the renewable energy sector, while traditional fossil fuel industries may encounter transition risks. Astute investors capable of identifying these trends can position their portfolios strategically to capitalize on sectoral growth opportunities.

Environmental and Financial Data. We retrieved data on total returns, market capitalization, total emissions over sales, and Refinitiv environmental scores for publicly traded active stocks headquartered in the following ten European countries, which feature the most capitalized stock markets: *i*) Italy, *ii*) Spain, *iii*) Belgium, *iv*) France, *v*) Germany, *vi*) Luxembourg, *vii*) Ireland, and *viii*) Sweden, *ix*) Netherlands, *x*) Denmark. The data spans from January 1, 2018, to June 30, 2023. We applied data quality filters to exclude non-standard company shares and companies with missing information. Consequently, our dataset comprises 622 stocks, for which both environmental (i.e., CO2 emissions and ESG scores) and financial data are available for the entire sample period.

Table 2 summarizes the descriptive statistics of portfolio returns across various sorting criteria, shedding light on stock performance within distinct sectors and categories. Notable observations include the relatively high volatility observed in the Housing and Utilities sector, with standard deviation values of 1.30775 and 1.79323, respectively, which witnessed significant price fluctuations. The Fossil-Fuel sector displays a moderate mean return of approximately 0.0176 and a standard deviation of 0.89141. On the other hand, the Transportation sector boasts a relatively high mean return of 0.0957, which suggests potentially attractive investment opportunities. Meanwhile, the Utilities sector exhibits the lowest mean return of -0.0093. Portfolios sorted by CO2/Sales ratios and ESG scores reveal variations in returns and volatility across the different parts of the distribution, offering investors diverse investment profiles. For instance, when examining portfolios categorized by Size and CO2/Sales ratios, we observe that the SmallHighCO2 portfolio exhibits the highest mean return of 0.0394. In contrast, the MidLowCO2 portfolio presents the smallest mean return of 0.0212, suggesting a less attractive investment opportunity. Similarly, when analyzing portfolios based on Size and ESG scores, the SmallHighESG portfolio boasts a mean return of 0.0405, while the BigHighESG portfolio's performance less than halves SmallHighESG at only 0.0192. These numerical differences highlight how variations in size and environmental criteria intersect with portfolio performance metrics, which enables investors to tailor their investment strategies to match their risk preferences and financial objectives.

Table 1: European Green Deal News (N=100 Events)

Date	Event	Category
11 December 2019	Presentation of the European Green Deal	Sustainability
14 January 2020	Presentation of the European Green Deal Investment Plan and the Just Transition Mechanism	Sustainability
4 March 2020	Proposal for a European climate law to ensure a climate neutral European Union by 2050	Sustainability
10 March 2020	Adoption of the European Industrial Strategy, a plan for a future-ready economy	Sustainability
11 March 2020	Proposal of a Circular Economy Action Plan focusing on sustainable resource use	Sustainability
20 May 2020	Presentation of the EU Biodiversity Strategy for 2030 to protect the fragile natural resources on our planet	Agriculture
8 July 2020	Adoption of the EU strategies for energy system integration and hydrogen to pave the way towards a fully decarbonised, more efficient and interconnected energy sector	Renewable Energy
17 September 2020	Presentation of the 2030 Climate Target Plan	Sustainability
14 October 2020	Renovation wave / Methane Strategy / Chemicals strategy for sustainability	Gas/Sustainability
19 November 2020	The European Commission presents the EU Strategy on Offshore Renewable Energy. The Strategy proposes to increase Europe's offshore wind capacity from its current level of 12 GW to at least 60 GW by 2030 and to 300 GW by 2050.	Renewable Energy
9 December 2020	The European Commission launches the European Climate Pact (i.e., an EU-wide initiative inviting people, communities and organisations to participate in climate action and build a greener Europe)	Sustainability
10 December 2020	European Battery Alliance: the European Commission proposes to modernise EU legislation on batteries	Sustainability
18 January 2021	New European Bauhaus: the European Commission launches an environmental, economic and cultural project, aiming to combine design, sustainability, accessibility, affordability and investment in order to help deliver the European Green Deal	Sustainability
24 February 2021	The European Commission adopts today a new EU Strategy on Adaptation to Climate Change	Sustainability
25 March 2021	The European Commission sets out an action plan for organic production in the EU	Agriculture
12 May 2021	The European Commission adopts the EU Action Plan: "Towards Zero Pollution for Air, Water and Soil"	Emissions
17 May 2021	The European Commission proposes a new approach aimed at developing a sustainable blue economy in the European Union	Sustainability
14 July 2021	Delivering the ECD	Sustainability
15 September 2021	New European Bauhaus: new actions and funding	Sustainability
17 November 2021	The European Commission adopts three new initiatives that are necessary for making the EGD a reality: (i) new rules to curb EU-driven deforestation and facilitate intra-EU waste shipments and (ii) a new Soil strategy to have all European soils restored, resilient, and adequately protected by 2050	Agriculture
14 December 2021	The European Commission adopts four proposals that will make the EU's transport system more efficient and sustainable	Emissions
15 December 2021	The European Commission adopts new proposals to remove, recycle and sustainably store carbon and introduce a new framework to decarbonise gas markets, promote hydrogen and reduce methane emissions	Emissions
8 March 2022	REPowerEU: The European Commission propose a plan to make Europe independent from Russian fossil fuels well before 2030	Gas
23 March 2022	The European Commission outlines options to mitigate high energy prices with common gas purchases and minimum gas storage obligations	Gas
30 March 2022	The European Commission presents a package of new proposals to make sustainable products the norm and boost Europe's resource independence	Sustainability

5 April 2022	The European Commission presents (i) proposals to update and modernise the Industrial Emissions Directive, (ii) key legislation to help prevent and control pollution and (iii) new Regulations to more tightly control fluorinated greenhouse gases (F-gases) and ozone depleting substances (ODS)	Emissions
22 April 2022	The European Commission joins the European Climate Pact and pledges to make its operations climate neutral by 2030	Emissions
18 May 2022	REPowerEU updates	Gas
22 June 2022	The European Commission adopts pioneering proposals to restore Europe's nature by 2050 and halve pesticide use by 2030	Agriculture
20 July 2022	The European Commission proposes a new legislative tool and a European Gas Demand Reduction Plan to reduce gas use	Gas
15 September 2022	The European Commission proposes an emergency market intervention to reduce energy bills for Europeans	Gas
26 October 2022	The European Commission proposes stronger rules for cleaner air and water	Emissions
27 October 2022	The Council and the European Parliament reach a provisional political agreement on stricter CO2 emission performance standards for new cars and vans	Emissions
10 November 2022	The European Commission proposes new Euro 7 standards to reduce pollutant emissions from vehicles and improve air quality	Emissions
15 November 2022	EU Algae Initiative: The European Commission proposes action to fully harness the potential of algae in Europe for healthier diets, lower CO2 emissions, and addressing water pollution	Agriculture
30 November 2022	European Green Deal: Commission proposes certification of carbon removals to help reach net zero emissions	Emissions
6 December 2022	EU agrees law to fight global deforestation and forest degradation driven by EU production and consumption	Agriculture
9 December 2022	The European Commission introduces New rules on applying the EU emissions trading system in the aviation sector	Emissions
18 December 2022	EU agrees to strengthen and expand emissions trading, and creates a Social Climate Fund to help people in the transition	Emissions
24 January 2023	Presentation of a 'A New Deal for Pollinators' to tackle the alarming decline in wild pollinating insects in Europe	Agriculture
1 February 2023	The European Commission presents a Green Deal Industrial Plan to enhance the competitiveness of Europe's net-zero industry and support the fast transition to climate neutrality	Sustainability
13 February 2023	The European Commission sets out rules for renewable hydrogen	Renewable Energy
14 February 2023	The European Commission proposes 2030 zero-emissions target for new city buses and 90% emissions reductions for new trucks by 2040	Emissions
21 February 2023	The European Commission presents a package of measures to improve the sustainability and resilience of the EU's fisheries and aquaculture sector.	Agriculture
10 March 2023	EU agrees stronger rules to boost energy efficiency	Sustainability
14 March 2023	The European Commission proposes reform of the EU electricity market design to boost renewables, better protect consumers and enhance industrial competitiveness	Renewable Energy
16 March 2023	The European Commission proposes the (i) Net-Zero Industry Act (i.e., a plan to make the EU the home of clean technologies manufacturing and green jobs) and (ii) Critical Raw Materials Act (i.e., a plan to ensure secure and sustainable supply chains for EU's green and digital future)	Sustainability
22 March 2023	The European Commission (i) introduces new consumer rights for easy and attractive repairs and (ii) proposes common criteria against greenwashing and misleading environmental claims	Sustainability
23 March 2023	Agreement reached between the European Parliament and the Council on cutting maritime transport emissions by promoting sustainable fuels for shipping	Emissions
28 March 2023	The Commission welcomes the political agreement reached between the European Parliament and the Council to boost the number of publicly accessible electric recharging and hydrogen refuelling stations	Renewable Energy
21 April 2023	The European Commission updates marketing standards of agri-food products to better address consumer needs and prevent food waste	Agriculture
25 April 2023	The European Commission launches first call for companies to jointly buy gas and the Council adopts five laws that will enable the EU to cut greenhouse gas emissions within the main sectors of the economy	Gas/Emissions
26 April 2023	The European Commission welcomes the political agreement between the European Parliament and the Council to cut aviation emissions	Emissions
16 June 2023	Proposal to revise the Energy Labelling Regulation for more informed and sustainable consumer choices.	Sustainability
5 July 2023	The Commission presents a package for the sustainable use of key natural resources, including soil resilience and food systems.	Sustainability
11 July 2023	Measures to make freight transport more efficient and sustainable through better infrastructure and incentives.	Sustainability
13 July 2023	Initiative to enhance circularity in the automotive sector, covering design, production, and end-of-life treatment.	Sustainability
2 October 2023	Entry into application of the transitional phase of the Carbon Border Adjustment Mechanism (CBAM).	Emissions
9 October 2023	Adoption of the final proposals for the Fit for 55 package, legally binding EU climate targets across key sectors.	Emissions
24 October 2023	The Commission presents the European Wind Power Action Plan.	Renewables
22 November 2023	The Commission proposes a new forest monitoring law to improve the resilience of European forests.	Sustainability
28 November 2023	The Commission sets out actions to accelerate the roll-out of electricity grids.	Renewables
29 November 2023	Political agreement on modernizing management of industrial emissions.	Emissions
4 December 2023	COP28: EU President Ursula von der Leyen launches Global Pledge on Renewables and Energy Efficiency.	Renewables

5 December 2023	Political agreement on improving classification, labeling, and packaging of hazardous chemicals.	Sustainability
7 December 2023	Political agreement on new rules to boost energy performance of buildings across the EU.	Sustainability
8 December 2023	Political agreement on updated EU rules to decarbonize the gas market and create a hydrogen market.	Gas
14 December 2023	Political agreement on the reform of the EU's electricity market design.	Renewables
19 December 2023	Political agreement on more sustainable and resilient trans-European transport network.	Sustainability
18 January 2024	Political agreement on strong EU targets to reduce CO2 emissions from new trucks and urban buses.	Emissions
25 January 2024	The Commission launches Strategic dialogue on the future of EU agriculture.	Agriculture
29 January 2024	Political agreement on more thorough and cost-effective urban wastewater management.	Sustainability
2 February 2024	Political agreement on common rules to promote the repair of goods for consumers.	Sustainability
6 February 2024	Political agreement on the Net-Zero Industry Act.	Sustainability
6 February 2024	The Commission presents recommendations for the 2040 emissions reduction target to set the path to climate neutrality in 2050.	Emissions
6 February 2024	The Commission adopts an EU Industrial Carbon Management Strategy, setting out how to sustainably capture, store, and use CO2.	Sustainability
8 February 2024	Political agreement to ban all remaining intentional uses of toxic mercury in the EU.	Sustainability
16 February 2024	Political agreement on tackling ship-source pollution to help make European seas cleaner.	Sustainability
19 February 2024	The EU and Rwanda sign a Memorandum of Understanding on Sustainable Raw Materials Value Chains.	Sustainability
20 February 2024	Political agreement on new air quality standards in the EU.	Emissions
20 February 2024	Political agreement on the first EU-wide certification scheme for carbon removals.	Emissions
11 March 2024	Entry into force of the Regulation on fluorinated greenhouse gases.	Gas
12 March 2024	The Commission sets out key steps for managing climate risks to protect people and prosperity.	Sustainability
15 March 2024	Commission proposes a targeted review of the Common Agricultural Policy to support EU farmers.	Agriculture
21 March 2024	The EU and Norway sign a strategic partnership on sustainable land-based raw materials and battery value chains.	Sustainability
27 March 2024	Entry into force of the Directive on empowering consumers for the green transition.	Sustainability
05/04/2024	Strategic partnership with Uzbekistan on critical raw materials.	Sustainability
10/04/2024	The Commission reviews Clean Transition Dialogues on transforming Europe into a clean, resource-efficient economy.	Sustainability
12/04/2024	Adoption of the strengthened Energy Performance of Buildings Directive.	Sustainability
12/04/2024	The Council adopts the revised directive on industrial emissions and the regulation on establishing an industrial emissions portal.	Emissions
12/04/2024	New rules on emission limits for cars, vans, and trucks are adopted.	Emissions
15/04/2024	Entry into force of the Regulation on the deployment of alternative fuels infrastructure.	Renewables
22/04/2024	The Commission defines principles on limiting the use of the most harmful chemicals to essential uses.	Sustainability
13 May 2024	The Council adopts the regulation on CO2 emission standards for heavy-duty vehicles.	Emissions
21 May 2024	Adoption of electricity and gas market reforms and a new framework to boost hydrogen development.	Renewables
21 May 2024	The Council adopts the electricity market design reform and the decarbonized gases and hydrogen package.	Renewables
27 May 2024	Adoption of the Net-Zero Industry Act and of the EU Regulation to reduce methane emissions in the energy sector.	Gas
28 May 2024	The EU and Australia sign a partnership on sustainable critical and strategic minerals.	Sustainability
30 May 2024	The Council adopts the Right-to-Repair Directive, promoting the repair of goods for longer lifespans.	Sustainability
13 June 2024	New regulation is adopted ensuring better and sustainable connectivity in Europe.	Sustainability

Portfolios construction. We examine the short-term impact of official press releases related to the European Green Deal on a range of portfolios categorized by different attributes.

Specifically, we construct stock portfolios based on (*i*) the CO2/Sales ratio, (*ii*) Environmental Score (ESG), (*iii*) Size and CO2/Sales ratio, (*iv*) Size and ESG, and (*v*) Climate change exposure, in the spirit of (Battiston et al., 2017).

To examine the impact of Green Deal-related press releases, we employ a comprehensive approach. Initially, we create portfolios sorted on two key factors: CO2 emissions relative to Sales (CO2/Sales) and Environmental, Social, and Governance (ESG) scores. In both cases, we sort stocks into ten deciles, ranging from the least polluting (with higher ESG scores) to the most polluting (with lower ESG scores). This allows us to capture a broad spectrum of environmental and sustainability characteristics.

To ensure the robustness of our analysis, we extend our portfolio construction by adding an extra factor: Size, measured by market capitalization. We then create two sets of portfolios by combining Size with two other factors: CO2 emissions relative to sales (CO2/Sales) and ESG scores (ESG). For each set, we divide the stocks into three distinct bins based on their market capitalization. This two-dimensional approach helps us better understand how different stock characteristics interact with Green Deal-related developments.

Finally, informed by the methodology established by Battiston et al. (2017), our objective is to gain valuable insights into the impact of Green Deal-related developments on various stock market sectors, particularly those with notable exposure to climate change effects. To achieve this, we categorize stocks into seven distinct sectors, each representing a specific facet of climate change risk and resilience:

i) **Energy-Intensive Sector.** This category encompasses companies that heavily rely on energy-intensive processes and operations. These companies are especially vulnerable to the evolving energy landscape and environmental regulations.

ii) **Fossil-Fuel Sector.** Companies that operate in the extraction, production, and distribution of fossil fuels fall under this sector. They face unique challenges as the economy gravitates towards cleaner energy sources.

iii) **Transportation Sector.** This category houses companies engaged in transportation services, including businesses within aviation, shipping, and land transportation. Transportation companies typically grapple with the imperative to reduce carbon emissions and adopt sustainable practices.

iv) **Housing Sector.** Housing-related companies play a crucial role in sustainable urban development. This sector encompasses firms involved in real estate, construction, and housing infrastructure

v) **Utilities Sector.** Companies providing essential utilities such as electricity, water, and gas are part of this sector. They encounter pressures to transition towards cleaner and more efficient energy production.

vi) **Financials Sector.** The financial industry is increasingly attuned to the risks posed by climate change. This sector comprises financial institutions, banks, and investment firms, which are under scrutiny for their role in financing sustainable initiatives.

vii) **Non-Exposed Sector.** This sector represents companies that, to a significant extent, are not directly exposed to climate change-related risks. These firms operate in industries with relatively lower environmental impact.

In our analysis, we compute the portfolio returns for each of these sectors by employing a value-weighted average of the constituent stocks. This approach allows us to evaluate the influence of Green Deal-related press releases on the performance of individual stocks within each sector. To enhance the robustness of our findings and provide a more comprehensive view, we additionally construct equally-weighted portfolios for comparative purposes.

Table 2: Summary statistic

	Number of assets	Mean	Std. Dev.	25th perc.	Median	75th perc.
Climate change exposed						
Energy intensive (EI)	357	0.0263	0.9665	-0.40094	0.1242	0.55745
Fossil fuel (FF)	20	0.0176	0.89141	-0.33381	0.0994	0.46542
Financials (FIN)	91	0.0276	0.82333	-0.37968	0.0761	0.53377
Housing (H)	26	0.0251	1.30775	-0.6706	0.0364	0.78404
Not Exposed	663	0.0062	1.0804	-0.53502	0.0547	0.62678
Transport (T)	19	0.0957	1.2343	-0.58379	0.0584	0.75466
Utilities (U)	6	-0.0093	1.79323	-1.00058	-0.0601	0.83235
CO2/Sales						
Low CO2	63	0.0386	0.97398	-0.39395	0.0826	0.57231
2CO2	62	0.0474	1.08428	-0.44835	0.097	0.64573
3CO2	62	0.0284	1.03022	-0.44831	0.0912	0.61392
4CO2	62	0.035	1.13319	-0.50219	0.1064	0.67051
5CO2	62	0.0217	1.03771	-0.49822	0.0887	0.59337
6CO2	62	0.0374	0.97591	-0.45146	0.1105	0.57168
7CO2	62	0.0126	0.94184	-0.44417	0.1007	0.55027
8CO2	62	0.0123	1.00394	-0.47065	0.0776	0.55967
9CO2	62	0.0332	0.99943	-0.48001	0.0931	0.60255
High CO2	63	0.0362	1.15598	-0.5483	0.0734	0.71752
ESG						
Low ESG	63	0.0445	1.0063	-0.40243	0.1193	0.61736
2ESG	62	0.0406	1.0334	-0.46204	0.0959	0.6328
3ESG	62	0.0276	1.05103	-0.50504	0.0908	0.64218
4ESG	62	0.0199	0.93936	-0.44947	0.0843	0.54632
5ESG	62	0.0294	1.02454	-0.45147	0.0808	0.63889
6ESG	62	0.0186	1.10013	-0.51389	0.0827	0.62326
7ESG	62	0.0293	1.17322	-0.52371	0.0832	0.63147
8ESG	62	0.0216	0.99634	-0.47726	0.101	0.5809
9ESG	62	0.0397	1.01862	-0.46387	0.1095	0.60521
High ESG	63	0.0301	1.08681	-0.524	0.1089	0.61216
Size & CO2/Sales						
BigHighCo2	65	0.0392	0.89878	-0.37823	0.0856	0.53424
BigMedCO2	71	0.0263	0.7868	-0.34607	0.0829	0.44794
BigLowCo2	72	0.0249	0.80572	-0.37227	0.0804	0.47772
MidHighCO2	62	0.0309	1.01291	-0.44925	0.1007	0.58859
MidMedCO2	71	0.0329	0.99303	-0.4312	0.0786	0.57188
MidLowCO2	74	0.0212	0.99492	-0.43032	0.0806	0.56752
SmallHighCO2	81	0.0394	1.15714	-0.50412	0.1307	0.68196
SmallMedCO2	65	0.0292	1.15518	-0.52599	0.1038	0.70267
SmallLowCO2	61	0.0281	1.2399	-0.61727	0.0992	0.74616
Size & ESG score						
BigHighESG	65	0.0192	0.74584	-0.34815	0.0722	0.44801
BigMedESG	71	0.036	0.81442	-0.35491	0.101	0.48614
BigLowESG	72	0.03	0.87488	-0.39092	0.0803	0.50042
MidHighESG	62	0.0254	0.87173	-0.359	0.0808	0.5061
MidMedESG	71	0.0328	1.01287	-0.45783	0.1049	0.58585
MidLowESG	74	0.0277	1.11977	-0.50662	0.0918	0.61293
SmallHighESG	81	0.0405	1.10179	-0.488	0.1414	0.65021
SmallMedESG	65	0.0291	1.17878	-0.59124	0.1176	0.70731
SmallLowESG	61	0.0205	1.36654	-0.62545	0.076	0.74095
Corporate bonds						
1ESG	327	-0.000033	0.002067	-0.001043	0.000053	0.001027
2ESG	315	-0.000048	0.002975	-0.001591	-0.000005	0.001526
3ESG	339	-0.000035	0.002705	-0.001328	0.000093	0.00125
4ESG	303	-0.000015	0.002631	-0.001283	0.000044	0.001303
5ESG	316	-0.000036	0.001894	-0.000807	0.000017	0.000799

Notes: This table reports the number of firms and the mean, standard deviation, 25th, 50th (median) and 75th percentiles of the portfolio returns for each sorting rule. The sample period rund from Januart 1, 2018 to June 30, 2024.

3.2 Methodology

Our research methodology encompasses a combination of well-established approaches, including event study methodology, regression analysis, and the design of trading strategies.

Event study methodology Our utilization of the event study methodology is informed by the work of MacKinlay (1997). This approach involves the computation of Cumulative Abnormal Returns (CARs), which represent the disparity between the observed returns and the anticipated returns of a stock. These expected returns are determined using a well-established Capital Asset Pricing Model (CAPM). The CAPM model is employed to calculate what the stock's return should have been if the event under consideration had not occurred.

The event study methodology proceeds in three steps. The first step involves estimating a one-factor CAPM model over a specific period leading up to the event, which is denoted as the *estimation window*. In this example, the estimation window ranges from $t-250$ (250 days before the event) to $t-30$ (30 days before the event). The CAPM model is based on historical data and market conditions leading up to the event. In the second step, the estimated return of the stock is calculated for a specific window around the event date, which spans from $t-5$ (5 days before the event) to $t+9$ (9 days after the event). These estimated returns represent the counterfactual returns – what the returns would have been if the event had not taken place. In the third step, to calculate CARs, we sum up the differences between the actual returns of the stock and the expected returns (predicted by the CAPM model) over the event window. Any significance in the CARs can be attributed to the investor's reaction to `GDN`. In practice, for each event we estimate

$$R_{i,[t-250,t-30]} - R_{f,[t-250,t-30]} = \alpha_i + \beta_i \left(R_{m,[t-250,t-30]} - R_{f,[t-250,t-30]} \right) + \epsilon_{i,[t-250,t-30]}$$

, where $R_{i,[t-250,t-30]}$, $R_{m,[t-250,t-30]}$ and $R_{f,[t-250,t-30]}$ are the expected stock's i return, the market return and the risk free rate from $t-250$ to $t-30$, respectively. We compute the theoretical price of the stock according to the estimated α and β around the CARs estimation window, from $t-5$ to $t+9$ relative to events. CARs are then defined by:

$$CAR_{i,t} = \sum_{t-5}^{t+9} \epsilon_{i,t} = \sum_{t-5}^{t+9} \left((R_{i,t} - R_{f,t}) - \alpha_i - \beta_i \left(R_{m,t} - R_{f,t} \right) \right) \tag{1}$$

Regression analysis Following the empirical literature studying the implications of news events on stock prices we perform a regression analysis to assess the effects of GDN from the five categories on the portfolio returns (Kaplanski and Levy, 2010a,b, 2014; Donadelli et al., 2017, 2020). Specifically, we run the following regression:

$$R_t^s = c + \sum_{i=1}^{3} \beta_{1,i} R_{t-i}^s + \sum_{i=1}^{4} \beta_{2,i} D_{i,t} + \beta_3 E_{1,t} + \nu_t^s \tag{2}$$

where R_t^s denotes the daily rate of return on portfolio s at time t, c is the regression intercept, R_{t-i}^s are lagged portfolio returns, D_1, D_2, D_3, and D_4 are dummy variables capturing the Monday, Tuesday, Wednesday, and Thursday effect, respectively. Additionally, $E_{1,t}$ is the dummy variable capturing the event day effect. Specifically, $E_{1,t}$ takes the value of 1 either on the day of the event or on the next trading day (in case the event occurs over the weekend or outside working hours), and 0 otherwise.[1] Although our main variable of interest is $E_{1,t}$, including all the above additional variables allows us to control for well known financial market anomalies and thus to not contaminate the results, in particular the estimated coefficient β_3. First, following Schwert (1990a,b), we include lagged portfolio returns in order to account for possible serial correlation, as prior research has indicated that movements in aggregate stock returns may exhibit persistence. This behavior has been attributed to factors such as non-synchronous trading, market-maker inventory control, transaction costs, and time-varying expected returns. Second, policy changes and reports may not be uniformly distributed across the week. Given the existence of the "weekend effect" or "Monday effect", as found in earlier studies (French, 1980; Schwert, 1990a; Kaplanski and Levy, 2010a,b), this may bias regression results. We include dummy variables for the day of the week to account for this effect.

[1] In the case in which the day after the European Commission official press release is a non-trading day then the first available trading day will be considered.

4 Empirical results

In this section, we present and discuss the findings from our research. To begin, in Section 4.1, we examine the results from our event study. Then, in Section 4.2, we evaluate the results from our regression analysis. To ensure our findings are reliable, we carry out robustness checks in Section 4.3, confirming that the results hold across different approaches. Finally, in Section 4.5, we explore trading strategies informed by GDNs. This section highlights the practical applications of our research, bridging the gap between theory and real-world practice.

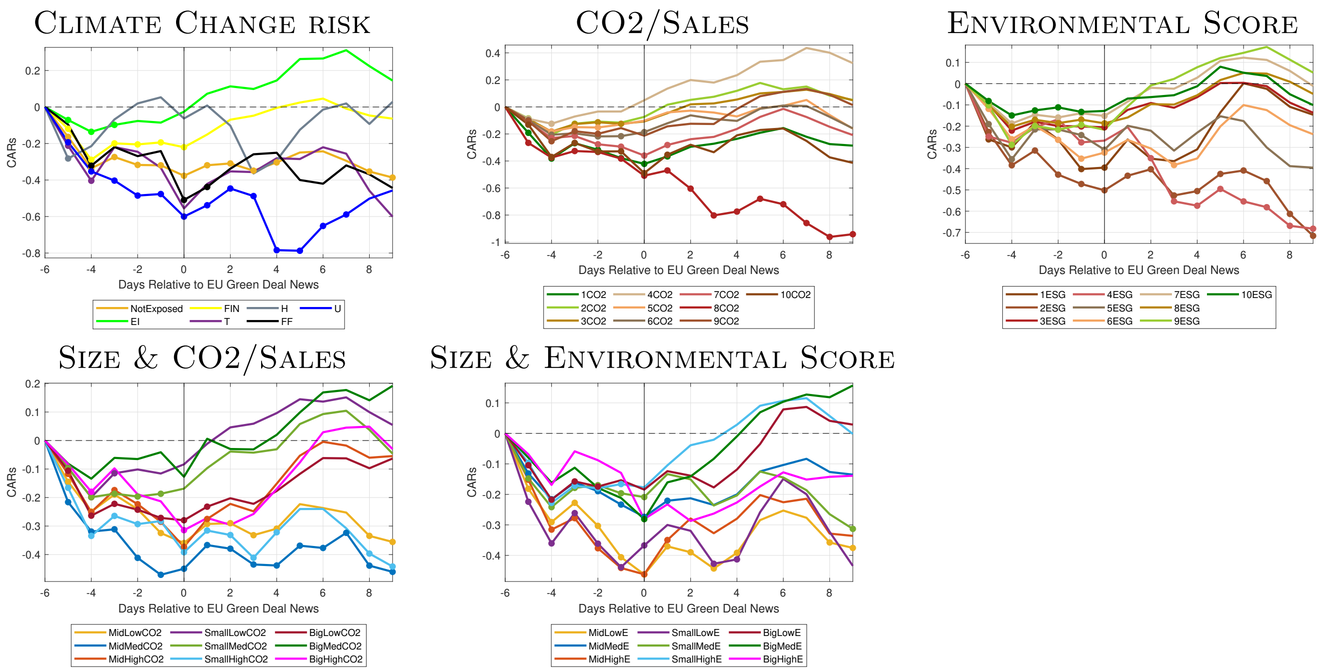
4.1 Cumulative Abnormal Returns

In this subsection, we examine how Green Deal News can drive cumulative abnormal returns (CARs) on portfolio sorted on various climate change or environmental indicators.

Response of Portfolios to all events. We commence our analysis by evaluating the response of portfolios to the entire set of news events. Figure 1 illustrates CARs for the portfolios sorted on *i*) climate change risk, *ii*) CO2/sales, *iii*) environmental score, *iv*) size & CO2/sales, and *v*) size & ESG score. The response of all portfolios to GDNs is negative, regardless of whether the portfolios are classified as green or brown. When portfolios are sorted by CO2/sales and environmental score, more heterogeneous effects emerge. For portfolios where "greenness" is defined by carbon emissions relative to sales, the response of CARs does not follow a clear or consistent pattern. In contrast, when portfolios are sorted by ESG scores, the greener portfolios outperform the browner ones.

The EGD introduces significant uncertainty about future regulatory changes, their scope, importance, and precise timing. Investors are uncertain about which specific policies will be implemented and how these will affect various sectors. This uncertainty is akin to the political risk premium introduced by Pástor and Veronesi (2013), which offers a robust theoretical framework to understand the negative impact of GDNs on stock portfolios. According to Pástor and Veronesi's general equilibrium model of government policy choice, returns on stock market investments are influenced by both economic and political shocks. The politi-

Figure 1: All EU Green Deal News



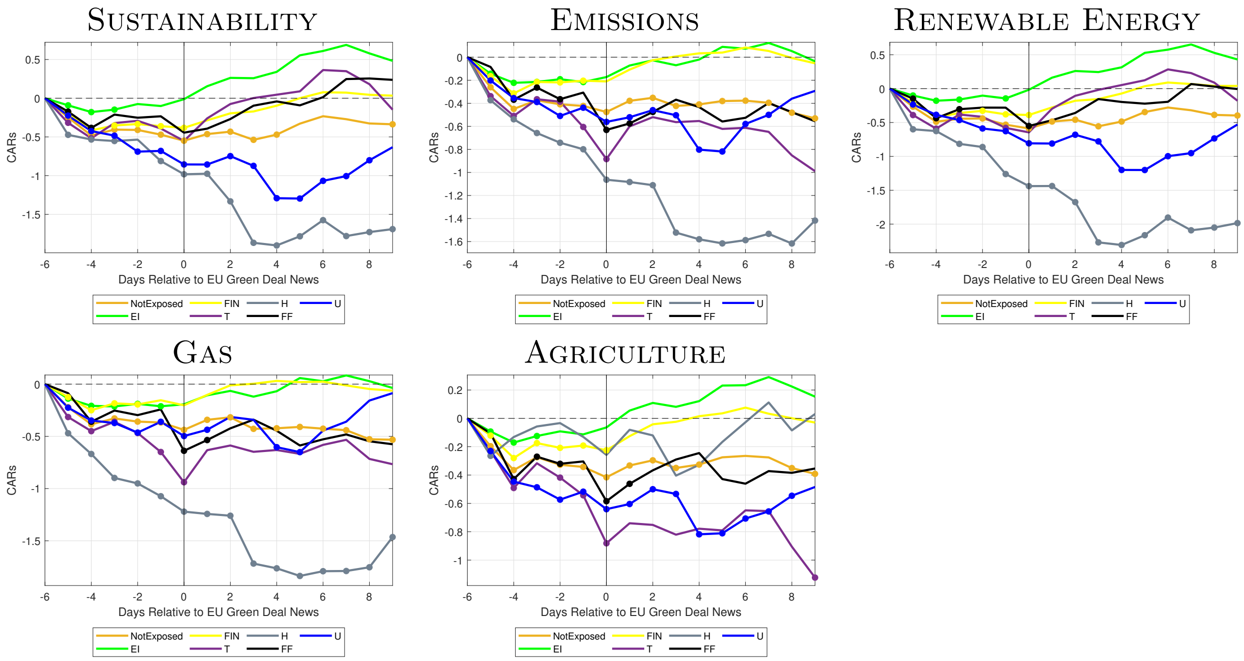
Notes: This figure depicts CARs around different category of GDN for portfolios sorted on *i*) climate change exposure (Battiston et al., 2017), *ii*) CO2/Sales, *iii*) Refinitiv Environmental Score, *iv*) Size & CO2/Sales and *v*) Size & Refinitiv Environmental Score. The theoretical price is estimated according to a one factor CAPM model over a window from $t-250$ to $t-30$ using market return and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

cal risk premium compensates investors for the uncertainty surrounding future government policy decisions. Moreover, greater heterogeneity among potential new government policies increases the risk premium, thereby amplifying the negative impact on stock returns when news about regulatory changes, such as the EGD, is announced. Similar to the political uncertainty explored by Pástor and Veronesi (2013), the EGD is generally not considered a diversifiable risk with the European economy. In fact, it aims to transform the entire European economy by setting ambitious targets for reducing greenhouse gas emissions, enhancing energy efficiency, and promoting sustainable practices across multiple sectors. Its broad scope means that its effects will be felt across various industries, making it a market-wide phenomenon. In line with this, Bolton and Kacperczyk (2021) argue that carbon emissions can be seen as a systematic risk factor, especially when anticipated regulatory measures to reduce emissions are applied uniformly across all sectors.

To further dissect the impact of GDNs on stock portfolios, we categorize the news into five distinct types: *i*) sustainability, *ii*) emissions, *iii*) renewable energy, *iv*) gas, and *v*) agriculture. By examining portfolio responses to each category of GDNs, we can gain a better understanding of how different aspects of the EGD influence market behavior. This categorization allows us to isolate the effects of specific regulatory announcements and measure their respective impacts on greener versus browner portfolios. For example, news about emissions regulations might have a more pronounced negative effect on high-emission industries compared to sustainability initiatives, which could positively influence firms already committed to sustainable practices. Similarly, news focused on renewable energy might boost portfolios containing companies involved in clean energy, while adversely affecting traditional energy sectors. Examining these distinct categories of news provides a comprehensive view of how various elements of the EGD drive portfolio returns.

Portfolios sorted on Climate Change risk exposure We continue our analysis by examining portfolios categorized based on their exposure to climate-change risk. Within this categorization, stocks are distributed into seven value-weighted portfolios, each representing distinct sectors: *i*) Energy intensive, *ii*) Fossil fuel, *iii*) Utilities, *iv*) Financials, *v*) Housing, *vi*) Transport, and *vii*) a non-exposed portfolio of stocks. Figure 2 we present five panels, each segmented by the type of Green Deal News. Specifically, we consider Green Deal News related to sustainability, emissions, renewable energy, gas, and agriculture. Our findings reveal that news across all these categories generally leads to a decrease in CARs for the majority of portfolios. The impact of emissions-related news exhibits a negative association with returns across all seven portfolios, albeit with varying degrees of magnitude. Utilities and Housing portfolios appear to be the most vulnerable to these adverse effects, experiencing the sharpest declines in CARs. In contrast, Financials and Fossil fuels display the smallest reduction in CARs. For other categories of Green Deal News, some sporadically yield positive responses in abnormal returns, but the majority still result in a negative impact. Once more, Utilities emerge as one of the sectors most affected by Green Deal News, while Fossil Fuels and Transport show positive responses for specific Green Deal News categories, such as renewable agriculture, energy, renewable energy and sustainability.

Figure 2: Porfolios sorted on Climate Change risk exposure

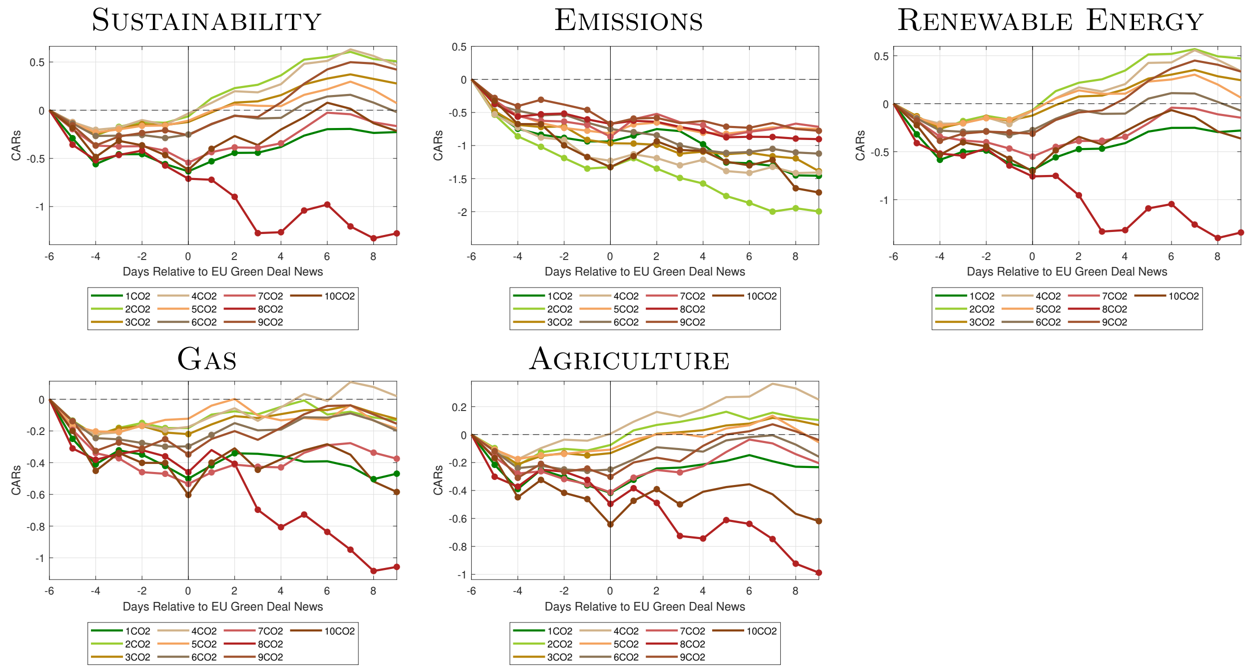


Notes: This figure depicts CARs around different category of GDN for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped into seven sectoral value-weighted portfolios *i*) Energy intensive (EI), *ii*) Fossil fuel (FF), *iii*) Utilities (U), *iv*) Financials (FIN), *v*) Housing (H), *vi*) Transport (T) and *vii*) Not exposed. The theoretical price is estimated according to a one factor CAPM model over a window from $t-250$ to $t-30$ using market return and risk-free rate retrieved from Fama and French European Factors https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

Portfolios sorted on CO2/Sales We now turn to the examination of CARs on investment portfolios sorted according to the CO2 to sales ratio, categorized into 10 deciles. Figure 3 illustrates a substantial variation of CARs across the different categories of Green Deal News. Notably, GDNs associated with emissions and gas consistently trigger negative CARs across the entire spectrum of portfolios. Conversely, GDNs linked to renewable energy exhibit predominantly positive returns across the majority of portfolios. Further insights emerge when considering specific GDN categories, where the sign of CARs oscillates across deciles. For instance, following a GDN related to sustainability, renewable energy, and agriculture, the impact tends to be negative for portfolios in the lower deciles.

Portfolios sorted on Environmental Score (ESG) We further investigate how GDNs influence portfolios sorted based on environmental scores. The event study analysis results are presented in Figure 4. At first glance, the estimated responses of CARs mirror those in

Figure 3: Porfolios sorted on CO_2/Sales

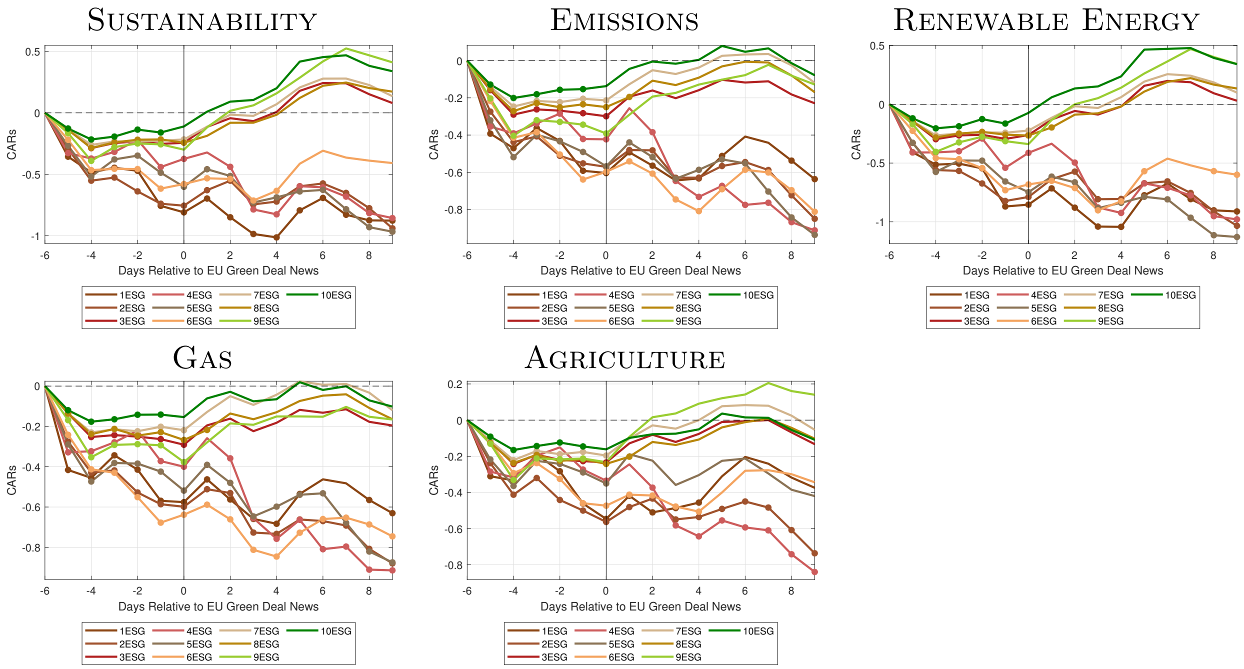


Notes: This figure depicts CARs around different category of GDN for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in ten value-weighted portfolios based on company CO_2/Sales. The theoretical price is estimated according to a one factor CAPM model over a window from $t-250$ to $t-30$ using market return and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

Figure 3. GDNs associated with emissions and gas consistently yield negative CARs, while those linked to renewable energy predominantly yield positive returns. For the remaining GDN categories, sustainability and agriculture, the sign fluctuates across deciles. However, in contrast to portfolios sorted based on the CO_2 to sales ratio, we now observe a noteworthy distinction. Portfolios that amalgamate stocks from more environmentally friendly industries tend to exhibit positive returns in response to GDNs related to sustainability, renewable energy, and agriculture. By contrast, portfolios that comprise less environmentally friendly stocks show positive returns in reaction to these GDN categories.

Portfolios sorted on Size & CO_2/Sales We further examine portfolios categorized by size and CO_2/sales ratios. These portfolios are constructed by interacting three categories of size ('Small', 'Mid', and 'Big') and three categories of CO_2/sales ratios ('Low', 'Medium', and 'High'). This two-dimensional sort yields 9 portfolios. Figure 5 summarizes the impact of GDNs on CARs on these portfolios. Akin to the results portrayed in Figures 3 and 4,

Figure 4: Porfolios sorted on Environmental Score (ESG)

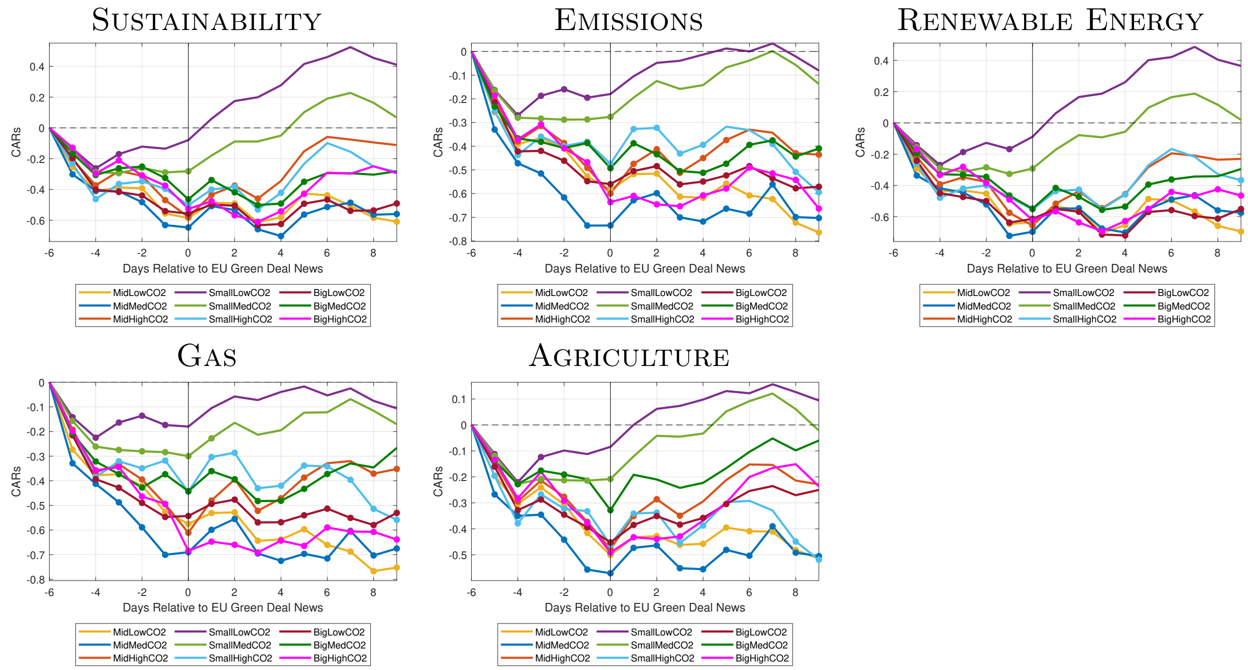


Notes: This figure depicts CARs around different category of **GDN** for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in ten value-weighted portfolios based on company Refinitiv environmental score. The theoretical price is estimated according to a one factor CAPM model over a window from $t-250$ to $t-30$ using market return and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

GDNs associated with emissions and gas trigger generally negative responses in the nine portfolios, whereas renewable energy-related GDN yields positive CARs for the majority of portfolios. We also observe that portfolios that comprise small stocks are more sensitive to GDNs.

Portfolios sorted on Size & Environmental Score (ESG) Similarly as described in the last paragraph we construct portfolios sorted on size and environmental scores. Stocks are categorized in three bins according to their size ('Small', 'Mid', and 'Big') and three bins according to their environmental scores ('Low', 'Medium', and 'High'). The cumulative abnormal returns around GDNs events are shown in Figure 6. The responses of the portfolios to emissions and gas are negative and significant for the majority of the portfolios, consistent with the results for portfolios sorted by different criteria described earlier. In contrast, GDNs related to agriculture and renewable energy yield positive abnormal returns. For the latter event category, smaller stocks outperform compared to other portfolios.

Figure 5: Porfolios sorted on Size & CO2/Sales

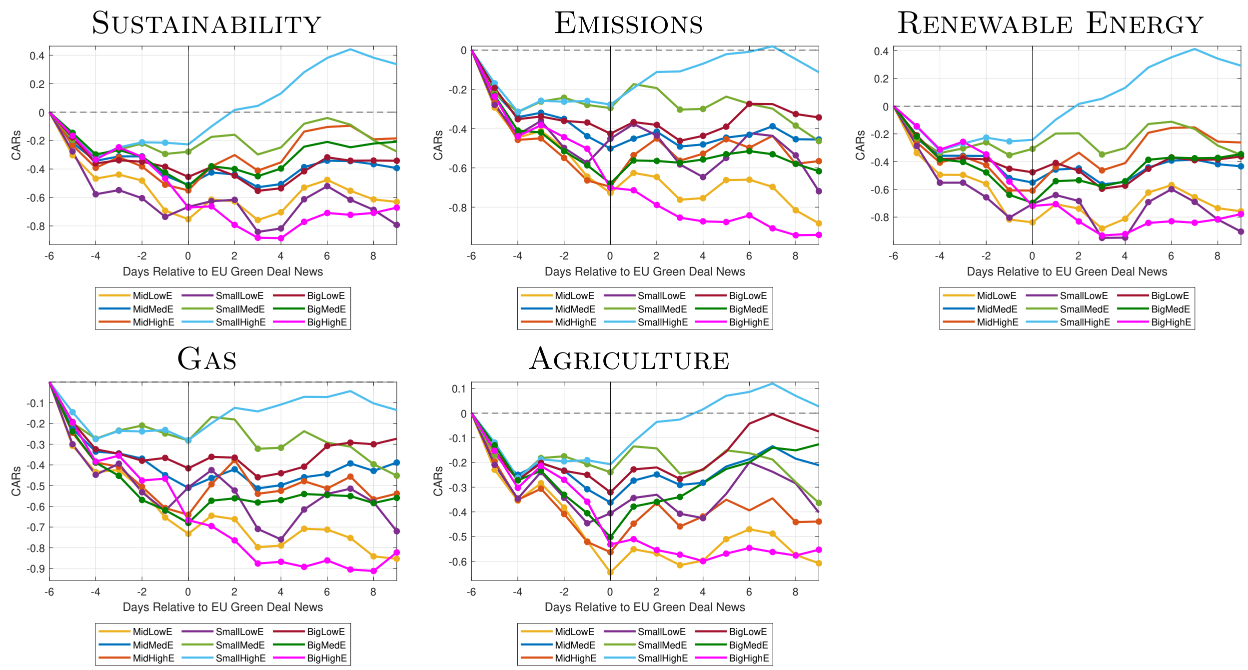


Notes: This figure depicts CARs around different category of **GDN** for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in nine value-weighted portfolios sorted on Size and CO2/Sales. The theoretical price is estimated according to a one factor CAPM model over a window from $t-250$ to $t-30$ using market return and risk-free rate retrieved from Fama and French European Factors https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

4.2 Regression analysis

We now proceed to examine the estimated regression models, with the results presented in Table 3. Panels A through E summarise the estimated models for returns on portfolios sorted based on CO2/Sales (Panel A), ESG (Panel B), Size & CO2/Sales (Panel C), Size & ESG (Panel D), and climate change exposure (Panel E). Portfolios are depicted in columns, whereas event categories are illustrated in rows. Each cell in the table contains the estimated effect of the event on the portfolio return. The results consistently show that the **GDN** exerts a negative effect on the portfolio return, a trend observed across all portfolio sorts, deciles, and event categories. However, the statistical significance of these effects varies notably depending on the portfolio's characteristics. For instance, when considering portfolios sorted by the CO2 to sales ratio (Panel A), the estimated coefficient remains insignificant for the first six deciles, which represent firms with relatively lower emissions. In contrast, from the 7th decile onwards, which comprises the highest polluters, the coefficients

Figure 6: Porfolios sorted on Size & Environmental Score (ESG)



Notes: This figure depicts CARs around different category of GDN for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in nine value-weighted portfolios sorted on Size and Refinitiv environmental score. The theoretical price is estimated according to a one factor CAPM model over a window from $t-250$ to $t-30$ using market return and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

become both negative and statistically significant across all event categories. This suggests that investors may penalize firms with higher carbon emissions more harshly in response to sustainability-related news, which reflects heightened concerns about the regulatory and financial risks these firms face in transitioning to a low-carbon economy. Turning to Panel B, which focuses on portfolios sorted by ESG scores, we observe a similarly negative impact of GDN on portfolio returns. However, in this case, the negative effects become significant from the 2nd decile onwards, particularly for specific event categories such as 'All events', 'Sustainability', and 'Renewables'. These results suggest that companies with moderate ESG scores are susceptible to negative market reactions following GDNs, especially when the news pertains to sustainability initiatives. This is consistent with the idea that investors are increasingly factoring ESG performance into their decision-making processes, particularly as sustainability policies become more prominent. In Panel C, we scrutinize portfolios formed through a two-dimensional sorting based on Size and CO2/Sales ratios. This yields nine portfolios, formed by the intersection of 'Small,' 'Mid', and 'Big' sizes, along with 'Low', 'Medium', and 'High' CO2/Sales ratios. Here, the analysis reveals a pronounced negative and significant impact of GDNs on six out of the nine portfolios, with the effect being particularly strong for medium and high polluters. Sustainability-related GDNs emerge as the most influential driver of negative portfolio returns, likely due to investors' concerns about the long-term viability of high-polluting firms in an increasingly regulated environment. In Panel D, stocks are allocated to nine portfolios based on the two-dimensional sort of 'Size' and 'ESG'. Again, the effects of GDNs are overwhelmingly negative and significant, particularly for portfolios exposed to sustainability-related news. This underscors the growing importance of ESG factors in shaping investor sentiment and market behavior. Finally, in Panel E, which categorizes portfolios based on their exposure to climate change, six out of seven portfolios respond significantly to GDNs, with the exception of the 'not exposed' sector. This implies that industries with higher exposure to climate-related risks, are more sensitive to policy developments associated with the EGD. The limited variability in significance across different news categories suggests that investor concerns about climate change are pervasive across sectors, regardless of the specific type of sustainability-related announcement.

Table 3: Green Deal News (GDN) vs. Green and Brown Portfolio Returns

Panel A: Co2/Sales	**Least CO2/Sales**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Most CO2/Sales**
All events	−0.155	−0.148	−0.084	−0.145	−0.137	−0.13	−0.216*	−0.309**	−0.246***	−0.349***
Sustainability	−0.218*	−0.211*	−0.12	−0.196*	−0.187*	−0.171*	−0.293**	−0.351**	−0.318***	−0.407***
Emissions	−0.231*	−0.212	−0.136	−0.221	−0.171	−0.181	−0.249	−0.366*	−0.315**	−0.423**
Renewables	−0.289**	−0.25*	−0.167*	−0.255*	−0.211*	−0.215**	−0.324**	−0.411**	−0.373**	−0.486**
Gas	−0.263*	−0.247*	−0.153	−0.254*	−0.197	−0.212*	−0.298*	−0.404*	−0.378**	−0.474***
Agriculture	−0.29**	−0.239	−0.156	−0.262*	−0.213*	−0.215*	−0.281*	−0.402*	−0.366**	−0.482***
Panel B: ESG	**Low ESG**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**High ESG**
All events	−0.219	−0.248*	−0.161*	−0.274*	−0.202*	−0.199	−0.14*	−0.113	−0.211*	−0.155*
Sustainability	−0.308*	−0.29*	−0.212**	−0.325*	−0.241**	−0.226	−0.165**	−0.157*	−0.293**	−0.2**
Emissions	−0.326	−0.284	−0.219*	−0.331	−0.225	−0.198	−0.186*	−0.155	−0.308*	−0.189
Renewables	−0.335	−0.328*	−0.239**	−0.359*	−0.303**	−0.286	−0.205**	−0.197**	−0.378**	−0.225*
Gas	−0.339	−0.287	−0.24**	−0.359*	−0.266*	−0.247	−0.201*	−0.196*	−0.359**	−0.223*
Agriculture	−0.366	−0.303	−0.243**	−0.363*	−0.274*	-0.252	−0.2*	−0.195*	−0.359**	−0.222*
Panel C: Size & CO2/Sales	**'SmallLowCO2'**	**'SmallMedCO2'**	**'SmallHighCO2'**	**'MidLowCO2'**	**'MidMedCO2'**	**'MidHighCO2'**	**'BigLowCO2'**	**'BigMedCO2'**	**'BigHighCO2'**	
All events	−0.223*	−0.178	−0.286**	−0.114	−0.148	−0.293**	−0.159	−0.262*	−0.272**	
Sustainability	−0.272**	−0.251*	−0.357***	−0.164*	−0.2*	−0.351**	−0.198	−0.341**	−0.346**	
Emissions	−0.272*	−0.226	−0.367**	−0.173	−0.202	−0.356**	−0.206	−0.333*	−0.37**	
Renewables	−0.299*	−0.275	−0.428***	−0.209*	−0.249**	−0.414**	−0.214	−0.353*	−0.401**	
Gas	−0.288*	−0.231	−0.41**	−0.199*	−0.24*	−0.414**	−0.207	−0.345*	−0.395**	
Agriculture	−0.289*	−0.264	−0.396**	−0.203*	−0.241*	−0.408**	−0.221	−0.349*	−0.384**	
Panel D: Size & ESG	**'SmallLowE'**	**'SmallMedE'**	**'SmallHighE'**	**'MidLowE'**	**'MidMedE'**	**'MidHighE'**	**'BigLowE'**	**'BigMedE'**	**'BigHighE'**	
All events	−0.267**	−0.21**	−0.233*	−0.172	−0.189**	−0.163*	−0.21*	−0.233*	−0.286**	
Sustainability	−0.328**	−0.261**	−0.317**	-0.196	−0.227**	−0.223**	−0.275**	−0.292**	−0.363**	
Emissions	−0.328	−0.267	−0.298	−0.182	−0.236	−0.227	−0.261	−0.319	-0.39	
Renewables	−0.367*	−0.309*	−0.357	−0.265	−0.262*	−0.281*	−0.283*	−0.333*	−0.412**	
Gas	−0.351**	−0.281**	−0.333*	−0.219	−0.261**	−0.271**	−0.268*	−0.322**	−0.434**	
Agriculture	−0.359**	−0.281*	−0.338*	−0.237	−0.263*	−0.271**	−0.281	−0.317*	−0.426**	
Panel E: Climate change exposed	**EI**	**NotExposed**	**FIN**	**FF**	**H**	**T**	**U**			
All events	−0.21*	−0.151	−0.144*	−0.508**	−0.43*	−0.391***	−0.144			
Sustainability	−0.268**	−0.207*	−0.193**	−0.601***	−0.444*	−0.448***	−0.185*			
Emissions	−0.272*	−0.203	−0.198*	−0.689***	−0.601**	−0.583***	−0.29**			
Renewables	−0.333**	−0.242*	−0.235**	−0.633**	−0.657**	−0.635**	−0.278**			
Gas	−0.319*	−0.237*	−0.228*	−0.661**	−0.485	−0.601***	−0.319***			
Agriculture	−0.323*	−0.232*	−0.244*	−0.719***	−0.539*	−0.597***	−0.302**			

Notes: This table reports the coefficient on the event dummy $E_{1,t}$ of the regression in Eq. 2 for the five event categories: *i*) General, *ii*) Emissions, *iii*) Renewables energy, *iv*) Gas and *v*) Agriculture. Test assets are portfolios sorted on *i*) CO2/Sales (Panel A), *ii*) Refinitiv environmental score (ESG) (Panel B), *iii*) Size & CO2 (Panel C), *iv*) Size & Refinitiv environmental score (ESG) (Panel D) and *v*) Climate change exposed sectors (Battiston et al., 2017) (Panel E). In Panel E, stocks have been grouped into seven sectoral value-weighted portfolios: *a*) Energy intensive (EI), *b*) Not exposed, *c*) Financials (FIN), *d*) Fossil fuel (FF), *e*) Housing (H), *f*) Transport (T), and *g*) Utilities (U). Standard errors (not reported) are corrected for heteroskedasticity and autocorrelation following Newey and West (1986). *, **, and *** indicate a significance level of 10%, 5% and 1%, respectively.

Reversal effects. We conduct a more in-depth analysis of GDN impact on portfolio returns by augmenting the regression model in Eq. 2 with three dummy variables that capture up to three days after the event day. In Table 4, we present the estimated coefficients of $E_{1,t}$, $E_{2,t}$ and $E_{3,t}$ for each sorting rule. In general, GDNs result in negative returns three days after the event, but the significance is varies across portfolios. For portfolios categorized by the CO2/Sales ratio (Panel A), negative and significant coefficients are observed for portfolios 7 to 10, which represent the most polluting stocks. Conversely, greener portfolios sorted by their environmental exhibit greater sensitivity to GDNs (Panel B). Examining the portfolios sorted by size and CO2/Sales (Panel C), significant response is noted for four out of ten portfolios. Interestingly, within each size category the most polluting portfolios show larger (more negative) coefficients. Considering portfolios sorted by size and environmental scores, a pattern emerges, particularly for smaller stocks. The coefficient that captures the effect of GDNs three days after the event is significant for the first three portfolios and increases in magnitude moving from the lowest to the higher environmental scores. Finally, we focus on portfolios sorted based on climate change exposure, utilizing the categorization by Battiston et al. (2017). Among the exposed sectors, fossil fuel, transport and utilities appear to be the most impacted by the Green Deal announcements. For other sectors, we observe negative coefficients, although not statistically significant, becoming more pronounced a few days after the event.

Table 4: Green Deal News vs. Green and Brown Portfolio Returns: Reversal Effect

Panel A: Co2/Sales	**Least CO2/Sales**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Most CO2/Sales**
$E_{1,t}$	0.021	0.044	0.044	-0.079	0.057	0.01	0.027	0.008	0.084	0.089
$E_{2,t}$	-0.014	-0.032	-0.016	0.058	0.023	-0.044	-0.005	0.032	-0.025	-0.056
$E_{3,t}$	-0.155	-0.147	-0.086	-0.145	-0.148	-0.124	-0.218^{*}	-0.315^{**}	-0.251^{**}	-0.35^{***}
Panel B: ESG	**Low ESG**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**High ESG**
$E_{1,t}$	-0.045	0.011	0.019	-0.047	0.05	0.114	-0.018	0.016	0.102	-0.002
$E_{2,t}$	0.11	-0.042	-0.046	0.085	-0.047	-0.025	-0.031	-0.013	-0.035	0.031
$E_{3,t}$	-0.232	-0.242^{*}	-0.156^{*}	-0.283^{*}	-0.199^{*}	-0.208	-0.133^{*}	-0.113	-0.217^{*}	-0.16^{*}
Panel C: Size & CO2/Sales	**'SmallLowCO2'**	**'SmallMedCO2'**	**'SmallHighCO2'**	**'MidLowCO2'**	**'MidMedCO2'**	**'MidHighCO2'**	**'BigLowCO2'**	**'BigMedCO2'**	**'BigHighCO2'**	
$E_{1,t}$	0.041	0.059	0.111	0.021	0.007	0.055	0.074	0.147	0.232^{**}	
$E_{2,t}$	0.013	0.019	0.01	-0.012	-0.006	-0.026	-0.061	0.059	0.039	
$E_{3,t}$	-0.23^{*}	-0.188	-0.3^{**}	-0.114	-0.148	-0.295^{**}	-0.157	-0.288^{**}	-0.304^{**}	
Panel D: Size & ESG	**'SmallLowE'**	**'SmallMedE'**	**'SmallHighE'**	**'MidLowE'**	**'MidMedE'**	**'MidHighE'**	**'BigLowE'**	**'BigMedE'**	**'BigHighE'**	
$E_{1,t}$	0.068	0.063	0.09	-0.021	-0.018	0.047	0.107	0.164	0.235^{**}	
$E_{2,t}$	0.012	0.031	-0.005	-0.023	-0.011	-0.014	-0.004	0.031	0.03	
$E_{3,t}$	-0.276^{**}	-0.223^{**}	-0.242^{*}	-0.166	-0.185^{*}	-0.166^{*}	-0.221^{*}	-0.257^{**}	-0.318^{**}	
Panel E: Climate change exposed	**'EI'**	**'NotExposed'**	**'FIN'**	**'FF'**	**'H'**	**'T'**	**'U'**			
$E_{1,t}$	0.065	0.002	-0.025	0.106	0.518^{**}	0.199	-0.032			
$E_{2,t}$	-0.021	0.007	-0.043	0.02	0.084	-0.06	-0.021			
$E_{3,t}$	$-0.214F^{*}$	-0.152	-0.134	-0.523^{***}	-0.502^{**}	-0.403^{***}	-0.137			

Notes: This table reports the coefficients of the event dummies $E_{1,t}$, $E_{2,t}$, and $E_{3,t}$ estimated from an augmented version of the regression model in Eq. (2). Formally, we estimate the following regression:

$$R_t^s = c + \sum_{i=1}^{3} \beta_{1,i} R_{t-i}^s + \sum_{i=1}^{4} \beta_{2,i} D_{i,t} + \sum_{i=1}^{3} \beta_3 E_{i,t} + \nu_t^s$$

where $E_{i,t}$ $i = 1, 2, 3$ stand for the event effect days. All events (i.e., GDNs) listed in Table 1 are considered. We consider portfolios sorted on *i*) CO2/Sales (Panel A), *ii*) Refinitiv environmental score (ESG) (Panel B), *iii*) Size & CO2 (Panel C), *iv*) Size & Refinitiv environmental score (ESG) (Panel D), and *v*) Climate change exposed sectors (Battiston et al., 2017) (Panel E). In Panel E, stocks have been grouped into seven sectoral value-weighted portfolios: *a*) Energy intensive (EI), *b*) Not exposed, *c*) Financials (FIN), *d*) Fossil fuel (FF), *e*) Housing (H), *f*) Transport (T), and *g*) Utilities (U). Standard errors (not reported) are corrected for heteroskedasticity and autocorrelation (Newey and West, 1986). *, **, and *** indicate a significance level of 10%, 5% and 1%, respectively.

Placebo test (random events). Are the implications on portfolio returns truly due to Green Deal official announcements? To address this concern we simulated 100 sets of events during the observed sample and replicate the regression analysis for each of these dates. Table 5 reports the average coefficient of the event day dummy across all simulations and the t-statistic for the difference between the latter and the 'true' coefficient for all events reported in Table 3. For all sorting rules and across deciles, the average estimated coefficient is close to zero and never significant. Most importantly, the t-statistic for the difference is highly significant and suggests that the 'true' coefficients are far from those obtained exploiting the random events. This exercise corroborates our previous findings on the negative impact of GDNs on portfolio returns.

Table 5: Regression Analysis with Random Events

Panel A: Co2/Sales	Least CO2/Sales	2	3	4	5	6	7	8	9	Most CO2/Sales
Coefficient	0.01295	0.00195	-0.00093	0.01285	0.00848	0.00574	0.00027	0.01815	0.01035	0.00735
t-test	20.22934	18.04786	15.27935	17.69631	19.75165	19.16321	23.14896	25.77449	26.55788	32.3828
Panel B: ESG	Low ESG	2	3	4	5	6	7	8	9	High ESG
Coefficient	0.01067	0.01542	0.00399	0.02857	-0.00337	0.01088	-0.00346	0.00119	0.00755	0.00973
t-test	16.97953	25.99135	22.8445	22.95511	25.52633	19.50358	22.0313	19.65428	21.60657	23.38976
Panel C: Size & CO2/Sales	'SmallLowCO2'	'SmallMedCO2'	'SmallHighCO2'	'MidLowCO2'	'MidMedCO2'	'MidHighCO2'	'BigLowCO2'	'BigMedCO2'	'BigHighCO2'	
Coefficient	0.00787	0.0091	0.00844	0.00352	0.00607	0.01229	0.01512	0.00504	0.00212	
t-test	26.42798	19.21286	33.10287	17.45302	19.91238	29.56842	19.63201	26.8095	28.60732	
Panel D: Size & ESG	'SmallLowE'	'SmallMedE'	'SmallHighE'	'MidLowE'	'MidMedE'	'MidHighE'	'BigLowE'	'BigMedE'	'BigHighE'	
Coefficient	0.00605	0.00759	0.01223	0.01821	0.00823	0.00548	0.00541	0.00902	0.01075	
t-test	28.42289	27.62995	24.90196	15.65131	24.54691	21.66305	23.87853	24.88423	29.267	
Panel E: Climate change exposed	'EI'	'NotExposed'	'FIN'	'FF'	'H'	'T'	'U'			
Coefficient	0.00886	0.00732	0.00328	0.01733	0.02517	0.00534	-0.00449			
t-test	24.12442	19.98455	19.85981	26.73525	25.44831	33.62005	16.97471			

Notes: This table reports the average coefficient on the $E_{1,t}$ of the regression in Eq. 2 for 100 simulated sets of events. The t-test is the test statistic for the difference between the "true" coefficients for all events categories (3) and the random events coefficients. For each simulated set 100 events are randomly drawn using a uniform distribution over the sample period. Test assets are portfolios sorted on *i*) CO2/Sales (Panel A), *ii*) Refinitiv environmental score (ESG) (Panel B), *iii*) Size & CO2 (Panel C), *iv*) Size & Refinitiv environmental score (ESG) (Panel D) and *v*) Climate change exposed sectors (Battiston et al., 2017) (Panel E). In Panel E, stocks have been grouped into seven sectoral value-weighted portfolios: *a*) Energy intensive (EI), *b*) Not exposed, *c*) Financials (FIN), *d*) Fossil fuel (FF), *e*) Housing (H), *f*) Transport (T), and *g*) Utilities (U). *, **, and *** indicate a significance level of 10%, 5% and 1%, respectively.

4.3 Robustness checks and additional empirical tests

Three factor Model: Fama-French Factors. To evaluate the robustness of our findings, we re-estimate CARs using the Fama-French three-factor model, where theoretical returns are now calculated based on this framework. Newly estimated CARs are illustrated in Appendix A.

We begin by examining the portfolios constructed based on firms' varying exposure to climate change, as classified by Battiston et al. (2017). As shown in Figure A.1, the CARs are qualitatively similar to those in Figure 2, which were estimated using the one-factor market model. Green Deal News related to emissions, gas, and agriculture generally lead to negative and significant abnormal returns. Conversely, GDNs on sustainability and renewable energy yield positive CARs, but only within the transport and fossil fuel sectors. However, in those instances where the CARs turn out to be positive, they are insignificant.

These findings are broadly confirmed when looking at portfolios sorted on the CO2/Sales ratio. At all deciles Figure A.2 depicts an underperformance compared to the theoretical model around emissions and gas GDNs, whereas a more heterogeneous response is found for sustainability and renewable energy. Interestingly, the most polluting portfolios exhibit positive CARs after GDNs regarding the latter categories. Moreover, the 'greener' portfolios' abnormal returns are never significant and far from zero.

In Figure A.3 cumulative abnormal returns for portfolios sorted on environmental score are reported. Including Small-minus-Big and High-minus-Low to the CAPM model yields to no substantial differences in the estimated CARs and confirms the previous findings. Contrary to the results concerning portfolios sorted on CO2/Sales, sustainability and renewable energy portfolios that combine stocks with higher environmental scores outperform their 'browner' counterparts. Similarly, more environmental friendly portfolios are less sensitive to emissions and gas GDNs, although the cumulative abnormal returns around these events is negative and significant.

Next, we examine the CARs around GDNs are estimated on portfolios sorted on size and CO2/Sales, shown in Figure A.4. Our main findings remain unaltered after controlling for additional market factors. Emissions and gas still induce a negative response in abnormal returns, especially for portfolios including smaller stocks. A generally positive effect is reported around sustainability, renewable energy and agriculture events. Actually, the abnormal returns for portfolios 'Small' are larger than those of other portfolios which instead exhibit negative or close to zero abnormal response.

Additionally, we examine the dynamics of CARs estimated from a three-factor model on portfolios sorted on size and environmental scores. Comparing Figure A.4 and 6, few differences emerge. Consistent with the results discussed thus far, emissions and gas (sustainability, renewable energy and agriculture) yield negative (positive) CARs. Notably, the estimated effects of GDNs are larger in magnitude compared to those obtained from a one-factor model. For instance, The cumulative abnormal return for the 'SmallHighE' portfolio around renewable energy is 1% larger.

Four-factor model: Liquidity For the sake of robustness we replicate the results discussed here above including a forth factor, namely liquidity constructed in the spirit of Fama and French. Stock level liquidity is constructed as the ratio of absolute total return and volume traded (Amihud, 2002). Formally, the liquidity measure for stock i at time t is defined as:

$$\text{Liquidity}_{i,t} = \frac{|R_{i,t}|}{\text{Volume traded}_{i,t}} \tag{3}$$

Utilizing the estimated stock liquidity, we construct decile portfolios to capture varying levels of liquidity. The liquidity factor is defined as the return differential between the least liquid and most liquid portfolios. To evaluate performance around GDNs, we compute CARs, which are calculated as the difference between realized returns and theoretical returns. These theoretical returns are derived from a four-factor model that incorporates the market excess return, small-minus-big (SMB), high-minus-low (HML), and the liquidity factor. This approach allows us to assess whether liquidity plays a key role in driving green and brown stock return dynamics following GDNs.

The estimated CARs derived from this additional econometric specification can be found in Appendix B. The dynamics of these CARs – depicted in Figures B.1 through B.5 –for green and brown equity portfolios, sorted according to various criteria, closely resemble those estimated using the three-factor model.

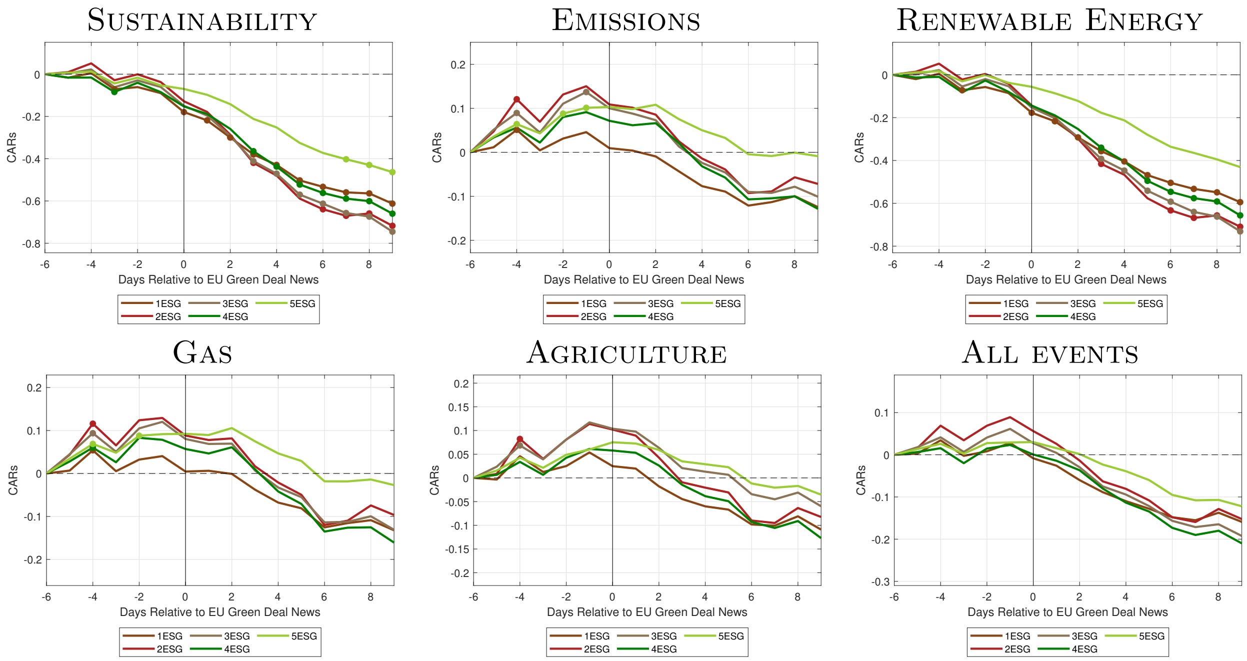
4.4 Green vs. Brown Bond Portfolios

We further investigate the response of corporate bond portfolios to `GDNs`. These portfolios are constructed by grouping corporate bonds into five equally-weighted bins based on the issuing company's Refinitiv environmental score (ESG). Summary statistics for these portfolios are presented in Table 2. CARs are calculated in accordance with the methodology outlined in Bessembinder et al. (2008). Formally, the model is expressed as:

$$CAR_{i,t} = \sum_{t-5}^{t+9} \epsilon_{i,t} = \sum_{t-5}^{t+9} [(R_{i,t} - R_{f,t}) - \alpha_i - \beta_{i,mkt}(R_{mkt,t} - R_{f,t}) - \beta_{i,smb}SMB_t - \beta_{i,hml}HML_t - \beta_{i,term}Term_t - \beta_{i,Def}Def_t] \quad (4)$$

where $R_{i,t}$ denotes the return on the portfolio of corporate bonds, $R_{mkt,t} - R_{f,t}$ represents the excess market returns, and SMB_t and HML_t are the Fama-French small-minus-big and high-minus-low factors, respectively. $Term_t$ is the term spread (term structure) that refers to the slope of the yield curve, calculated as the yield difference between 10-year and 1-year German government bonds. Def_t is the default spread, representing the corporate bond risk premium relative to long-term government bonds, measured as the return differential between corporate bonds and 10-year German government bonds. Following Fama and French (1993), the term and default spreads capture almost all the common variation in bond returns in the US market. Table 6 visualizes the estimated Kaplanski and Levi regression models. The analysis of `GDNs` for corporate bond portfolios sorted by Refinitiv environmental scores shows how these portfolios respond to various categories of `GDNs`. The results are organized into six panels: A) All events, B) Sustainability, C) Emissions, D) Renewables, E) Gas, and F) Agriculture. Across all event categories, bond portfolios exhibit consistently negative valuation effects of `GDNs` on event days. It is worth noting that bond portfolios with high ESG performance feature negative, albeit smaller effects than portfolios with lower ESG performance. Negative CARs in response to `GDNs` indicate heightened investor concerns over regulatory risks and the transition to a low-carbon economy. However, these effects remain insignificant.

Figure 7: Corporate Bond Portfolios Sorted on Environmental Scores (ESG)



Notes: Notes: This figure depicts CARs around different category of GDN for corporate bond portfolios sorted on Refinitiv environmental score. Corporate bonds have been grouped in five equal-weighted portfolios based on company Refinitiv environmental score. The theoretical price is estimated according to a five-factor CAPM model over a window from $t-250$ to $t-30$, as suggested by the CARs definition in Eq. (4). CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

Figure 7 depicts CARs around different categories of GDNs for corporate bond portfolios sorted by Refinitiv ESG scores. The analysis reveals significant differences in how bond portfolios respond to Green Deal-related announcements based on their ESG performance. In the pre-event window, bond portfolios typically exhibit positive CARs, with the highest values reaching approximately 0.15% just before the event (see Emissions). However, these CARs begin to decline as the event approaches, which reflects a market adjustment as investors reevaluate their expectations. Following the GDN announcement, CARs for bonds related to Sustainability and Renewable Energy news turn negative, which indicates a shift in investor sentiment as the market factors in potential risks associated with the implementation of new policies. In contrast, CARs for bond portfolios responding to news related to Emissions, Gas, and Agriculture diminish and turn negative approximately 5 days after the event, which reflects growing concerns about regulatory pressures and the long-term viability of companies in these sectors. The overall reaction indicates that while there is initial optimism surrounding sustainability initiatives, the subsequent market response indicates caution as investors consider the broader implications of these policies on corporate performance. The negative CARs following announcements related to Sustainability and Renewable Energy highlight the challenges firms may face in adapting to new environmental standards, despite initial positive expectations.

Additionally, Figure 7 illustrates the disparity in CARs between high and low ESG bonds. In particular, bond portfolios in the top quintile consistently exhibit larger CARs compared to those with lower ESG performance, both in the pre-event and post-event windows. Additionally, portfolios with superior ESG ratings tend to demonstrate lower sensitivity to `GDNs` compared to their underperforming counterparts, which highlights the resilience of high ESG bonds in the face of regulatory announcements.

Overall, Figure 7 illustrates that bond portfolios sorted by ESG scores respond distinctly to Green Deal-related News. The highest CARs in the pre-event window, though positive, are short-lived as the market adjusts quickly to the implications of policy announcements. The differing reactions to various types of news further underscore the heterogeneous nature of investor sentiment and the importance of ESG alignment in evaluating bond investment risks and opportunities in the evolving regulatory landscape.

Stock vs. Bond Portfolios In the context of the EGD, the stock market typically exhibits a more pronounced reaction to `GDN` announcements compared to the bond market. Stocks with high ESG scores often experience significant negative CARs, sometimes as low as -2.5%, for stock portfolios with high CO2 intensity approximately seven days after the event. Conversely, CARs on stock portfolios in response to `GDNs` related to Sustainability, Renewable Energy, and Agriculture can reach 0.75%-1.00% approximately seven days after the event, depending on the specific portfolio sorting rule and the category of `GDN`. These responses contrast sharply with the bond market, where CARs are far less sensitive to different categories of `GDNs`. This heightened responsiveness of stock portfolios can be attributed to several factors, including the perceived ability of these firms to capitalize on regulatory incentives, enhance future cash flows, and attract environmentally conscious investors. Moreover, stocks with low ESG scores often suffer considerable declines, reflecting heightened concerns about their long-term viability in an increasingly sustainability-focused regulatory environment.

In contrast, the bond market generally demonstrates more muted reactions. High ESG bonds tend to experience positive CARs, peaking at 0.15% in response to GDN events, while low ESG bonds may experience negative CARs that drop to -0.75%. The disparity in responses can be explained by the inherent characteristics of bond investing, where fixed-income securities are often seen as lower risk and less volatile compared to equities. According to a study by Pastor and Stambaugh (2012), fixed-income investors tend to prioritize stability and credit risk over the more pronounced growth prospects that drive stock market valuations. Brenner et al. (2009) provide valuable insights into the differences in sensitivity to macroeconomic news between stock and bond returns, which is particularly relevant to our study on `GDNs`. They find that stock returns exhibit higher volatility in response to macroeconomic announcements compared to bond returns. This is largely because stocks are more directly tied to the economic outlook and investor sentiment, which can be significantly influenced by such news. In the context of our analysis of `GDNs`, we observe similar patterns where stock returns react more dramatically to sustainability-related policy announcements compared to bond returns. Both positive and negative CARs on stock portfolios often reach levels significantly higher (in absolute value) than on bond portfolios. Moreover, Brenner et al. (2009) note that the comovement between stock and bond returns increases around aggregate shocks, but this comovement is asymmetric. Specifically, stock returns show a stronger reaction to `GDNs` than bond returns. This observation parallels our findings regarding the asymmetric responses of stock and bond portfolios to `GDNs`. It is worth noting that the processes of price formation differ. Stocks are more influenced by changes in expectations about future economic conditions and market-wide news, while bonds are primarily affected by interest rate changes and default risk (Fama and French, 1993). This foundational difference partly explains why stock returns are generally more sensitive to aggregate shocks compared to bond returns.

4.5 Exploiting European Green Deal-Related Announcements

Figure 8 illustrates the trading strategy employed around `GDN` events is designed to optimize the portfolio's performance by switching between risky assets and risk-free assets based

Table 6: Green Deal News vs. Bond Portfolio Returns

Panel A: All events	Low ESG	2	3	4	High ESG
$E_{1,t}$	-0.007	-0.022	-0.021	-0.027	-0.007
$E_{2,t}$	0.035	0.05	0.022	0.027	0.015
$E_{3,t}$	-0.022	-0.04	-0.027	-0.031	-0.021
Panel B: Sustainability	**Low ESG**	**2**	**3**	**4**	**High ESG**
$E_{1,t}$	-0.02	-0.032	-0.036	-0.038	-0.017
$E_{2,t}$	0.03	0.043	0.022	0.023	0.013
$E_{3,t}$	-0.026	-0.04	-0.024	-0.037	-0.021
Panel C: Emissions	**Low ESG**	**2**	**3**	**4**	**High ESG**
$E_{1,t}$	-0.027	-0.052	-0.054	-0.045	-0.026
$E_{2,t}$	0.03	0.049	0.02	0.023	0.016
$E_{3,t}$	-0.019	-0.044	-0.031	-0.028	-0.026
Panel D: Renewables	**Low ESG**	**2**	**3**	**4**	**High ESG**
$E_{1,t}$	-0.024	-0.035	-0.046	-0.037	-0.019
$E_{2,t}$	0.037	0.045	0.027	0.03	0.02
$E_{3,t}$	-0.006	-0.016	-0.014	-0.01	-0.01
Panel E: Gas	**Low ESG**	**2**	**3**	**4**	**High ESG**
$E_{1,t}$	-0.012	-0.029	-0.037	-0.026	-0.014
$E_{2,t}$	0.034	0.043	0.025	0.025	0.019
$E_{3,t}$	-0.013	-0.027	-0.022	-0.02	-0.019
Panel F: Agriculture	**Low ESG**	**2**	**3**	**4**	**High ESG**
$E_{1,t}$	-0.03	-0.065	-0.057	-0.047	-0.026
$E_{2,t}$	0.038	0.057	0.03	0.031	0.021
$E_{3,t}$	-0.012	-0.024	-0.021	-0.019	-0.016

Notes: This table reports the coefficients of the event dummies $E_{1,t}$, $E_{2,t}$, and $E_{3,t}$ estimated from an augmented version of the regression model defined in Eq. (2). Formally, coefficients are estimated from the following regression:

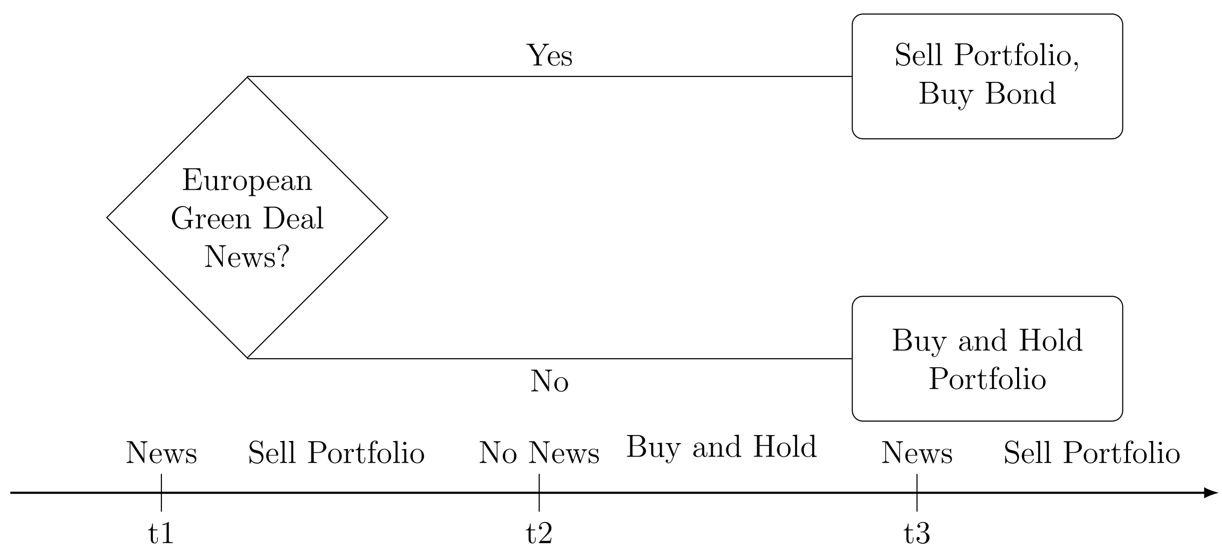
$$R_t^s = c + \sum_{i=1}^{3} \beta_{1,i} R_{t-i}^s + \sum_{i=1}^{4} \beta_{2,i} D_{i,t} + \sum_{i=1}^{3} \beta_3 E_{i,t} + \beta_{term} Term_t + \beta_{Def} Def_t + \nu_t^s$$

where $E_{i,t}$ $i = 1, 2, 3$ stand for the event effect days, $Term_t$ is a proxy for the slope of the yield curve and Def_t captures the default spread. Estimates are reported for all the five event categories: *i*) All events, *ii*) General, *iii*) Emissions, *iv*) Renewable Energy, *v*) Gas and *vi*) Agriculture. We consider portfolios of corporate bonds sorted on Refinitiv environmental score (ESG). Standard errors (not reported) are corrected for heteroskedasticity and autocorrelation (Newey and West, 1986). *, **, and *** indicate a significance level of 10%, 5% and 1%, respectively.

on the timing of the event. The core of the strategy revolves around two key actions: *holding risky assets* on non-event days and *moving to risk-free assets* on or around the event day. On non-event days, the strategy allocates the entire portfolio to risky assets, with the proportion of risky assets (RA_t) set to 1 and the proportion of risk-free assets (RF_t) set to 0. This implies that, during normal market conditions, the portfolio is fully invested in risky assets to capitalize on potential gains. When a GDN event occurs, the strategy shifts to a more conservative allocation by moving into risk-free bonds. On the day of the GDN announcement ($t = T_e$), the portfolio is fully allocated to a risk-free asset ($\text{RF}_{T_e} = 1$), thereby minimizing exposure to market volatility that may arise from GDNs. In addition to the GDN-based strategy, we also consider an alternative strategy that anticipates market reactions by reallocating to risk-free bonds *one day before the event* ($\text{RA}_{T_e-1} = 0$), which captures potential pre-event movements in the market (the so-called anticipated strategy).

After the event, the portfolio rebalances by reallocating back to risky assets. This occurs on the day after the event ($t = T_e + 1$), where the portfolio is once again fully invested in risky assets ($\text{RA}_{T_e+1} = 1$). It's worth noting that each reallocation from risky to risk-free assets (and vice versa) incurs a cost. This transaction cost, denoted by c, reduces the overall portfolio value each time a switch occurs. The strategy must therefore weigh the benefits of minimizing exposure to event-driven volatility against the cost of frequent rebalancing. In summary, the `GDN`-based trading strategy relies on *timing* and *asset reallocation* to optimize returns. By dynamically shifting between risky and risk-free assets around `GDN` events, the strategy seeks to benefit from the valuation effects of `GDNs`. The decision to hold or switch assets is driven by the anticipation of market reactions to `GDN` announcements. Figure 8 exemplifies the trading strategy in three periods.

Figure 8: The `GDN`-Based Trading Strategy



Notes: This figure illustrates the Green Deal News-based trading strategy. When no event occurs, we invest in the buy-and-hold portfolio with the lowest coefficient on the announcement dummy variable. When an announcement is made regarding the European Green Deal, we sell the portfolio and buy a risk-free bond.

The cumulative return for each sorting are shown in Figure 9. This figure consists of four panels. In Panel A, the trading strategy involves portfolios constructed based on the CO2/Sales sorting. In Panel B, the trading strategy involves portfolios constructed based on the ESG sorting. In Panel C, the trading strategy involves portfolios constructed based on the two-dimensional Size & CO2/Sales sorting. Finally, in Panel D, the trading strategy is involves portfolios constructed on the two-dimensional Size & ESG sorting. The black (blue) line depicts the cumulative return of GDN investment (buy-and-hold) strategy on the left axis and the red line is the difference between the two on the right axis. In the left column, the GDN trading strategy involves holding a *buy-and-hold* portfolio on non-event days and selling the portfolio on event days. This strategy aims to capitalize on abnormal returns triggered by market reactions to policy announcements related to GDNs. In contrast, the right column implements the GDN trading strategy *one day before the event* (the anticipation strategy) to capture potential pre-event market responses, which reflect investor anticipation of policy developments. Both strategies use portfolios based on the most negative and significant coefficients from the Kaplanski and Levi regressions, which identify portfolios that are highly sensitive to policy changes. A conservative 1% transaction cost is assumed for each trade.

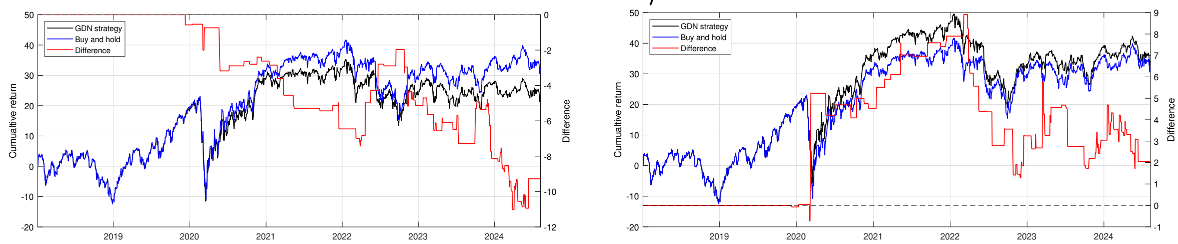
The results show contrasting outcomes depending on the timing of the strategy. In the left column, the GDN trading strategy yields positive returns during specific periods. However, toward the end of the sample period, the strategy becomes negative, which indicates diminishing effectiveness. This is driven by several factors: first, investor anticipation of policy changes and media reports ahead of the event leads to a market adjustment before the actual event; second, accumulating transaction costs erode profitability each time the strategy is activated. As a result, the GDN strategy becomes largely ineffective over time.

In all cases, by the end of the investment period, the spread between the GDN strategy and the benchmark is substantial, ranging from 1% to 6%. This difference suggests that the GDN strategy is effective in capturing pre-event market reactions, particularly in portfolios formed on the two-dimensional sorting of Size and CO2/Sales ratio. The anticipation strategy enables the investor to enter positions before the market fully incorporates the expected policy impacts. Notably, the spread drops during the period 2022–2023, likely due to the war in Ukraine. This conflict introduced significant geopolitical risks and market volatility, which temporarily reduced the effectiveness of the GDN-based trading strategy. This drop in the spread can be attributed to the shifting focus of global markets toward energy security, military spending, and broader macroeconomic concerns, which could have diminished the immediate relevance of environmental policies and sustainability initiatives. As the market's attention moved away from the EGD during this period, ESG-focused portfolios were likely impacted by heightened uncertainty surrounding the war and its effects on the energy sector, particularly due to Europe's reliance on Russian energy imports.

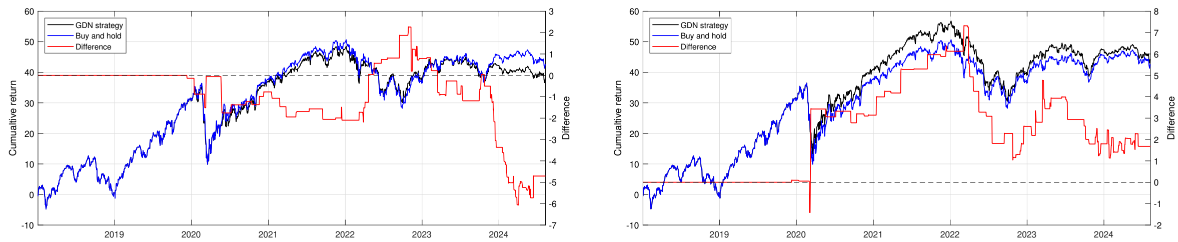
Figure 9: Investment strategy based on Green Deal News (GDN) - CO2/Sales

Kaplanski and Levy (2010b) strategy **Anticipated strategy**

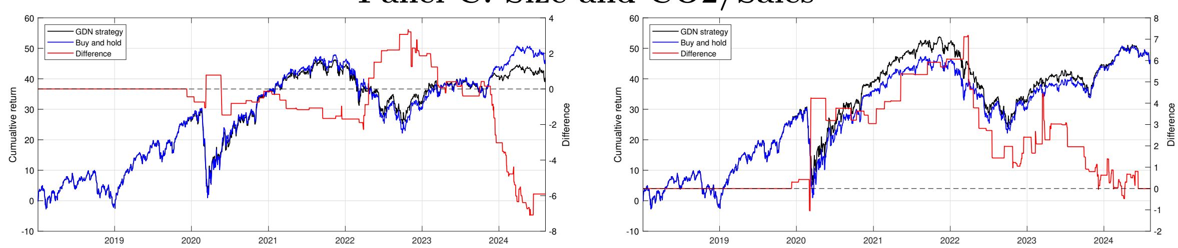
Panel A: CO2/Sales



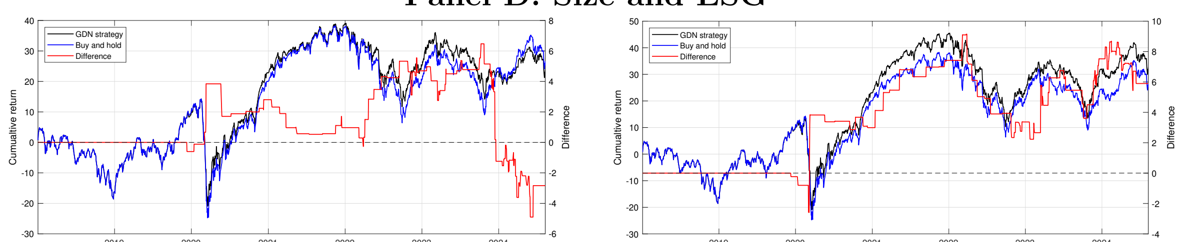
Panel B: ESG



Panel C: Size and CO2/Sales



Panel D: Size and ESG



Notes: The figure depicts the cumulative return of the GDN strategy (left axis, black line), buy-and-hold strategy (left axis, blue line) and the difference between the two strategies (right axis, red line). The GDN strategy assumes a buy-and-hold strategy on non-event days and selling the portfolio and investing in a risk-free bond on event days. The test asset is "Most CO2/Sales". The risk-free rate is from Fama and French European Factors. Sample 01-01-2018 – 30-06-2024.

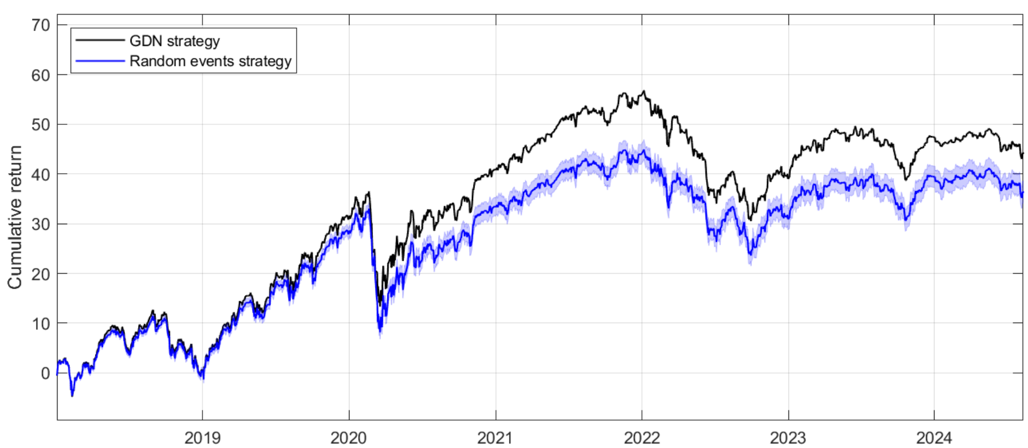
Random events. To ensure the reliability of our findings, akin to our approach in the regression analysis, we perform a placebo test. The placebo test allows assessing whether the returns on the GDN-based trading strategies reported in Figure 9 are merely random or genuinely driven by the predictability of market performance following GDN. To conduct this test, we randomly select the same number of non-GDN events and construct 100 investment strategies, juxtaposing the average random investment strategy with the GDN strategy. In order to evaluate the statistical difference between the GDN and random strategies, we report the 99% confidence bands. The results of the comparison reveal that the performance of the GDN strategy is statistically larger relative to the random event-based strategies. Figures 10 - 13 demonstrate that, across all four sorting rules (e.g., CO2/Sales, ESG, Size & CO2/Sales, and Size & ESG), the strategy consistently yields markedly higher returns compared to the investment strategy based on random events. This underscores the importance of the timing and relevance of GDNs in driving stock market performance.

This exercise demonstrates the predictive power of GDNs in influencing market valuations. The significantly higher returns generated by the GDN strategy—compared to the random event-based strategies—affirm that GDNs provide valuable information that is promptly reflected in the stock market. This further strengthens the argument that GDNs offer market-relevant insights, conducive to investment opportunities.

Figure 10: Investment strategy based on Green Deal News (GDN) - CO2/Sales

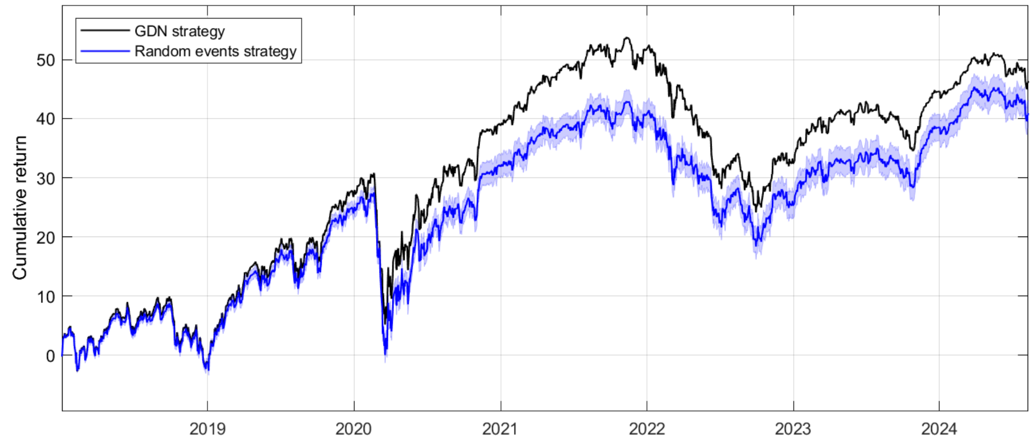
Notes: The figure depicts the cumulative return of the GDN strategy (black line) and the average cumulative return under random events strategy for 100 simulated sets of events. For each simulated set 100 events are randomly drawn from a uniform distribution over the sample period. Blue shaded areas represent 99% confidence interval over the 100 simulated sets of events. The GDN and random events strategies assume a buy-and-hold strategy on non-event days and selling the portfolio and investing in a risk-free bond on event days. The risk-free rate is from Fama and French European Factors. Sample 01-01-2018 – 30-06-2024.

Figure 11: Investment strategy based on Green Deal News (GDN) - ESG



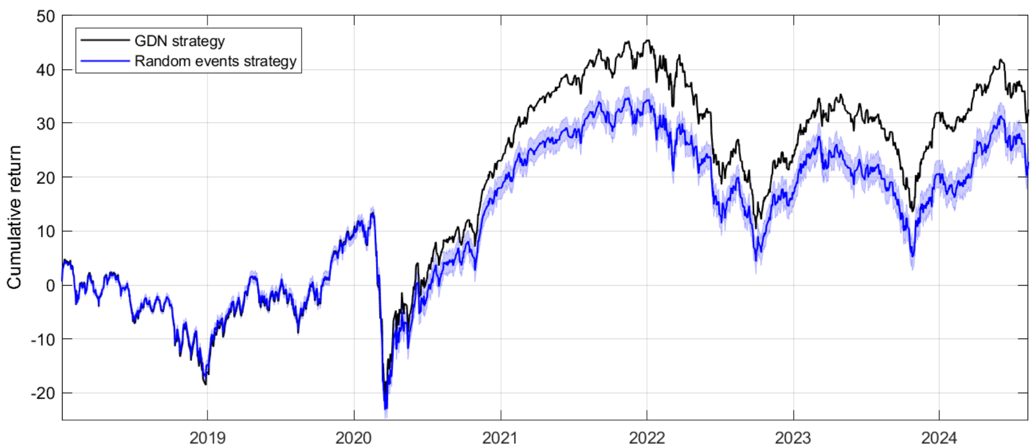
Notes: The figure depicts the cumulative return of the GDN strategy (black line) and the average cumulative return under random events strategy for 100 simulated sets of events. For each simulated set 100 events are randomly drawn from a uniform distribution over the sample period. Blue shaded areas represent 99% confidence interval over the 100 simulated sets of events. The GDN and random events strategies assume a buy-and-hold strategy on non-event days and selling the portfolio and investing in a risk-free bond on event days. The risk-free rate is from Fama and French European Factors. Sample 01-01-2018 – 30-06-2024.

Figure 12: Investment strategy based on Green Deal News (GDN) - Size & CO2/Sales



Notes: The figure depicts the cumulative return of the GDN strategy (black line) and the average cumulative return under random events strategy for 100 simulated sets of events. For each simulated set 100 events are randomly drawn from a uniform distribution over the sample period. Blue shaded areas represent 99% confidence interval over the 100 simulated sets of events. The GDN and random events strategies assume a buy-and-hold strategy on non-event days and selling the portfolio and investing in a risk-free bond on event days. The risk-free rate is from Fama and French European Factors. Sample 01-01-2018 – 30-06-2024.

Figure 13: Investment strategy based on Green Deal News (GDN) - Size & ESG



Notes: The figure depicts the cumulative return of the GDN strategy (black line) and the average cumulative return under random events strategy for 100 simulated sets of events. For each simulated set 100 events are randomly drawn from a uniform distribution over the sample period. Blue shaded areas represent 99% confidence interval over the 100 simulated sets of events. The GDN and random events strategies assume a buy-and-hold strategy on non-event days and selling the portfolio and investing in a risk-free bond on event days. The risk-free rate is from Fama and French European Factors. Sample 01-01-2018 – 30-06-2024.

4.6 Rising European Green Deal Awareness and the Cross-Section of Green and Brown Stock Returns

The current analysis in our study has primarily focused on discerning the immediate stock market effects of the EGD. However, for a comprehensive understanding that encompasses both short-term and long-term dynamics, we extend our examination to evaluate the average impact of rising attention on the EGD on the returns of both browner and greener portfolios through standard Fama-McBeth cross-sectional regressions. In this analysis, we conceptually align with the approach taken by Bolton and Kacperczyk (2021), who investigate whether the increasing investor awareness of carbon risk resulted in a higher carbon premium following the 2015 Paris Agreement.[2] In practical terms, we conduct cross-sectional regressions to ascertain whether an unexpected rise in the level of attention to the EGD (hereinafter GDA) carries either a positive or negative risk premium on greener and browner stocks.

To achieve this, we first a construct a GDA proxy represented by the first principal component (1stPC) extracted from country-level weekly Google search volume indexes related the topic "European Green Deal". We choose to measure investor attention by examining aggregate search volume data from Google for several reasons. Firstly, Google is the most popular search engine, which makes its search volume a reliable indicator of overall internet search patterns (Da et al., 2011). Secondly, searching for a stock on Google clearly shows that someone is paying attention to it, making aggregate search frequency a direct measure of attention (Da et al., 2011). Third, the study by Choi et al. (2020) utilized Google Search Volume Index (GSVI) to measure investor attention in relation to local temperature anomalies. The researchers employed GSVI as a proxy for public interest in climate change by tracking changes in search activity related to global warming during periods of abnormal local temperatures.[3] This proxy aims to capture the average interest of EU population in

[2] Methodologically, our approach differs Bolton and Kacperczyk (2021) in several key aspects. First, while Bolton and Kacperczyk (2021) employ two methods to evaluate the financial impact of this shifting awareness—regressing stock returns on total carbon emissions before and after the Paris Agreement, and estimating the carbon premium in the 1990s by imputing emissions based on levels from 2005—we focus on a different timeline and metrics. Second, our Green Deal Awareness measure does not differentiate between professional investors ('Wall Street') and retail investors or the general population ('Main Street').

[3] The search is performed for each of the ten countries included in our sample. The 1stPC explains around 42% of the variability across the search volume indexes of these countries the ten countries included in our sample.

the EGD. Stock returns are aggregated weekly to match the weekly frequency of our newly developed GDA measure. To test whether GDA is priced differently between browner and greener portfolios, we categorize our full sample of available stocksinto tertiles and quintiles based on the Refinitiv environmental score (ESG) or CO2/Sales ratio (CO2). We then consider the top and bottom groups, which represent stock belonging to the bottom 33rd (20th) and top 67th (80th) percentiles for tertiles (quintiles) of the distribution.[4] Formally, for each portfolio, in the first stage we estimate the following time-series regression model:

$$R^e_{n,p,t} = \alpha_n + \beta_{n,mkt}(mkt_t) + \beta_{n,smb}(smb_t) + \beta_{n,hml}(hml_t) + \beta_{n,GDA}(GDA_t) + \epsilon_{n,t} \quad (5)$$

where $R^e_{n,p,t}$ is the excess return of stock n belonging to portfolio p, while mkt_t, smb_t, hml_t denote the market return, small-minus-big and high-minus-low European factors from the Fama and French Library, respectively, and GDA_t is our proxy that captures changes in the degree of GDA.

In the second stage, we use the estimated βs as regressors and run the following weekly cross-sectional regression

$$\mathbb{E}\left(R^e_{n,p}\right) = \lambda_{mkt}(\widehat{\beta}_{mkt,n}) + \lambda_{smb}(\widehat{\beta}_{smb,n}) + \lambda_{hml}(\widehat{\beta}_{hml,n}) + \lambda_{GDA}(\widehat{\beta}_{GDA,n}) + \epsilon_n \quad (6)$$

where $\mathbb{E}\left(R^e_{n,p}\right)$ is the excess return on asset n averaged over time, $\lambda = [\lambda_{mkt}, \lambda_{smb}, \lambda_{hml}, \lambda_{GDA}]$ is the vector accounting for the implied factor risk premia that encompasses both the vector of the underlying prices of risks and the quantity of risks.

Results from Fama-McBeth cross-sectional regressions on greener and browner stocks are reported in Table 7. When estimating the GDA risk premium, we control first for the aggregate market dynamics including the Fama-French market factor, mkt_t, and then for all the Fama-French mkt, smb and hml, as specified in Eq. (5).

Table 7 presents the estimates of the GDA risk premium derived from the second stage of

[4] It is worth noting that stocks falling within the bottom 33rd (top 67th) percentile correspond to those included in the first (last) three portfolios detailed in Table 2 (i.e., Low CO2, 2CO2, 3CO2, 8CO2, 9CO2, High CO2, as well as Low ESG, 2ESG, 3ESG, 8ESG, 9ESG, High ESG). Similarly, stocks falling within the bottom 20th and 80th percentiles are those that constitute the first and last two portfolios, respectively, when sorted by either C02/size or ESG score listed in Table 2 (i.e., Low CO2, 2CO2, 9CO2, High CO2 and Low ESG, 2ESG, 9ESG, High ESG).

Table 7: Risk Premium of Green Deal Awareness: Green vs. Brown Stocks

Panel A: Tertiles

	2F				4F			
	ESG		CO2		ESG		CO2	
	67th	33th	67th	33th	67th	33th	67th	33th
	G	B	B	G	G	B	B	G
λ_{GDA}	6.9845***	-0.6106	3.1396*	0.7709	7.0418***	-0.5453	3.2749**	0.8017
(*t-stat*)	3.5323	-0.3941	1.9973	0.4329	3.5490	-0.3519	2.0990	0.4533
[*t-stat HAC*]	1.8599	-0.4954	2.5580	0.6930	1.8091	-0.4884	2.6434	0.7045
{*t-stat Shanken*}	3.1864	-0.3937	1.9590	0.4320	3.1888	-0.3505	2.0506	0.4521

Panel B: Quintiles

	2F				4F			
	ESG		CO2		ESG		CO2	
	80th	20th	80th	20th	80th	20th	80th	20th
	G	B	B	G	G	B	B	G
λ_{GDA}	2.6952	0.5112	3.0961*	0.7270	2.3953	0.6511	3.2911*	0.7097
(*t-stat*)	1.3098	0.2986	1.6981	0.3614	1.1768	0.3806	1.8183	0.3525
[*t-stat HAC*]	2.1032	0.2896	1.6484	0.5929	1.8954	0.4033	1.7413	0.5733
{*t-stat Shanken*}	1.2876	0.2984	1.6627	0.3608	1.1571	0.3768	1.7713	0.3516

Notes: This table reports the estimated `GDN` risk premium from Fama-MacBeth cross-sectional regressions. The sample is based on weekly data from 01-01-2019 to 30-06-2024. The test assets are the top and bottom 33% of stocks sorted on environmental score (ESG) or CO2/Sales (Panel A) and top and bottom 20% of stocks sorted on environmental score (ESG) or CO2/Sales (Panel B). G:= greener stocks. B:= browner stocks. We consider (*i*) a two-factor model where only the market return is used as control (2F) and (*ii*) a four-factor model where the standard Fama and French factors (i.e., market return, small-minus-big and high-minus-low) are used as controls (4F). `GDN` is proxied by the first principal component (1st PC) of country-level Google Trends search volume for the topic "European Green Deal". Standard t-statistics are reported in parentheses, i.e., (*t-stats*). Newey and West (1986)-adjusted t-statistics are reported in square brackets, i.e., [*t-stats HAC*]. t-statistics adjusted for Shanken correction following Shanken (1992) are reported in curly brackets, i.e., {*t-stats Shanken*}. ***, ** and * denote significance at the 1%, 5% and 10% levels with respect to Shanken (1992) corrected t-stat, respectively.

Fama-MacBeth regressions, utilizing weekly data from January 1, 2019, to June 30, 2024. The analysis reveals that the risk premium estimates resulting from GDA shocks are positive and statistically significant exclusively for stocks within two specific categories: (i) those belonging to the top 67th percentile of ESG portfolios and (ii) those found in both the top 67th and top 80th percentile of CO2 emission portfolios. For these particular stocks, GDA shocks are associated with a positive risk premium. Notably, the top 67th ESG portfolio comprises greener stocks – defined as those exhibiting superior environmental performance – while the top 67th and top 80th CO2 portfolios, by construction, include browner stocks characterized by higher carbon intensity. This nuanced categorization presents a challenge in definitively establishing the existence of a climate change concern-induced carbon premium (or in the other way round 'greenium'). Our empirical analysis indicates that GDA shocks yield a positive risk premium irrespective of the environmental categorization of the stocks, thereby suggesting that the influence of GDA is not strictly correlated with the greenness or browness of the assets involved. This finding underscores the complexity of the relationship between climate policy awareness and asset pricing, highlighting the need for a more comprehensive understanding of how climate-related factors impact financial markets.

To further elucidate the relationship between greener and browner stocks in the context of rising climate and environmental concerns, we present the distribution of the GDA betas estimated from the first-stage regression (see Eq. 5). However, similar to the findings regarding estimated GDA risk premia, our analysis does not yield a robust or unequivocal empirical pattern concerning the exposure of green and brown stocks to fluctuations in European climate policy concerns. For example, we observe that green stocks – defined either by their higher ESG score or by their lower CO2 emissions relative to sales – display a diverse range of beta values, manifesting both negative and positive exposures. This ambiguous evidence becomes even more pronounced when different econometric specifications are employed, as illustrated by the contrasting distributions in the left-hand and right-hand plots of Figure 14.

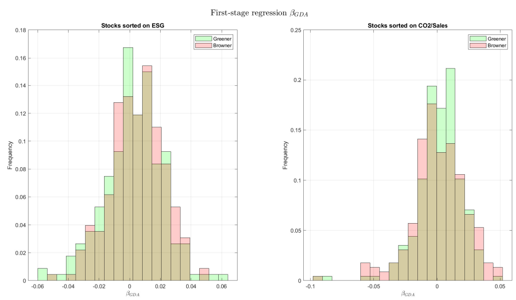
These findings highlight the complexity of the relationship between stock classifications based on environmental criteria and their sensitivity to changes in climate policy. The variability in beta values suggests that the market response to climate concerns is not solely dictated by a stock's environmental performance, warranting further investigation into the underlying factors that influence this dynamic.

Broadly, the mixed evidence that emerge from entries in Table 7 corroborate the ambiguous and contradictory results present in the most recent literature focusing on the implications of rising climate change salience on green vs. brown stocks. For instance, Bolton and Kacperczyk (2021) using data covering the period 2005-2017 find that stocks of firms with higher total carbon dioxide emissions (and changes in emissions) earn higher returns. For the period 2013–2020, Ľuboš Pástor et al. (2022) observe that U.S. green stocks tend to outperform brown stocks following strong increases in environmental concerns. Görgen et al. (2020) find instead that brown firms are associated with higher average returns, while decreases in the

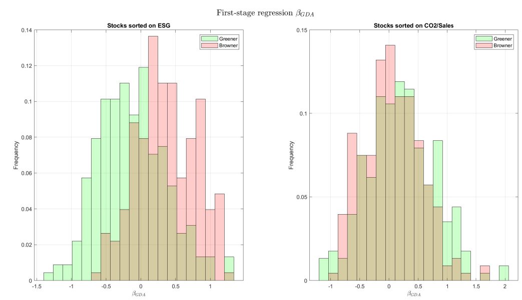
Figure 14: First stage regression β_{GDA}

Panel A: Tertiles

2F

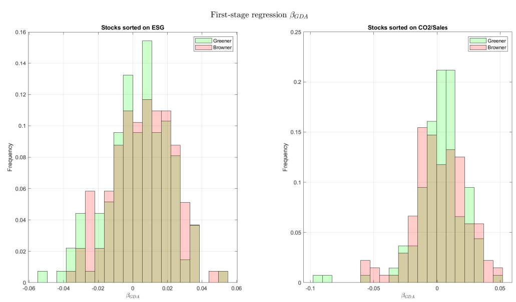


4F

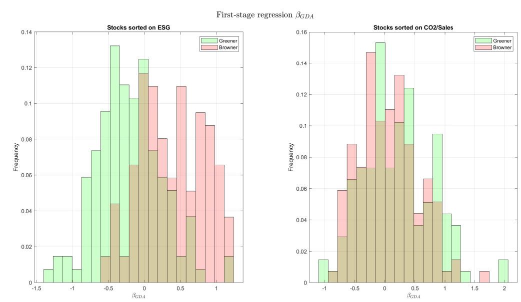


Panel B: Quintiles

2F



4F



Notes: This figure reports the distribution of the first-stage regression coefficients on the level of attention to the European Green Deal (GDA) from Eq. 5. Test assets are the top and bottom 33% of stocks sorted on environmental score or CO2/Sales ratio (Panel A) and top and bottom 20% of stock sorted on environmental score or CO2/Sales ratio (Panel B).

greenness of firms are associated with lower announcement returns. As supported by our empirical evidence, there two main possible explanations for the presence of such ambiguous and contradictory results: (i) different and non-robust classification criteria for identifying the degree of stocks' "brown-/green-ness" are used, and (ii) short and different sample periods with different start and end dates are accounted for estimating the risk premium of rising climate concerns. In addition, one has to account for the fact that – regardless of the model specification - there can be other factors than those commonly used identifying changes in GDA, and more generally, in changes in climate/environmental concerns. Put differently, it can be extremely difficult to disentangle climate change-related phenomena effect from other factors.

4.7 Rising European Green Deal Awareness and the Cross-Section of Green and Brown Corporate Bond Returns

The results presented in the Table 8 highlight the complex nature of market responses to GDA shocks for both green and brown corporate bond portfolios. The risk premium is generally positive, albeit insignificant. Additionally, there is notable variation in the GDA risk premium on investments in corporate bonds between the first tertile and the first quintile. Specifically, bonds associated with higher ESG ratings exhibit a positive GDA risk premium, while those with lower ESG performance do not consistently carry a positive premium. Overall, these findings indicate that bonds in the lowest tertiles and quintiles exhibit distinct characteristics, leading to varying levels of comovement between bond returns and shifts in attention to climate concerns. This variation persists despite both being classified as green portfolios, highlighting the heterogeneity within green bonds and the need for more nuanced evaluation/classification criteria.

Similar conclusions can be drawn from analyzing the exposure of green and brown bond returns to increases in GDA. This is evident from the distribution of the estimated GDA coefficients derived from the first-stage regression, as shown in Figure 15. The results reveal two important insights. First and foremost, both green and brown bonds exhibit a range of exposures to rising GDA, indicating that they can be either positively or negatively correlated with changes in GDA. This suggests that the classification of bonds as 'green' or 'brown' does not uniformly determine their sensitivity to shifts in climate-related attention. Second, the choice of factor model significantly affects the distribution of GDA exposures, with notable differences observed when green and brown bond portfolios are constructed using the highest and lowest quintiles. This highlights the critical role of model specification in shaping the assessment of bond exposure to GDA, underscoring the importance of methodological consistency when interpreting such findings.

Collectively, our novel empirical analysis of the relationship between green and brown bond returns and heightened climate policy concerns reveals critical insights. Consistent with findings from the analysis of green and brown stocks, the estimated risk premium linked to GDA shocks is highly sensitive to a range of factors. These factors include the selection of

Table 8: Risk premium of Green Deal Awareness: Green vs. Brown Corporate Bonds

Panel A: Tertiles				
	2F		**6F**	
	67th	**33th**	**67th**	**33th**
	G	**B**	**G**	**B**
λ_{GDA}	4.4416	4.5573	3.8056	11.1674
(*t-stat*)	(0.7144)	(0.7337)	(0.6468)	(1.3316)
t-stat HAC	[1.1506]	[1.304]	[1.5728]	[3.5614]
{*t-stat Shanken*}	{0.6616}	{0.6788}	{0.5696}	{0.9676}
Panel B: Quintiles				
	2F		**6F**	
	80th	**20th**	**80th**	**20th**
	G	**B**	**G**	**B**
λ_{GDA}	4.6974	-0.1802	1.5287	5.8959
(*t-stat*)	(0.8364)	(-0.0377)	(0.2957)	(0.7577)
t-stat HAC	[1.0675]	[-0.0763]	[0.607]	[1.6936]
{*t-stat Shanken*}	{0.7685}	{-0.0373}	{0.2642}	{0.663}

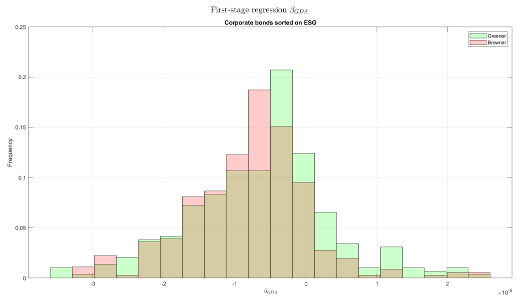
Notes: This table reports the estimated `GDN` risk premium from Fama-MacBeth cross-sectional regressions. The sample is based on weekly data from 01-01-2019 to 30-06-2024. The test assets are the top and bottom 33% of corporate bonds sorted on issuers' environmental score (ESG) (Panel A) and top and bottom 20% of corporate bonds sorted on issuers' environmental score (ESG) (Panel B). G:= greener corporate bonds. B:= browner corporate bonds. We consider (*i*) a two-factor model where only the market return is used as control (2F) and (*ii*) a six-factor model where the Fama and French factors (i.e., market return, small-minus-big and high-minus-low), term structure spread and default spread are used as controls (6F). `GDN` is proxied by the first principal component (1st PC) of country-level Google Trends search volume for the topic "European Green Deal". Standard t-statistics are reported in parentheses, i.e., (*t-stats*). Newey and West (1986)-adjusted t-statistics are reported in square brackets, i.e., [*t-stats HAC*]. t-statistics adjusted for Shanken correction following Shanken (1992) are reported in curly brackets, i.e., {*t-stats Shanken*}. ***, ** and * denote significance at the 1%, 5% and 10% levels with respect to Shanken (1992) corrected t-stat, respectively.

test assets, the criteria used for classifying securities as 'green' or 'brown', and the particular econometric model applied. Each of these elements can substantially impact the resulting risk premium estimates, emphasizing the need for meticulous selection and standardization of methodologies. This is essential for ensuring consistency and robustness in the assessment of risk premia and drawing reliable conclusions about the financial implications of climate policy awareness

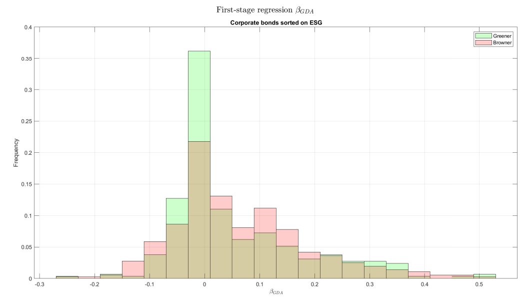
Figure 15: First stage regression β_{GDA}

TERTILES

1F

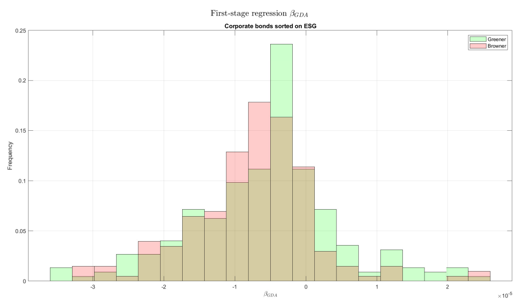


5F

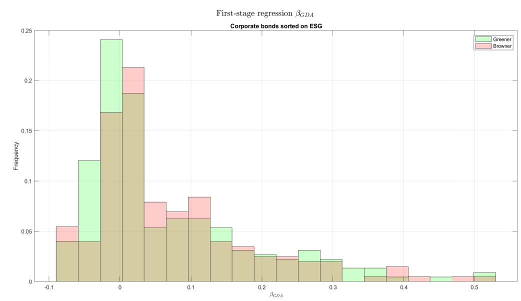


QUINTILES

1F



5F



Notes: This figure reports the distribution of the first-stage regression coefficient on the level of attention to the European Green Deal (GDA). The assets are the top and bottom 33% of corporate bonds sorted on issuer environmental score (Panel A) and top and bottom 20% of corporate bonds sorted on issuer environmental score (Panel B).

5 Concluding remarks

Our research explores into the critical sustainability policy – portfolio investment nexus within the context of the EGD. As a comprehensive policy framework endorsed by all 27 EU member states, the EGD aims to transform the EU into the world's first climate-neutral continent by 2050, addressing multifaceted aspects such as economy, transportation, industrial revolution, energy systems, building renovation, and global climate action. Our investigation focuses on the impact of Green Deal News (`GDNs`) on diversified portfolios of EU stocks, aiming to answer crucial questions about their influence on different sectors, the valuation of green and brown sectors, and the differential responses of large and small stocks. Our research design employs a systematic approach with three key components: Event Study Methodology, Regression Analysis, and Design of Investment Strategies.

By means of the Event Study Methodology, we assesses the potential of GDNs to induce abnormal returns in diversified portfolios of EU corporate bonds and stocks, sector-specific portfolios, and portfolios based on the combination of carbon intensity, company size, and ESG criteria. While GDNs generally result in negative CARs, positive returns are observed in certain portfolios associated with sustainability, renewable energy, or agriculture. Further, the relationship between GDNs and returns on portfolios of bonds and stocks, quantifying the marginal effect of GDNs on diversified and sector-specific portfolios, is examined by means of the regression analysis. The consistently negative marginal effect across all portfolio sorts and deciles underscores the robust influence of GDNs on portfolio performance. We also ask whether and, if so, how results from the event study and regression analysis can inform the design of investment strategies. These strategies optimize the allocation of financial resources in response to GDNs and inform investors how to adjust their portfolios on the event day or even prior to the event day and subsequently reposition them after the event has settled, resulting in a positive return.

However, our research is not without limitations and thus associated areas of opportunity. One significant constraint is that our study primarily examines investment opportunities in isolation, focusing separately on bond and stock markets. This approach may not fully reflect the reality that investors often consider these markets jointly when making decisions. As a result, future research could explore the connectedness between equity and fixed-income investments, particularly in the context of sustainability-related policies. Understanding how shifts in Green Deal Awareness (GDA) influence investor behavior across asset classes could yield valuable insights into portfolio management strategies. Additionally, while our findings indicate a relationship between GDA and portfolio performance, they do not reveal a consistent pattern in the GDA premium related to sustainability. This ambiguity invites further exploration into the underlying dynamics of this nexus, as future studies could focus on identifying the factors that shape the relationship between GDA and sustainability performance. Moreover, although we have identified trends in portfolio performance in response to GDNs, the long-term implications of these shifts remain uncertain and warrant further investigation. It is essential to assess how sustained GDA influences the risk-return profile of various investments over time, especially as market conditions and regulatory environments

evolve. Lastly, future research could delve deeper into the responses of Cumulative Abnormal Returns (CARs) for both bond and stock portfolios in reaction to sustainability-related policies. By examining how different types of securities respond to regulatory changes and environmental policies, researchers can provide a more comprehensive understanding of market dynamics in the context of green finance. This could inform investors and policymakers alike, facilitating more effective strategies for promoting sustainable investment practices.
In essence, our research transcends academic inquiry to provide valuable insights for financial professionals, policymakers, and academia alike. Not only does it deepen our understanding of how sustainability policies influence bond and stock markets, but it also serves as a practical guide for those concerned with financial decision-making in the era of green and sustainable finance.

References

Amihud, Y., 2002. Illiquidity and stock returns: cross-section and time-series effects. Journal of financial markets 5, 31–56.

Barnett, M., 2023. A run on fossil fuel? climate change and transition risk. Working Paper .

Battiston, S., Mandel, A., Monasterolo, I., Schütze, F., Visentin, G., 2017. A climate stress-test of the financial system. Nature Climate Change 7, 283–288.

Bauer, M., Offner, E., Rudebusch, G. D., 2023. The effect of u.s. climate policy on financial markets: An event study of the inflation reduction act. Tech. Rep. 10739, CESifo Working Paper, 38 Pages Posted: 8 Nov 2023.

Bessembinder, H., Kahle, K. M., Maxwell, W. F., Xu, D., 2008. Measuring abnormal bond performance. The Review of Financial Studies 22, 4219–4258.

Bolton, P., Kacperczyk, M., 2021. Do investors care about carbon risk? Journal of Financial Economics 142, 517–549.

Borghesi, S., Castellini, M., Comincioli, N., Donadelli, M., Gufler, I., Vergalli, S., 2022. European green policy announcements and sectoral stock returns. Energy Policy 166, 113004.

Brenner, M., Pasquariello, P., Subrahmanyam, M., 2009. On the volatility and comovement of u.s. financial markets around macroeconomic news announcements. Journal of Financial and Quantitative Analysis 44, 1265–1289.

Choi, D., Gao, Z., Jiang, W., 2020. Attention to Global Warming. The Review of Financial Studies 33, 1112–1145.

Da, Z., ENGELBERG, J., GAO, P., 2011. In search of attention. The Journal of Finance 66, 1461–1499.

Donadelli, M., Grüning, P., Hitzemann, S., 2021. Understanding macro and asset price dynamics during the climate transition. Working Paper .

Donadelli, M., Gufler, I., Pellizzari, P., 2020. The macro and asset pricing implications of rising italian uncertainty: evidence from a novel news-based macroeconomic policy uncertainty index. Economics Letters 197, 109606.

Donadelli, M., Kizys, R., Riedel, M., 2017. Dangerous infectious diseases: Bad news for main street, good news for wall street? Journal of Financial Markets 35, 84–103.

Fama, E. F., French, K. R., 1993. Common risk factors in the returns on stocks and bonds. Journal of Financial Economics 33, 3–56.

French, K. R., 1980. Stock returns and the weekend effect. Journal of Financial Economics 8, 55–69.

Gupta, S., Goldar, B., 2005. Do stock markets penalize environment-unfriendly behaviour? evidence from india. Ecological Economics 52, 81–95.

Görgen, M., Jacob, A., Nerlinger, M., Riordan, R., Rohleder, M., Wilkens, M., 2020. Carbon risk. Working Paper .

Hengge, M., Panizza, U., Varghese, R., 2023. Carbon policy and stock returns: Signals from financial markets. Tech. Rep. 2023/013, International Monetary Fund (IMF), Washington, D.C., iMF Working Paper.

Kaplanski, G., Levy, H., 2010a. Exploitable predictable irrationality: The fifa world cup effect on the us stock market. Journal of Financial and Quantitative Analysis 45, 535–553.

Kaplanski, G., Levy, H., 2010b. Sentiment and stock prices: The case of aviation disasters. Journal of Financial Economics 95, 174–201.

Kaplanski, G., Levy, H., 2014. Sentiment, irrationality and market efficiency: The case of the 2010 fifa world cup. Journal of Behavioral and Experimental Economics 49, 35–43.

Koijen, R. S., Philipson, T. J., Uhlig, H., 2016. Financial health economics. Econometrica 84, 195–242.

MacKinlay, A. C., 1997. Event studies in economics and finance. Journal of economic literature 35, 13–39.

Newey, W. K., West, K. D., 1986. A simple, positive semi-definite, heteroskedasticity and autocorrelationconsistent covariance matrix .

Pástor, , Veronesi, P., 2013. Political uncertainty and risk premia. Journal of Financial Economics 110, 520–545.

Ramiah, V., Martin, B., Moosa, I., 2013. How does the stock market react to the announcement of green policies? Journal of Banking and Finance 37(5), 1747–1758.

Schwert, G. W., 1990a. Indexes of us stock prices from 1802 to 1987. Journal of Business 63, 399–426.

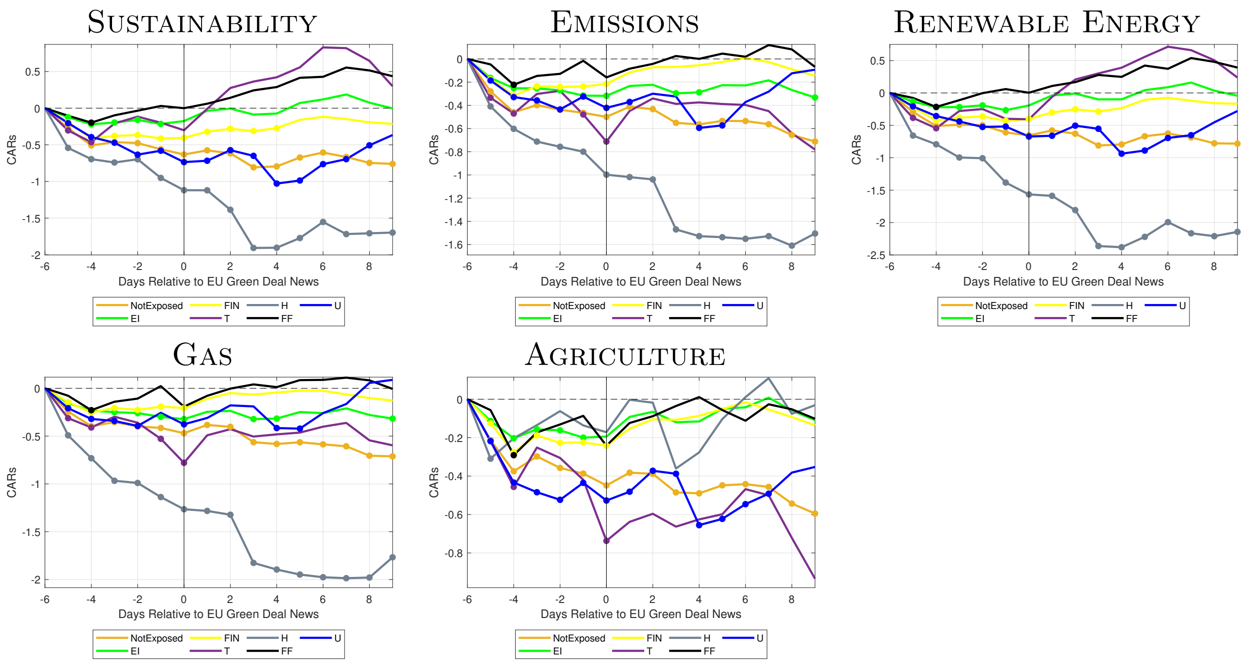
Schwert, G. W., 1990b. Stock volatility and the crash of 87. The Review of Financial Studies 3, 77–102.

Shanken, J., 1992. On the estimation of beta-pricing models. Review of Financial Studies 5, 1–33.

Ľuboš Pástor, Stambaugh, R. F., Taylor, L. A., 2022. Dissecting green returns. Journal of Financial Economics 146, 403–424.

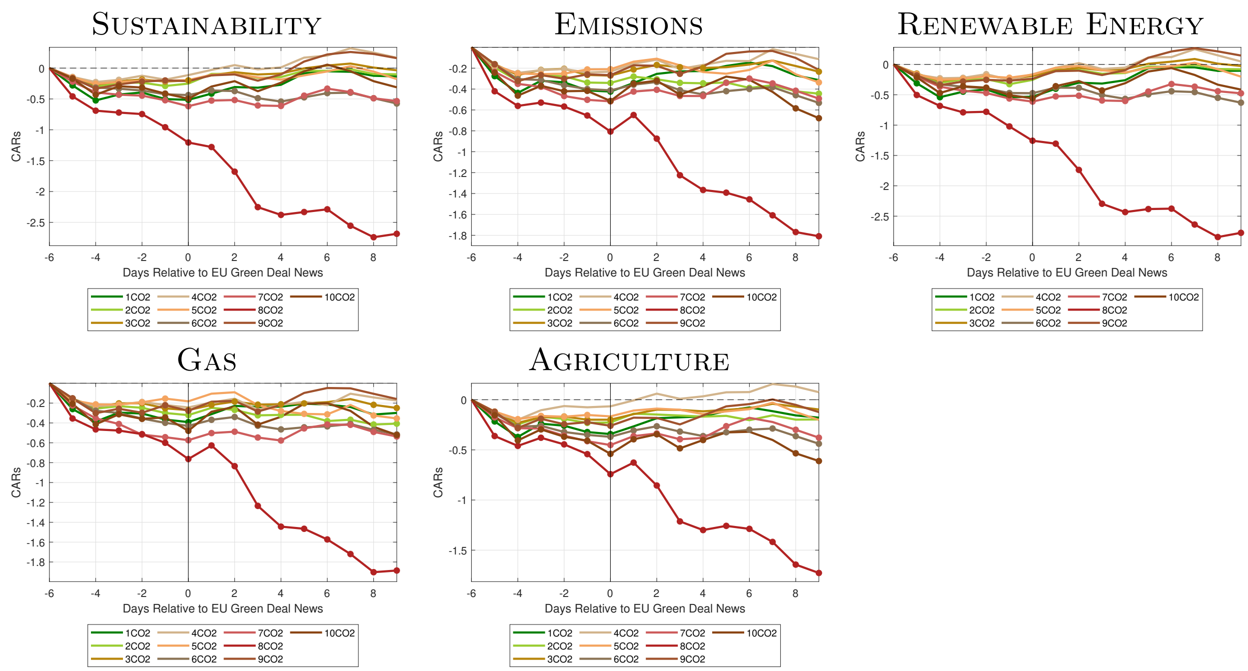
A Three Factor Model

Figure A.1: Porfolios sorted on Climate Change risk exposure



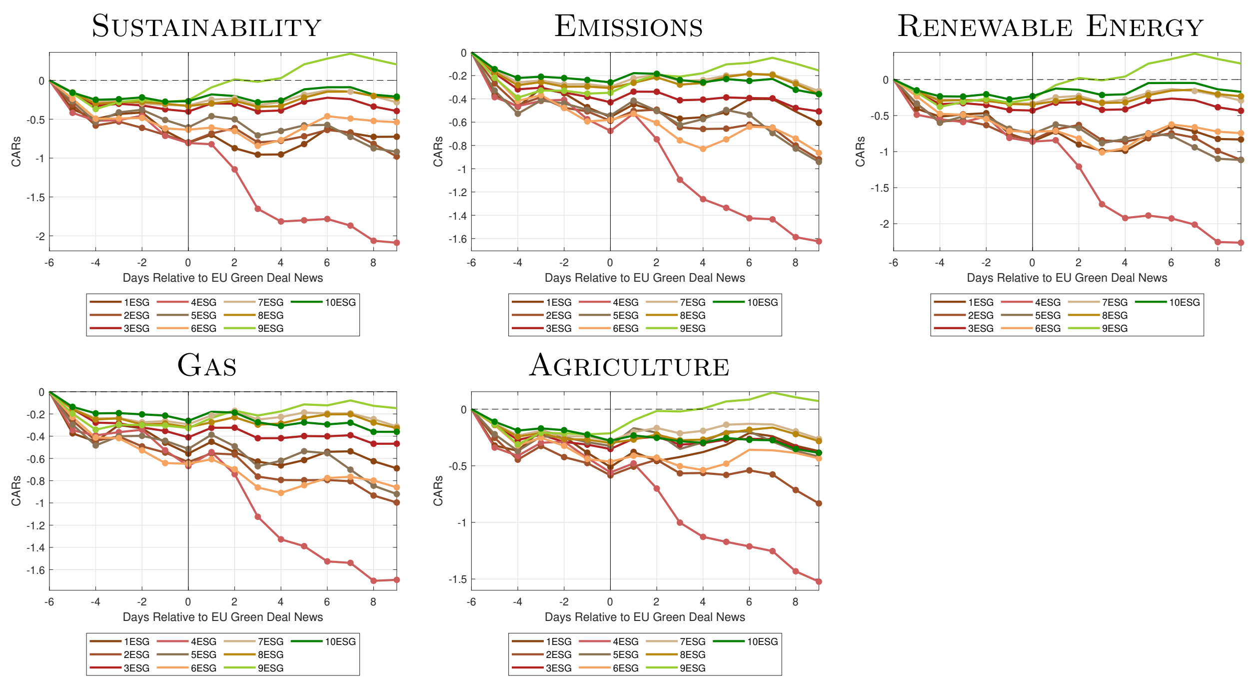
Notes: Notes: This figure depicts CARs around different category of GDN for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in seven sectoral value-weighted portfolios *i*) Energy intensive (EI), *ii*) Fossil fuel (FF), *iii*) Utilities (U), *iv*) Financials (FIN), *v*) Housing (H), *vi*) Transport (T) and *vii*) Not exposed.
The theoretical price is estimated according to a three factors model over a window from $t-250$ to $t-30$ using market return, small-minus-big (smb), high-minus-low (hml) and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

Figure A.2: Porfolios sorted on CO2/Sales



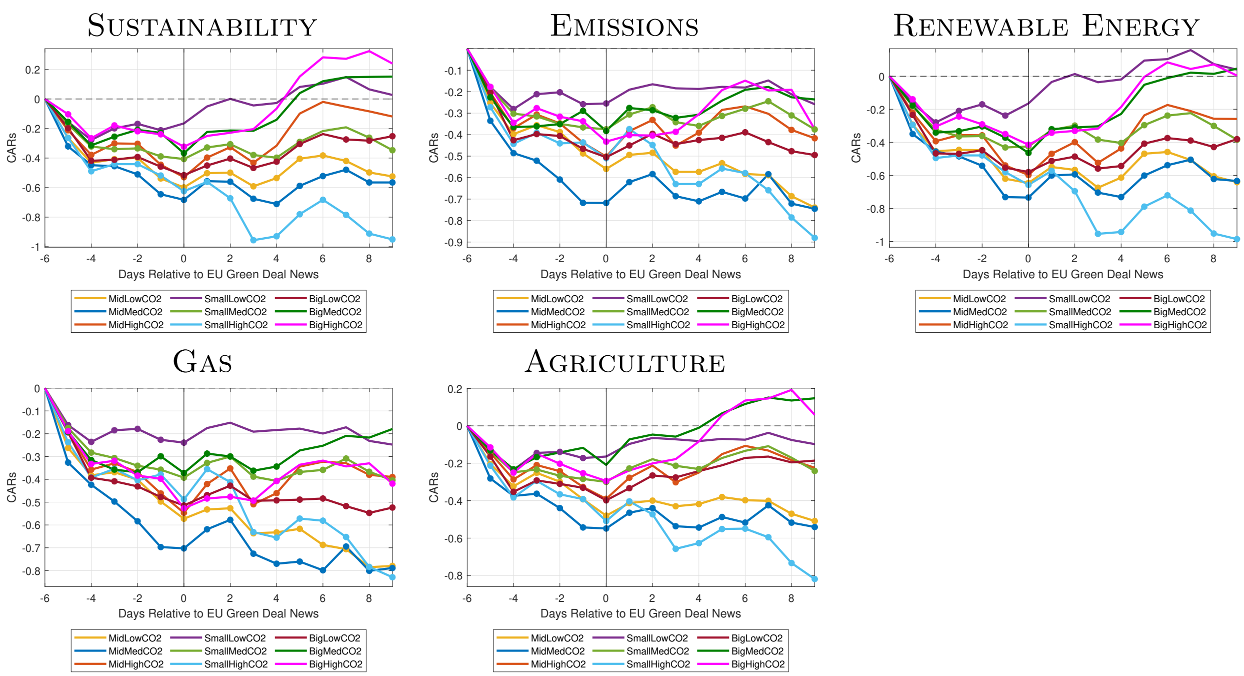
Notes: Notes: This figure depicts CARs around different category of **GDN** for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in ten value-weighted portfolios based on company CO2/Sales. The theoretical price is estimated according to a three factors model over a window from $t-250$ to $t-30$ using market return, small-minus-big (smb), high-minus-low (hml) and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

Figure A.3: Porfolios sorted on Environmental Score (ESG)



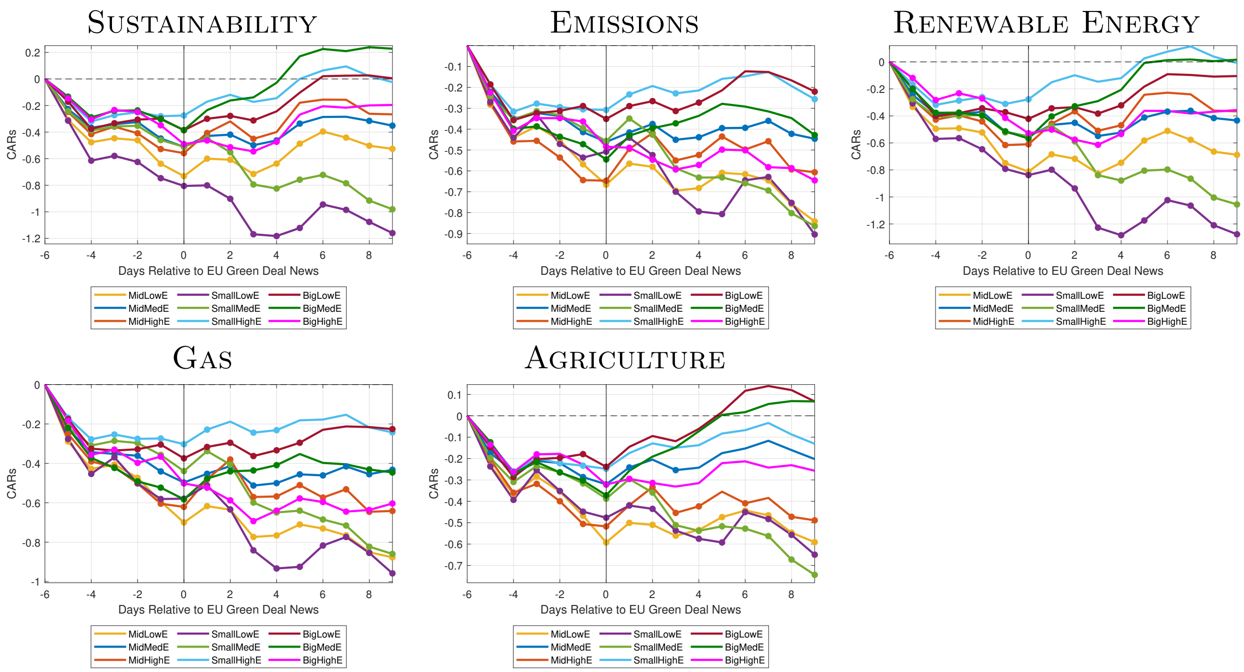
Notes: Notes: This figure depicts CARs around different category of **GDN** for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in ten value-weighted portfolios based on company Refinitiv environmental score. The theoretical price is estimated according to a three factors model over a window from $t - 250$ to $t - 30$ using market return, small-minus-big (smb), high-minus-low (hml) and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. CARs are estimated from $t - 5$ to $t + 9$. Dots indicate significance at 1%.

Figure A.4: Porfolios sorted on Size & CO2/Sales



Notes: Notes: This figure depicts CARs around different category of **GDN** for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in nine value-weighted portfolios sorted on Size and CO2/Sales The theoretical price is estimated according to a three factors model over a window from $t-250$ to $t-30$ using market return, small-minus-big (smb), high-minus-low (hml) and risk-free rate retrieved from Fama and French European Factors https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

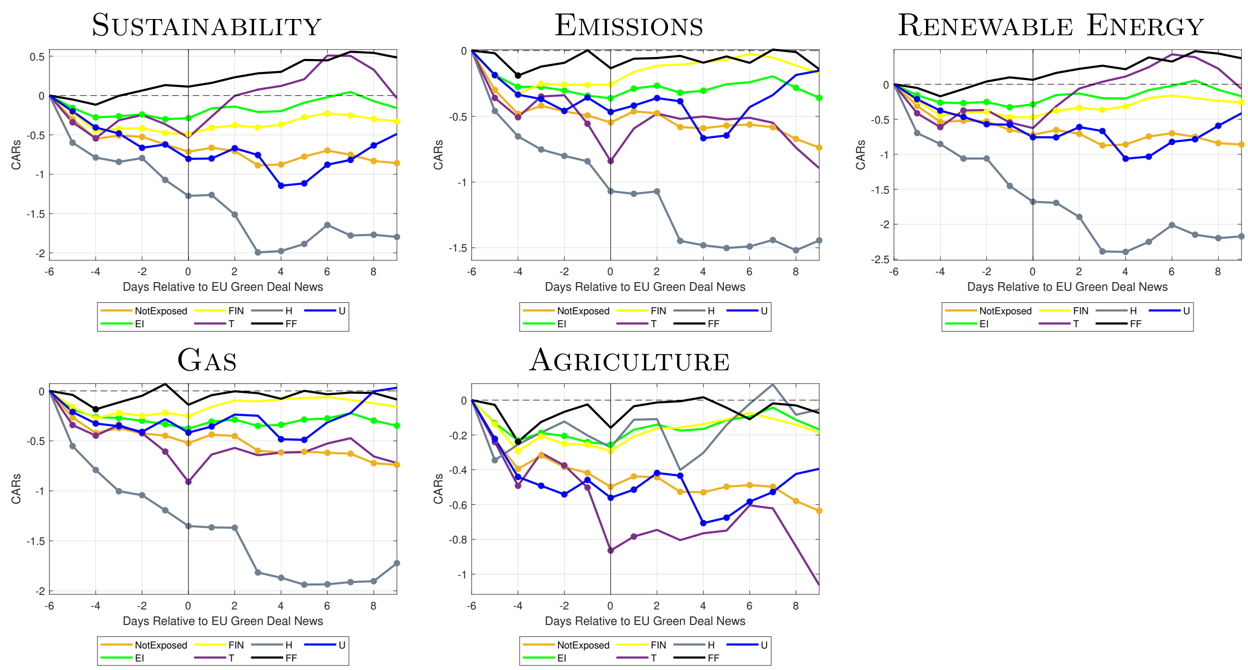
Figure A.5: Porfolios sorted on Size & Environmental Scores (ESG)



Notes: Notes: This figure depicts CARs around different category of **GDN** for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in nine value-weighted portfolios sorted on Size and Refinitiv environmental score. The theoretical price is estimated according to a three factors model over a window from $t-250$ to $t-30$ using market return, small-minus-big (smb), high-minus-low (hml) and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

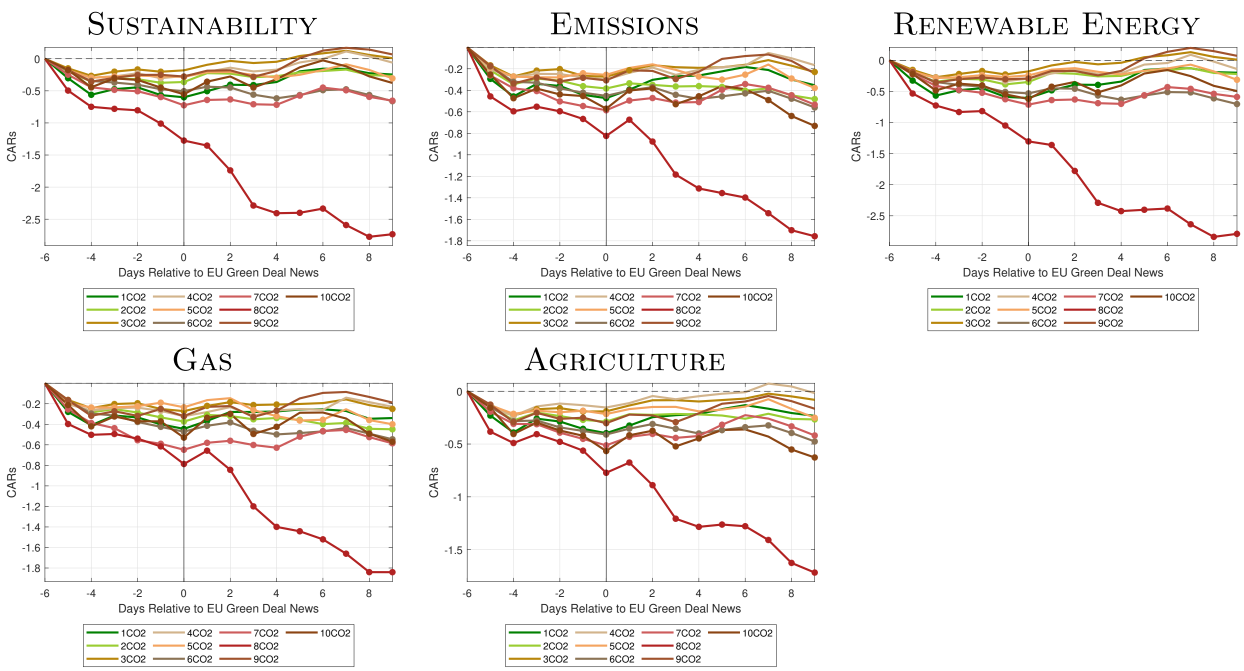
B Four Factor Model

Figure B.1: Porfolios sorted on Climate Change risk exposure



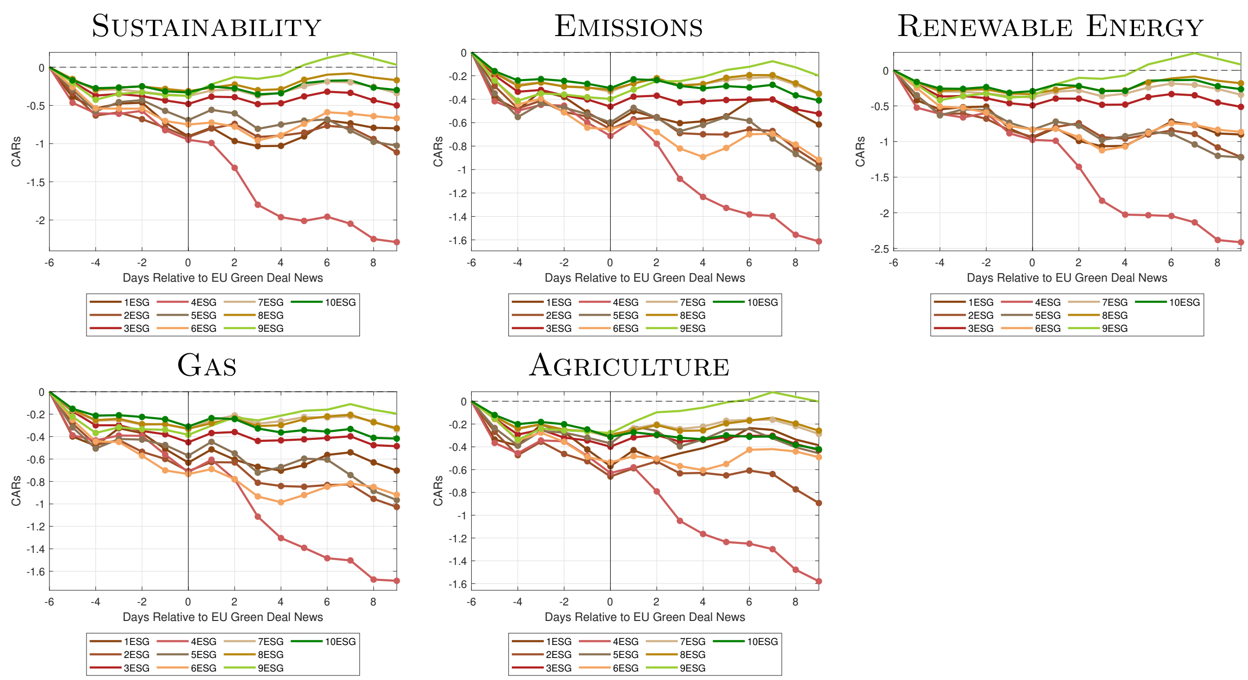
Notes: Notes: This figure depicts CARs around different category of GDN for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in seven sectoral value-weighted portfolios *i*) Energy intensive (EI), *ii*) Fossil fuel (FF), *iii*) Utilities (U), *iv*) Financials (FIN), *v*) Housing (H), *vi*) Transport (T) and *vii*) Not exposed.
The theoretical price is estimated according to a four factors model over a window from $t-250$ to $t-30$ using market return, small-minus-big (smb), high-minus-low (hml) and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. Additionally, we control for liquidity. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

Figure B.2: Porfolios sorted on CO2/Sales



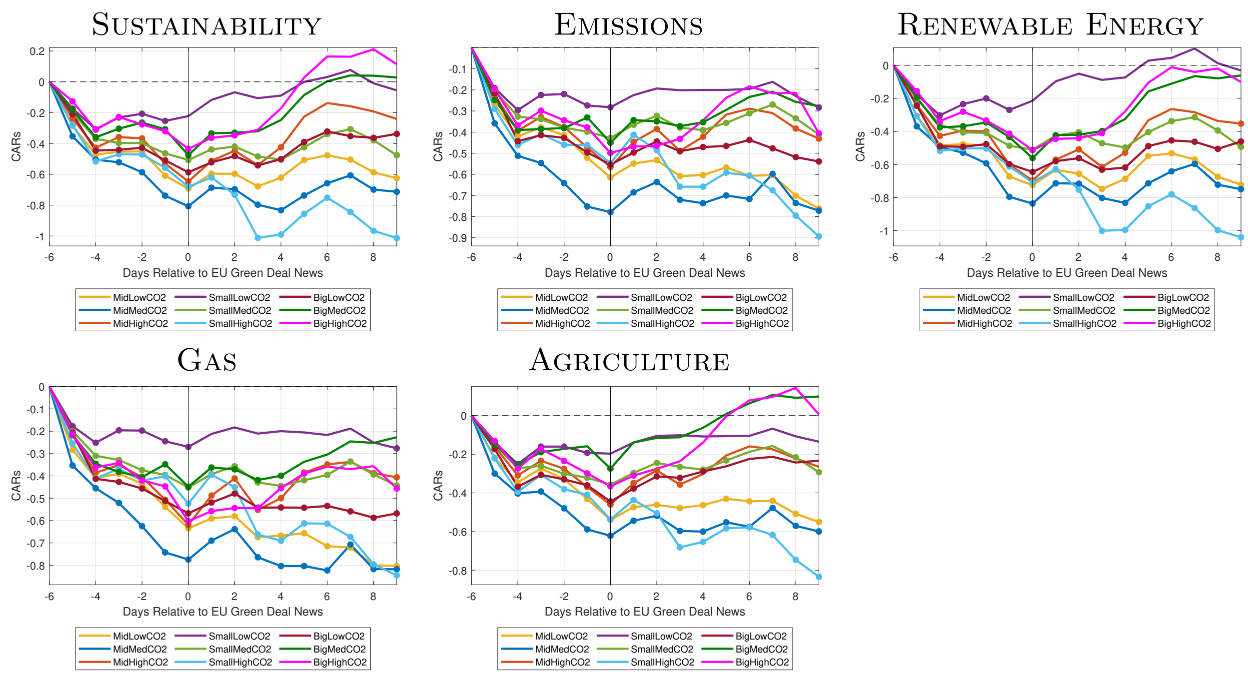
Notes: Notes: This figure depicts CARs around different category of **GDN** for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in ten value-weighted portfolios based on company CO2/Sales. The theoretical price is estimated according to a four factors model over a window from $t-250$ to $t-30$ using market return, small-minus-big (smb), high-minus-low (hml) and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. Additionally, we control for liquidity. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

Figure B.3: Porfolios sorted on Environmental Score



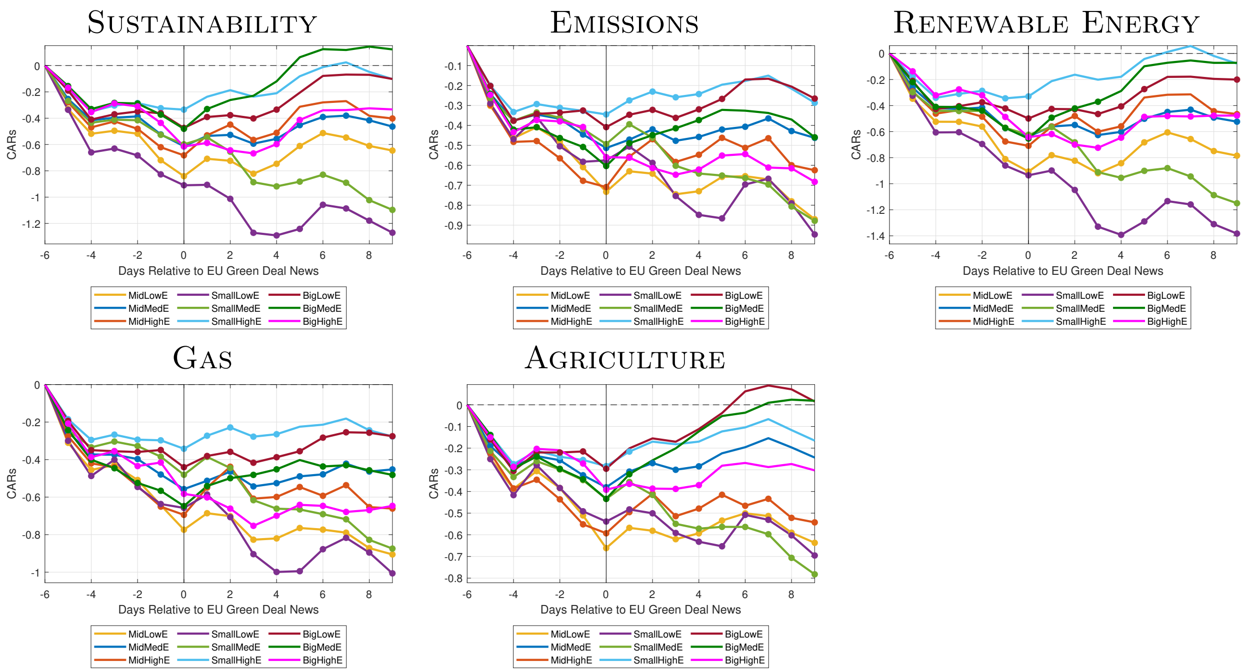
Notes: Notes: This figure depicts CARs around different category of GDN for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in ten value-weighted portfolios based on company Refinitiv environmental score. The theoretical price is estimated according to a four factors model over a window from $t-250$ to $t-30$ using market return, small-minus-big (smb), high-minus-low (hml) and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. Additionally, we control for liquidity. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

Figure B.4: Porfolios sorted on Size & CO2/Sales



Notes: Notes: This figure depicts CARs around different category of **GDN** for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in nine value-weighted portfolios sorted on Size and CO2/Sales The theoretical price is estimated according to a four factors model over a window from $t-250$ to $t-30$ using market return, small-minus-big (smb), high-minus-low (hml) and risk-free rate retrieved from Fama and French European Factors `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`. Additionally, we control for liquidity. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.

Figure B.5: Porfolios sorted on Size & Environmental Scores



Notes: Notes: This figure depicts CARs around different category of GDN for portfolios sorted on climate change exposure (Battiston et al., 2017). Stocks have been grouped in nine value-weighted portfolios sorted on Size and Refinitiv environmental score. The theoretical price is estimated according to a four factors model over a window from $t-250$ to $t-30$ using market return, small-minus-big (smb), high-minus-low (hml) and risk-free rate retrieved from Fama and French European Factors https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. Additionally, we control for liquidity. CARs are estimated from $t-5$ to $t+9$. Dots indicate significance at 1%.