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July 2025

Jiyuan Dai
University of Cyprus
Gaizka Ormazabal
IESE Business School, CEPR & ECGI
Fernando Penalva
IESE Business School, ECGI
Robert Raney
IESE Business School

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Abstract

We study the decarbonization effects of imposing sustainability regulation on investors. Our focus is the EU Sustainable Finance Disclosure Regulation (SFDR), which requires funds domiciled or marketed in the EU to classify themselves based on different degrees of sustainability commitment and imposes disclosure requirements based on such classification. Using a broad sample of international investment funds, we document that the SFDR was followed by a significant decarbonization (around 10 percent) of investment portfolios of funds domiciled or marketed in the EU claiming to invest based on sustainability criteria. Additional tests suggest that the lower level of emissions is primarily driven by changes in funds' investment decisions, although there is some indication that firm-level emissions may also contribute to the observed decarbonization. Overall, our evidence suggests that the regulation resulted not only in shifting capital flows away from high-emission firms, but also in increased pressure on portfolio firms to achieve emissions reductions at the firm level.

Keywords: SFDR, Institutional Investors, Mutual Funds, Disclosure, Carbon Emissions.

JEL Classification: G28, M10, M41, M48, Q51

Jiyuan Dai
University of Cyprus

Gaizka Ormazabal
IESE Business School, CEPR & ECGI

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ABSTRACT

We study the decarbonization effects of imposing sustainability regulation on investors. Our focus is the EU Sustainable Finance Disclosure Regulation (SFDR), which requires funds domiciled or marketed in the EU to classify themselves based on different degrees of sustainability commitment and imposes disclosure requirements based on such classification. Using a broad sample of international investment funds, we document that the SFDR was followed by a significant decarbonization (around 10 percent) of investment portfolios of funds domiciled or marketed in the EU claiming to invest based on sustainability criteria. Additional tests suggest that the lower level of emissions is primarily driven by changes in funds' investment decisions, although there is some indication that firm-level emissions may also contribute to the observed decarbonization. Overall, our evidence suggests that the regulation resulted not only in shifting capital flows away from high-emission firms, but also in increased pressure on portfolio firms to achieve emissions reductions at the firm level.

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1. Introduction

There is ongoing debate about the role of institutional shareholders in the transition toward a more sustainable economy. One view holds that asset managers face strong market incentives to improve sustainability performance (e.g., Dyck et al., 2019; Azar et al., 2021). Consistent with this perspective, a growing number of institutions have made public commitments to reduce the carbon footprint of their portfolios (Krueger et al., 2020).

At the same time, however, concerns have emerged that such pledges are not translating into meaningful decarbonization at the aggregate level (e.g., Raghunandan and Rajgopal, 2022; Kim and Yoon, 2022; Atta-Darkua et al., 2023), prompting calls for regulatory intervention (Andersson et al., 2016; OECD, 2017). In particular, regulating the disclosure of investors' ESG activities based on their stated sustainability commitments is often viewed as a way to strengthen environmental accountability.[1] Whether this approach leads to improved environmental outcomes, however, remains an open question.

This paper contributes to this debate by studying whether mandating disclosure for funds that choose to promote sustainability influences asset managers' incentives to decarbonize their portfolios. For identification, we exploit the recent introduction of the EU Sustainable Finance Disclosure Regulation (SFDR) which was approved in November of 2019 and came into effect in March of 2021. This regulation is unique because it is the first wide-ranging sustainability disclosure mandate imposed on investment funds without directly affecting portfolio firms.[2]

[1] For example, in a 2023 targeted consultation completed by the European Commission 55 percent (26 percent) of respondents mostly or totally agreed (disagreed) that the EU should impose additional disclosure requirements for financial products that choose to make sustainability claims. https://finance.ec.europa.eu/ *Summary Report of the Open and Targeted Consultations on the SFDR assessment 14 September 2023 - 22 December 2023.*

[2] To the best of our knowledge existing disclosure regulations do not provide wide-ranging sustainability disclosure mandates for investment funds. This is consistent with Paragraph 24 of the SFDR which states current disclosure requirements "do not require the disclosure of all the information necessary to properly inform end investors about the sustainability-related impacts of their investments." This is not to say that no prior sustainability disclosure

According to the regulatory text, the SFDR aims to reduce information asymmetry regarding sustainability risks and impacts, the promotion of environmental or social characteristics, and sustainability investment (Regulation EU 2019/2088).

Asset managers make two important choices that subject them to the disclosure mandates of the SFDR. First is the choice to domicile or market a fund within the EU. All funds that are domiciled or marketed within the EU are required to disclose the extent to which sustainability risks are considered in their investment decisions. Second is the choice to promote sustainability characteristics or objectives of the fund. Such funds, commonly referred to as "Article 8" or "Article 9" funds, are subject to specific additional disclosure requirements under the SFDR.

It is plausible that—beyond the provision of information—the SFDR has meaningful real effects. As shown by prior literature, disclosure regulation can influence the behavior of reporting entities, which in this case are investment funds (Kanodia and Sapra, 2016). While the EU SFDR could affect several dimensions of the sustainability performance of investors' portfolios, we focus our analysis on carbon emissions. A decrease in emissions is commonly perceived as an improvement in sustainability performance, whereas the interpretation of a decrease in other sustainability metrics could be more contentious. Moreover, given the current concerns about climate change, a large proportion of the efforts to direct capital towards sustainable investments are centered around decarbonization, including several initiatives sponsored by investors. As such, it is likely that a disconnect between sustainability claims and emission performance is perceived negatively by investment clients. Mandated disclosure when funds choose to promote sustainability could shine a light on instances where such disconnects exist, thereby changing asset managers' incentives to decarbonize their portfolios.

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regulation impacting investment companies exists. One example is Article 173 of the French Energy Transition Law from 2015, which we exploit in supplemental analyses.

Nonetheless, there are several reasons why one could not expect any observable effect of the introduction of the SFDR on the average emissions of funds' investment portfolios. First, funds with publicly stated sustainability commitments may have already been maximizing efforts to decarbonize their portfolios before the introduction of the SFDR. Second, it is unclear ex-ante whether funds bear significant costs from a perceived disconnect between their sustainability claims and their environmental performance measured in terms of carbon emissions. Investment clients might not understand or process information on carbon emissions and might instead focus on ESG ratings or other sustainability claims the fund emphasizes in its marketing materials. At the same time, regulators might not find sufficient grounds for conducting enforcement actions against a perceived disconnect between sustainability disclosures and emission performance. Critics also argue that the SFDR is not specific enough and leaves room for greenwashing (Lambillon and Chesney, 2023; Negrin Ochoa, 2021).[3]

Even if mandatory disclosure for funds with stated sustainability commitments generates meaningful sustainability incentives among asset managers, decarbonization at the portfolio level may not translate into decarbonization at the firm level. Funds could decarbonize their portfolios by divesting "brown" stocks and reweighting rather than driving corporate change through engagement with investees (Atta-Darkua et al., 2023). Such asset reallocation introduces a threat of divestment, but it is unclear ex-ante whether this threat provides meaningful incentives for portfolio firms to decarbonize (Pastor et al., 2021). As such, whether regulating sustainability disclosure for investors results in a decrease in emissions at the aggregate economic level is an open question.

[3] In the context of our study, we consider greenwashing a claim to invest based on sustainability criteria without maximizing efforts to improve the portfolio's sustainability performance.

Our analysis is based on a wide sample of mutual funds across Europe, the US, and the rest of the world. We exploit the variation induced by the SFDR, which prescribes that asset managers classify their funds based on whether the investment strategy has a sustainability dimension and, if it does, mandates detailed disclosures supporting how promoted sustainability characteristics or objectives are met. We define as our "treatment" group funds impacted by the SFDR that claim to integrate sustainability criteria in their investment strategy (i.e., funds that choose to publicly identify themselves as Article 8 or Article 9 under the SFDR; see description in Section 2.1). We compare changes in the weighted average carbon emissions of the firms in the portfolios of these funds with those of the portfolios of funds from non-Article 8 or Article 9 funds managed by PRI signatories (i.e. funds that also have made a choice to promote sustainability but are not subject to the SFDR sustainability disclosures).[4] In supplemental analyses, we demonstrate the robustness of our findings using five alternative control groups as described in Section 4.1.

We find that, relative to the control funds, the portfolios of the funds in our treatment group exhibit significantly lower emissions following the implementation of the SFDR. We observe this pattern across all three common perspectives of measuring emissions: (i) the Direct GHG Emissions of portfolio firms (i.e. Scope 1); (ii) the Operational GHG Emissions of portfolio firms (i.e. Scope 1 and 2); and (iii) the Total GHG Emissions of portfolio firms (Scope 1, 2 and 3).[5] A dynamic analysis around the introduction of the new rule shows that the portfolios of treatment and control funds experienced similar (parallel) trends in carbon emissions prior to the

[4] The UN Principles for Responsible Investment (PRI) was initiated in 2006 as a voluntary mechanism for asset manager to signal their commitment to sustainable investing. PRI signatories voluntarily make a commitment to incorporate ESG issues into their investment analysis, decision making, and ownership practices. They also make voluntary commitments to seek disclosure on sustainability issues by portfolio firms and to report on their activities and progress towards implementing the principles on an annual basis.

[5] Scope 1 are emissions of green-house gases from sources that a company owns or controls directly (e.g., from running its machinery). Scope 2 emissions are indirect emissions from purchased energy. Scope 3 emissions are all indirect emissions (not included in Scope 2) from the company's upstream and downstream value chains.

implementation of the SFDR but diverged in the years following. The magnitude of the documented patterns is not negligible. The funds in our treatment group reduce annual Scope 1 (total Scope 1, 2 and 3) portfolio carbon emissions by 15.4% (9.0%) more than our control funds.

To further sharpen identification, we exploit sources of cross-sectional variation in disclosure costs. First, we explore variation in the ex-ante level of funds exposure to disclosure regulation. We find that the effect of the SFDR is significantly reduced for the subset of funds that were already exposed to sustainability disclosure regulation prior to the new rule. Second, we observe that emission decreases are more pronounced for funds with higher levels of portfolio emissions prior to the SFDR, where a larger ex-ante difference may have existed between "sustainability" or "ESG" labels and the actual portfolio emissions. Third, we explore variation in the extent to which our sample funds are exposed to public scrutiny. Our results are more pronounced for funds registered to market in countries with relatively higher sensitivity towards sustainability.

To understand whether the SFDR results not only in decarbonization at the portfolio level, but also in decarbonization at the firm-level, we analyze to which extent the documented decrease in weighted average portfolio emissions comes from: (i) changes in portfolio weights (i.e., driven by changes in market values), (ii) changes in portfolio composition (i.e. driven by asset reallocation), and/or (iii) changes in carbon emissions of portfolio firms (i.e. driven by changes at the firm level). We find initial evidence for (ii) a "Flow" effect and for (iii) a "Firm" effect. While the "Flow" effect is larger, a substantial part of the documented decarbonization (roughly one third) is due to changes in carbon emissions of portfolio firms.

To account for the possibility that funds base their decision to continue holding a firm after the SFDR on that firm's emissions trajectory, we replicate our main analysis using a static portfolio

comprised of the firms held immediately prior to the introduction of the SFDR. The results reveal patterns similar to those found in our main tests, but with a smaller magnitude of effect. The static portfolios for funds in our treatment group reduce annual Scope 1 (total Scope 1, 2 and 3) portfolio carbon emissions by 3.2% (2.7%) more than our control funds. This evidence is difficult to reconcile with the notion that the firm-level emissions results described above are solely driven by changes in portfolio composition (i.e. Article 8/9 funds disproportionately retaining firms with pre-existing trends of declining emissions and divesting from those with increasing or stable emissions after the introduction of the SFDR).

To account for funds' self-selection into the Article 8/9 classification, we identify an alternative treatment sample composed of funds that the EU intended to treat with the SFDR (i.e. funds domiciled in the EU promoting sustainability characteristics/objectives). Inferences are unaffected. We obtain similar results when we repeat our main test excluding portfolio holdings of EU firms, which suggests that our results are unlikely to be driven by the potential confounding effect of contemporaneous developments in the EU. Finally, we conduct a large battery of tests to explore the sensitivity of our inferences to research design choices. Our inferences are robust to alternative measures of our key dependent variable (i.e., portfolio emissions) and alternative ways of decomposing portfolio emissions to isolate the effect of portfolio weights, portfolio composition, and portfolio firms.

Our paper contributes to the burgeoning literature on the relationship between sustainability disclosures by investment funds and their sustainability commitments. This literature focuses on voluntary public commitments such as becoming signatory of ESG initiatives (e.g., PRI or CDP) or adopting an ESG label. The evidence in some of these papers suggests that *voluntary* sustainability disclosures are not clearly related to improved sustainability performance (i.e.

Raghunandan and Rajgopal, 2022; Kim and Yoon, 2022). Other papers find some effect of investors' voluntary commitments on environmental performance, but the results seem to be restricted to certain jurisdictions (Gibson et al., 2022) and reflect shifting capital flows away from high emission firms without contributing to an overall reduction in global emissions (Atta-Darkua et al., 2023).

In contrast, our findings suggest that *mandatory* sustainability disclosures —combined with regulatory self-classification based on sustainability commitments— are accompanied by meaningful reductions in portfolio emissions, with suggestive evidence of firm-level decarbonization. As such, our evidence is in line with a growing body of evidence showing that, when properly incentivized, institutional investors can play a meaningful role in the transition towards a more sustainable economy (Dyck et al, 2019; Azar et al, 2021; Dimson et al., 2015, Cohen et al., 2023). One possible explanation for the contrast between our results and prior work on voluntary ESG commitments is that the SFDR introduces public enforcement, which is inherently different from private disciplining mechanisms (e.g., La Porta, Lopez-de-Silanes, and Shleifer, 2006; Jackson and Roe, 2009). Moreover, the costs associated with ceasing to market sustainability characteristics or objectives could vary significantly from those incurred by voluntarily joining initiatives like the PRI, where opting out remains a feasible.

Our paper also speaks to the literature studying the real effects of sustainability disclosure mandates. While some of this literature touches on decarbonization, the focus of this prior work is on regulating sustainability reporting by *issuers* (e.g., Chen et al., 2018; Downar et al., 2021; Jouvenot and Krueger, 2021; Yang et al., 2021; Tomar, 2023). In contrast, we study a disclosure mandate on *investors*. At a broader level, our study relates to research on other non-financial disclosure mandates (e.g., Christensen et al., 2017; Grewal et al., 2019; Fiechter et al., 2022;

Krueger et al., 2024), which generally find positive effects on the regulated dimensions (for example, mine safety and CSR-related actions). However, our setting is unique in that it combines disclosure regulation with investors' stated sustainability commitments (as previously explained, the SFDR imposes disclosure requirements if a fund classifies itself as Article 8/9).

Several considerations suggest that this is a fundamental departure from previous literature and that our results cannot be inferred from prior work. First, investment funds generally do not have direct operational control over the firms they invest in, altering the potential channels and costs of reducing portfolio emissions. It follows that the costs and benefits of disclosure for asset managers are likely to be different vis-à-vis those for managers and directors of non-financial firms. Second, funds typically have diverse portfolios with varying degrees of exposure to firms from different industries, each with its own emission measurement challenges and disclosure practices. This diversity can make standardization and verifiability of fund disclosures challenging, impacting the efficacy of disclosure regulation and enforcement in ways that may differ from non-financial firm disclosure settings. Finally, the sensitivity towards environmental issues among clients of asset management firms is not necessarily the same as non-financial firms.

Our results should be of interest to regulators, market participants, and other players in the current efforts to decarbonize the economy. Understanding the effects of the implementation of the SFDR can inform the worldwide debate around mandating investment fund sustainability representations and performance disclosure. Other jurisdictions—notably, the US and the UK—are also exploring legislation related to this topic and the EU continues to evaluate modifications and potential expansion of the SFDR.[6]

[6] In September of 2023 the SEC approved changes to the Investment Company Act's "Names Rule" that broadened the rule's scope to include funds with names featuring terms like ESG, green, or sustainable. The changes also included enhanced disclosure requirements (https://www.sec.gov/news/press-release/2023-188). In the UK, the Financial

2. Background and hypothesis

2.1. Institutional background

The EU Sustainable Finance Disclosure Regulation (SFDR) was approved in November of 2019 and came into effect in March of 2021 (Regulation EU 2019/2088) with the requirement that asset managers begin providing entity-level and product-level disclosures with 2021 as the first reference period. Asset managers make two important choices that subject them to the disclosure mandates of the SFDR. First is the choice to domicile or market a fund within the EU. Second is the choice to promote sustainability characteristics or objectives of the fund. The SFDR mandates all funds that domicile or market their product in the EU disclose the extent to which sustainability risks are considered in their investment decisions. The SFDR also imposes specific additional disclosure requirements when a fund promotes sustainability characteristics or has sustainable investment as its objective.

Asset Managers marketing their fund in the EU are asked to classify the fund as "Article 6", "Article 8", or "Article 9" (in reference to the corresponding articles of the regulatory text; see Appendix B) consistent with how they promote sustainability characteristics/objectives of the fund. Article 6 funds, which are not meant to promote sustainability characteristics or objectives, are subject to minimum sustainability disclosure requirements (see Appendix B). Article 8 funds consider environmental and/or social characteristics as part of their investment process (e.g., they

Conduct Authority closed a public consultation in June of 2024 on extending its sustainability disclosure requirements to investment management firms and expects to publish a policy statement about implementation in 2025. (https://www.fca.org.uk/publications/consultation-papers/cp24-8-extending-sdr-regime-portfolio-management). In the EU, the European Commission and other European Supervisory Authorities continue to evaluate implementation of the SFDR and consider modifications and improvements with a set of revisions expected in the fourth quarter of 2025 according to the European Commission's 2025 Work Programme. See for example: (https://www.esma.europa.eu/press-news/esma-news/esma-sets-out-its-long-term-vision-functioning-sustainable-finance-framework or https://commission.europa.eu/strategy-and-policy/strategy-documents/commission-work-programme/commission-work-programme-2025_en).

may consider portfolio company emissions and ESG performance or exclude certain sectors from portfolio eligibility) but typically integrate sustainability performance as a consideration rather than a defining objective of the fund. These funds are required to disclose the methodologies they use to assess the environmental or social characteristics of the investments and how levels of sustainability are achieved by the fund. Article 9 funds, in contrast, are those that have chosen to promote a sustainability objective—for example, investing in renewable energy and energy transition solutions. Article 9 funds typically invest in companies that contribute to specific environmental or social objectives.[7] The SFDR requires Article 9 funds to disclose how they measure and monitor the impact of their investments on these objectives. In addition, Article 9 funds must publish a detailed sustainable investment policy, which outlines the specific environmental and social objectives they aim to achieve.

The initial provisions of the SFDR, also commonly referred to as SFDR Level 1, delegated clarification of disclosure content and presentation for funds self-classified as Article 8 and Article 9 to the European Banking Authority (EBA), the European Insurance and Occupational Pensions Authority (EIOPA), and the European Securities and Markets Authority (ESMA). This clarifying information, commonly referred to as SFDR Level 2, was to be published via two sets of Regulatory Technical Standards ("RTS"). However, as noted by the European Commission, "in terms of substance, the application of the [SFDR] is not conditional on the formal adoption and entry into force or application of the [RTS]" (European Commission 2020). Article 8 and Article

[7] Examples of investments that could be considered Article 9 include investments in: (i) renewable energy infrastructure, such as solar power plants, wind farms, or hydroelectric facilities that contribute to the reduction of greenhouse gas emissions. (ii) sustainable infrastructure projects, including public transportation systems, green buildings, or water and waste management facilities. (iii) addressing social issues, such as affordable housing, healthcare, education, or initiatives supporting underprivileged communities. (iv) companies involved in developing and deploying clean technologies, sustainable agriculture practices, or waste management solutions. (v) initiatives focused on biodiversity conservation, habitat restoration, or sustainable land use practices. (vi) activities that contribute to mitigating climate change, such as carbon capture and storage projects, emissions reduction programs, or sustainable forestry.

9 funds were required to comply with the additional disclosure requirements from March of 2021, albeit without clear guidance on the exact substance and form those disclosures should take. During initial implementation this led to non-standardized disclosure and confusion among funds self-classified as Article 8 and Article 9 (Goldman Sachs 2022).

The first draft RTS for climate and environment-related topics was targeted for December 2020 and the first draft RTS for social, employee, human rights, and anti-corruption topics was targeted for December 2021. The final consolidated RTS covering both sets of topics was ultimately published in July of 2022 (Regulation EU 2022/1288). Per SFDR Level 2, Article 8 and 9 funds need to disclose qualitative and quantitative indicators in periodic reports that demonstrate how they meet promoted characteristics or objectives. Such disclosures are organized around the consideration of Principal Adverse Impact (PAI) indicators, which are intended to identify potential adverse impacts portfolio holdings may have on sustainability factors relating to environmental performance and other sustainability factors. Appendix C includes the greenhouse gas PAI disclosure template from the RTS. Disclosures consistent with this template were first required for the 2022 reference year.

SFDR Articles 10 and 11 require that financial market participants publish and maintain disclosures on their websites and in periodic reports. As clarified in the additional materials published by the Joint Committee of the EU Supervisory Authorities, disclosures by means of periodic reports should be carried out annually (JC 2023 18). Usually, funds disclose this information on websites, monthly factsheets, and/or prospectuses. Appendix D presents an example fund disclosure. Penalties for non-compliance with the SFDR include fines and loss of authorization to operate in the EU. Enforcement of the SFDR is entrusted to national competent authorities and coordinated by the ESMA at the European level.

2.2. Hypothesis development

2.2.1. Decarbonization at the portfolio level ("hypothesis H1")

We first focus on the potential effect of the SFDR on decarbonization *at the portfolio level* (referred to as "hypothesis H1"). We hypothesize that the introduction of a disclosure mandate when funds choose to promote sustainability is followed by a decarbonization of the funds' investment portfolios. Asset managers have significant incentives to be perceived as sustainable, primarily to capture superior capital inflows to their funds (Hartzmark and Sussman, 2019; Kim and Yoon, 2022). Moreover, as explained in Section 2.1, the new regulation increases the transparency of sustainability performance in investment portfolios, and higher transparency could highlight potential inconsistencies between sustainability claims and sustainability performance. It is thus plausible that, to avoid any negative reaction among investment clients triggered by such inconsistencies, asset managers have an incentive to increase the sustainability performance of their portfolio. Consistent with this possibility, some prominent EU regulators and commentators view the SFDR as a tool to verify whether investment funds honor their sustainability commitments (ESMA 2023; Negrin Ochoa, 2021).

Decarbonization is likely to be at the heart of investors' efforts to increase sustainability performance. A decrease in emissions is commonly perceived as an improvement in sustainability performance, whereas the interpretation of a decrease in other sustainability metrics could be more contentious.[8] Moreover, there is ample evidence that, given concerns about climate change, investors' environmental efforts are centered around decarbonization.[9] Survey evidence also

[8] For example: A decrease in water usage could be due to improved water efficiency or cutting corners in processes that might compromise quality or lead to other environmental issues. A decrease in land use could imply less habitat destruction or if the reduction is due to intensification of land use it might lead to other environmental or social issues.
[9] See for example the Net Zero Asset Owner Alliance, Climate Action 100+ initiative, or the ShareAction Investor Decarbonization Initiative.

shows a growing number of investment funds embedding net zero goals and strategies into portfolio decisions, which implies that investment clients appreciate decarbonization efforts.[10] The SFDR prioritizes development of detailed disclosures for environmental impacts above other facets of sustainability (see SFDR Article 4(6)). Moreover, the SFDR "Principal Adverse Impact" disclosures place a heavy emphasis on emissions (see CDR 2022 Annex 1, an excerpt from which is also included as Appendix C herein), which potentially facilitates related enforcement actions.

We envision two primary channels through which funds could decarbonize their investment portfolios. A fund can either (i) make changes in portfolio composition via purchases and sales of assets, or (ii) it can increase pressure on portfolio firms to improve their environmental performance.

Nonetheless, there are several reasons why one could not expect any observable effect of the SFDR on the average emissions of funds' investment portfolios. To begin, it is possible that the incentives to decarbonize investment portfolios generated by the regulation are not first order. While there is evidence that some investment clients have intrinsic ESG preferences, many others—perhaps a majority—could be more focused on traditional metrics related to the fund's economic performance (Barber et al.; 2016). Moreover, the regulation could generate incentives to increase sustainability performance in dimensions other than decarbonization. This could occur, for example, if investment clients focus on ESG ratings or other sustainability claims highlighted in the fund's marketing materials.

[10] In 2021, 733 institutional investors representing over $52 trillion in assets under management signed the 2021 Global Investor Statement to Governments on the Climate Crisis, which urged governments to work with institutional investors to accelerate action to tackle the climate crisis. The signatories observed more investors than ever are embedding Net Zero goals and strategies into their portfolio decisions, engaging with companies to cut emissions and calling on policymakers to deliver climate action (see the 2021 Global Investor Statement to Governments on the Climate Crisis, coordinated by the seven founding partners of The Investor Agenda https://theinvestoragenda.org/wp-content/uploads/2021/09/2021-Global-Investor-Statement-to-Governments-on-the-Climate-Crisis.pdf).

It is also possible that funds were already maximizing efforts to improve sustainability performance before the introduction of the SFDR (Dikolli et al., 2022). This would be the case if, absent disclosure regulation, the benefits of maximizing efforts towards improving sustainability outweigh the costs for investors. There is some evidence in support of this possibility. On the benefit side, survey evidence suggests that institutional investors believe climate risks have financial implications for their portfolio firms and that reducing carbon emissions is beneficial (Krueger et al., 2020). On the cost side, there is mixed evidence that managing a portfolio in a sustainable way imposes substantial costs (Pastor and Vorsatz, 2020; Kim and Yoon, 2022; Liang et al., 2022).

Yet a final possibility is that funds do not comply with the disclosure requirements of the SFDR. Fund classification as Article 6, Article 8 or Article 9 is a choice by the asset manager. In theory, the fund classification should flow from the choice to promote sustainability characteristics or objectives of the fund. However, in practice a fund self classifies and could choose to promote sustainability and not identify as Article 8/9 despite being noncompliant with the SFDR. Funds may also misclassify as Article 8/9 (either intentionally or unintentionally) without investing based on sustainability criteria or following the disclosure mandates.

Regarding enforcement, some critics argue that the SFDR is not specific enough to enable successful prosecutions and thus could open the door for greenwashing (Lambillon and Chesney, 2023; Negrin Ochoa, 2021). Funds may have diverse portfolios with varying degrees of exposure to different industries, each with its own emission measurement challenges and disclosure practices. This diversity can complicate the standardization and verification of fund disclosures.

Moreover, litigation and prosecution on grounds of sustainability are still rare, although the number of such cases is increasing.[11]

2.2.2. Decarbonization at the firm level ("hypothesis H2")

We next focus on the potential effect of the SFDR on decarbonization *at the firm level* (referred to as Hypothesis H2). Such an effect is plausible to the extent that investment funds have been shown to influence portfolio companies' environmental performance—either directly, through engagement, or indirectly, through the threat of divestment (Dimson et al., 2015; Tsang et al., 2019; Azar et al., 2021; Flammer and Viswanathan, 2021).

Nonetheless, decarbonization at the portfolio level may not translate into decarbonization at the firm level. Funds could decarbonize their portfolios by divesting brown stocks and reweighting rather than driving corporate change through engagement with investees (Atta-Darkua et al., 2023). Such asset reallocation introduces a threat of divestment, but it is unclear ex-ante whether this threat provides meaningful incentives for portfolio firms to decarbonize (Pastor et al., 2021).

3. Sample and descriptive statistics

To construct our sample, we start with the universe of mutual funds in FactSet, which covers portfolio equity holdings data for institutional investors worldwide (Ferreira and Matos, 2008; Gibson et al., 2022). We first remove index funds and non-equity funds following Humphrey and Li (2021). Next, we keep the funds with available FactSet Ownership data on equity portfolio holdings between 2015 and 2022. We exclude funds with total net assets (*TNA*) under management

[11] In May 2022, German prosecutors raided asset manager DWS and the headquarters of its majority owner Deutsche Bank over allegations of misleading investors about "green" investments (https://www.reuters.com/business/german-police-raid-deutsche-banks-dws-unit-2022-05-31/). In July 2023, ESMA (i.e., the EU's financial markets regulator and supervisor) launched a Common Supervisory Action with NCAs to assess the compliance of supervised asset managers with the relevant provisions in the SFDR (https://www.esma.europa.eu/press-news/esma-news/esma-and-ncas-assess-disclosures-and-sustainability-risks-investment-fund). In October 2024 BlackRock was reported to a market regulator for allegedly misleading sustainability claims and non-compliance with the SFDR (https://www.clientearth.org/media/0tuj2bit/clientearth-complaint-to-the-amf-english.pdf).

less than $15 million (Pastor and Vorsatz, 2020).[12] We also require portfolio holdings to have Trucost carbon emissions data for all years in which the asset is held by a fund to avoid potential distortions related to availability of emissions data (Bolton and Kacperczyk, 2021). We require that the ratio *AUM*/*TNA* (i.e., assets under management to total net assets) is between 0.1 and 2 to ensure reasonable fund portfolio coverage after imposing data restrictions to facilitate our fund level analyses.[13] Finally, we require a minimum of 4 consecutive observations in our pre-SFDR period and 2 consecutive observation in our post-SFDR period.

We define the "treatment" group as the subset of funds that choose to publicly classify as Article 8 and Article 9.[14] We expect the effect of the SFDR on decarbonization to be concentrated among these funds, as they are the ones publicly claiming to invest based on sustainability criteria that are subject to the SFDR disclosure requirements supporting how promoted sustainability characteristics or objectives are met. The "control" group in our primary tests contains non-Article 8/9 funds (i.e., funds not subject to the additional SFDR sustainability disclosures) that were signatories to the United Nations PRI before the ratification of the SFDR (e.g. in the funds first year in the sample). Non-Article 8/9 PRI signatories are similar to Article 8/9 funds in that they choose to publicly make a commitment to incorporate sustainability considerations into their investment analysis, decision making, and ownership practices. However, they are not required to publicly disclose the outcomes of such commitments or how promoted sustainability characteristics or objectives are met.

[12] Total net assets (*TNA*) is calculated as the sum of net asset value of different share classes of a fund. Total net assets is the total value of assets owned by a fund after subtracting its liabilities. The data is obtained from Morningstar.
[13] *AUM* is the sum of the market value of all portfolio holdings of a fund that remains after imposing other data requirements. *AUM*/*TNA* provides an indication of the percentage of *TNA* that we capture. The lower threshold of 10% is meant to ensure we capture a material portion of sample funds' portfolios. The upper threshold of 2x is based on the UCITS Directive Article 51(3) which sets leverage limitations at 1x assets, implying that the max ratio of assets to net assets should be 2x.
[14] We obtain this information from Refinitiv. Refinitiv reviews publicly available fund materials to identify whether a fund choose to identify as Article 8/9. SFDR Article 8/9 fund indicators were retrieved on February 6, 2023.

Using this procedure, we identify a comprehensive list of portfolio holdings for 2,487 active equity mutual funds, spanning 19,211 fund-years between 2015 and 2022. Table 1, Panel A, presents the sample selection procedure and the sample composition. As shown in Table 1, Panel B, our treatment group funds are scattered throughout the European Union, although a significant number are domiciled in Ireland and Luxembourg, reflecting those countries' regulatory clarity and responsiveness, tax and cost efficiency, and the ability they provide asset managers to bring products to market swiftly (Economist Intelligence Unit, 2014). We also note that some European Union domiciled funds do not publicly identify as Article 8/9 and are not subject to the disclosure mandate.[15] Table 1, Panel C, provides descriptive statistics of the variables we use in our tests. The average fund in our sample invests in firms that have aggregated Direct Emissions (Total GHG Emissions) of over 214 (504) million tons of CO_2 equivalents, highlighting the materiality of emissions that originate from the firms in our sample funds' portfolios.

4. Decarbonization at the portfolio level

Our first set of tests focus on our hypothesis H1, namely that the introduction of the SFDR is followed by decarbonization *at the portfolio level*.

4.1. Average portfolio emissions around the introduction of the SFDR

Our measure of carbon emissions at the portfolio level follows prior literature (e.g., Raghunandan and Rajgopal, 2022). For each mutual fund *i* in year *t*, we compute the weighted average of portfolio emissions (*Avg. Portfolio Emissions*$_{it}$):

$$Avg.\ Portfolio\ Emissions_{it} = log(\sum_{n}^{N} w_{int} \times Firm\ Emissions_{nt}) \quad (1)$$

[15] It is possible that some of these funds could be Article 8/9 funds that (i) were misclassified by Refinitiv, (ii) identified as Article 8/9 but choose not to publicly disclose that, or (iii) chose to not comply with the SFDR. To ensure that these funds are not driving results, we conduct several robustness tests where we exclude these funds from the control group. Inferences are unaltered. These results are tabulated in Tables OA.2 and OA.3.

where w_{int} is the weight of firm n in the portfolio of fund i in year t and $Firm\ Emissions_{nt}$ is the amount of emissions of firm n in year t (in tons of carbon equivalents). Weights w_{int} are the market value of a fund's shareholdings in each firm divided by the sum of the market value of all the fund´s shareholdings in the period. For instance, if a fund with $100 in assets under management owns $60 worth of shares in Firm A and $40 worth of shares in Firm B in a given year, and if Firm A has 200 metric tons of emissions and Firm B has 100 metric tons of emissions, *Avg. Portfolio* $Emissions_{nt}$ is computed as (0.6×200 + 0.4×100). For completeness, we compute *Avg. Portfolio* $Emissions_{nt}$ separately for (i) the Direct GHG Emissions of portfolio firms (i.e. Scope 1); (ii) the Operational GHG Emissions of portfolio firms (i.e. Scope 1 and 2); and (iii) the Total GHG emission of portfolio firms (i.e. Scope 1, 2 and 3). We caution that the measurement of Scope 3 emissions is a particularly contentious issue (Condon, 2023; Ducoulombier, 2021).

To test the potential impact of the SFDR on portfolio-level emissions, we estimate the following model:

$$Log\ (Avg.\ Portfolio\ Emissions_{it}) = \beta\ I(Article\_8/9)_i \times Post + \delta_i + \phi_t + \varepsilon_{it} \quad (2)$$

where *I(Article_8/9)* is an indicator variable that equals one if the fund is labeled as Article 8 or 9, and zero otherwise.[16] *Post* is an indicator variable that equals one if the year is 2020 or later.[17] δ_i

[16] Testing whether there is a differential effect among Article 8 and Article 9 funds is difficult, as our sample contains a small number of Article 9 funds. However, our inferences are unchanged if we drop Article 9 funds from the sample entirely (untabulated).

[17] The SFDR was ratified at the end of 2019 and first required disclosures related to a 2021 reference period. Prior research examining firm responses to a sustainability disclosure mandate show an anticipation effect where firms change behavior following the ratification of the regulation but prior to the effective date (Fiechter et al. 2022). In the case of investment funds, improving emissions through orderly portfolio rebalancing or influencing firm level decarbonization is expected to take time. It is thus expected that, in anticipation of the impending rule, funds changed their behavior progressively over the period following ratification through at least the effective date of the regulation. That said, we repeat the analysis in Table 2 redefining the "post" period as (i) starting in 2019, the year the SFDR was ratified, and (ii) starting in 2021, the first reference period for which SFDR sustainability disclosures were required. Inferences are unaltered (untabulated). However, we note that the treatment over time analyses (untabulated) suggest that these alternative research designs do not capture the underlying timing of the decarbonization effect of the SFDR as well as our primary research design.

and ϕ_t represent fund and year fixed effects, respectively. This fixed-effects structure controls for time invariant characteristics of individual funds as well as changes in market or other conditions across time that affect all firms (e.g., increases in oil and gas prices). Following prior literature (e.g., Raghunandan and Rajgopal, 2022; Kim and Yoon, 2022), we cluster standard errors by fund.[18]

As shown in Table 2, Panel A, the average amount of emissions of Article 8/9 funds' portfolios is relatively lower after the introduction of the SFDR compared to those of control funds. In terms of Direct GHG Emissions, the estimated magnitude of β suggests a relative decrease of 15.4% compared to control funds. The reductions in Operational GHG Emissions and Total GHG Emissions are 13.3% and 9.0%, respectively. These reductions are consistent with an overall improvement in decarbonization for the SFDR treated funds, but also reflect how examining Direct GHG Emissions reductions alone may overstate the magnitude given some shifting may have occurred from Direct GHG Emissions (Scope 1) into indirect emissions from purchased energy (Scope 2) and upstream and downstream emissions (Scope 3).

We conduct a dynamic version of equation (2), in which we take 2019 as our reference year and plot yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. As shown in Figure 1, we find no discernible differences in patterns in the pre-SFDR period for Article 8/9 funds relative to our control group. The results indicate that, prior to the implementation of the SFDR, the treated and control funds experienced similar (parallel) trends.[19]

[18] For robustness, we repeat our primary tests clustering standard errors alternatively by domicile, domicile × year, fund family, and fund family × year. Inferences remain unaltered (untabulated).
[19] We provide similar parallel trends figures for all subsequent difference in differences analyses, including cross sectional tests, in the Online Appendix unless specifically noted otherwise.

In contrast, Figure 1 shows a sharp decline in 2020, followed by further reductions in 2021 and 2022. The effect in 2020 suggests that funds increase decarbonization efforts shortly after the ratification of the SFDR, which is consistent with prior research documenting a change in firm behavior in the period between the ratification of the regulation and its effective date (Fiechter et al., 2022). The incremental effect in 2021 corresponds with the first reference period for which funds were required to provide sustainability disclosures. We offer two potential explanations for the incremental effect in 2022. First, the absence of clear guidance on the precise form and structure of the SFDR disclosures created uncertainty that was resolved with the issuance of the Regulatory Technical Standards (RTS) in 2022 (see Appendix C). Second, decarbonization resulting from increased pressure on portfolio firms to improve their environmental performance could manifest over a period of years, not immediately.

In Table OA.1 we explore the sensitivity of the previous results to measurement choices. We repeat the analysis in Table 2 using six variants of the dependent variable that capture alternative perspectives on decarbonization measurement. As shown in Table OA.1, our inferences are unaltered across the different measures for portfolio emissions.

In Table 3, we explore the sensitivity of our inferences to using alternative control groups. These additional analyses help further alleviate concerns regarding potentially confounding factors such as common shocks and fund heterogeneity. In Panel A, we define the control group as Non-Article 8/9 PRI funds matched based on pre-SFDR size (*AUM*) and environmental performance (*Avg. Portfolio Emissions)*. This matching provides additional assurance that any potential differences between treatment and control funds before the SFDR do not influence decarbonization effects. In Panel B we limit the control group to US domiciled PRI funds. This eliminates EU domiciled, non-Article 8/9 funds, addressing concerns that some observations in our control group

could represent missed SFDR funds or non-compliant funds. It also eliminates funds from smaller markets that could be less comparable to a large market like the European Union, addressing concerns our results are concentrated in less material marketplaces.

In Panel C we examine non-Article 8/9 Sustainable funds as designated by Morningstar as the control group. This allows us to demonstrate robustness using an alternative metric for identifying funds with a sustainability commitment that are not subject to a disclosure mandate. Morningstar considers a fund to be a sustainable investment product if in the prospectus or other regulatory filings it is described as focusing on sustainability, impact investing, or environmental, social or governance factors.[20] In Panel D we limit our sample to PRI signatory funds from within the same fund family (i.e. funds managed by the same asset manager), addressing concerns that the results could be driven by heterogeneity in asset managers. Following prior research, we require existence of a treated and control fund from the same fund family in each period and use fund family × year fixed effects in this specification (see Raghunandan and Rajgopal, 2022, for a similar analysis).

Finally, in Panel E we use SFDR Article 6 funds as the control group. We note that, strictly speaking, Article 6 funds also receive some treatment, as they are subject to minimal sustainability disclosure requirements under the SFDR (see Section 2.1 and Appendix B). As such, one could view this additional analysis as examining variation in treatment intensity (Article 8/9 funds are subject to substantially more extensive and detailed sustainability disclosure requirements than Article 6 funds).

[20] Funds must claim to have a sustainability objective, and/or use binding ESG criteria for their investment selection. Funds that employ only limited exclusions or only consider ESG factors in a non-binding way are not considered to be a sustainable investment product. We use ratings from year end 2019.

As shown in Table 3, our inferences are not affected when we repeat the analysis in Table 2 using these alternative control groups. The magnitude of effect is relatively similar, ranging from 13.4% to 20.4% for Direct GHG Emissions (vs. 15.4% in our primary test), 11.6% to 16.7% for Operational GHG Emissions (vs. 13.3%), and 5.4% to 11.1% for Total GHG Emissions (vs. 9.0%). Plots of the treatment effects over time for all tests are included in the Online Appendix.

4.2. Cross sectional variation in disclosure costs

To further sharpen identification, we exploit sources of cross-sectional variation in the costs of disclosure. Funds facing higher costs from disclosure plausibly have stronger incentives to decarbonize following the passage of the SFDR.

We start by exploring variation in the ex-ante level of funds' exposure to disclosure regulation. We expect costs of disclosure to be relatively lower for investment funds with a pre-existing exposure to disclosure regulation before the SFDR. We exploit variation generated by the French Energy Law of 2015, which was passed in 2015 and effective in 2016. Article 173-VI of this law requires that institutional investors domiciled or operating in France provide information on how they consider environmental, social, and governance factors in their strategies and decision making. That is, the funds in our sample marketed in France were already exposed to disclosure regulation prior to the SFDR. We expect a lower decarbonization effect for these funds compared to the Article 8/9 funds not exposed to the French Energy Law. Accordingly, we define an indicator *Prior Disclosure Rule* equal to 1 for funds registered to market in France, and 0 otherwise.[21] As shown in Table 4 Panel A, we observe a material attenuation of the main effect for funds with exposure to disclosure regulation prior to the SFDR.

[21] For purposes of this test only, we limit our period of analysis to the years 2017 to 2022 as we observe violations of the parallel trend assumption in the periods following the approval and effective date of the French Energy Law.

Second, we measure variation in the level of average portfolio emissions prior to the implementation of the SFDR. Funds with relatively worse emissions performance prior to the SFDR could face greater costs from disclosing emissions and accordingly have a stronger incentive to decarbonize their portfolios. Accordingly, we define *Higher_Emissions* as an indicator variable that equals one if *Avg. Portfolio Emissions* in 2019 (i.e., when the regulation was ratified) is above the median for the treatment sample, and zero otherwise. As shown in Table 4 Panel B, we observe that emission decreases are more pronounced for funds with higher levels of portfolio emissions prior to the SFDR.

Third, we explore variation in the extent to which our sample funds are exposed to public scrutiny. We test whether our results are more pronounced for Article 8/9 funds that market to investors in countries with higher sensitivity towards sustainability (which is likely associated with public pressure and tighter enforcement). In Panel C of Table 4, we split our treatment group into two parts based on the 2019 level of sensitivity to sustainability in the countries where a fund is registered to market. We define *Higher (Lower) Sensitivity Article_8/9* as indicator variables that equal one if the fund is registered to market in a country where *Sustainability_Sensitivity* in 2019 is above (below) the in-sample median for countries with Article 8/9 funds, and zero otherwise. *Sustainability_Sensitivity* is the Environmental Performance Index ("EPI") commonly used in prior literature (e.g., Dyck et al. (2019)).[22] Funds registered to market in multiple countries are included in the higher sensitivity group if all countries they are registered to market in are above the in-sample median and are included in the lower sensitivity group otherwise. In Table 4 Panel C, we observe significant incremental declines in emissions for both partitions of the treatment

[22] Our sample size is reduced slightly in Table 4 Panel C because EPI data is not available for Liechtenstein.

sample. However, the effects are significantly larger for funds registered to market in countries with higher sensitivity towards sustainability.

4.3. Fund holdings

Finally, we test whether investors are less likely to hold shares of firms with higher emissions under the SFDR. Such evidence would further support Hypothesis H1, as it would strengthen the notion that the regulation induced fund managers to adjust their portfolios with the aim of reducing portfolio-level emissions. We conduct the analysis at the fund-firm-year level. After excluding singletons (i.e., fund-firm groups with only one observation), the test includes 1,968,422 fund-firm-year observations. We estimate the following model:

$$\begin{aligned} Log(1+Shares_{int}) = {} & \beta_1\, I(Article\_8/9)_i \times Post \times Higher\_FirmEmissions_{in} + \\ & \beta_2\, Post \times Higher\_FirmEmissions_{in} + \beta_3\, I(Article\_8/9)_i \times Post + \\ & \Theta_1\, I(Article\_8/9)_i \times Post \times FirmControls_{nt} + \Theta_2\, Post \times FirmControls_{nt} + \\ & \Theta_3 I(Article\_8/9)_i \times FirmControls_{nt} + \Theta_4 FirmControls_{nt} + \delta_{in} + \phi + \varepsilon_{it} \end{aligned} \quad (3)$$

where $Shares_{int}$, is the number of shares of firm n owned by fund i in year t. We code $Shares_{int}$ as zero in the period immediately prior to (after) a firm's entry into (exit from) a fund's portfolio. *Higher_FirmEmissions* is an indicator variable that equals one if firm n emissions are in the highest decile of emissions of firms in the fund i portfolio at the end of 2019, and zero otherwise. We include this variable to identify firms contributing the largest emissions per dollar of investment to a specific fund's portfolio. *FirmControls* is a vector of firm characteristics related to performance, risk and growth that includes *Log(revenues)*, *Leverage, ROE, EPS growth*, *BM*, and *SalesGrowth* (see Appendix A for variable definitions). δ_{in} represent fund-firm fixed effects. ϕ represents either year fixed effects or fund-year fixed effects (we include them alternatively in the specifications). Year fixed effects control for unobserved characteristics in each year that impacted all funds and fund-year fixed effects are included to control for unobserved characteristics that

impacted each fund specifically in each year (e.g., capital inflows and outflows, management changes). All other variables are as previously defined.

Table 5 presents the results. The coefficient β_1 is negative and significant across all specifications, consistent with the notion that the SFDR induces funds to reduce their holdings in portfolio firms with the highest emissions. The magnitude of the effect ranges from 23.3% to 33.2%, depending on the specification.

5. Decarbonization at the firm level

Our second set of tests focus on hypothesis H2, namely that the introduction of the SFDR is followed by decarbonization *at the firm level*. Finding such an effect would imply that the regulation resulted not only in shifting capital flows away from high-emission firms, but also in increased pressure on portfolio firms to achieve emissions reductions at the firm level.

5.1. Decomposing Average Portfolio Emissions

As a first approach to shed light on H2, we decompose changes in average portfolio emissions into three components (see Appendix E for additional details): (i) changes in portfolio weights due to changes in returns, (ii) changes in funds' investment decisions, and (iii) changes in firm-level carbon emissions. For convenience, we refer to (i), (ii), and (iii) as "Return", "Flow", and "Firm" effects, respectively. We note that this decomposition is grounded in prior literature (e.g., Cheema-Fox et al., 2021; Atta-Darkua et al. 2023).

The results in Table 6, Panel A columns (3) and (4) are consistent with the notion that the documented patterns for Direct GHG Emissions are driven by both changes in funds' investment decisions (i.e., a "Flow" effect away from firms with relatively higher emissions) and by changes in firms' environmental performance (i.e., a "Firm" effect of emission reductions). In terms of Direct GHG Emissions, the "Flow" effect is more than double the "Firm" effect. However, the

"Firm" effect is economically meaningful; it is estimated at approximately 32% of the improvement in decarbonization in Table 6 (i.e. 0.036 divided by 0.113·measured in terms of Direct GHG Emissions of the SFDR treated funds).

The direction of the results remains consistent when the emissions measure is expanded to include Operational GHG Emissions (Panel B) and Total GHG Emissions (Panel C). However, only the "Firm" effect is significant for Operational (Total) GHG Emissions and represents approximately 41% (18%) of the improvement in decarbonization for the SFDR treated funds. In summary, the previous results provide initial evidence that the SFDR is associated with significant decarbonization arising not only from portfolio asset reallocation, but also from firms held in the portfolio of an Article 8/9 fund exhibiting greater decarbonization in the post SFDR period compared to firms held in the portfolios of the control funds.

5.2. Fixing Ex-ante Portfolio Composition

One difficulty in interpreting the "Firm" effect described above (i.e., column 4 of Table 6) as evidence for H2 is that funds may base their decision to continue holding a firm on that firm's emissions trajectory. That is, under the SFDR, Article 8/9 funds may have disproportionately retained positions in firms with a pre-existing trend of declining emissions and divested from those with increasing or stable emissions. While this possibility remains consistent with the notion that the SFDR induced portfolio decarbonization (i.e., Hypothesis H1), it would not support the idea that the regulation influenced firms' incentives to decarbonize (i.e., Hypothesis H2).

To account for this possibility, we conduct a variant of our main analysis. For each fund, we construct a static portfolio comprised of the firms held in 2019—i.e., prior to the treated fund's decision to classify itself as an Article 8/9 fund. These firms are maintained as part of the fund portfolio throughout the sample period and portfolio weights are held constant at the 2019 values.

This ensures we do not restrict the analysis to firms that remain in the funds' portfolios, as such firms may have been selectively retained based on their decarbonization trajectory.

As shown in Table 7, Panel A, and consistent with prior tests, we continue to find evidence of incremental decarbonization for Article 8/9 fund portfolios following the introduction of the SFDR using static portfolios. The effect sizes remain economically meaningful, with a 3.2% decrease in Direct GHG Emissions, a 2.3% decrease in Operational GHG Emissions and a 2.7% decrease in Total GHG Emissions. Figure 2 and Table 7 Panel B illustrate the treatment effects over time. In the pre-SFDR period, we observe no noticeable trend in emissions for the static portfolios of Article 8/9 funds relative to those of the control group. In contrast, we observe a significant decline in 2020 through 2022.[23]

Taken together, the evidence presented in this Section 5 is consistent with the notion that the SFDR was followed by decarbonization at the firm level (i.e., Hypothesis H2). Nonetheless, we acknowledge that the above tests cannot completely rule out the possibility that some funds—despite not knowing their future regulatory classification—were already more sustainability-oriented and selected portfolio firms based on expectations about future emissions trajectories. These funds may also have been more likely to subsequently classify themselves as Article 8 or 9. As such, while the results are suggestive, any conclusion regarding a causal link between SFDR and firm-level decarbonization should be interpreted with caution, given the potential for selection effects and anticipatory behavior among funds.

[23] To explore the sensitivity of the results in Table 7 we repeat the analysis (i) using fund portfolios and weights from 2018, a year before the ratification of the SFDR and 3 years before the first reference period for disclosure, (ii) enforcing a balanced panel over the subsample 2016 to 2021, (iii) using fund portfolios and weights from 2021, the year before the first reference period for disclosure and (iv) dropping fund portfolio coverage requirements. Inferences are unchanged. See Table OA.5 and Figures OA.23 to OA.26 for details.

6. Additional analyses

In this section we include a series of additional analyses aimed at further corroborating our interpretation of the previous patterns.

6.1. Self-selection

As previously explained, the classification as Article 6, Article 8, or Article 9 is an endogenous decision by each fund. Such self-selection could affect our inferences. To further explore the validity of our interpretation of the previous results, we conduct three variants of our main tests. First, in the spirit of an "intent to treat" analysis, we include in the treatment group funds domiciled in the EU that were PRI signatories in the first sample year (this was likely the group that the EU intended to treat with the SFDR). This mitigates self-selection concerns, as the treatment is assigned before fund managers knew they could later classify as articles 8 or 9. It also addresses concerns about potential impacts from firms beginning to promote sustainability during our sample window. The control sample includes non-EU funds that were PRI signatories in the first sample year. As shown in Table 8, Panel A, we obtain the same inferences as in prior tests. The magnitude of the effect is similar to that in Table 2, although somewhat smaller: 13.3 percent (versus 15.4 percent) for Direct GHG Emissions, 11.3 percent (versus 13.3 percent) for Operational GHG Emissions, and 8.2 percent (versus 9.0 percent) for Total GHG Emissions. In Table OA.6 we conduct an analysis parallel to that in Table 6 (i.e., decomposition of changes in portfolio emissions) using this alternative research design and continue to find evidence of both a "Flow" and a "Firm" effect.

Second, we include in the treatment group only funds labeled as Article 8 or 9 that were PRI signatories in their first sample year. This alternative research design also speaks to the sensitivity of our inferences to self-selection around the SFDR, as restricting the treatment group to PRI

signatories from the start of our sample likely eliminates funds that previously did not historically promote themselves as actively supporting sustainability, but decided to classify themselves as Article 8 or 9.[24] As shown in Table 8, Panel B, and Table OA.7, we obtain the same inferences as in our main tests.

Third, we include in the treatment group funds covered by the SFDR that were PRI signatories in 2019, regardless of whether they subsequently publicly identified as Article 6, Article 8, or Article 9. This alternative research design speaks to the sensitivity of our inferences to self-selection around the SFDR, as the revised treatment group includes funds that may have responded to the SFDR by backing away from prior sustainability promotion.[25] As shown in Table 8, Panel C, and Table OA.8, we obtain the same inferences as in our main tests.

6.2. Potentially confounding contemporaneous developments

(i) Other sustainability disclosure mandates

Surrounding our sample period, significant firm sustainability disclosure changes occurred in the EU, such as those related to the European Green Deal.[26] The Corporate Sustainability Reporting Directive (CSRD), which includes a firm disclosure mandate related to carbon emissions, was proposed in April of 2021. Prior to the CSRD, the European Commission approved the Non-financial Reporting Directive (NFRD), which was passed in 2014 and set into force in 2017 and had reporting requirements for firms from the 2018 financial year onwards (Fiechter et

[24] We view this possibility as unlikely for two reasons. First, funds already had incentives to have their products perceived as "sustainable" prior to the SFDR (Kim and Yoon 2022, Liang et. al 2022). Second, the SFDR imposed greater reporting and disclosure requirements on Article 8/9 funds than on Article 6 funds, creating a potential disincentive to change the positioning of a fund towards sustainability.

[25] There is anecdotal evidence that some funds responded to the SFDR by backing away from sustainability claims and chose to identify as Article 6 funds rather than make significant changes to their portfolio composition and investment management practices (Bioy et. al 2022).

[26] The European Green Deal is a set of policy initiatives introduced by the European Union with the aim of making Europe climate neutral by 2050. Key elements include a significant reduction in greenhouse gas emissions, investment in green technologies, and the promotion of sustainable energy, finance, industry and transportation.

al., 2022). The funds in our treatment sample may be more exposed to the NFRD/CSRD, as they allocate a greater proportion of capital to EU firms compared to the funds in our primary control group. Consequently, our results could capture an aggregation of decarbonization by EU firms driven by the NFRD/CSRD (or other European specific firm events) and be unrelated to the SFDR.

Several considerations suggest it is unlikely that European-specific firm events affect our inferences. First, the timing of the introduction of these regulations is different from that of the SFDR. Reporting required under the NFRD preceded our treatment period and any impacts from this regulation on the relative decarbonization across our treatment and control samples would be visible in a violation of the parallel trends assumption in the pre-period. We see no evidence of this (see Figure 1 for example). The first reporting under the CSRD was not scheduled to occur until 2025 and our results are robust to excluding observations from 2022 (i.e., the year in which CSRD was approved). Second, the potential confounding effect of the NFRD/CSRD is not consistent with the "Flow" effect documented in Table 6.

That said, we conduct additional tests to further mitigate this potential concern. We repeat the analyses in Tables 2 and 6 using only non-EU portfolio firms. We exclude all portfolio firms domiciled in the EU and re-calculate value weighted average emissions for each fund using just the non-EU firms. We again require that the ratio of captured assets under management to total net assets be between 0.1 and 2 to ensure reasonable fund portfolio coverage, which reduces the sample size. Table 9 provides corroborating evidence that the results in Tables 2 and 6 are not explained by contemporaneous firm-level disclosure changes in the EU. In Panel A we continue to find evidence of incremental decarbonization for treated funds across all three measures of emissions after excluding EU portfolio firms. The magnitude of the effect is similar to our main

tests. Further, we find evidence of "Firm" decarbonization effects across all three measures of emissions.

(ii) Other potentially confounding effects

We also consider the possibility that—beyond the explanations discussed above—our inferences may be confounded by an unidentified contemporaneous change correlated with portfolio-level emissions. We offer several considerations that we believe help mitigate this concern. First, our econometric models include year fixed effects, which helps account for common shocks experienced across the sample in any given year. Second, our use of a generalized difference in difference research design controls for contemporaneous shocks experienced by both the treatment and control groups of investment funds. Third we conduct analyses where we freeze portfolio weights/compositions. In addition, we run tests controlling for observable characteristics at the firm level and unobservable characteristics at the fund-firm and fund-year level. Finally, we demonstrate the robustness of our findings using five alternative control groups that account for a wide variety of potential common shocks and sources of heterogeneity.

Nevertheless, to provide additional support for our interpretation of the documented patterns, in Table 10 we repeat the analysis from Table 2 dropping all funds that became CDP signatories during our sample period (Panel A). We obtain similar results, which further corroborates that our inferences are not affected by non-SFDR related changes in funds' voluntary ESG public commitments (becoming a CDP signatory is a prominent example of such commitments).

We also repeat the analysis including control variables (Panel B) that capture fund and firm characteristics potentially correlated with portfolio-level emissions, firm-level Trucost emissions data, and firm performance, growth, and risk characteristics (e.g., Raghunandan and Rajgopal, 2022; Aswani et al. 2024). For fund characteristics, we include the *Log(fund AUM) and*

Log(number of stocks) which help control for changes in emissions related to capital inflows or outflows and investment strategy shifts. We also include value weighted averages of portfolio firm characteristics including *Log(revenues)*, *Avg. Leverage, Avg. ROE, Avg. EPS growth*, and *Avg. BM*. All variables are defined in Appendix A. As shown in Table 10, our main inferences are unchanged across all additional analyses.

7. Conclusions

In this paper, we document that the introduction of the EU SFDR—the first wide-ranging disclosure rule imposed on investment funds—was followed by a decrease in the average portfolio emissions of funds that self-classified as having a sustainability commitment. Additional tests suggest that this reduction is primarily driven by changes in funds' investment decisions, although there is some indication that firm-level emissions may have also contributed to the observed decarbonization. The patterns exhibit cross-sectional variation consistent with differences in disclosure costs and remain robust across a broad set of sensitivity tests addressing selection concerns, research design choices, and alternative explanations. Overall, our findings support the view that mandatory disclosure—combined with regulatory self-classification based on sustainability commitments—can incentivize decarbonization by asset managers in a way that contributes to a broader reduction in global emissions.

We conclude with several suggestions for future research. First, regulating investor disclosure—combined with regulatory self-classification— may influence dimensions of sustainability performance not examined in this paper. Second, while our analysis focuses on active equity mutual funds, the type of regulation we study—at least in the EU—applies more broadly to a range of financial institutions and actors, including index funds, non-equity mutual funds, credit institutions, and financial advisers. Third, understanding the mechanisms through

which portfolio firm emissions are affected by a regulation targeted at investors remains an important area for further investigation. Finally, evaluating the welfare implications of sustainability disclosure regulation requires additional evidence on the presence and magnitude of potential market-wide effects.

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Appendix A. Variable Definitions

Variable	Description	Source
Avg. Portfolio Emissions	The weighted average of the carbon emissions of the firms in the fund's portfolio (expressed in tons of CO_2 equivalents). Weights are based on the fund's reported value of portfolio firm holdings.	FactSet & Trucost
Article_8/9	Indicator variable that equals one if the fund is labeled as an Article 8 or 9 fund, and zero otherwise.	Refinitiv
Post	Indicator variable that equals one for observations after 2019 (i.e., the year when the SFDR was ratified), and zero otherwise.	
Year 20XX	Indicator variable that equals one for observations from year 20XX (15, 16, 17, 18, 20, 21, or 22) and zero otherwise.	
Δ Avg. Portfolio Emissions	Annual change in *Avg. Portfolio Emissions* calculated as weighted average emissions from year *t* less weighted average emissions from year *t-1* (expressed in millions of tons of CO_2 equivalents). See Appendix E for additional detail.	FactSet & Trucost
Return	The part of *Δ Avg. Portfolio Emissions* attributed to changes in portfolio weights due to divergent returns. See Appendix E for additional detail.	FactSet & Trucost
Flow	The part of *Δ Avg. Portfolio Emissions* attributed to changes in funds' investment decisions. See Appendix E for additional detail.	FactSet & Trucost
Firm	The part of *Δ Avg. Portfolio Emissions* attributed to changes in portfolio firms' environmental performance. See Appendix E for additional detail.	FactSet & Trucost
Log (1+ *Shares*)	Logarithm of one plus the number of shares of a firm held by a fund. Missing *Shares* are coded to zero in the period immediately prior to (after) a firm's entry into (exit from) a fund's portfolio.	FactSet
Higher_FirmEmissions	Indicator variable that equals one if a firm *n's* emissions are in the highest decile of emissions of the firms in the portfolio of fund *i* at the end of 2019.	FactSet & Trucost
Revenues	Firm's annual consolidated revenues in millions of US dollars.	Trucost
Leverage	Firm's Long-term debt over total assets.	Compustat
ROE	Firm's net income divided by book value of equity.	Compustat
EPS growth	Firm's Growth in earnings per share (basic), excluding extraordinary items.	Compustat
Sales growth	Annual change in firm's sales scaled by sales of the last year.	Compustat
BM	Firm's book value of equity divided by market value of equity.	Compustat

Prior Disclosure Rule	Indicator variable that equals one if the fund is registered to market in a country with an investor sustainability disclosure requirement prior to the introduction of the SFDR.	Article 173-VI French Energy Law of 2015
Higher Emissions	Indicator variable that equals one if *Avg. Portfolio Emissions* in 2019 (i.e., when the regulation was ratified) is above the sample median in 2019 for treated (control) firms, and zero otherwise.	FactSet & Trucost
Higher Sensitivity Article_8/9	Indicator variable that equals one for funds registered to market in a country where *Sustainability_Sensitivity* is above the in-sample median for countries with Article_8/9 funds. *Sustainability_Sensitivity* is the 2019 country-year EPI score from the Environmental Performance Index ("EPI"). The EPI is developed through a collaborative effort by Yale and Columbia Universities and ranks 180 countries based on performance indicators across a variety of policy categories related to environmental health and ecosystem vitality.	https://epi.yale.edu/
Lower Sensitivity Article_8/9	Indicator variable that equals one for funds registered to market in a country where *Sustainability Sensitivity* is below the in-sample median for countries with Article_8/9 funds	https://epi.yale.edu/
Log(fund AUM)	The logarithm of total assets under management (AUM) by the fund expressed in US dollars.	FactSet
Log(number of stocks)	The logarithm of the number of unique stocks held by the fund.	FactSet
Log(Avg. revenues)	Logarithm of the value weighted average of the revenues of the firms in the fund's portfolio expressed in US dollars. Weights are based on the fund's reported value of portfolio firm holdings.	FactSet & Compustat
Avg. Leverage	Value weighted average of *Leverage* of the firms in the fund's portfolio. Weights are based on the fund's reported value of portfolio firm holdings.	FactSet & Compustat
Avg. ROE	Value weighted average of *ROE* of the firms in the fund's portfolio. Weights are based on the fund's reported value of portfolio firm holdings.	FactSet & Compustat
Avg. EPS growth	Value weighted average of *EPS Growth* of the firms in the fund's portfolio. Weights are based on the fund's reported value of portfolio firm holdings.	FactSet & Compustat
Avg. Sales growth	Value weighted average of *Sales Growth* of the firms in the fund's portfolio. Weights are based on the fund's reported value of portfolio firm holdings.	FactSet & Compustat
Avg. BM	Value weighted average of *BM* of the firms in the fund's portfolio. Weights are based on the fund's reported value of portfolio firm holdings.	FactSet & Compustat

Appendix B: Articles 6, 8 and 9 from REGULATION (EU) 2019/2088

Article 6

Transparency of the integration of sustainability risks

1. Financial market participants shall include descriptions of the following in pre-contractual disclosures:

(a) the manner in which sustainability risks are integrated into their investment decisions; and

(b) the results of the assessment of the likely impacts of sustainability risks on the returns of the financial products they make available.

Where financial market participants deem sustainability risks not to be relevant, the descriptions referred to in the first subparagraph shall include a clear and concise explanation of the reasons therefor.

2. Financial advisers shall include descriptions of the following in pre-contractual disclosures:

(a) the manner in which sustainability risks are integrated into their investment or insurance advice; and

(b) the result of the assessment of the likely impacts of sustainability risks on the returns of the financial products they advise on.

Where financial advisers deem sustainability risks not to be relevant, the descriptions referred to in the first subparagraph shall include a clear and concise explanation of the reasons therefor.

Article 8

Transparency of the promotion of environmental or social characteristics in pre-contractual disclosures

1. Where a financial product promotes, among other characteristics, environmental or social characteristics, or a combination of those characteristics, provided that the companies in which the investments are made follow good governance practices, the information to be disclosed pursuant to Article 6(1) and (3) shall include the following:

(a) information on how those characteristics are met;

(b) if an index has been designated as a reference benchmark, information on whether and how this index is consistent with those characteristics.

2. Financial market participants shall include in the information to be disclosed pursuant to Article 6(1) and (3) an indication of where the methodology used for the calculation of the index referred to in paragraph 1 of this Article is to be found.

Appendix B: Articles 6, 8 and 9 from REGULATION (EU) 2019/2088 (cont'ed)

Article 9

Transparency of sustainable investments in pre-contractual disclosures

1. Where a financial product has sustainable investment as its objective and an index has been designated as a reference benchmark, the information to be disclosed pursuant to Article 6(1) and (3) shall be accompanied by the following:

(a) information on how the designated index is aligned with that objective;

(b) an explanation as to why and how the designated index aligned with that objective differs from a broad market index.

2. Where a financial product has sustainable investment as its objective and no index has been designated as a reference benchmark, the information to be disclosed pursuant to Article 6(1) and (3) shall include an explanation on how that objective is to be attained.

3. Where a financial product has a reduction in carbon emissions as its objective, the information to be disclosed pursuant to Article 6(1) and (3) shall include the objective of low carbon emission exposure in view of achieving the long-term global warming objectives of the Paris Agreement.

By way of derogation from paragraph 2 of this Article, where no EU Climate Transition Benchmark or EU Paris-aligned Benchmark in accordance with Regulation (EU) 2016/1011 of the European Parliament and of the Council ([20]) is available, the information referred to in Article 6 shall include a detailed explanation of how the continued effort of attaining the objective of reducing carbon emissions is ensured in view of achieving the long-term global warming objectives of the Paris Agreement.

Appendix C. Template for GHG Emissions Disclosures from Annex 1 of the COMMISSION DELEGATED REGULATION (EU) 2022/1288

Indicators applicable to investments in investee companies

Adverse sustainability indicator		Metric	Impact [year n]	Impact [year n-1]	Explanation	Actions taken, and actions planned and targets set for the next reference period
CLIMATE AND OTHER ENVIRONMENT-RELATED INDICATORS						
Greenhouse gas emissions	1. GHG emissions	Scope 1 GHG emissions				
		Scope 2 GHG emissions				
		Scope 3 GHG emissions				
		Total GHG emissions				
	2. Carbon footprint	Carbon footprint				
	3. GHG intensity of investee companies	GHG intensity of investee companies				
	4. Exposure to companies active in the fossil fuel sector	Share of investments in companies active in the fossil fuel sector				
	5. Share of non-renewable energy consumption and production	Share of non-renewable energy consumption and non-renewable energy production of investee companies from non-renewable energy sources compared to renewable energy sources, expressed as a percentage of total energy sources				
	6. Energy consumption intensity per high impact climate sector	Energy consumption in GWh per million EUR of revenue of investee companies, per high impact climate sector				

(1) 'GHG emissions' shall be calculated in accordance with the following formula:

$$\sum_{n}^{i}\left(\frac{current\ value\ of\ investment_i}{investee\ company's\ enterprise\ value_i}\times investee\ company's\ Scope(x)\ GHG\ emissions_i\right)$$

(2) 'carbon footprint' shall be calculated in accordance with the following formula:

$$\frac{\sum_{n}^{i}\left(\frac{current\ value\ of\ investment_i}{investee\ company's\ enterprise\ value_i}\times investee\ company's\ Scope\ 1,2\ and\ 3\ GHG\ emissions_i\right)}{current\ value\ of\ all\ investments\ (€M)}$$

(3) 'GHG intensity of investee companies' shall be calculated in accordance with the following formula:

$$\sum_{n}^{i}\left(\frac{current\ value\ of\ investment_i}{current\ value\ of\ all\ investments\ (€M)}\times\frac{investee\ company's\ Scope\ 1,2\ and\ 3\ GHG\ emissions_i}{investee\ company's\ €M\ revenue_i}\right)$$

Appendix D. Example of Disclosure by an "Article 8" Fund

This appendix presents excerpts from an Article 8 Fund's according to the SFDR. Panel A includes a disclosure statement on the incorporation of sustainability factors into investment decision-making. Panel B includes a detailed disclosure on emissions performance.

Panel A. Incorporation of sustainability factors into investment decision-making

Statement on principal adverse impacts of investment decisions on sustainability factors

Nordea ASSET MANAGEMENT

30 June 2023

Financial market participant: Nordea Investment Funds S.A. (549300LCQUXMRSWPKT48)

Summary

Nordea Investment Funds S.A. (549300LCQUXMRSWPKT48) considers principal adverse impacts of its investment decisions on sustainability factors. The present statement is the consolidated statement on principal adverse impacts on sustainability factors of Nordea Investment Funds S.A.[1] Nordea Investment Funds S.A. has delegated the investment management function for the funds managed by it to Nordea Investment Management AB, collectively referred to as "we", "us" or "our".

This statement on principal adverse impacts on sustainability factors covers the reference period from 1 January to 31 December 2022.

We consider principal adverse impact as part of our investment due diligence process and procedures. At entity level, we consider principal adverse impact by measuring and monitoring the aggregated negative impact of our investments on sustainability factors. We consider the mandatory principal adverse impact indicators and two voluntary indicators defined by the Sustainable Finance Disclosure Regulation (SFDR)[2], subject to data availability and quality. In the absence of mandatory data reporting requirements for investee companies, we are still facing challenges in identifying all principal adverse impacts of our investments.

This statement includes the reported principal adverse impact of our investments measured using these indicators. Comparability between the principal adverse impact of our investments and industry benchmarks is challenging due to the diversity of our portfolios (asset class, nature of the instruments, sectors we invest into etc.). Without comparative data from previous reference periods, it is difficult to estimate on which sustainability factors our investments have the most significant negative impact. However, given that climate change is a large threat to the global economy and implies specific risks to the companies and other entities we invest in, reducing the climate impact of our investments is a cornerstone of our ESG (environmental, social and governance) strategy alongside our other core areas of interest – biodiversity loss

Panel B. Disclosure on emissions performance

Indicators applicable to investments in investee companies

Adverse sustainability indicator		Metric	Impact 2022 (year n)	Impact [year n -1][4]	Explanation[5]	Actions taken, and actions planned and targets set for the next reference period
CLIMATE AND OTHER ENVIRONMENT-RELATED INDICATORS						
Greenhouse gas emissions	1. GHG emissions	Scope 1 GHG emissions	3,368,336 tCO2e[6]	N/A	N/A	We are a signatory to the Net Zero Asset Managers Initiative and committed to supporting the goal of net zero greenhouse gas emissions by 2050 or sooner, in line with global efforts to limit warming to 1.5°C. We have an organisational-wide target to reduce the weighted average carbon intensity (WACI) of our investments; a set of portfolio-specific carbon footprint reduction targets, and a complementary target to ensure that individual companies are engaged to become 1.5°C aligned.
		Scope 2 GHG emissions	983,988 tCO2e	N/A	N/A	
		Scope 3 GHG emissions	23,780,378 tCO2e	N/A	N/A	
		Total GHG emissions[7]	4,352,325 tCO2e	N/A	N/A	
	2. Carbon footprint	Carbon footprint	45.49 tCO2e/million EUR invested	N/A	N/A	
	3. GHG intensity of investee companies	GHG intensity of investee companies	134.85 tCO2e/million EUR of owned revenue	N/A	N/A	We have set a 2025 target to ensure that 80% of our top 200 largest carbon footprint contributors are on a Paris-aligned trajectory or else subject to engagement to become aligned.
	4. Exposure to companies active in the fossil fuel sector	Share of investments in companies active in the fossil fuel sector	2.87% investments in fossil fuels	N/A	N/A	Investment products that have been categorised as Article 8 or Article 9 under the SFDR may be subject to our Paris Aligned Fossil Fuel Policy, which prohibits investments in fossil fuel

[4] Information on impact compared to previous year will be initially reported by 30 June 2024, and continuously on an annual basis.
[5] Explanation of difference in impact reported will be published initially by 30 June 2024, and continuously on an annual basis.
[6] tCO2e means tonnes of carbon dioxide equivalent.
[7] Total Scope 1 + 2 GHG emissions.

Appendix E. Decomposition of Change in Average Portfolio Emissions

This exhibit describes the decomposition of changes in average portfolio emissions used in the analysis of Table 6, as proposed by Cheema-Fox et al. (2021). As explained in Section 4.1 of the main body of the paper, for each mutual fund *i* in year *t*, the weighted average of portfolio emissions is computed as:

$$Avg.\ Portfolio\ Emissions_{it} = log\left(\sum_{n}^{N} w_{int} \times Firm\ Emissions_{nt}\right)$$

where w_{int} is the weight of firm *n* in the portfolio of fund *i* in year *t* and $Firm\ Emissions_{nt}$ is the amount of emissions of firm *n* in year *t* (in tons of carbon equivalents). Specifically, w_{int} is computed as:

$$w_{int} = \frac{P_{nt} \times\ sh_{int}}{AUM_{it}}$$

where P_{nt} is the price per share of firm *n* at time *t*, sh_{int} are the shares of firm *n* held by fund *i* at time *t* and AUM_{it} is the AUM of fund *i* at time *t*.

For each firm *n*, the contribution to the fund level change in emissions for fund *i* in year *t* can be computed as:

$$\Delta FirmEmissions_{int} = w_{int} \times FirmEmissions_{nt} - w_{int-1} \times FirmEmissions_{nt-1}$$

The previous equation can be rearranged as follows:

$$\begin{aligned}\Delta FirmEmissions_{int} = {} & FirmEmissions_{nt-1} \times sh_{int-1} \times \left(\frac{P_{nt}}{AUM_{it}} - \frac{P_{nt-1}}{AUM_{it-1}}\right) \\ & + FirmEmissions_{nt-1} \times \frac{P_{nt}}{AUM_{it}} \times (sh_{int} - sh_{int-1}) \\ & + \frac{P_{nt} \times sh_{int}}{AUM_{it}} \times (FirmEmissions_{nt} - FirmEmissions_{nt-1})\end{aligned}$$

Thus:

$$\begin{aligned}\Delta Avg.\ Portfolio\ Emissions_{it} = {} & \left(\sum_{n}^{N} FirmEmissions_{nt-1} \times sh_{int-1} \times \left(\frac{P_{nt}}{AUM_{it}} - \frac{P_{nt-1}}{AUM_{it-1}}\right)\right) \\ & + \left(\sum_{n}^{N} FirmEmissions_{nt-1} \times \frac{P_{nt}}{AUM_{it}} \times (sh_{int} - sh_{int-1})\right) \\ & + \left(\sum_{n}^{N} \frac{P_{nt} \times\ sh_{int}}{AUM_{it}} \times (FirmEmissions_{nt} - FirmEmissions_{nt-1})\right)\end{aligned}$$

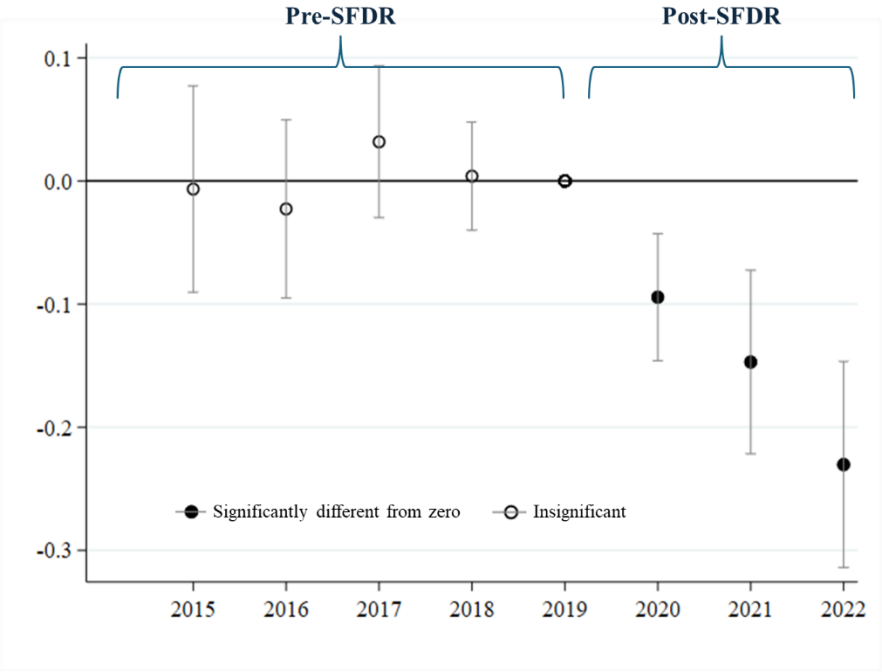
The first, second, and third terms of the above expression are denoted as "*Return*", "*Flow*" and "*Firm*", respectively. That is:

$$\boldsymbol{\Delta Avg.\ Portfolio\ Emissions_{it} = Return_{it} + Flow_{it} + Firm_{it}}$$

Figure 1: SFDR Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 2 Panel B for the regression model used. Panel A examines Direct GHG Emissions, Panel B Operational GHG Emissions and Panel C Total GHG Emissions. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)

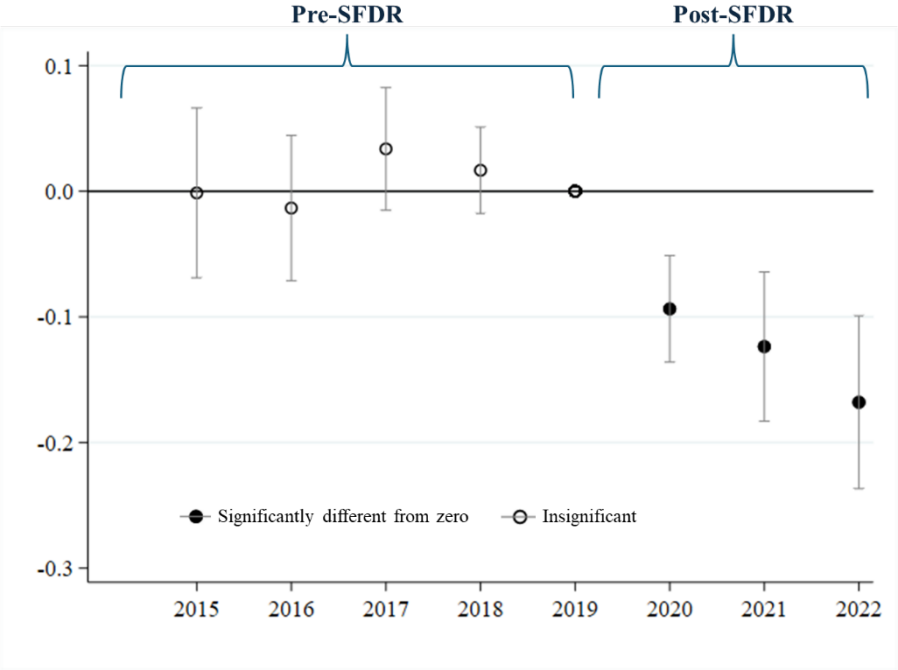


Figure 1: SFDR Treatment Effects over Time (cont'ed)

Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

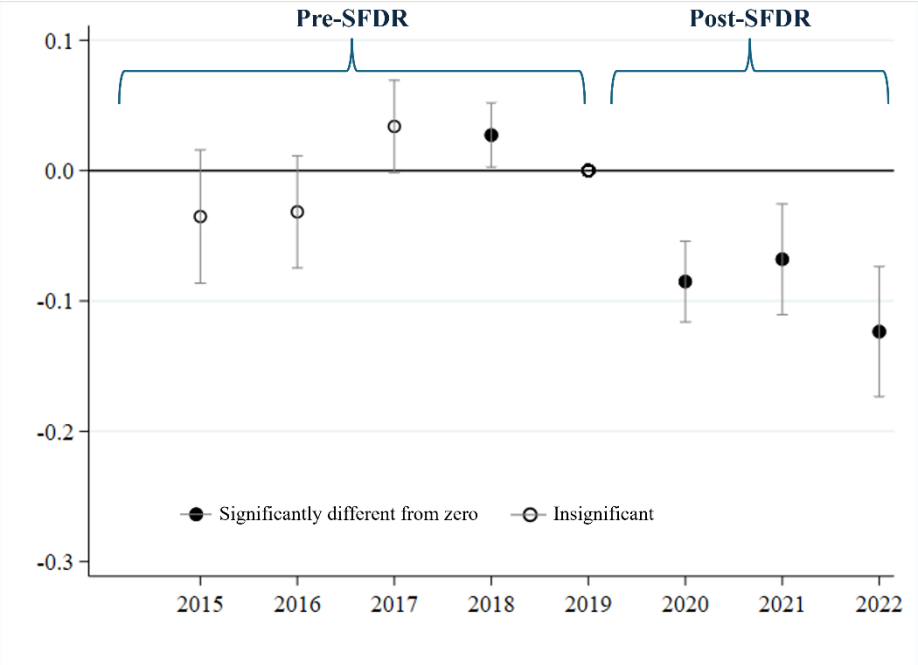
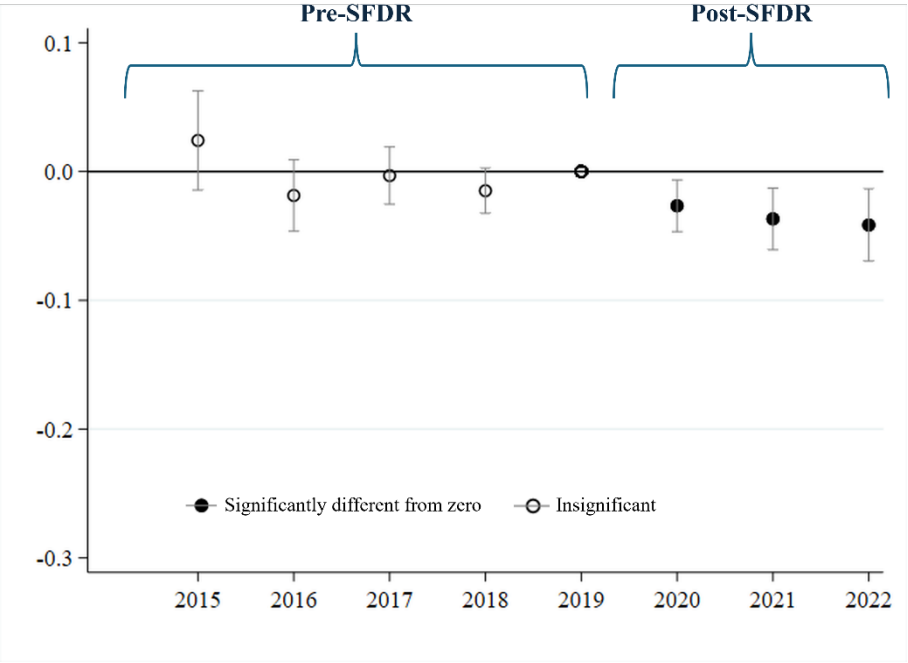


Figure 2: Treatment Effects over Time Fixing Ex-ante Portfolio Composition

This figure plots yearly treatment point estimates together with the 95% confidence intervals for *Log Avg. Portfolio Emissions* computed for all years based on a static portfolio comprised of the firms held in 2019 — i.e. prior to the fund's decision to classify itself as Article 8 or 9. These firms are maintained as part of the fund portfolio throughout the sample period and portfolio weights are held constant at the 2019 values. See Table 7 Panel B for the regression model used. Panel A examines Direct GHG Emissions, Panel B Operational GHG Emissions and Panel C Total GHG Emissions. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)

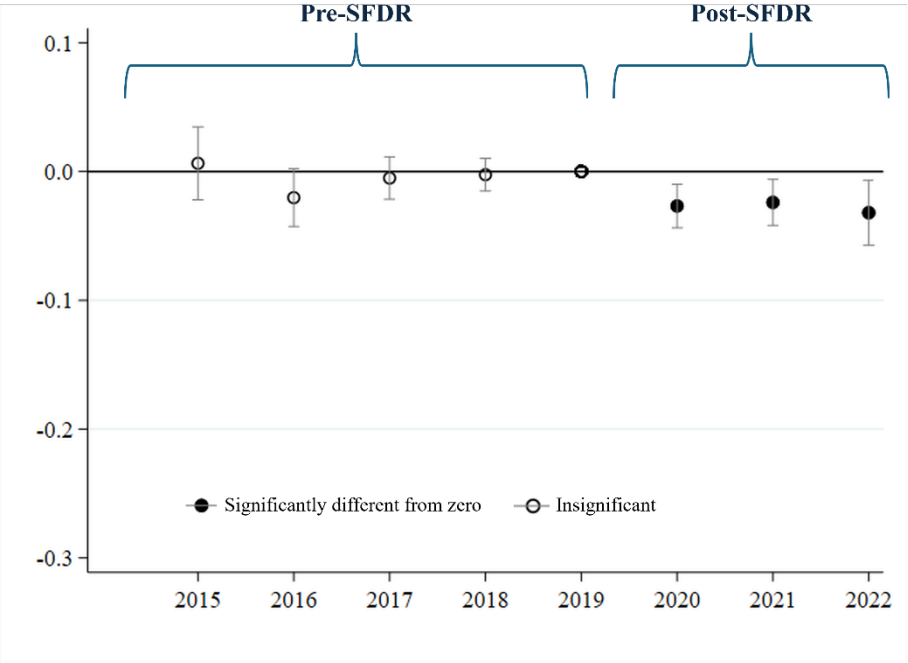


Figure 2: Treatment Effects over Time Fixing Ex-ante Portfolio Composition (cont'ed)

Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

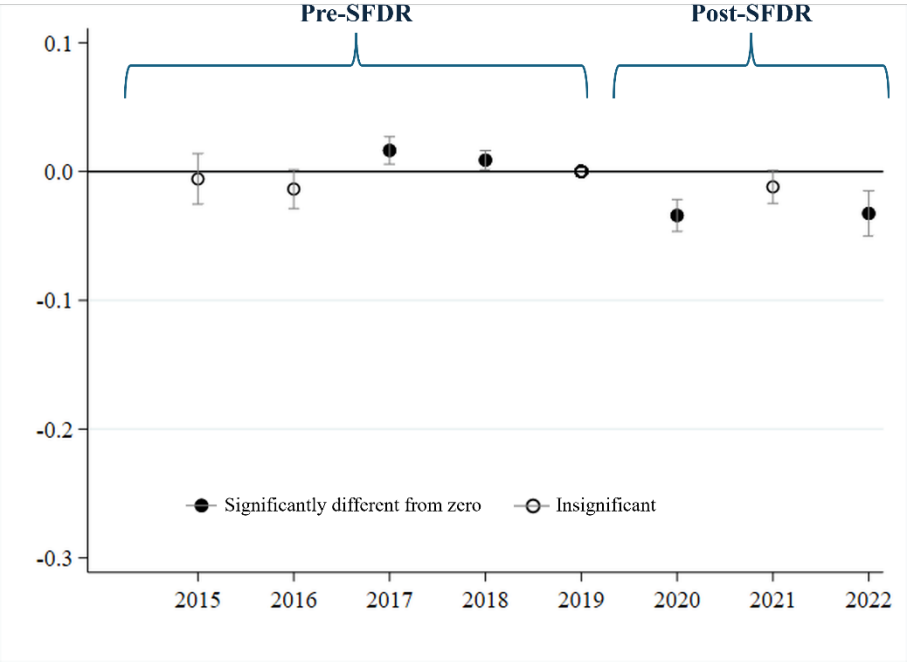


Table 1. Sample and Descriptive Statistics

Panel A presents the sample selection process and the composition of the sample funds. Panel B shows the distribution of fund-year observations across country of domicile partitioning by "Treatment" and "Control" groups. Panel C provides descriptive statistics of the variables used in the analysis. All variables are defined in Appendix A.

Panel A. Sample composition

	# of unique funds
Universe of mutual funds from FactSet	59,134
Remove index funds and funds without equity portfolio holdings data	-42,729
Require min AUM (>$15 million) and AUM coverage between 0.1 and 2	-5,831
Select Article 8/9 funds and funds issued by Non-Article_8/9 PRI Signatories	-4,997
Require at least 4 years in Pre period and 2 Years in Post period	-3,053
Final Sample of Unique Funds	2,487
Article 8 funds	1,321
Article 9 funds	137
Non-Article 8/9 PRI funds	1,029
Total sample funds	2,487

Panel B. Country of domicile

Country of Domicile	*Article_8/9 ("Treatment" group)*	*Non-Article_8/9 PRI ("Control" group)*	Total
Australia	0	228	228
Austria	315	0	315
Belgium	191	42	233
Denmark	308	27	335
Finland	344	66	410
France	1,419	172	1,591
Germany	557	8	565
Ireland	1,137	107	1,244
Luxembourg	5,987	196	6,183
Spain	248	8	256
Switzerland	109	509	618
United Kingdom	151	782	933
United States	0	5,714	5,714
EU Other	459	34	493
Non-EU Other	0	93	93
Total Fund -Year	11,225	7,986	19,211

Table 1. Sample and Descriptive Statistics (cont'ed)

Panel C. Descriptive statistics

Variable	*Obs.*	*Mean*	*SD*	*P25*	*P50*	*P75*
Fund-Level Emission Measures						
Avg. Direct GHG Emissions (Scope 1)	19,211	2,872,481	3,255,324	440,087	1,776,905	4,227,619
Avg. Operational GHG Emissions (Scope 1&2)	19,211	3,730,891	3,711,839	826,891	2,728,157	5,376,882
Avg. Total GHG Emissions (Scope 1,2&3)	19,211	8,021,433	6,461,499	3,007,676	6,838,413	11,500,000
Log Avg. Direct GHG Emissions	19,211	14.00	1.62	12.99	14.39	15.26
Log Avg. Operational GHG Emissions	19,211	14.47	1.38	13.63	14.82	15.50
Log Avg. Total GHG Emissions	19,211	15.43	1.17	14.92	15.74	16.26
Δ Direct GHG Emissions	19,211	(0.14)	1.63	(0.50)	(0.01)	0.28
Return (Direct GHG) Decomposition	19,211	(0.38)	1.41	(0.65)	(0.09)	0.02
Flow (Direct GHG) Decomposition	19,211	0.24	1.67	(0.12)	0.05	0.62
Firm (Direct GHG) Decomposition	19,211	(0.01)	0.63	(0.08)	0.00	0.08
Δ Operational GHG Emissions	19,211	(0.13)	1.79	(0.60)	(0.02)	0.39
Return (Operational GHG) Decomposition	19,211	(0.45)	1.64	(0.85)	(0.15)	0.05
Flow (Operational GHG) Decomposition	19,211	0.28	1.92	(0.18)	0.09	0.81
Firm (Operational GHG) Decomposition	19,211	0.03	0.67	(0.10)	0.00	0.13
Δ Total GHG Emissions	19,211	(0.19)	3.20	(1.06)	(0.04)	0.85
Return (Total GHG) Decomposition	19,211	(0.82)	3.09	(1.83)	(0.38)	0.17
Flow (Total GHG) Decomposition	19,211	0.54	3.53	(0.46)	0.24	1.73
Firm (Total GHG) Decomposition	19,211	0.08	1.43	(0.30)	0.06	0.54
Other Variables						
Log(Fund AUM)	19,211	19.75	1.53	18.60	19.67	20.78
Log(Number of Stocks)	19,211	4.50	0.74	3.99	4.36	4.86
Log(Avg. revenues)	19,211	9.91	1.09	9.41	10.30	10.69
Avg. Leverage	19,211	0.20	0.07	0.16	0.20	0.24
Avg. ROE	19,211	0.15	0.11	0.10	0.15	0.19
Avg. EPS growth	19,211	0.12	0.43	(0.09)	0.09	0.29
Avg. Sales growth	19,211	0.10	0.09	0.04	0.08	0.14
Avg. BM	19,211	0.38	0.19	0.25	0.35	0.48
PRI	19,211	0.81	0.39	1.00	1.00	1.00

Table 2. Average Portfolio Emissions around the Implementation of the SFDR

This table presents results from examining average portfolio emissions around the implementation of the SFDR. The analysis is conducted at the fund-year level. Panel A compares the periods before and after the ratification of the regulation. Panel B shows the results by year taking 2019 as the reference year. *Avg. Portfolio Emissions* is the logarithm of the weighted average of the carbon emissions of the firms in the fund's portfolio. Weights are based on the fund's reported value of portfolio firm holdings. The variable is computed separately for *Direct GHG Emissions* (Scope 1), *Operational GHG Emissions* (Scope 1&2), and *Total GHG Emissions* (Scope 1, 2 & 3). *Article_8/9* is an indicator variable that equals one if the fund is labeled as an Article 8 or 9 fund, and zero otherwise. *Post* is an indicator variable that equals one for observations after 2019 (i.e., the year when the SFDR was ratified), and zero otherwise. *Year 20XX* are indicator variables for year 20XX. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Pre-Post SFDR

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.154***	-0.133***	-0.090***
	(-4.63)	(-4.85)	(-4.45)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.841	0.854	0.892
Observations	19,211	19,211	19,211

Panel B. Analysis by year

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Year 2015	-0.007	-0.001	-0.035
	(-0.16)	(-0.04)	(-1.37)
Article_8/9 × Year 2016	-0.023	-0.013	-0.032
	(-0.62)	(-0.46)	(-1.46)
Article_8/9 × Year 2017	0.032	0.034	0.034*
	(1.02)	(1.37)	(1.89)
Article_8/9 × Year 2018	0.004	0.017	0.027**
	(0.18)	(0.96)	(2.19)
Article_8/9 × Year 2020	-0.094***	-0.094***	-0.085***
	(-3.62)	(-4.37)	(-5.44)
Article 8/9 × Year 2021	-0.147***	-0.124***	-0.068***
	(-3.91)	(-4.12)	(-3.17)
Article 8/9 × Year 2022	-0.230***	-0.168***	-0.124***
	(-5.45)	(-4.83)	(-4.90)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.841	0.854	0.892
Observations	19,211	19,211	19,211

Table 3. Alternative Control Groups

This table repeats the analysis in Table 2 using five alternative control groups: (i) Non-Article_8/9 PRI funds matched based on pre-SFDR size and environmental performance (Panel A), (ii) US based PRI funds (Panel B), (iii) ESG funds as designated by Morningstar (Panel C), (iv) Non-Article_8/9 PRI funds in the same fund family (i.e. funds managed by the same asset manager) (Panel D), and (v) Article 6 Funds (Panel E). Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Matching based on size and environmental performance

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article 8/9 × Post	-0.142***	-0.116***	-0.069***
	(-3.41)	(-3.40)	(-2.78)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.837	0.850	0.882
Observations	22,474	22,474	22,474

Panel B. US PRI funds

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.204***	-0.167***	-0.111***
	(-5.73)	(-5.68)	(-5.10)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.841	0.853	0.893
Observations	16,939	16,939	16,939

Panel C. Sustainable funds as designated by Morningstar

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article 8/9 × Post	-0.134**	-0.116**	-0.054
	(-2.49)	(-2.52)	(-1.52)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.820	0.832	0.867
Observations	13,077	13,077	13,077

Table 3. Alternative Control Groups (cont'ed)

Panel D. Funds in the same fund family

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.158**	-0.136***	-0.080*
	(-2.55)	(-2.62)	(-1.94)
Article_8/9	0.042	0.061	0.117**
	(0.55)	(0.95)	(2.06)
Fund Family×Year FE	Yes	Yes	Yes
adj R−squared	0.060	0.051	0.045
Observations	12,087	12,087	12,087

Panel E. Article 6 Funds

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article 8/9 × Post	-0.185***	-0.144***	-0.089***
	(-5.46)	(-5.13)	(-4.24)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.824	0.837	0.870
Observations	19,475	19,475	19,475

Table 4. Cross-sectional Variation in Disclosure Costs

This table repeats the analysis in Table 2 analyzing variation in fund decarbonization across three different settings where funds' disclosure costs are expected to vary. In Panel A, *Prior Disclosure Rule* is an indicator variable that equals one if the fund is registered to market in a country with an investor sustainability disclosure requirement prior to the introduction of the SFDR. In Panel B, *Higher Emissions* is an indicator variable that equals one if *Avg. Portfolio Emissions* in 2019 (i.e., the year when the regulation was ratified) is above the median for the year. In Panel C, we split our treatment group into two parts based on the 2019 level of sensitivity to sustainability in the country where the fund is registered to market. *Higher (Lower) Sensitivity Article 8/9* is an indicator for funds registered to market in a country where *Sustainability Sensitivity* is above (below) the in-sample median for countries with Article_8/9 funds. *Sustainability_Sensitivity* is the 2019 country-year EPI (Environmental Performance Index) score. Funds registered to market in multiple countries are included in the higher sensitivity group if all countries they are registered to market in are above the in-sample median and are included in the lower sensitivity group otherwise. The rest of the variables and the specifications are as in Table 2. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Prior disclosure rule in the country

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article 8/9×Post×Prior Disclosure Rule	0.179*	0.126	0.144**
	(1.66)	(1.38)	(2.13)
Article_8/9 × Post	-0.187***	-0.165***	-0.139***
	(-4.14)	(-4.54)	(-5.24)
Post × Prior Disclosure Rule	-0.159	-0.101	-0.112*
	(-1.63)	(-1.22)	(-1.82)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.863	0.877	0.911
Observations	14,452	14,452	14,452

Panel B. Prior portfolio emissions

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article 8/9 × Post × Higher Emissions	-0.152**	-0.105*	-0.118***
	(-2.29)	(-1.91)	(-2.94)
Article_8/9 × Post	-0.078	-0.081*	-0.031
	(-1.52)	(-1.91)	(-1.01)
Post × Higher Emissions	-0.017	-0.012	-0.008
	(-0.36)	(-0.32)	(-0.27)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.841	0.854	0.892
Observations	19,211	19,211	19,211

Table 4. Cross-sectional Variation in Disclosure Costs (cont'ed)

Panel C. Country sensitivity towards sustainability

		Dependent variable: *Log Avg. Portfolio Emissions*		
		Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:		(1)	(2)	(3)
Higher Sensitivity Article_8/9 × Post	β_1	-0.254***	-0.231***	-0.166***
		(-4.55)	(-5.03)	(-4.79)
Lower Sensitivity Article 8/9 × Post	β_2	-0.139***	-0.117***	-0.075***
		(-3.97)	(-4.03)	(-3.54)
p-value of $\beta_1 - \beta_2$		*0.043***	*0.014***	*0.009****
Fund Fixed Effects		Yes	Yes	Yes
Year Fixed Effects		Yes	Yes	Yes
adj R−squared		0.841	0.854	0.892
Observations		19,150	19,150	19,150

Table 5. Fund Holdings

This table presents results of the effect of SFDR on portfolio holdings. The analysis is conducted at the fund-firm-level. The dependent variable, *Log* (1+ *Shares*), is the logarithm of one plus the number of shares of a firm held by a fund in a given year. *Higher_FirmEmissions* is an indicator variable that equals one if the total emissions of the firm in 2019 are in the top decile of the respective fund portfolio, and zero otherwise. *Article_8/9* is an indicator variable that equals one if the fund is labeled as an Article 8 or 9 fund, and zero otherwise. *Post* is an indicator variable that equals one for observations after 2019 (i.e., the year when the SFDR was ratified), and zero otherwise. *Revenue*, *Leverage, ROE, EPS growth*, *BM* and *Salesgrowth* are firm-level variables defined in Appendix A. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

	Dependent variable: *Log(1+Shares)*			
Independent variables:	(1)	(2)	(3)	(4)
Article_8/9×Post×Higher_FirmEmissions	-0.257***	-0.233***	-0.332***	-0.313***
	(-3.87)	(-3.79)	(-3.22)	(-5.21)
Post × Higher_FirmEmissions	0.469***	0.388***	0.228***	0.100**
	(9.75)	(8.74)	(4.77)	(2.34)
Article_8/9 × Post	-0.283**		-0.296**	
	(-2.18)		(-2.15)	
Article_8/9 × Post × Revenue			0.000	0.000
			(0.90)	(0.63)
Article_8/9 × Post × Leverage			0.210	0.111
			(0.92)	(0.74)
Article_8/9 × Post × ROE			0.157***	0.191***
			(4.84)	(6.37)
Article_8/9 × Post × EPS growth			0.019***	0.013**
			(3.15)	(2.32)
Article_8/9 × Post × Salesgrowth			-0.050	-0.069*
			(-1.06)	(-1.79)
Article_8/9 × Post × BM			-0.240***	-0.090
			(-2.68)	(-1.45)
Controls & Interactions	No	No	Yes	Yes
Fund-Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	No	Yes	No
Fund-Year Fixed Effects	No	Yes	No	Yes
adj R−squared	0.242	0.303	0.251	0.312
Observations	1,968,422	1,968,422	1,968,422	1,968,422

Table 6. Decomposition of Average Portfolio Emissions

This table repeats the analysis in Table 2 using changes in portfolio-level emissions and the decomposition of these changes proposed by Cheema-Fox et al. (2021). See Appendix E for additional details of the decomposition calculation. Panel A, B, and C show the results of decomposition of funds' changes in Direct GHG, Operational GHG and Total GHG emissions, respectively. *Δ Avg. Portfolio Emissions* is the annual change in *Avg. Portfolio Emissions* (in millions of tons of CO2 equivalent). *Return*, *Flow*, and *Firm* are the three components into which *Δ Avg. Portfolio Emissions* is broken down. *Return* is the part of *Δ Avg. Portfolio Emissions* attributed to changes in portfolio weights due to divergent returns. *Flow* is the part of *Δ Avg. Portfolio Emissions* attributed to changes in funds' investment decisions. *Firm* is the part of *Δ Avg. Portfolio Emissions* attributed to changes in portfolio firms' environmental performance. *Article_8/9* and *Post* are as previously defined. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Direct GHG Emissions (Scope 1)

	Δ Avg. Portfolio Emissions (1)	*Return* (2)	*Flow* (3)	*Firm* (4)
Article_8/9 × Post	-0.113***	0.022	-0.100**	-0.036***
	(-2.61)	(0.58)	(-2.09)	(-2.92)
Article_8/9	-0.047*	-0.202***	0.144***	0.009
	(-1.90)	(-5.97)	(3.85)	(0.83)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.042	0.024	0.026	0.047
Observations	19,211	19,211	19,211	19,211

Panel B. Operational GHG Emissions (Scope 1 & 2)

	Δ Avg. Portfolio Emissions (1)	*Return* (2)	*Flow* (3)	*Firm* (4)
Article_8/9 × Post	-0.121**	0.019	-0.085	-0.050***
	(-2.51)	(0.40)	(-1.50)	(-3.74)
Article_8/9	-0.045*	-0.242***	0.168***	0.020
	(-1.66)	(-6.15)	(3.84)	(1.64)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.036	0.024	0.027	0.019
Observations	19,211	19,211	19,211	19,211

Panel C. Total GHG Emissions (Scope 1, 2 & 3)

	Δ Avg. Portfolio Emissions (1)	*Return* (2)	*Flow* (3)	*Firm* (4)
Article_8/9 × Post	-0.245***	-0.068	-0.144	-0.044*
	(-3.01)	(-0.74)	(-1.38)	(-1.90)
Article_8/9	-0.047	-0.440***	0.392***	0.003
	(-1.00)	(-5.89)	(4.82)	(0.21)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.096	0.025	0.033	0.282
Observations	19,211	19,211	19,211	19,211

Table 7. Fixing Ex-ante Portfolio Composition

This table replicates the analysis from Table 2 fixing ex-ante portfolio composition using a static portfolio comprised of the firms held by each fund in 2019 — i.e. prior to the treated fund's decision to classify itself as Article 8 or 9. These firms are maintained as part of the fund portfolio throughout the sample period and portfolio weights are held constant at the 2019 values, which ensures the analysis is not restricted to firms that remain in the funds' portfolios after the SFDR. The rest of the variables and the specifications are as in Table 2. Panel A compares the periods before and after the ratification of the regulation. Panel B shows the results by year taking 2019 as the reference year. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Pre-Post SFDR

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.032**	-0.023*	-0.027***
	(-2.08)	(-1.85)	(-2.82)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.979	0.980	0.984
Observations	18,709	18,709	18,709

Panel B. Analysis by year

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Year 2015	0.024	0.006	-0.006
	(1.24)	(0.44)	(-0.58)
Article_8/9 × Year 2016	-0.019	-0.020*	-0.014*
	(-1.33)	(-1.79)	(-1.78)
Article_8/9 × Year 2017	-0.003	-0.005	0.016***
	(-0.28)	(-0.61)	(3.04)
Article_8/9 × Year 2018	-0.015*	-0.002	0.009**
	(-1.68)	(-0.38)	(2.35)
Article 8/9 × Year 2020	-0.027***	-0.027***	-0.034***
	(-2.62)	(-3.14)	(-5.44)
Article_8/9 × Year 2021	-0.037***	-0.024***	-0.012*
	(-3.05)	(-2.65)	(-1.84)
Article_8/9 × Year 2022	-0.042***	-0.032**	-0.033***
	(-2.93)	(-2.51)	(-3.69)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.979	0.980	0.984
Observations	18,709	18,709	18,709

Table 8. Alternative Research Designs to Mitigate Self-Selection Concerns

This table replicates the analysis from Table 2 using alternative definitions of the treatment and control groups, aimed at mitigating self-selection concerns. In Panel A, the analysis includes in the treatment group funds domiciled in the EU that were PRI signatories in the first sample year (*EU Domicile PRI* is the corresponding indicator variable for those funds). The control sample includes non-EU funds that were PRI signatories. In Panel B, the analysis includes in the treatment group funds labeled as Article 8 or 9 that were PRI signatories in their first sample year (*Article_8/9 PRI* is the corresponding indicator variable for those funds). In Panel C, the analysis includes in the treatment group funds covered by the SFDR that were PRI signatories in 2019, regardless of whether they subsequently identified as Article 6, Article 8, or Article 9 (*Article_6/8/9 PRI* is the corresponding indicator variable for those funds). *Post* is an indicator variable that equals one for observations after 2019 (i.e., the year when the SFDR was ratified), and zero otherwise. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Including in the treatment EU domiciled funds that were PRI signatories at the start of the sample

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
EU Domicile PRI × Post	-0.133***	-0.113***	-0.082***
	(-4.07)	(-4.17)	(-4.07)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.850	0.864	0.900
Observations	19,243	19,243	19,243

Panel B. Including in the treatment Article 8/9 funds that were PRI signatories at the start of the sample

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 PRI × Post	-0.170***	-0.151***	-0.093***
	(-4.50)	(-4.81)	(-4.06)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.848	0.862	0.900
Observations	14,923	14,923	14,923

Panel C. Including in the treatment Article 6/8/9 funds that were PRI signatories in 2019

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article 6/8/9 PRI × Post	-0.106***	-0.090***	-0.062***
	(-3.56)	(-3.67)	(-3.36)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.849	0.861	0.896
Observations	23,836	23,836	23,836

Table 9. Excluding Portfolio Holdings in EU Firms

This table replicates the analyses from Tables 2 & 6 excluding holdings in EU firms from investors' portfolios. Panel A compares the periods before and after the ratification of the regulation. Panel B, C, and D show the results of decomposition of funds' changes in different measures of fund emissions. All Variables are as previously defined. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Pre-Post

	Dependent variable: *Log Avg. Portfolio Emissions_NonEU*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.141***	-0.118***	-0.072***
	(-3.65)	(-3.68)	(-2.97)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.816	0.830	0.867
Observations	16,209	16,209	16,209

Panel B. Direct GHG Emissions (Scope 1) decomposition

	Δ Avg. Portfolio Emissions	*Return*	*Flow*	*Firm*
Independent variables:	(1)	(2)	(3)	(4)
Article_8/9 × Post	-0.140***	-0.002	-0.086	-0.042***
	(-2.66)	(-0.05)	(-1.63)	(-2.80)
Article_8/9	-0.044	-0.215***	0.112***	0.050***
	(-1.56)	(-5.75)	(2.77)	(4.31)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.032	0.016	0.020	0.038
Observations	16,209	16,209	16,209	16,209

Panel C. Operational GHG Emissions (Scope 1 & 2) decomposition

	Δ Avg. Portfolio Emissions	*Return*	*Flow*	*Firm*
Independent variables:	(1)	(2)	(3)	(4)
Article_8/9 × Post	-0.175***	-0.025	-0.072	-0.070***
	(-2.94)	(-0.46)	(-1.13)	(-4.32)
Article_8/9	-0.032	-0.249***	0.141***	0.068***
	(-1.02)	(-5.71)	(2.92)	(4.77)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.027	0.017	0.022	0.015
Observations	16,209	16,209	16,209	16,209

Table 9. Excluding Portfolio Holdings in EU Firms (cont'ed)

Panel D. Total GHG Emissions (Scope 1, 2 & 3) decomposition

Independent variables:	*Δ Avg. Portfolio Emissions* (1)	*Return* (2)	*Flow* (3)	*Firm* (4)
Article_8/9 × Post	-0.452***	-0.154	-0.132	-0.119***
	(-3.95)	(-1.40)	(-1.06)	(-3.70)
Article_8/9	-0.016	-0.433***	0.356***	0.074***
	(-0.27)	(-5.07)	(3.82)	(3.84)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.062	0.020	0.028	0.209
Observations	16,209	16,209	16,209	16,209

Table 10. Additional robustness tests

This table presents the results of two additional variants of the analysis in Table 2. In Panel A we repeat the analysis in Table 2 excluding funds that became Carbon Disclosure Project Initiative (CDP) signatories during the sample period. In Panel B we repeat the analysis in Table 2 including additional control variables: *Log(revenues)*, *Log(fund AUM)*, *Log(number of stocks)*, *Avg. Leverage, Avg. ROE, Avg. EPS growth*, *Avg. Sales growth* and *Avg. BM*. The rest of the variables and specifications are as in Table 2. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Restricting the analysis to funds without change in CDP signatory status

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.149***	-0.135***	-0.098***
	(-3.72)	(-4.10)	(-4.05)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.837	0.850	0.888
Observations	13,612	13,612	13,612

Panel B. Including additional control variables

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.076***	-0.061***	-0.022
	(-2.72)	(-2.78)	(-1.62)
Log(fund AUM)	0.017	0.011	0.004
	(1.17)	(0.94)	(0.53)
Log(number of stocks)	0.276***	0.165***	0.071***
	(8.49)	(6.71)	(4.65)
Log(Avg. revenues)	1.013***	0.963***	0.934***
	(31.04)	(37.94)	(58.87)
Avg. Leverage	1.244***	0.752***	-0.055
	(3.93)	(3.12)	(-0.37)
Avg. ROE	-0.237***	-0.159***	-0.097***
	(-4.94)	(-4.46)	(-4.52)
Avg. EPS growth	-0.027**	-0.021**	-0.010
	(-2.01)	(-2.04)	(-1.61)
Avg. Sales growth	0.013	0.005	-0.017
	(0.13)	(0.07)	(-0.35)
Avg. BM	0.845***	0.566***	0.287***
	(8.84)	(7.56)	(6.02)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.879	0.898	0.948
Observations	19,211	19,211	19,211

Mandatory Investor Disclosure, Sustainability Commitments, and Portfolio Decarbonization

Online Appendices

Contents

OA.0. Additional variable definitions

Exhibit OA.0 includes the definitions of the additional variables used in the analyses included in this online appendix (these variables are not used in the tests tabulated in the main body of the paper). Table OA.0 presents the descriptive statistics of these additional variables.

OA.1. Alternative measures of decarbonization

To explore the sensitivity of the previous results to measurement choices, we repeat the analysis in Table 2 using six variants of the dependent variable that capture alternative perspectives on decarbonization measurement. The first measure, which we refer to as *Ownership Weighted Emissions* is the sum of the carbon emissions of the firms in the fund's portfolio (expressed in tons of CO2 equivalents) multiplied by the fund's ownership percentage of each firm. Ownership percentages are calculated by deflating the value of the fund's investment in the firm by the enterprise value of the firm and enterprise value is calculated as the market value of equity plus the book value of long-term debt. This variable provides a measure of the owned emissions of the fund but could create distortion when information for only a portion of the overall portfolio is publicly available. Additionally, variation in the net asset value of the fund can cause variation in this measure that could introduce noise into measurements of relative changes in emissions. However, as shown in Panel A of Table OA.1, our inferences are unaltered using *Ownership Weighted Emissions*.

Second, we compute *Carbon Footprint,* which is the *Ownership Weighted Emissions* deflated by the sum of the fund's reported value of portfolio firm holdings (expressed in tons of CO2 equivalents/$millions invested). This variable provides a measure of the owned emissions per million dollars invested by the fund and is less subject to the measurement issues of unscaled *Ownership Weighted Emissions.* As shown in Panel B of Table OA.1, our inferences are unaltered using *Carbon Footprint*.

Third, we compute the portfolio level value weighted average of carbon emissions *intensity* for portfolio firms. Carbon emission intensity is calculated for each portfolio firm as emissions scaled by sales. It provides a measure of carbon emissions in relation to volume and is useful for evaluating emission reductions relative to economic or firm specific growth (e.g., Aswani et al., 2024) but is less useful for measuring potential decreases in emissions at the aggregate economic level. As shown in Panel C of Table OA.1, our inferences are unaltered using carbon emissions *intensity*.

Fourth, we *aggregate* firm carbon emissions to the portfolio level by calculating the sum of carbon emissions for the firms in the fund's portfolio (in tons of CO2 equivalents) without applying any weighting metric. This measure provides a global perspective of aggregate carbon emissions originating from firms that a fund is directing capital to. As shown in Panel D of Table OA.1, our inferences are unaltered using *aggregate* emissions.

Fifth, we compute the *equally* weighted average of emissions at the portfolio level by averaging carbon emissions for the firms in the fund's portfolio. This measure provides an average perspective of carbon emissions originating from firms that a fund is directing capital to after

controlling for variation in the number of firms in the portfolio across time. As shown in Panel E of Table OA.1, our inferences are unaltered using *equally* weighted emissions.

Finally, we compute the portfolio level value weighted average of the components of a firm's total Total GHG Emissions (i.e. Scope 2 and Scope 3 emissions separately). We caution that changes in these variables may represent firms engaging in outsourcing of Scope 1 or Scope 2 emissions to their supply chains in a form of carbon leakage (e.g. Ben-David et al., 2021, Dechezleprêtre et al., 2022; Naegele and Zaklan, 2019; Borghesi et al., 2020). However, as shown in Panel F of Table OA.1 we continue to see some evidence of additional emission reductions in the fund Scope 2 and Scope 3 emissions measured separately, although the Scope 2 effects are not statistically significant.

OA.2. and OA.3. Dropping EU Non-Article 8/9 PRI Funds

It is possible that some of the funds in our control sample could be Article 8/9 funds that were misclassified by Refinitiv or that chose to not comply with the SFDR. To ensure that EU domiciled non-Article 8/9 PRI funds are not driving results, we conduct robustness tests where we exclude these funds from the control group and repeat our Table 2 and Table 6 analyses. Inferences are unaltered.

OA.4. Alternative Method for Decomposing Sources of Change in Fund Emissions

To explore the sensitivity of the sources of change results to our choice of decomposition model we repeat the analysis in Table 6 using an alternative method of decomposition following Atta-Darkua et al. (2023). See OA.0 for details of the variable definitions. This alternative decomposition breaks the sources of change into two components (i) a component related to portfolio reweighting over time $\Delta log(Reweighting)$ and (ii) a component related to changes at the firm level over time $\Delta log(Firm)$. As shown in OA.4 using this revised decomposition methodology we continue to find evidence of both a *Reweighting* effect (similar to our "Flow" & "Return" effects) and a *Firm* effect (similar to our "Firm" effect).

OA.5. Alternative Freeze Date for Fixing Ex-ante Portfolio Composition

To explore the sensitivity of the results in Table 7 we repeat the analysis using a variety of alternative methods for creating the static portfolio. Table OA.5 Panel A repeats the analysis using the 2018 portfolio assets and portfolio weights to address concerns that there may have been anticipation "Flow" effects already reflected in the 2019 portfolio holdings. The 2018 assets and weights are a year before the ratification of the SFDR and 3 years before the first reference period for mandated disclosure for funds that choose to promote sustainability. In Table OA.5 Panel B we use the 2019 portfolio holdings and weights with a balanced panel that restricts the sample to the period 2016 to 2021 (the years we require all funds to exist in the sample). In Table OA.5 Panel C we freeze portfolios using the 2021 portfolio holdings and asset weights to again look for evidence that retained or purchased assets post the SFDR exhibited a pre-SFDR differential decarbonization trend. The 2021 assets and weights are a year before the first reference period. In Table OA.5 Panel D we drop the filter requiring that the ratio AUM/TNA falls between 0.1 and 2

in the year portfolio weights are sourced from (i.e. we maintain the entire Table 2 sample). Inferences are unaltered.

OA.6 - OA.8. Decompositions: Self-selection Analyses

As previously explained, the classification as Article 6, 8, or 9 is an endogenous decision by each fund. Such self-selection could affect our inferences. To mitigate this concern, we conducted variants of our main Table 2 test as discussed in Section 6.1 and shown in Table 8. Here we conduct an analysis parallel to that of Table 6 (i.e., decomposition of changes in portfolio emissions) using these alternative research designs. Table OA.6 is done in the spirit of an "intention to treat" analysis and uses EU domiciled funds that were PRI signatories in the first year in our sample as a proxy for the group that the EU intended to treat with the SFDR (i.e. funds marketing their products in the EU and promoting sustainability characteristics/objectives).Table OA.7 restricts the treatment to Article 8/9 funds that were PRI signatories in the first year in our sample. Finally, Table OA.8 restricts the treatment to Article 6/8/9 funds that were PRI signatories in 2019. Inferences are unchanged and we continue to find evidence of "Flow" and "Firm" effects.

OA.9. Additional figures corresponding to treatment effects over time analyses

Exhibit OA.0 Additional Variable Definitions

Variable	Description	Source
Ownership Weighted Emissions	Sum of the carbon emissions of the firms in the fund's portfolio (expressed in tons of CO_2 equivalents) multiplied by the fund's ownership percentage of each firm. Ownership percentages are calculated by deflating the value of the fund's investment in the firm by the enterprise value of the firm. Enterprise value is calculated as the market value of equity plus the book value of long-term debt.	FactSet & Trucost
Carbon Footprint	The *Ownership Weighted Emissions* deflated by the sum of the fund's reported value of portfolio firm holdings (expressed in tons of CO_2 equivalents/$millions invested.	FactSet & Trucost
Avg. Emission Intensity	Value weighted average of the carbon emission intensity of the firms in the fund's portfolio (in tons of CO_2 equivalents per dollar). Carbon emission intensity is calculated as emission amounts scaled by sales expressed in millions of US dollars. Weights are based on the fund's reported value of portfolio firm holdings.	FactSet & Trucost
Aggregated Portfolio Emissions	Sum of the carbon emissions of the firms in the fund's portfolio (in tons of CO_2 equivalents).	FactSet & Trucost
Avg. Portfolio Emissions (*EW)*	Equally weighted average of the carbon emissions of the firms in the fund's portfolio (in tons of CO_2 equivalents).	FactSet & Trucost
Δlog(Avg. Portfolio Emissions)	Annual change in portfolio emissions calculated following Atta-Darkua et al. (2023) as: $= Log\left(\sum_{n}^{N}\left(\frac{P_{nt} * sh_{int}}{AUM_{it}}\right) * Firm\ Emissions_{nt}\right)$ $- Log\left(\sum_{n}^{N}\left(\frac{P_{nt-1} * sh_{int-1}}{AUM_{it-1}}\right) * Firm\ Emissions_{nt-1}\right)$	FactSet & Trucost
Δlog(Reweighting)	Proportion of annual change in portfolio emissions related to *Reweighting* calculated following Atta-Darkua et al. (2023) as: $= Log\left(\sum_{n}^{N}\left(\frac{P_{nt} * sh_{int}}{AUM_{it}}\right) * Firm\ Emissions_{nt}\right)$ $- Log\left(\sum_{n}^{N}\left(\frac{P_{nt-1} * sh_{int-1}}{AUM_{it-1}}\right) * Firm\ Emissions_{nt}\right)$	FactSet & Trucost
Δlog(Firm)	Proportion of annual change in portfolio emissions related to *Firm* changes calculated following Atta-Darkua et al. (2023) as: $= Log\left(\sum_{n}^{N}\left(\frac{P_{nt} * sh_{int}}{AUM_{it}}\right) * Firm\ Emissions_{nt}\right)$ $- Log\left(\sum_{n}^{N}\left(\frac{P_{nt} * sh_{int}}{AUM_{it}}\right) * Firm\ Emissions_{nt-1}\right)$	FactSet & Trucost

Table OA.0. Descriptive Statistics of Additional Variables

Variable	*Obs.*	*Mean*	*SD*	*P25*	*P50*	*P75*
Ownership Weighted Direct GHG Emissions	19,211	34,796	86,458	1,656	6,746	25,745
Ownership Weighted Operational GHG Emissions	19,211	43,918	104,334	2,746	9,696	34,326
Ownership Weighted Total GHG Emissions	19,211	88,341	191,692	7,666	24,053	75,810
Direct GHG Carbon Footprint	19,211	65.51	79.96	11.67	37.69	88.92
Operational GHG Carbon Footprint	19,211	81.34	89.62	20.84	51.84	108.94
Value Chain Carbon Footprint	19,211	159.52	132.48	65.60	126.20	210.85
Avg. Direct GHG Emission Intensity	19,211	130.26	144.35	34.04	82.96	170.05
Avg. Operational GHG Emission Intensity	19,211	167.37	157.02	64.65	119.73	211.60
Avg. Total GHG Emission Intensity	19,211	311.67	181.04	192.47	269.09	372.65
Aggregated Portfolio Direct GHG Emissions	19,211	214,000,000	323,000,000	17,100,000	86,900,000	275,000,000
Aggregated Portfolio Operational GHG Emissions	19,211	261,000,000	375,000,000	32,100,000	117,000,000	337,000,000
Aggregated Portfolio Total GHG Emissions	19,211	504,000,000	653,000,000	98,300,000	262,000,000	661,000,000
Avg. Portfolio Direct GHG Emissions (EW)	19,211	2,622,140	2,826,673	415,419	1,723,692	3,877,704
Avg. Portfolio Operational GHG Emissions (EW)	19,211	3,250,653	3,165,107	776,341	2,350,765	4,744,251
Avg. Portfolio Total GHG Emissions (EW)	19,211	6,521,052	5,134,354	2,467,969	5,572,430	9,215,905
Avg. Portfolio Scope 2 Emissions	19,211	852,052	738,714	285,657	720,015	1,164,215
Avg. Portfolio Scope 3 Emissions	19,211	4,280,769	3,316,962	1,714,369	3,815,939	6,053,543
Δlog(Avg. Portfolio Emissions Direct GHG)	19,008	(0.06)	0.56	(0.30)	(0.04)	0.20
Δlog(Reweighting Direct GHG)	19,008	(0.09)	0.53	(0.29)	(0.06)	0.14
Δlog(Firm Direct GHG)	19,008	(0.25)	0.50	(0.30)	(0.10)	(0.00)
Δlog(Avg. Portfolio Emissions Operational GHG)	19,008	(0.05)	0.45	(0.25)	(0.03)	0.18
Δlog(Reweighting Operational GHG)	19,008	(0.08)	0.42	(0.25)	(0.05)	0.12
Δlog(Firm Operational GHG)	19,008	(0.21)	0.41	(0.27)	(0.10)	(0.01)
Δlog(Avg. Portfolio Emissions Total GHG)	19,008	(0.03)	0.33	(0.20)	(0.02)	0.15
Δlog(Reweighting Total GHG)	19,008	(0.06)	0.31	(0.20)	(0.04)	0.08
Δlog(Firm Total GHG)	19,008	(0.17)	0.31	(0.25)	(0.11)	(0.00)

Table OA.1. Alternative Measures of Decarbonization

This table repeats the analysis in Table 2 using 6 alternative definitions of the dependent variable. In Panel A the dependent variable *Ownership Weighted Emissions* is the average of the carbon emissions of the firms in the fund's portfolio (in tons of CO_2 equivalents) weighted by the percentage ownership the fund in each firm. In Panel B the dependent variable *Carbon Footprint* is the *Ownership Weighted Emissions* scaled by the total value of all the fund's investments. In Panel C the dependent variable *Avg. Emission Intensity* is the value weighted average of the carbon emission intensity of the firms in the fund's portfolio. Carbon emission intensity is calculated as emission amounts (in tons of CO_2 equivalents) scaled by sales (in millions of US dollars). In Panel D the dependent variable *Aggregated Portfolio Emissions* is the sum of the carbon emissions of the firms in the fund's portfolio (in tons of CO_2 equivalents). In Panel E the dependent variable *Avg. Portfolio Emissions* (*EW)* is the equally weighted average of the carbon emissions of the firms in the fund's portfolio (in tons of CO_2 equivalents). In Panel F the dependent variable *Avg. Portfolio Emissions* is calculated separately for Scope 2 and Scope 3 emissions (in tons of CO_2 equivalents). The rest of the variables and the specification are as in Table 2. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Ownership weighted emissions

	Dependent variable: *Log Ownership Weighted Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article 8/9 × Post	-0.168***	-0.141***	-0.089**
	(-3.60)	(-3.36)	(-2.42)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.822	0.831	0.852
Observations	19,211	19,211	19,211

Panel B. Carbon footprint

	Dependent variable: *Log Carbon Footprint*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.192***	-0.165***	-0.112***
	(-5.79)	(-6.19)	(-6.04)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.802	0.806	0.839
Observations	19,211	19,211	19,211

Panel C. Emission intensity

	Dependent variable: *Log Avg. Emission Intensity*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.096***	-0.061***	-0.028**
	(-3.41)	(-2.84)	(-2.25)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.771	0.771	0.784
Observations	19,211	19,211	19,211

Table OA.1. Alternative Measures of Decarbonization (cont'ed)

Panel D. Aggregate emissions

	Dependent variable: *Log Aggregated Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article 8/9 × Post	-0.180***	-0.158***	-0.107***
	(-5.11)	(-5.34)	(-4.72)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.863	0.875	0.903
Observations	19,211	19,211	19,211

Panel E. Equal weighted emissions

	Dependent variable: *Log Avg. Portfolio Emissions (EW)*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.125***	-0.103***	-0.052***
	(-4.09)	(-4.15)	(-2.93)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.839	0.851	0.891
Observations	19,211	19,211	19,211

Panel F. Internal Energy (Scope 2) and External Upstream and Downstream (Scope 3) Emissions

	Dependent. variable: *Log Avg. Portfolio Emissions*	
	Scope 2	*Scope 3*
Indep. variables:	(1)	(2)
Article_8/9 × Post	-0.035	-0.066***
	(-1.54)	(-3.60)
Fund Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
adj R−squared	0.867	0.907
Observations	19,211	19,211

Table OA.2. Dropping EU Non-Article 8/9 PRI Funds

This table repeats the analysis in Table 2 dropping EU domiciled non-article 8/9 PRI funds from the control group. The rest of the variables and the specifications are as in Table 2. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article 8/9 × Post	-0.168***	-0.143***	-0.100***
	(-4.81)	(-4.97)	(-4.70)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.838	0.851	0.891
Observations	18,042	18,042	18,042

Table OA.3. Decompositions: Dropping EU Non-Article 8/9 PRI Funds

This table repeats the analysis in Table 6 using the alternative treatment and control groups defined in Table OA.2. Changes in portfolio-level emissions and the decomposition of these changes proposed by Cheema-Fox et al. (2021). See Appendix E for additional details of the decomposition calculation. Panel A, B, and C show the results of decomposition of funds' changes in Scope 1, 2, 3 emissions, respectively. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Direct GHG Emissions (Scope 1)

	Δ Avg. Portfolio Emissions	*Return*	*Flow*	*Firm*
	(1)	(2)	(3)	(4)
Article_8/9 × Post	-0.172***	0.013	-0.134***	-0.051***
	(-4.06)	(0.33)	(-2.84)	(-4.03)
Article_8/9	-0.032	-0.190***	0.153***	0.005
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.043	0.025	0.027	0.046
Observations	18,042	18,042	18,042	18,042

Panel B. Operational GHG Emissions (Scope 1 & 2)

	Δ Avg. Portfolio Emissions	*Return*	*Flow*	*Firm*
	(1)	(2)	(3)	(4)
Article_8/9 × Post	-0.178***	0.004	-0.114**	-0.065***
	(-3.72)	(0.09)	(-2.05)	(-4.76)
Article_8/9	-0.032	-0.224***	0.172***	0.015
	(-1.17)	(-5.58)	(3.94)	(1.21)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.038	0.025	0.029	0.020
Observations	18,042	18,042	18,042	18,042

Panel C. Total GHG Emissions (Scope 1, 2 & 3)

	Δ Avg. Portfolio Emissions	*Return*	*Flow*	*Firm*
	(1)	(2)	(3)	(4)
Article_8/9 × Post	-0.318***	-0.106	-0.166	-0.061***
	(-3.91)	(-1.14)	(-1.60)	(-2.60)
Article_8/9	-0.024	-0.388***	0.379***	-0.007
	(-0.51)	(-5.07)	(4.64)	(-0.40)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.095	0.025	0.034	0.281
Observations	18,042	18,042	18,042	18,042

Table OA.4. Decompositions: Alternative Decomposition Methodology

This table repeats the analysis in Table 6 using an alternative method of decomposition following Atta-Darkua et al. (2023). See OA.0 for details of the variable definitions. Panel A, B, and C show the results of decomposition of funds' changes in Scope 1, 2, 3 emissions, respectively. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Direct GHG Emissions (Scope 1)

	Δlog(Avg. Portfolio Emissions) (1)	*Δlog(Reweighting)* *(2)*	*Δlog(Firm)* (3)
Article 8/9 × Post	-0.058***	-0.050***	-0.086***
	(-3.45)	(-3.05)	(-5.60)
Article_8/9	-0.006	0.004	-0.028***
	(-0.75)	(0.49)	(-3.07)
Fund Fixed Effects	No	No	No
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.034	0.020	0.026
Observations	19,008	19,008	19,008

Panel B. Operational GHG Emissions (Scope 1 & 2)

	Δlog(Avg. Portfolio Emissions) (1)	*Δlog(Reweighting)* *(2)*	*Δlog(Firm)* (3)
Article_8/9 × Post	-0.043***	-0.038***	-0.068***
	(-3.09)	(-2.83)	(-5.46)
Article_8/9	-0.006	0.002	-0.024***
	(-0.81)	(0.27)	(-3.28)
Fund Fixed Effects	No	No	No
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.033	0.016	0.035
Observations	19,008	19,008	19,008

Panel C. Total GHG Emissions (Scope 1, 2 & 3)

	Δlog(Avg. Portfolio Emissions) (1)	*Δlog(Reweighting)* *(2)*	*Δlog(Firm)* (3)
Article 8/9 × Post	-0.036***	-0.033***	-0.057***
	(-3.60)	(-3.34)	(-6.28)
Article_8/9	-0.001	0.009	-0.020***
	(-0.22)	(1.60)	(-3.37)
Fund Fixed Effects	No	No	No
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.086	0.018	0.058
Observations	19,008	19,008	19,008

Table OA.5 Alternative Freeze Date for Constant Pre-SFDR Portfolio Composition

This table repeats the analysis in Table 7 computing *Avg. Portfolio Emissions* based on alternative static sample selection methodologies. In Panel A the computation of *Avg. Portfolio Emissions* for all years is based on the 2018 portfolio weights and asset composition. In Panel B we use the 2019 portfolio holdings and weights and a balanced panel that restricts the sample to the period 2016 to 2021 (the years we require all funds to exist in the sample). In Panel C the computation of *Avg. Portfolio Emissions* for all years is based on the 2021 portfolio weights and asset composition. Panel D removes the portfolio coverage filter requirement and repeats Table 7 Panel A. The rest of the variables and the specifications are as in Table 7. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Freeze Portfolios using 2018 Weights and Composition

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.032**	-0.023*	-0.028***
	(-2.20)	(-1.90)	(-3.08)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.980	0.981	0.985
Observations	18,888	18,888	18,888

Panel B. Balanced Panel 2016 to 2021

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article 8/9 × Post	-0.032***	-0.029***	-0.037***
	(-2.66)	(-2.98)	(-4.63)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.988	0.988	0.991
Observations	14,394	14,394	14,394

Panel C. Freeze Portfolios using 2021 Weights and Composition

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.043***	-0.029**	-0.021**
	(-2.69)	(-2.26)	(-2.16)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.973	0.976	0.982
Observations	18,674	18,674	18,674

Table OA.5 Alternative Freeze Date for Constant Pre-SFDR Portfolio Comp. (cont'ed)

Panel D. Remove Portfolio Coverage Filter Requirement for Static Portfolio

	Dependent variable: *Log Avg. Portfolio Emissions*		
	Direct GHG	*Operational GHG*	*Total GHG*
Independent variables:	(1)	(2)	(3)
Article_8/9 × Post	-0.040***	-0.032**	-0.033***
	(-2.63)	(-2.55)	(-3.43)
Fund Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
adj R−squared	0.979	0.981	0.985
Observations	19,211	19,211	19,211

Table OA.6. Decompositions: Intention to Treat

This table repeats the analysis in Table 6 using the alternative treatment and control groups defined in Table 8 Panel A. Changes in portfolio-level emissions and the decomposition of these changes proposed by Cheema-Fox et al. (2021). See Appendix E for additional details of the decomposition calculation. Panel A, B, and C show the results of decomposition of funds' changes in Scope 1, 2, 3 emissions, respectively. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Direct GHG Emissions (Scope 1)

	Δ Avg. Portfolio Emissions (1)	*Return* (2)	*Flow* (3)	*Firm* (4)
Article 8/9 × Post	-0.221***	0.034	-0.202***	-0.055***
	(-5.06)	(0.88)	(-4.25)	(-4.26)
Article_8/9	0.010	-0.139***	0.133***	0.016
	(0.42)	(-4.27)	(3.71)	(1.52)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.043	0.019	0.027	0.047
Observations	19,243	19,243	19,243	19,243

Panel B. Operational GHG Emissions (Scope 1 & 2)

	Δ Avg. Portfolio Emissions (1)	*Return* (2)	*Flow* (3)	*Firm* (4)
Article_8/9 × Post	-0.237***	0.020	-0.197***	-0.064***
	(-4.85)	(0.43)	(-3.51)	(-4.72)
Article_8/9	0.015	-0.151***	0.138***	0.027**
	(0.56)	(-3.96)	(3.27)	(2.22)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.037	0.019	0.029	0.017
Observations	19,243	19,243	19,243	19,243

Panel C. Total GHG Emissions (Scope 1, 2 & 3)

	Δ Avg. Portfolio Emissions (1)	*Return* (2)	*Flow* (3)	*Firm* (4)
Article_8/9 × Post	-0.333***	-0.037	-0.301***	-0.011
	(-4.06)	(-0.41)	(-2.82)	(-0.45)
Article_8/9	0.030	-0.193***	0.225***	0.009
	(0.66)	(-2.70)	(2.88)	(0.57)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.093	0.020	0.033	0.268
Observations	19,243	19,243	19,243	19,243

Table OA.7. Decompositions: Restricting the treatment to Article 8/9 funds that were PRI signatories at the start of the sample

This table repeats the analysis in Table 6 using the alternative treatment and control groups defined in Table 8 Panel B. Changes in portfolio-level emissions and the decomposition of these changes proposed by Cheema-Fox et al. (2021). See Appendix E for additional details of the decomposition calculation. Panel A, B, and C show the results of decomposition of funds' changes in Scope 1, 2, 3 emissions, respectively. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Direct GHG Emissions (Scope 1)

	Δ Avg. Portfolio Emissions	*Return*	*Flow*	*Firm*
	(1)	(2)	(3)	(4)
Article_8/9 × Post	-0.100**	0.047	-0.108**	-0.041***
	(-2.02)	(1.07)	(-2.01)	(-2.92)
Article_8/9	-0.045	-0.173***	0.106**	0.018
	(-1.60)	(-4.59)	(2.54)	(1.54)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.039	0.022	0.025	0.045
Observations	14,923	14,923	14,923	14,923

Panel B. Operational GHG Emissions (Scope 1 & 2)

	Δ Avg. Portfolio Emissions	*Return*	*Flow*	*Firm*
	(1)	(2)	(3)	(4)
Article_8/9 × Post	-0.107*	0.040	-0.094	-0.052***
	(-1.94)	(0.76)	(-1.49)	(-3.45)
Article_8/9	-0.044	-0.201***	0.119**	0.032**
	(-1.40)	(-4.61)	(2.42)	(2.24)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.033	0.023	0.026	0.018
Observations	14,923	14,923	14,923	14,923

Panel C. Total GHG Emissions (Scope 1, 2 & 3)

	Δ Avg. Portfolio Emissions	*Return*	*Flow*	*Firm*
	(1)	(2)	(3)	(4)
Article 8/9 × Post	-0.212**	-0.027	-0.160	-0.029
	(-2.28)	(-0.27)	(-1.35)	(-1.19)
Article_8/9	-0.047	-0.326***	0.267***	0.019
	(-0.86)	(-3.96)	(2.94)	(1.05)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.090	0.023	0.031	0.262
Observations	14,923	14,923	14,923	14,923

Table OA.8. Decompositions: Restricting the treatment to Article 6/8/9 funds that were PRI signatories in 2019

This table repeats the analysis in Table 6 using the alternative treatment and control groups defined in Table 8 Panel C. Changes in portfolio-level emissions and the decomposition of these changes proposed by Cheema-Fox et al. (2021). See Appendix E for additional details of the decomposition calculation. Panel A, B, and C show the results of decomposition of funds' changes in Scope 1, 2, 3 emissions, respectively. Standard errors are clustered by fund. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Direct GHG Emissions (Scope 1)

	Δ Avg. Portfolio Emissions (1)	*Return* (2)	*Flow* (3)	*Firm* (4)
Article 8/9 × Post	-0.111**	0.053	-0.146***	-0.024**
	(-2.54)	(1.33)	(-3.00)	(-1.97)
Article_8/9	-0.072***	-0.183***	0.099***	0.008
	(-2.86)	(-5.44)	(2.76)	(0.72)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.042	0.022	0.026	0.047
Observations	23,836	23,836	23,836	23,836

Panel B. Operational GHG Emissions (Scope 1 & 2)

	Δ Avg. Portfolio Emissions (1)	*Return* (2)	*Flow* (3)	*Firm* (4)
Article_8/9 × Post	-0.118**	0.053	-0.133**	-0.039***
	(-2.41)	(1.10)	(-2.32)	(-2.94)
Article_8/9	-0.074***	-0.217***	0.116***	0.020
	(-2.68)	(-5.61)	(2.74)	(1.52)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.036	0.022	0.028	0.016
Observations	23,836	23,836	23,836	23,836

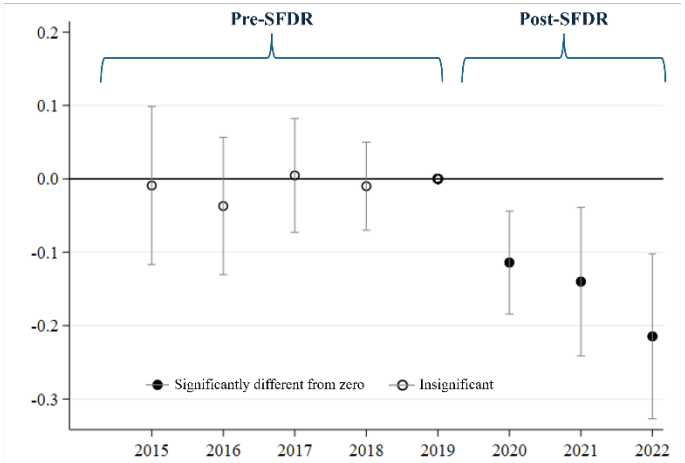
Panel C. Total GHG Emissions (Scope 1, 2 & 3)

	Δ Avg. Portfolio Emissions (1)	*Return* (2)	*Flow* (3)	*Firm* (4)
Article_8/9 × Post	-0.202**	0.019	-0.253**	0.018
	(-2.42)	(0.21)	(-2.36)	(0.82)
Article_8/9	-0.121**	-0.399***	0.285***	0.005
	(-2.54)	(-5.54)	(3.65)	(0.28)
Fund Fixed Effects	No	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
adj R−squared	0.092	0.024	0.033	0.267
Observations	23,836	23,836	23,836	23,836

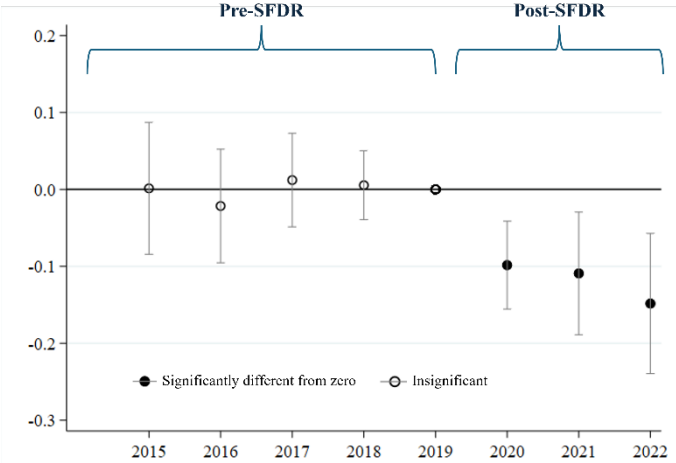
Figure OA.1: Table 3 Panel A Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 3 Panel A for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

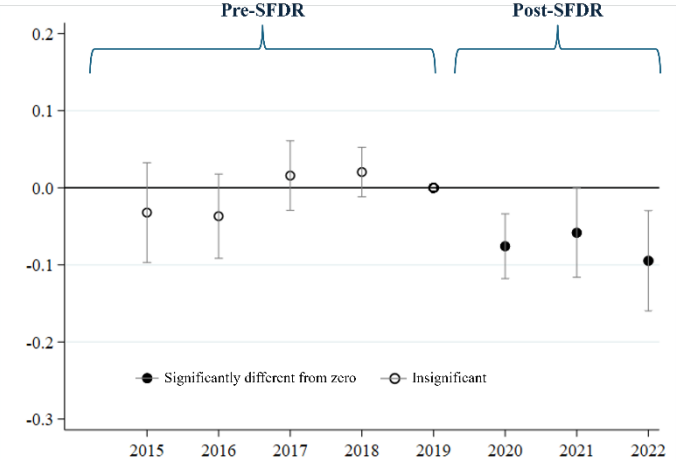
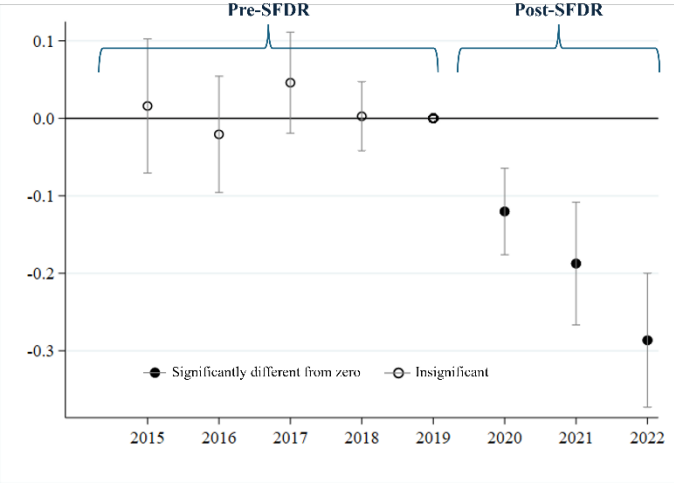


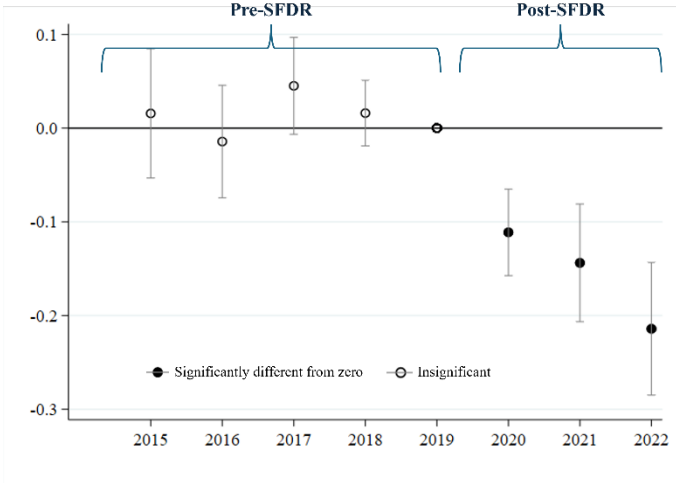
Figure OA.2: Table 3 Panel B Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 3 Panel B for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

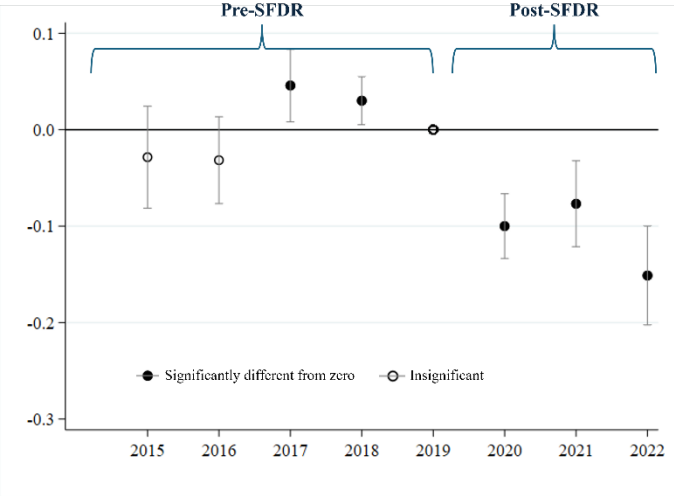
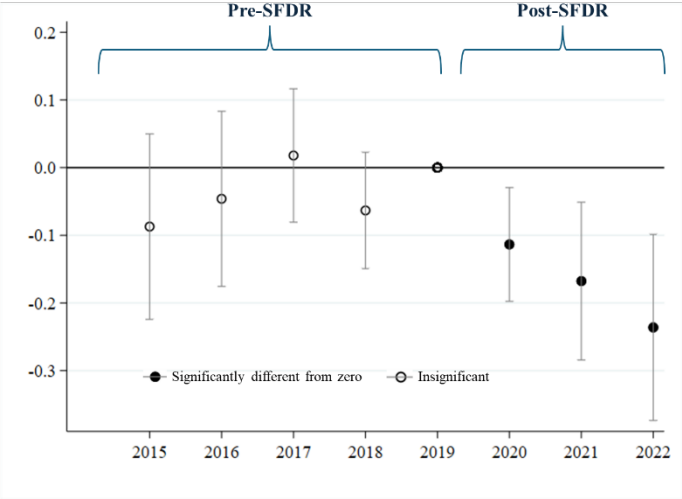


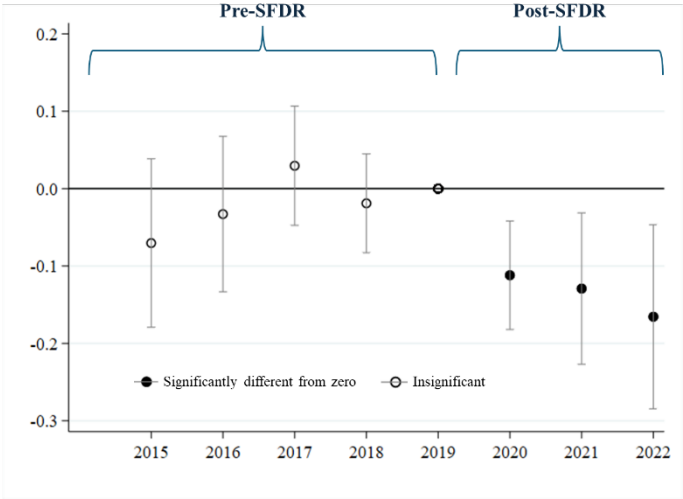
Figure OA.3: Table 3 Panel C Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 3 Panel C for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

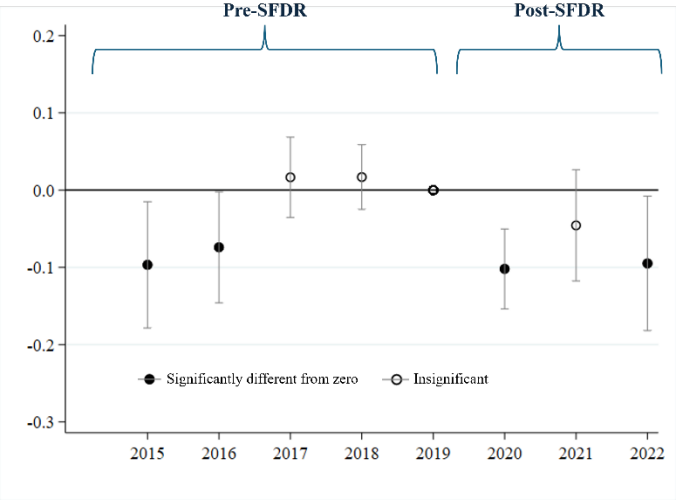
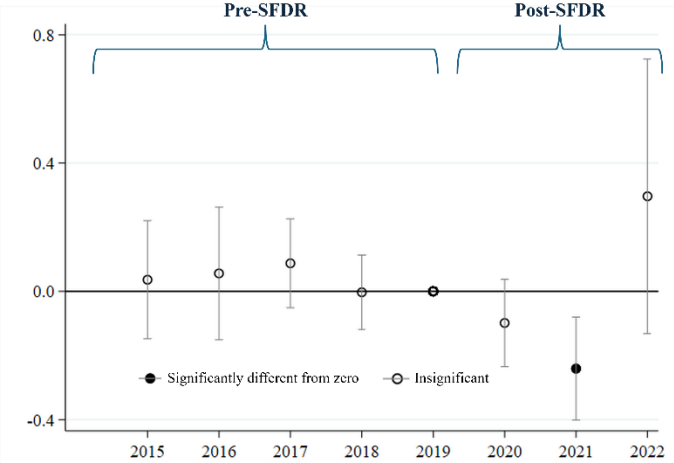


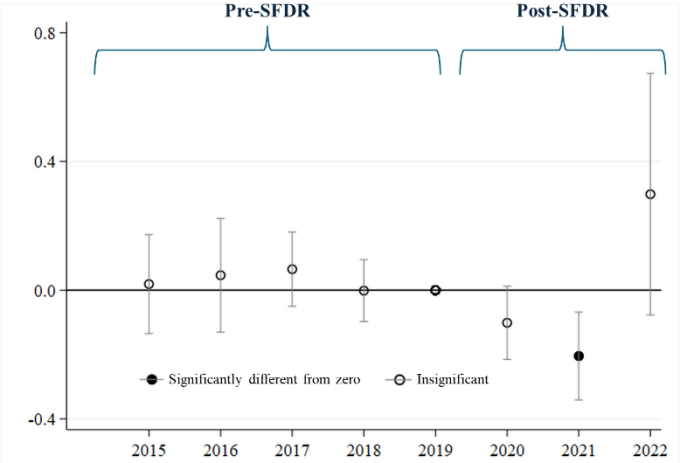
Figure OA.4: Table 3 Panel D Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 3 Panel D for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

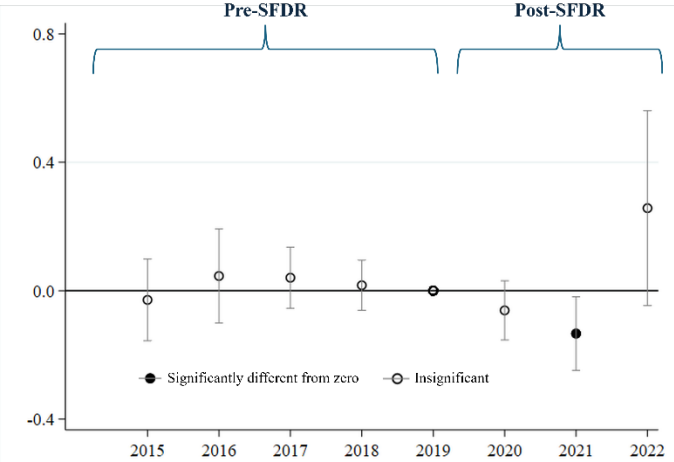
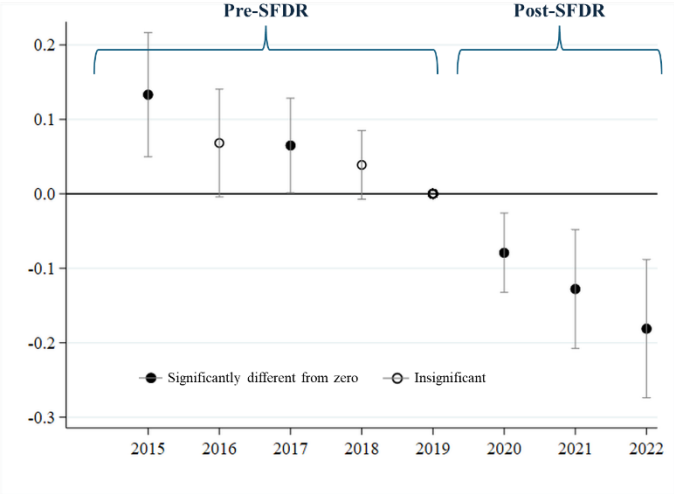


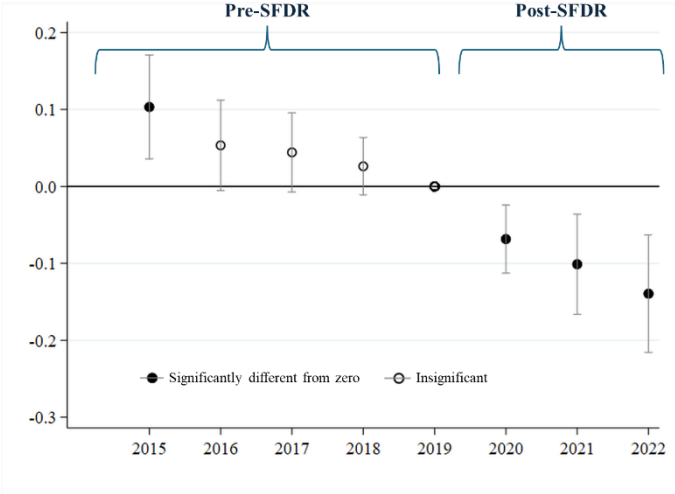
Figure OA.5: Table 3 Panel E Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 3 Panel E for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

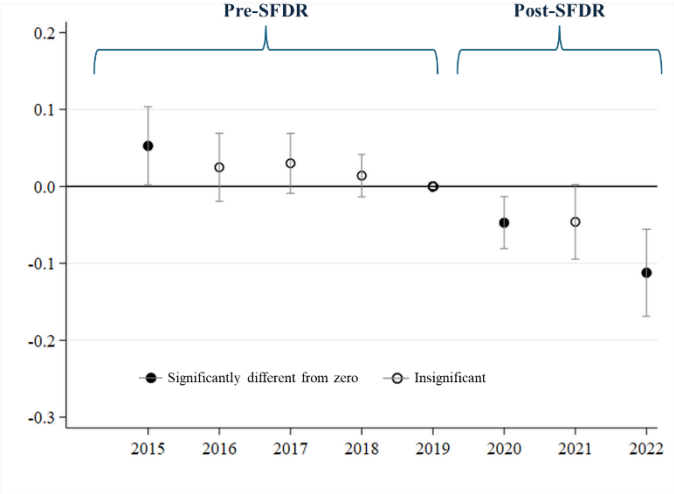
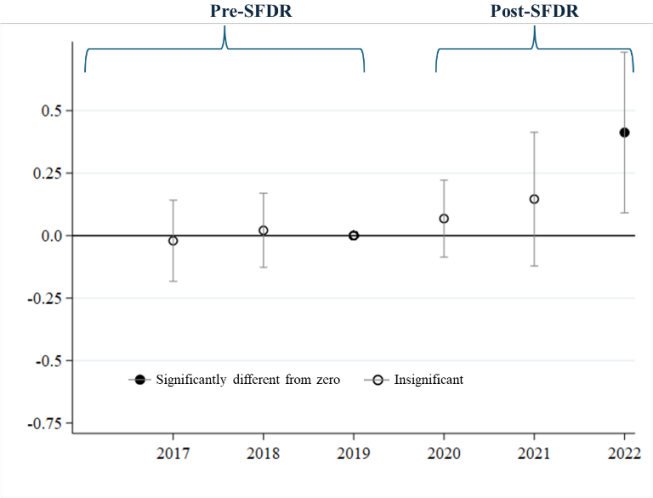


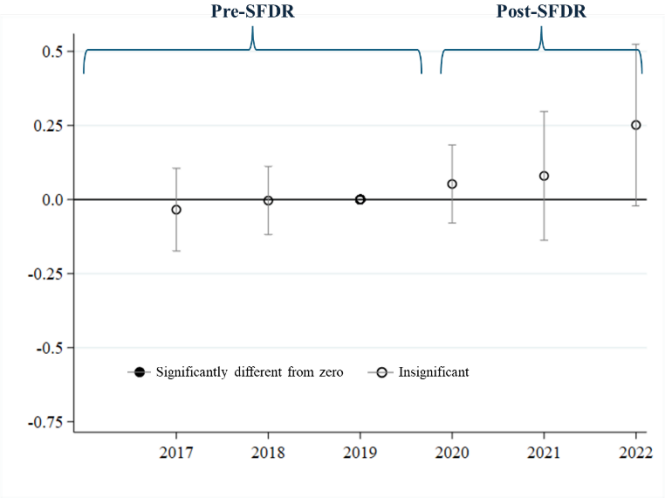
Figure OA.6: Table 4 Panel A Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 4 Panel A for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

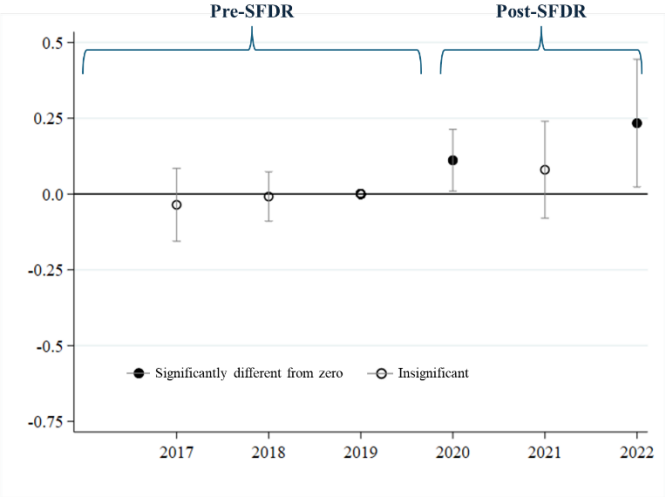
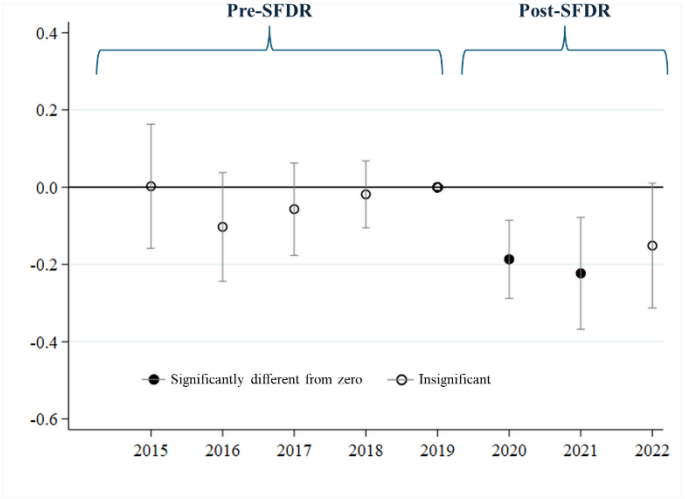


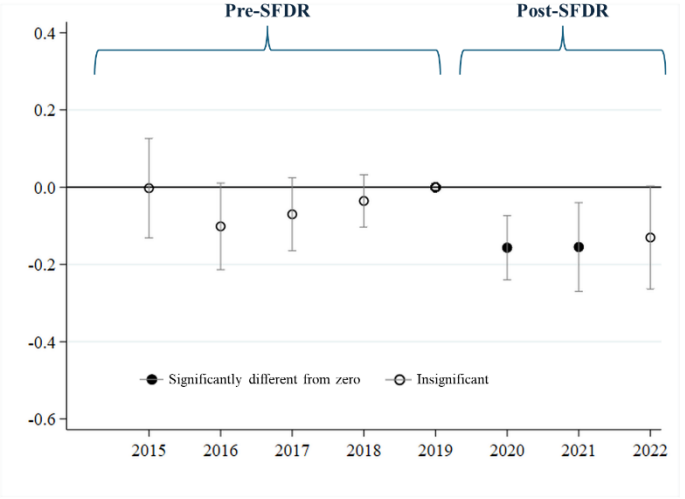
Figure OA.7: Table 4 Panel B Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 4 Panel B for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

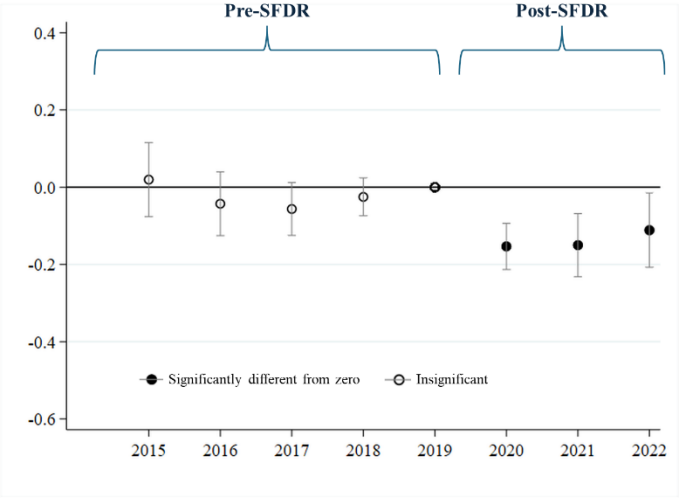
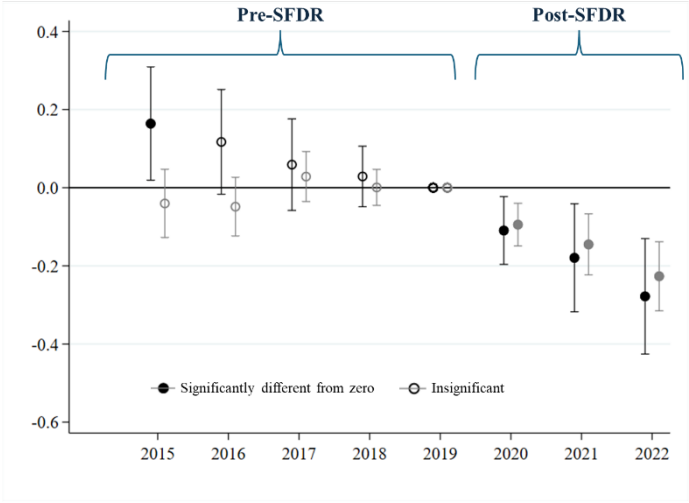


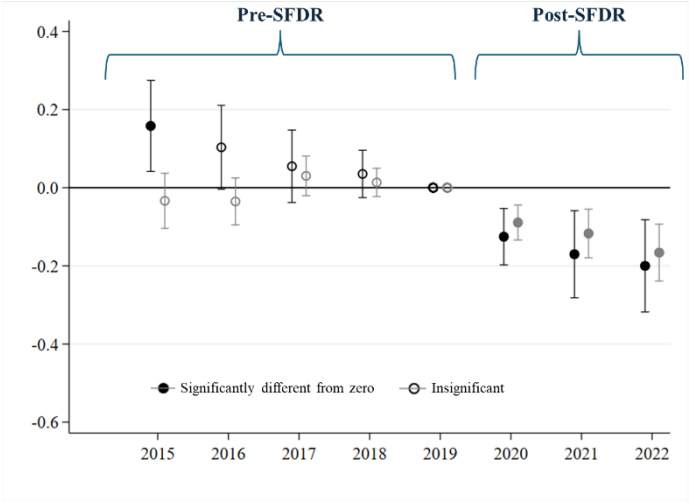
Figure OA.8: Table 4 Panel C Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 4 Panel C for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

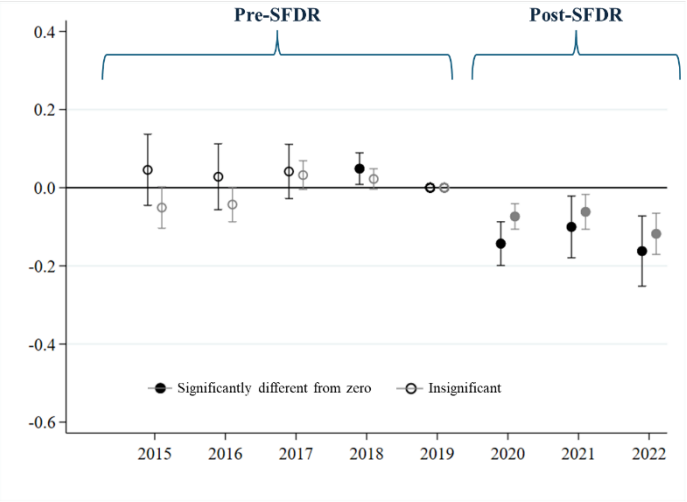
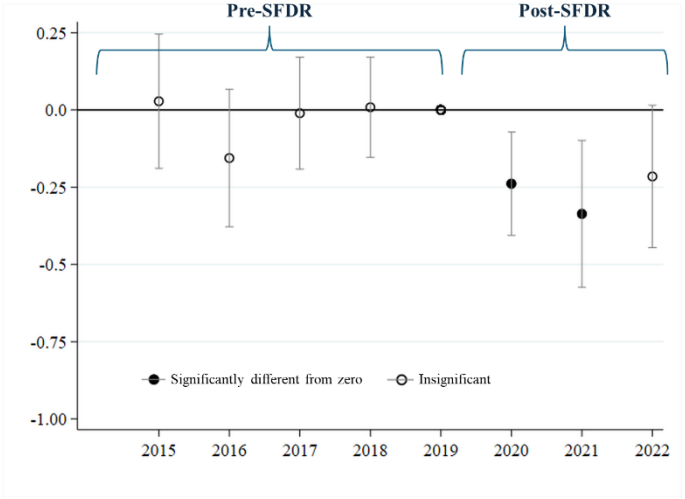


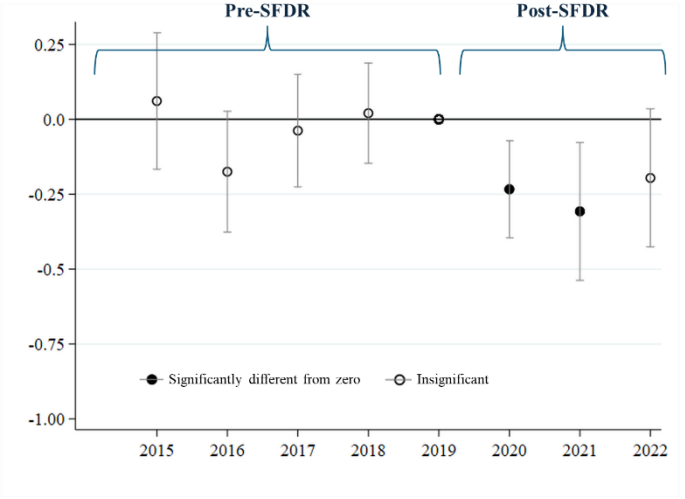
Figure OA.9: Table 5 Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log (1+ Shares)* around the implementation of the SFDR. See Table 5 for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

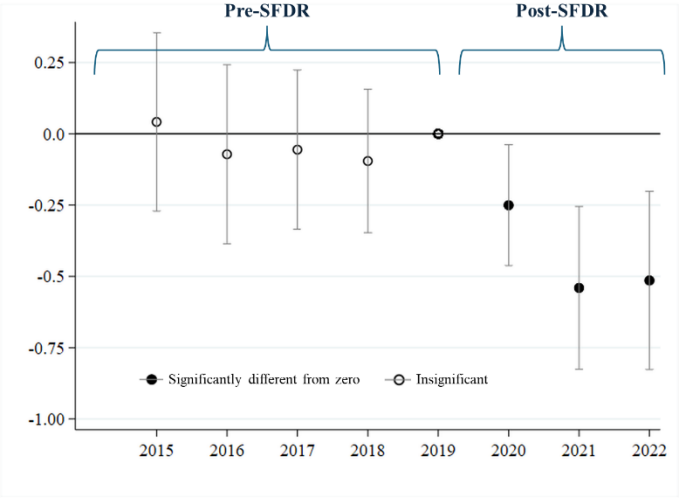
Panel A. Fund-Firm and Year Fixed Effects



Panel B. Fund-Firm and Fund-Year Fixed Effects



Panel C. Controls, Fund-Firm and Year Fixed Effects



Panel D. Controls, Fund-Firm and Fund-Year Fixed Effects

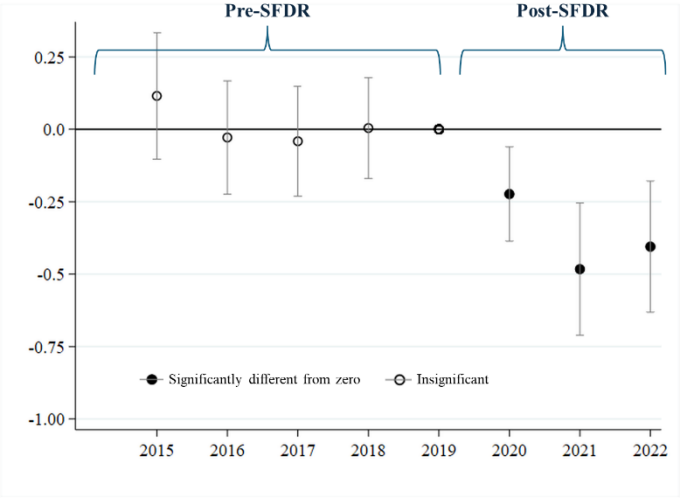
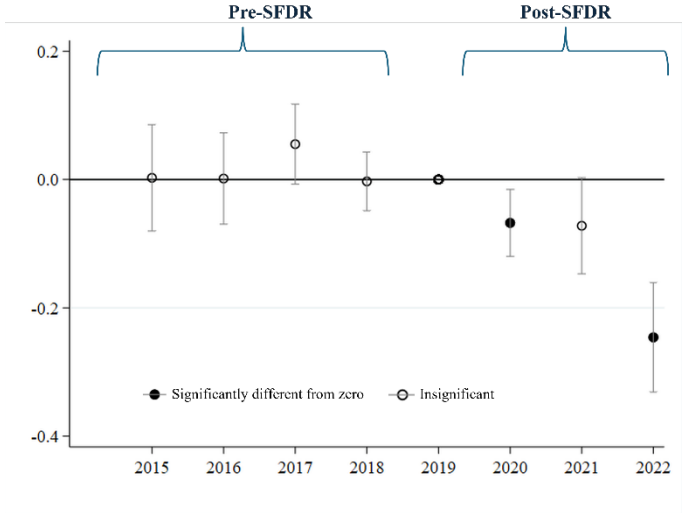


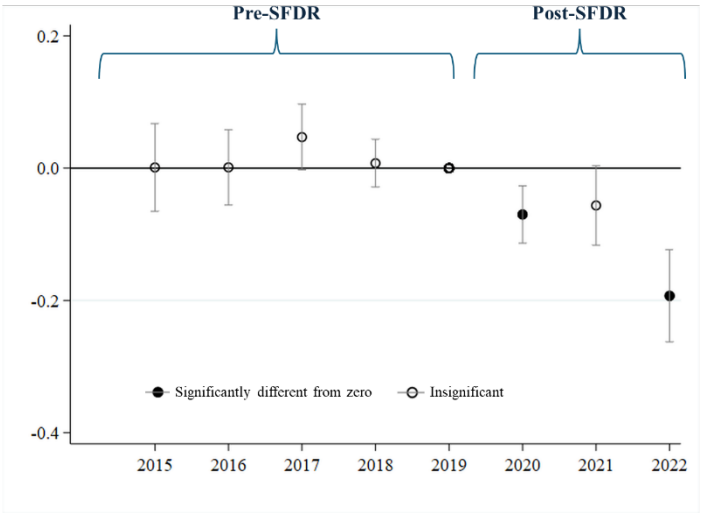
Figure OA.10: Table 8 Panel A Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 8 Panel A for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

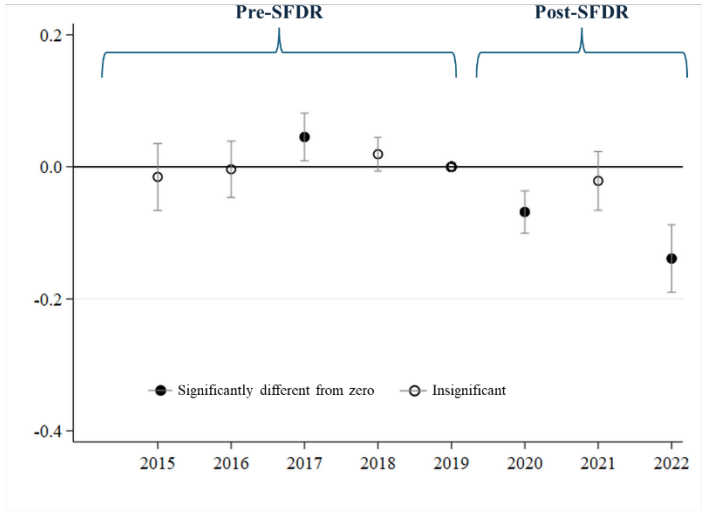
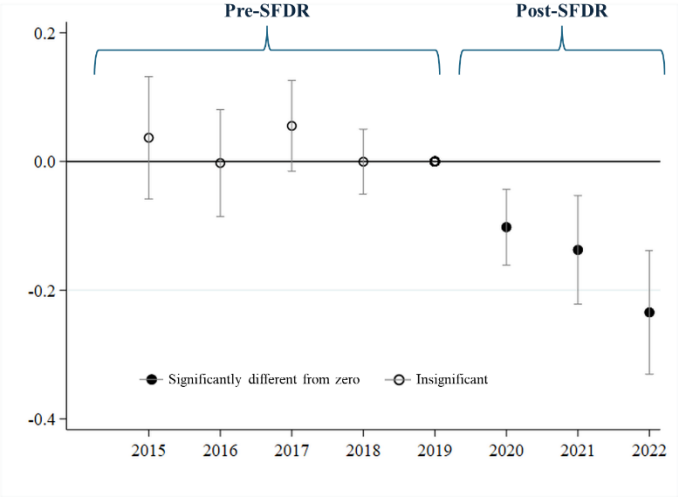


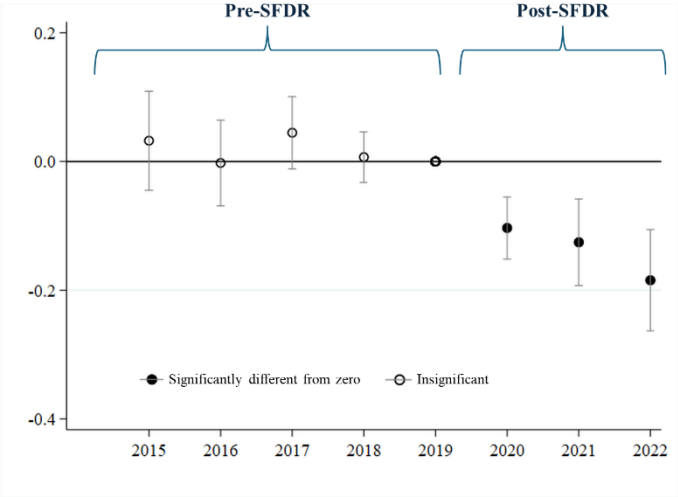
Figure OA.11: Table 8 Panel B Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 8 Panel B for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

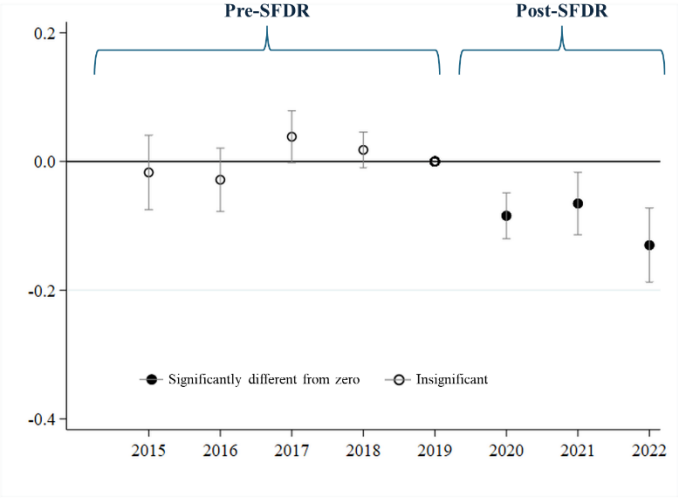
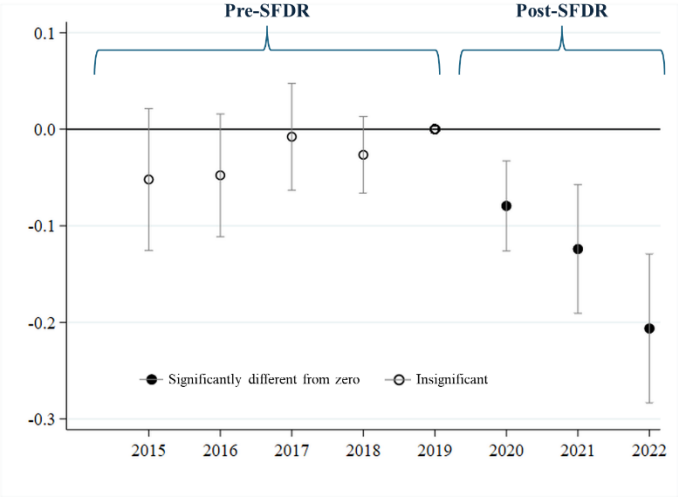


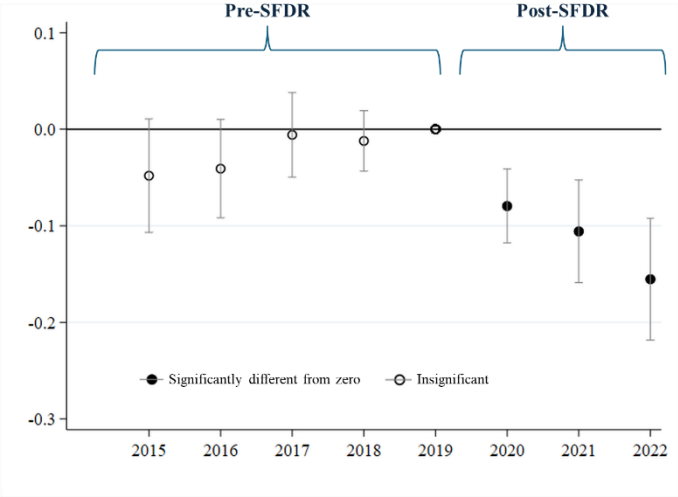
Figure OA.12: Table 8 Panel C Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 8 Panel C for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

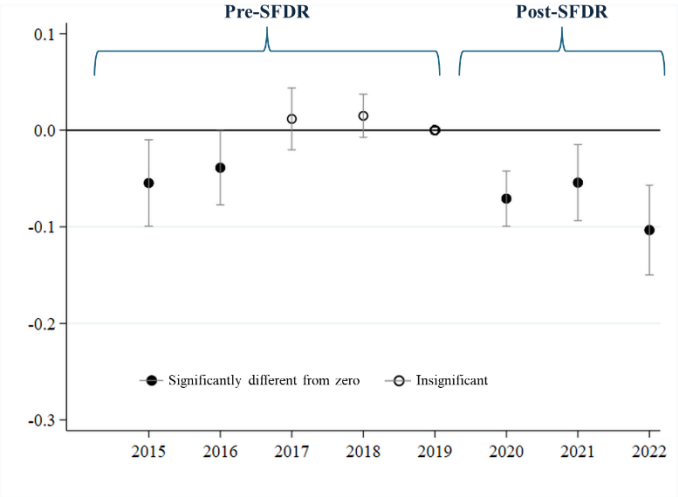
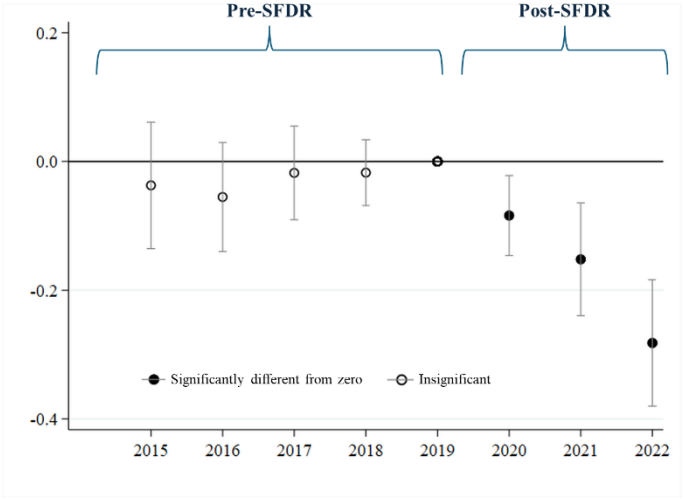


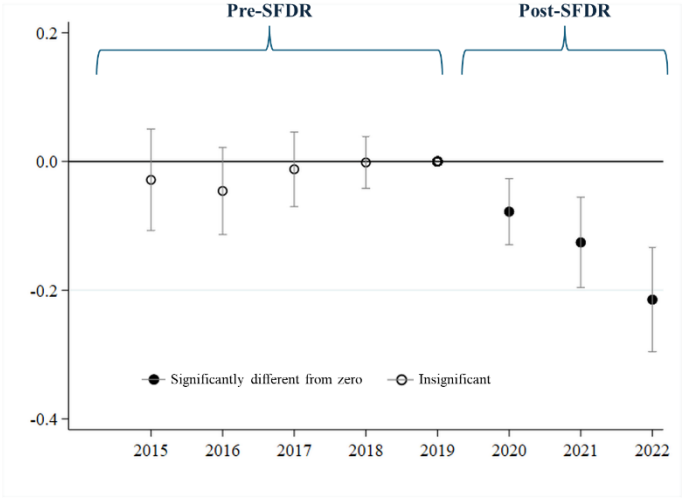
Figure OA.13: Table 9 Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 9 for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

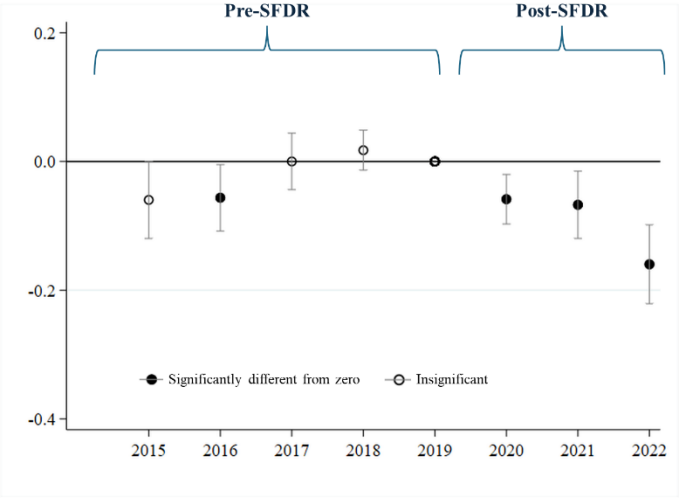
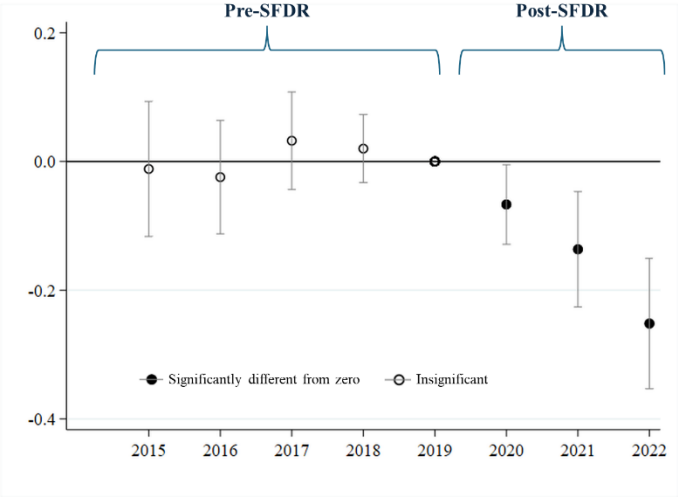


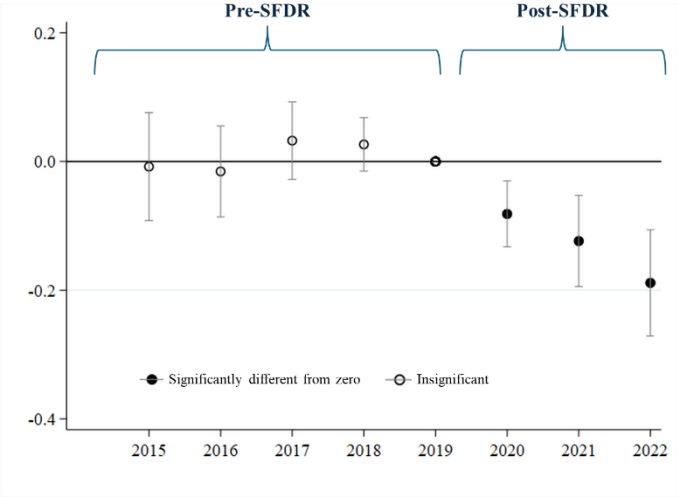
Figure OA.14: Table 10 Panel A Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 10 Panel A for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

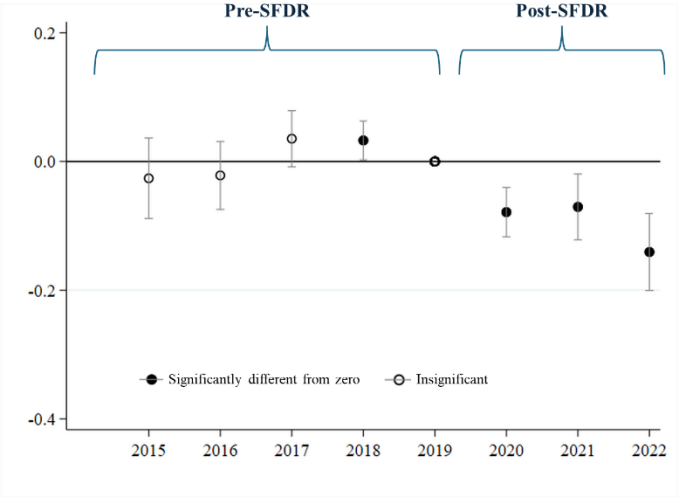
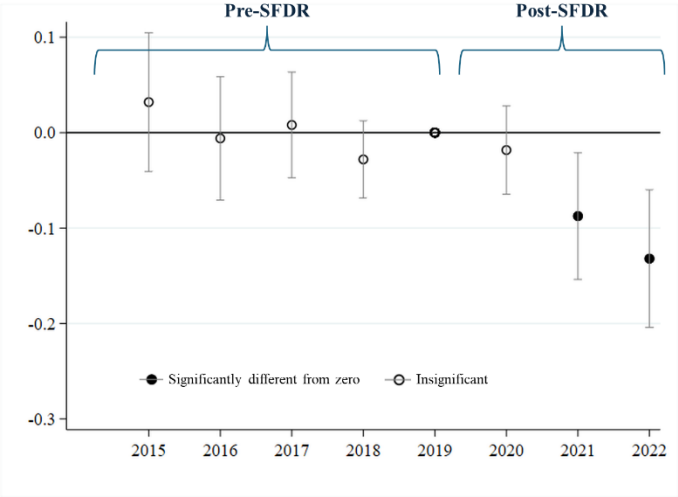


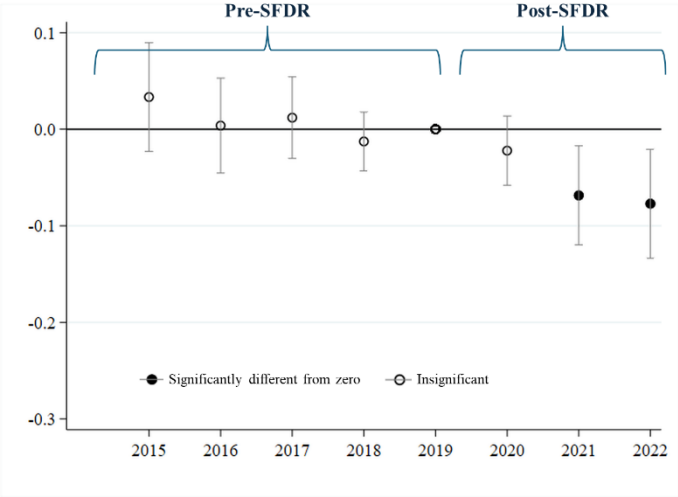
Figure OA.15: Table 10 Panel B Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See Table 10 Panel B for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

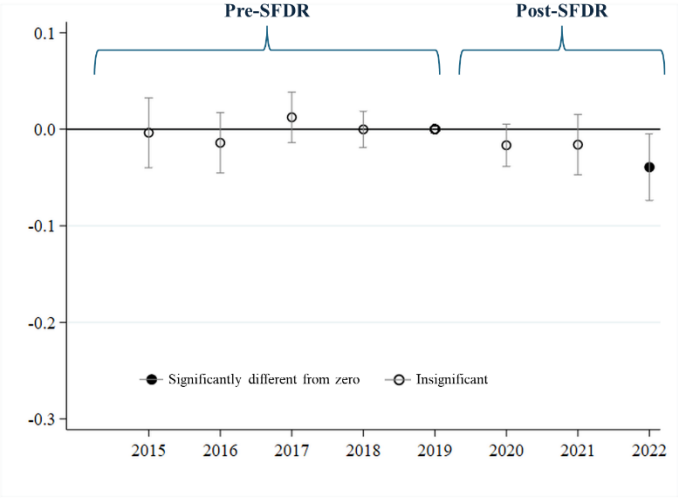
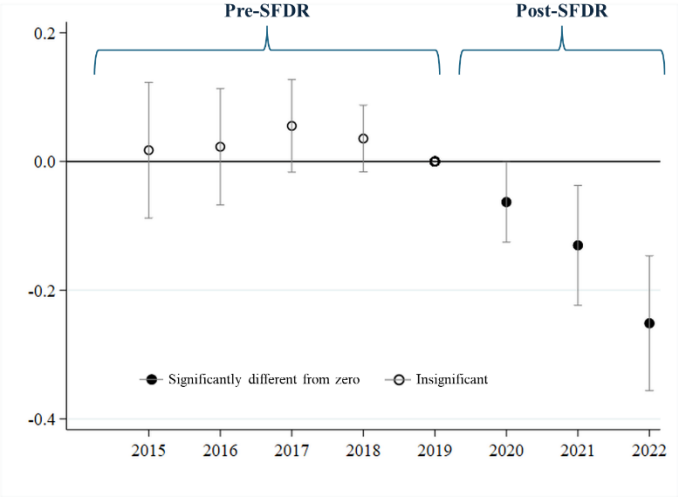


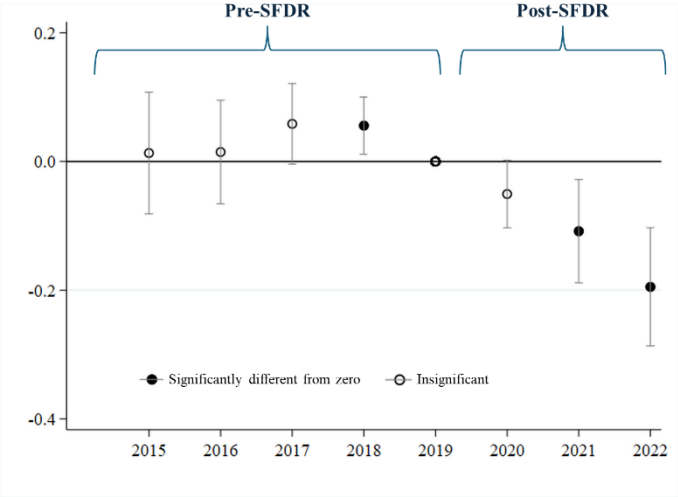
Figure OA.16: OA.1 Panel A Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Ownership Weighted Emissions* around the implementation of the SFDR. See OA.1 Panel A for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

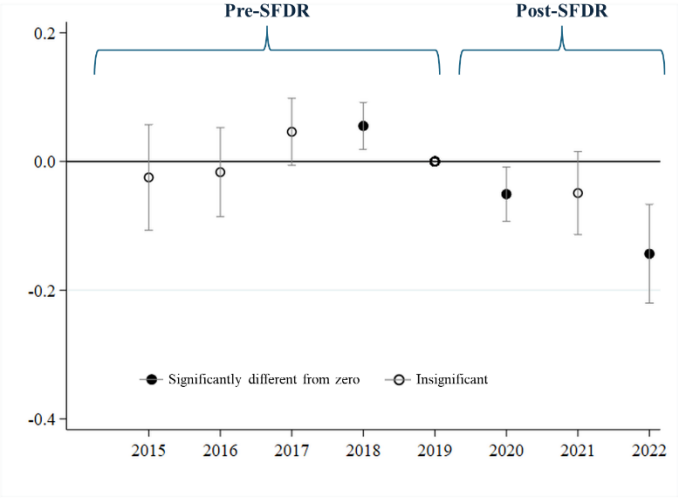
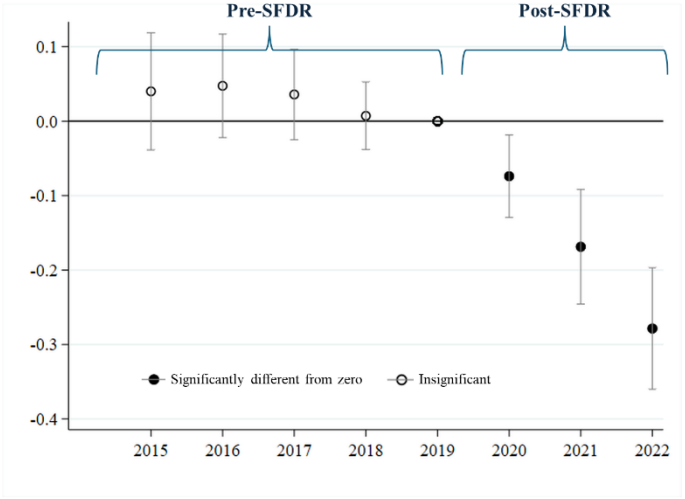


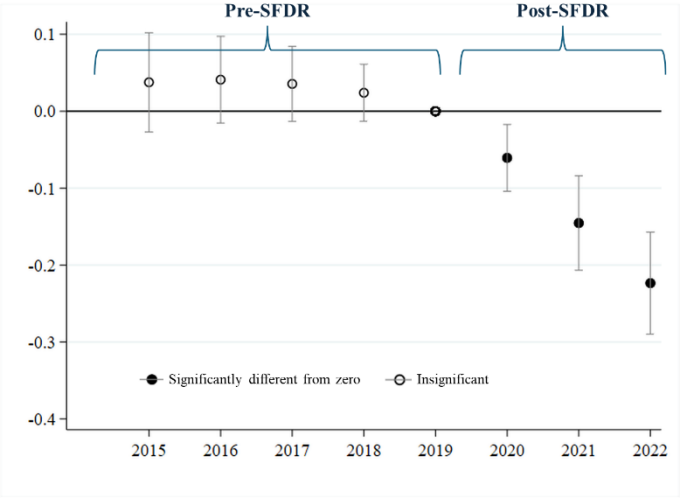
Figure OA.17: OA.1 Panel B Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Carbon Footprint* around the implementation of the SFDR. See OA.1 Panel B for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

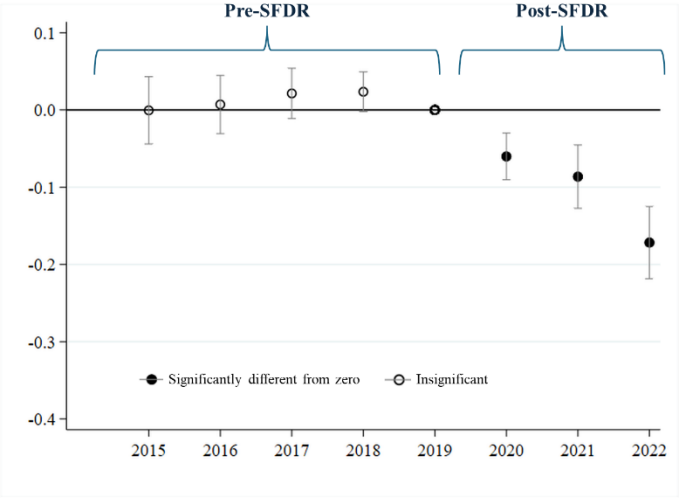
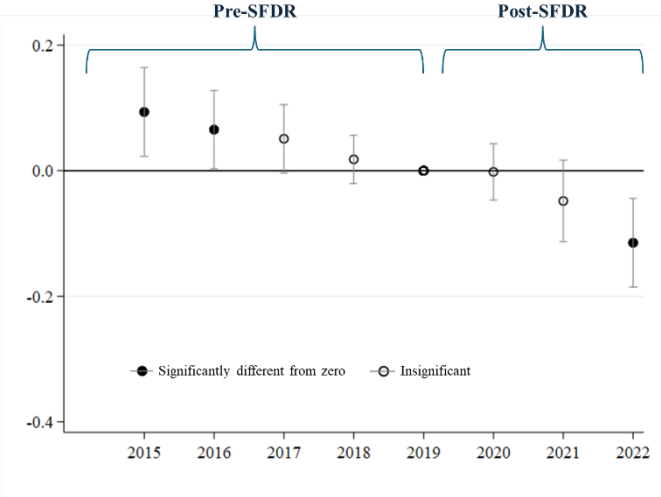


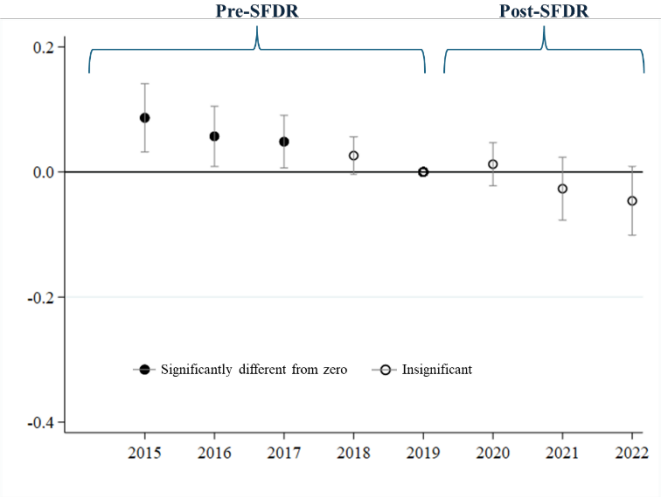
Figure OA.18: OA.1 Panel C Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Emission Intensity* around the implementation of the SFDR. See OA.1 Panel C for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

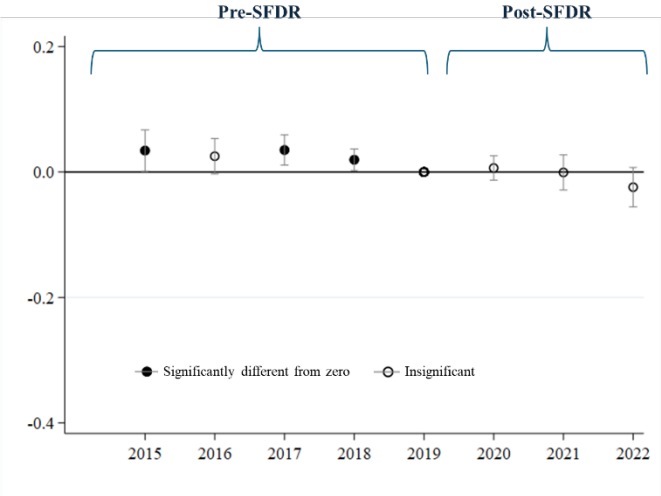
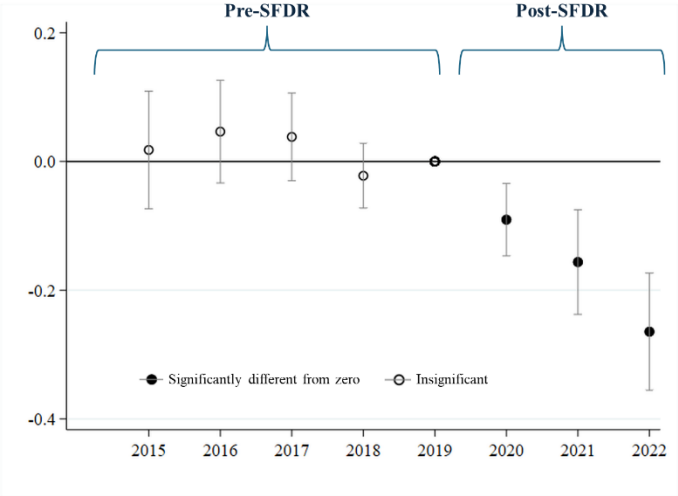


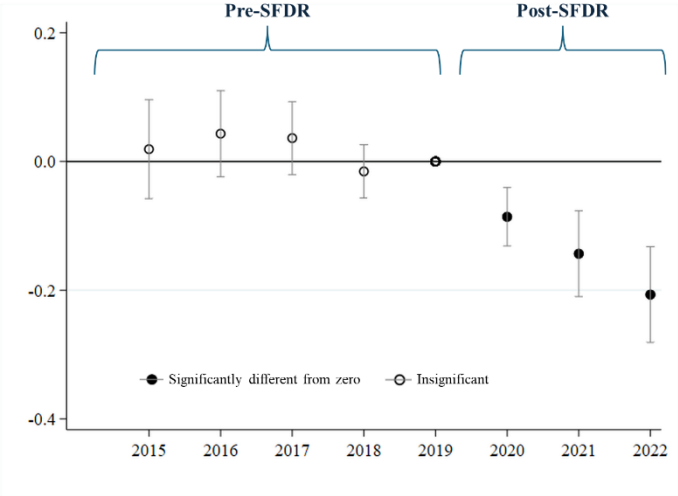
Figure OA.19: OA.1 Panel D Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Aggregated Portfolio Emissions* around the implementation of the SFDR. See OA.1 Panel D for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

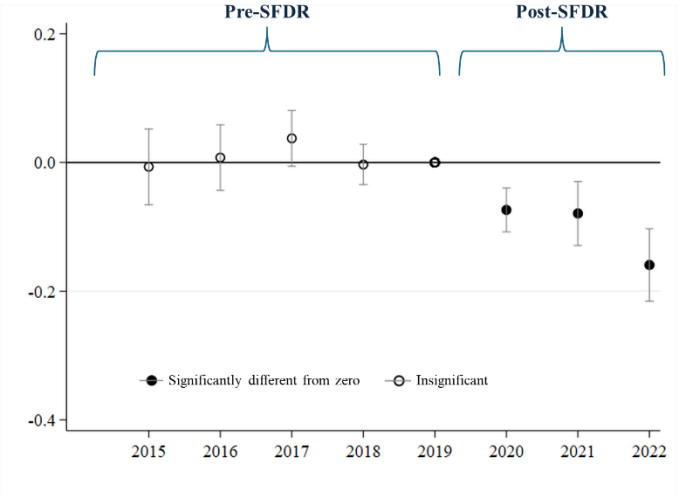
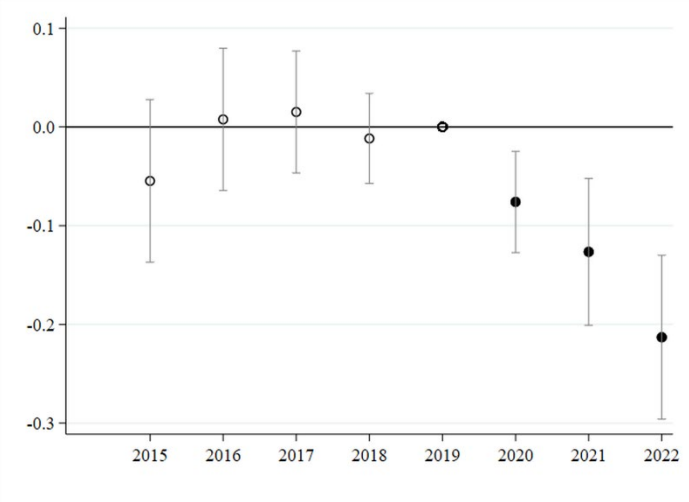


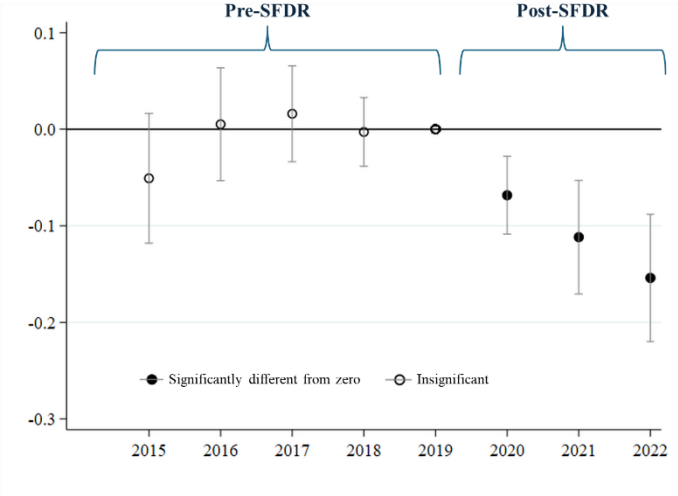
Figure OA.20: OA.1 Panel E Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions (EW)* around the implementation of the SFDR. See OA.1 Panel E for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

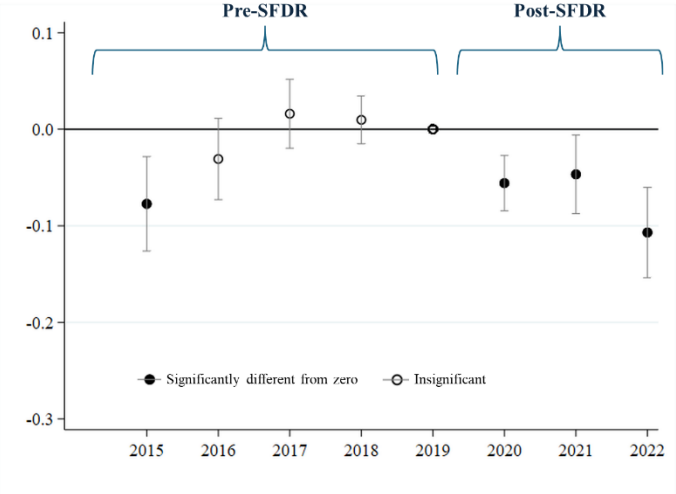
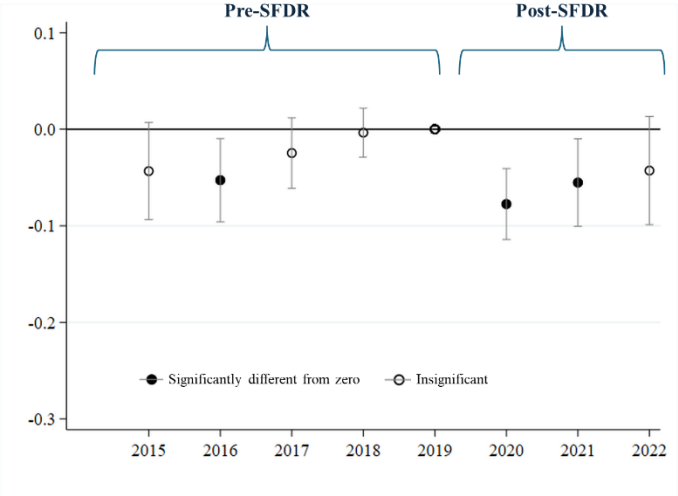


Figure OA.21: OA.1 Panel F Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See OA.1 Panel F for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Scope 2



Panel B. Avg. Scope 3

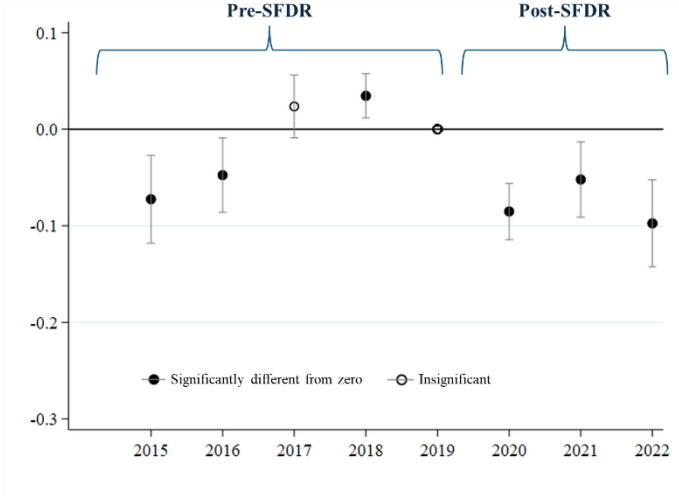
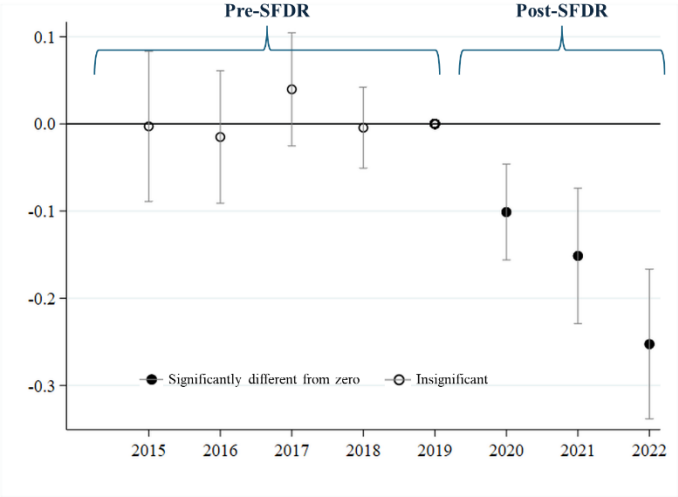


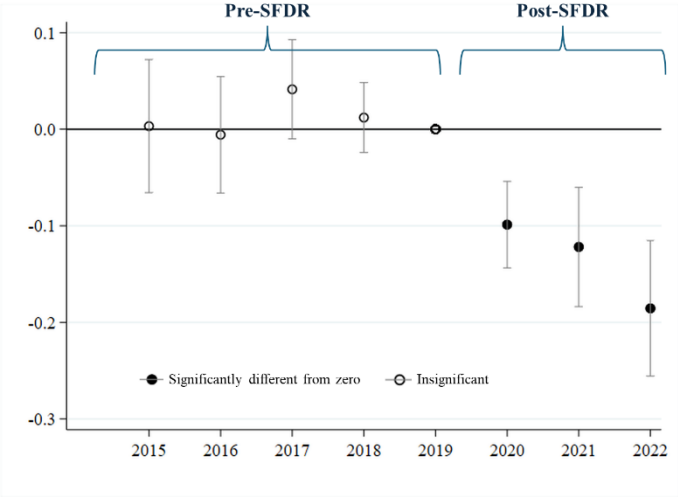
Figure OA.22: OA.2 Dropping EU Non-Article 8/9 PRI Funds

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* around the implementation of the SFDR. See OA.2 Panel A for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

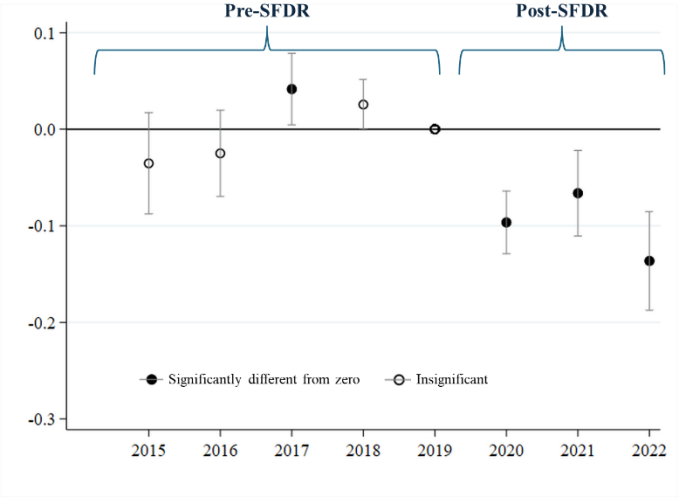
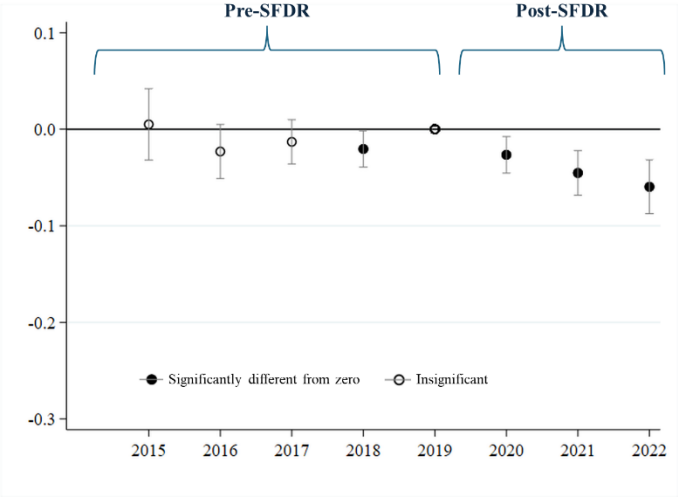


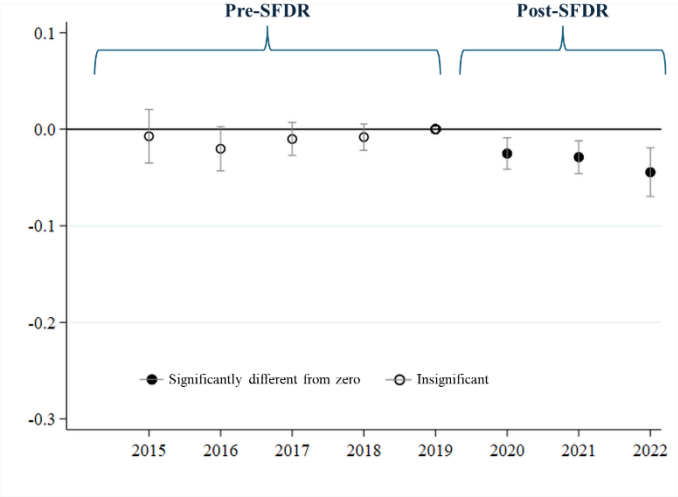
Figure OA.23: OA.5 Panel A Treatment Effects Over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* using static portfolios around the implementation of the SFDR. See OA.5 Panel A for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

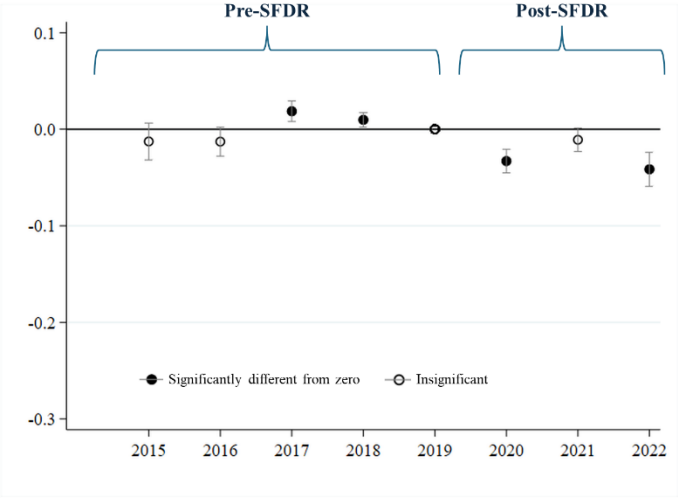
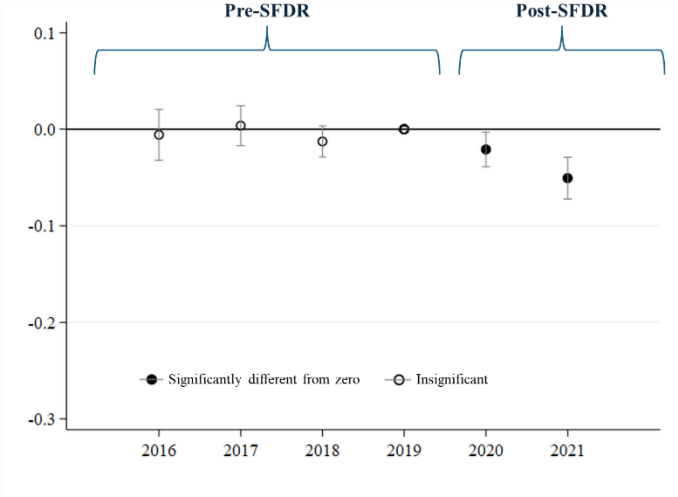


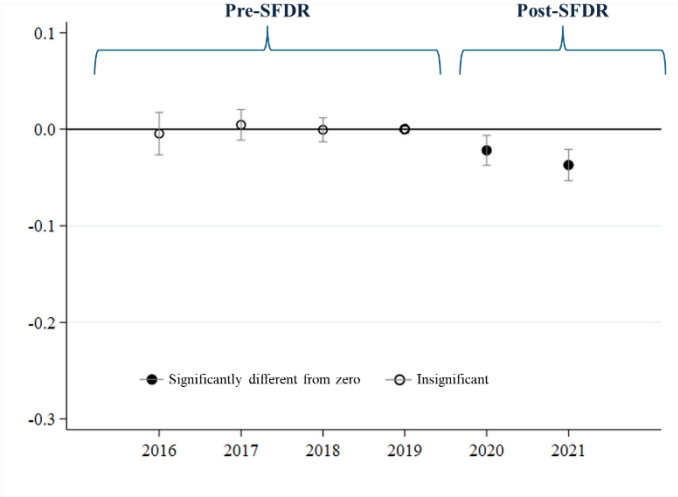
Figure OA.24: OA.5 Panel B Treatment Effects Over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* using static portfolios around the implementation of the SFDR. See OA.5 Panel B for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

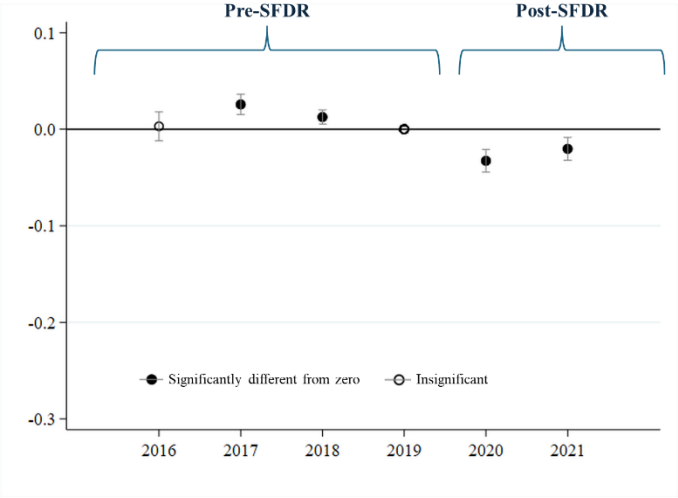
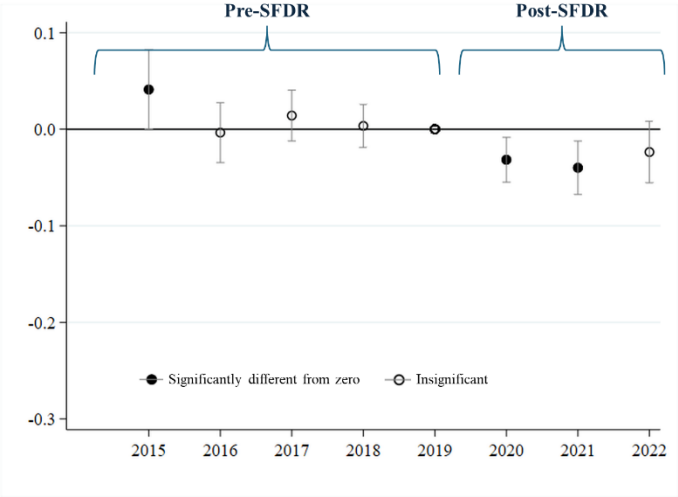


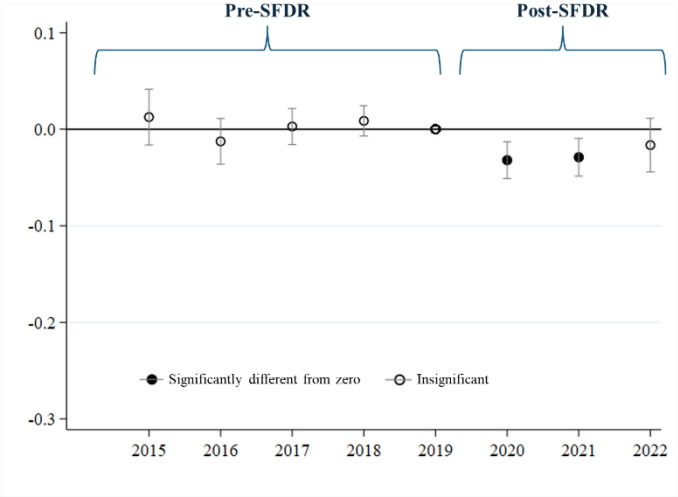
Figure OA.25: OA.5 Panel C Treatment Effects Over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* using static portfolios around the implementation of the SFDR. See OA.5 Panel C for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)

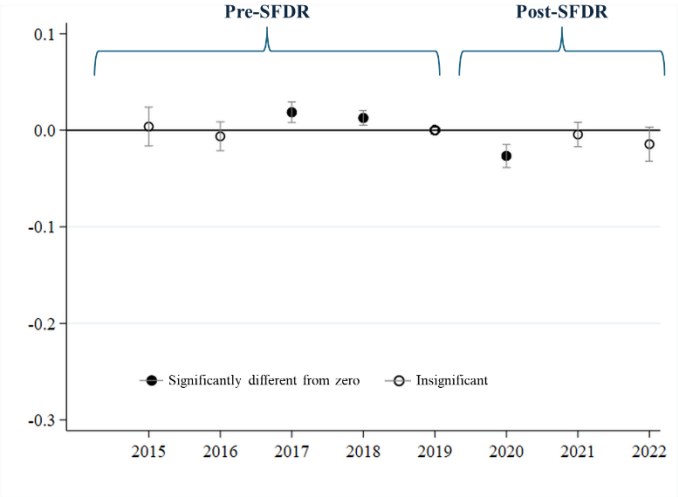
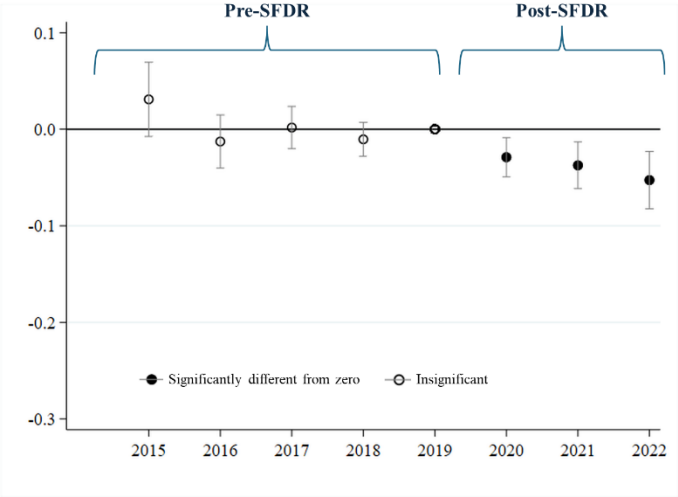


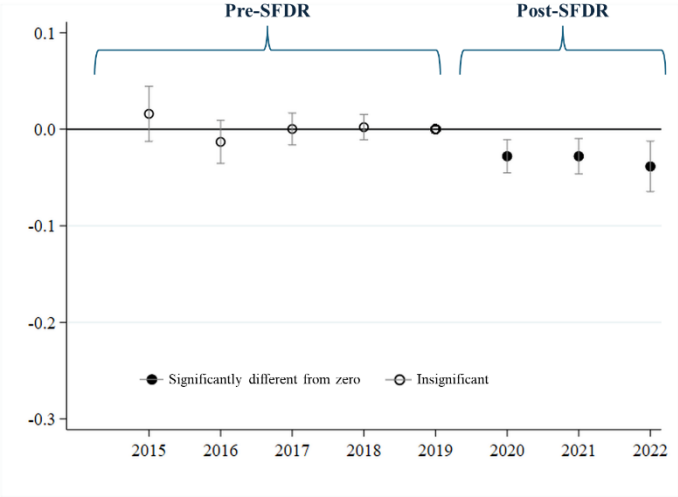
Figure OA.26: OA.5 Panel D Treatment Effects Over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for the *Log Avg. Portfolio Emissions* using static portfolios around the implementation of the SFDR. See OA.5 Panel D for the sample used. We omit 2019 × Article_8/9, which serves as the benchmark.

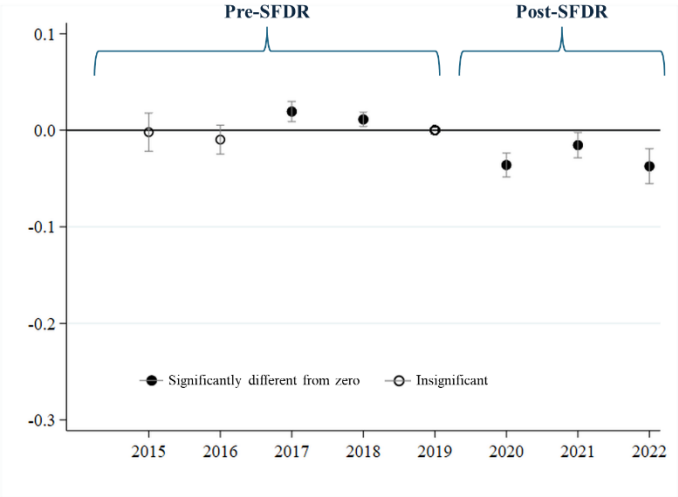
Panel A. Avg. Direct GHG Emissions (Scope 1)



Panel B. Avg. Operational GHG Emissions (Scope 1&2)



Panel C. Avg. Total GHG Emissions (Scope 1, 2 & 3)



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