Does mandatory disclosure enhance ESG performance of mutual funds? Evidence from EU SFDR Regulation

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Abstract: This study examines the effects of Environmental, Social, and Governance (ESG) reporting mandates on the sustainability performance of mutual funds. Specifically, we investigate the impact of the second phase of the Sustainable Finance Disclosure Regulation (SFDR Level 2) on EU-domiciled mutual funds. While the SFDR Level 1 faced criticism for greenwashing risks, Level 2 seeks to address these issues. This study investigates whether it effectively meets policymakers' goals for enhancing transparency and reducing greenwashing in ESG reporting. Our difference-in-differences design reveals that mutual funds subject to SFDR Level 2 significantly improve ESG performance following the introduction of the regulation, with these enhancements becoming evident shortly after the regulation's announcement. These improvements are mainly driven by funds categorised under Article 8, which promote environmental or social characteristics. Additionally, we find that the disparities between funds with different 'shades of green' become more pronounced post-regulation, indicating that stricter disclosure requirements have effectively refined fund classifications. Furthermore, we find that funds transitioning from non-sustainable ('brown') to sustainable ('green') labels show significant increases across all ESG pillar scores compared to those retaining their non-sustainable labels. Lastly, 'brown' funds upgrading their labels demonstrate reduced exposure to controversial activities compared to non-reclassified funds. Our findings suggest that enhanced disclosure requirements can effectively improve sustainability performance and mitigate the risks of greenwashing among institutional investors.

Keywords: SFDR, mutual funds, sustainability, mandatory disclosure, ESG performance

1. Introduction

This study examines whether sustainability-related disclosure regulations can compel institutional investors to accurately disclose their commitment to environmental, social, and governance (ESG) principles, thereby reducing greenwashing risks and enhancing transparency. Greenwashing has long been a systemic issue in sustainability reporting where asset managers apply ESG labels to investment products without genuinely implementing ESG practices, resulting in legal exposure and reputational damage. High-profile cases such as those involving DWS Investment Management Americas Inc. (2023), BNY Mellon Investment Adviser (2022), and HSBC (2022) illustrate the consequences of misleading ESG claims, including regulatory penalties and public scrutiny (SEC, 2023; SEC, 2022; Makortoff, 2022). These incidents highlight the inadequacy of voluntary disclosure initiatives and underscore the necessity of binding regulatory frameworks to ensure that ESG labelling reflects substantive and verifiable action.

Compared to non-financial sectors, there is less study on the effects of sustainability-related disclosure regulation in the financial services sector, primarily due to the historical scarcity of such frameworks. The introduction of Sustainable Finance Disclosure Regulation (SFDR) by the European Commission has opened avenues for relevant studies in this area. The first phase of SFDR R—Level 1, which came into force in November 2019, has been found to exert significant real effects on the ESG performance of institutional investors (Becker et al., 2022;Ding, 2023;Dai et al., 2023). However, this regulation has faced criticism for its lack of precise definitions and implementation guidance, raising concerns about potential greenwashing practices (Quirici, 2023; Lambillon & Chesney, 2023; Müller & Illarionova, 2023). For instance, thirteen funds classified under Article 9 of the SFDR—which mandates sustainable investment objectives—have been reported to hold shares in fast fashion companies such as ASOS and Boohoo, both of which have faced scrutiny for environmental and human rights violations (Lee, 2022). This suggests that the regulation may fall short in effectively addressing greenwashing risks.

In this study, we analyse the impact of the second phase of the SFDR—Level 2—which replaced Level 1 in January 2023, with the aim of addressing persistent greenwashing concerns and improving transparency in ESG reporting. We focus on Level 2 for two primary reasons. First, it represents the first region-wide regulatory framework requiring asset

managers to categorise their investment funds into three distinct levels of ESG commitment: funds that do not integrate sustainability considerations (Article 6), those that promote environmental or social characteristics (Article 8), and those with sustainable investment as their core objective (Article 9). Unlike earlier initiatives that merely distinguish between ESG and non-ESG products, Level 2 mandates detailed classification criteria designed to better align disclosed sustainability objectives with actual investment practices. Second, Level 2 builds upon the foundations of Level 1 by introducing more comprehensive guidance and stricter reporting standards. As the most extensive ESG disclosure regulation currently in force for institutional investors across the European Union, the SFDR offers a unique opportunity to evaluate the effectiveness of mandatory sustainability disclosure. Insights from this study may inform future regulatory development and support policymakers in enhancing the credibility and accountability of sustainable finance.

Greenwashing has been widely observed among investment funds, particularly those that voluntarily sign up with organisations promoting sustainable investment such as the Principles for Responsible Investment (PRI), or that self-identify as sustainable by incorporating sustainability-related keywords into their fund names without demonstrating improvements in ESG performance or implementing strategies to enhance the sustainability of their portfolios (Kim & Yoon, 2020; Raghunandan & Rajgopal, 2022; Gibson Brandon et al., 2022). In the context of mandatory disclosure, the SFDR Level 1 has been shown to have significant positive impact on the ESG performance of funds subject to the regulation. However, existing research has not yet examined whether the mandatory ESG classifications under the SFDR correspond to actual differences in ESG performance across these categories. At the same time, numerous policy-oriented papers have raised concerns that the lack of clear guidance in SFDR Level 1 may exacerbate greenwashing rather than mitigate it (Quirici, 2023; Müller & Illarionova, 2023). Our study addresses this gap by focusing on SFDR Level 2, which introduces more detailed classification criteria and stricter reporting obligations.

The improvement in ESG performance and the reduction of greenwashing following mandated disclosure can be attributed to litigation risk. Previous research has explored the relationship between litigation risk and disclosure (Skinner, 1995; Field et al., 2005; Rogers et al., 2011; Dong & Zhang, 2019), highlighting the role of litigation risk in ascertaining consistency between disclosures and actual practices (Huang et al., 2023). While these studies

have generally focused on sustainability disclosure within non-financial firms, real-world cases have demonstrated that investment funds also become targets of lawsuits when they fail to uphold their ESG statements, thus faced substantial fines, significant losses in the stock market, and severe reputation damage. Building on this, we argue that once sustainability reporting becomes compulsory, the litigation consequences for failing to align performance with disclosed commitments would be more severe.

We begin our empirical analysis by investigating whether EU-domiciled institutional investors improve their ESG performance following the release of SFDR Level 2. While prior studies have documented such effects under SFDR Level 1 and other regulatory frameworks (Becker et al., 2022; Gajewski & Tran, 2024; Martinez-Meyers et al, 2024), we revisit this relationship in the context of Level 2 to establish a foundation for our main analysis on greenwashing mitigation. Our sample focuses on equity funds domiciled in EU member states, with data sourced from the Morningstar database. We use a difference-in-differences design and estimate treatment effects for the period from December 2021 to December 2023, using April 2022, when Level 2 was announced, as the baseline following prior literature (Becker et al., 2022; Fiechter et al., 2022; Gibson Brandon et al., 2022). We use UK equity funds as the control group, comparing them with the treated group of EU equity funds. The choice of UK funds as a comparative group is motivated by several considerations. Historically, the UK was part of the EU, suggesting that the operational markets for both EU and UK funds could share similarities. After Brexit, the UK has implemented various initiatives to advance sustainability and address climate change, such as the Green Finance Strategy (2019), the Task Force on Climate-related Financial Disclosures, the UK Stewardship Code (2020), and the Pension Schemes Act (2021). Such progressive stance on ESG, alongside growing market expectations and pressures concerning sustainability, makes the UK an appropriate benchmark for comparing the impact of SFDR on EU funds. Additionally, there are no similar regulatory interventions in the UK during the period when SFDR Level 2 is introduced and the reclassification wave occurs in the EU financial market. Our findings reveal that EU funds on average improved ESG scores across all the pillars relative to their UK counterparts. More specifically, certain ESG pillars improve immediately after the announcement date, while others show changes only months later.

In our main analysis, we examine which of the three SFDR fund categories exhibit improvements in ESG performance following the release of Level 2. We expect that funds

classified under Articles 8 and 9—commonly referred to as 'green' funds—would demonstrate such improvements, given their commitments to environmental and social objectives under the enhanced Level 2 requirements, whereas funds under Article 6, which do not integrate sustainability considerations, are not expected to show similar changes. Our difference-in-differences analysis reveals that the improvement is primarily observed from Article 8 funds. These funds occupy the intermediate category, promoting environmental and social characteristics without being required to invest exclusively in sustainable assets. In contrast, funds under Articles 6 and 9 do not exhibit statistically significant improvements in ESG performance after the regulation was announced. These findings are robust both in the entire sample without matching and in the sample using propensity score matching (PSM). We also conduct an analysis of variance (ANOVA) which indicates that prior to the regulation announcement, the two green categories show no significant differences across most ESG pillars. After the announcement of SFDR Level 2, however, Article 9 funds significantly outperform Article 8 across most ESG metrics, although their environmental score remains lower, albeit with a reduced gap. Taken together, these results suggest that the stricter disclosure and classification requirements introduced in Level 2 may have been effective in curbing greenwashing practices that persisted under Level 1.

We subsequently investigate the variations in ESG performance between funds that switch their classifications and those that maintain their existing labels. We expect that funds moving to a greener label will increase their ESG scores relative to those that either do not change or downgrade their classifications. This expectation is grounded in the assumption that funds change their article classification because they consider their sustainability commitment to align more closely with the new labels than with their existing ones. This analysis aims to shed light on whether reclassification is accompanied by actual changes in sustainability practices. We find that funds moving from 'brown' to 'green' labels experience increase in all ESG metrics compared to funds that remain 'brown'. However, such significant changes are not observed among funds shifting between 'dark green' and 'light green' labels.

Our study contributes to the existing literature on the effects of sustainability disclosure regulations among financial firms. Consistent with previous research showing that sustainability disclosure rules influence asset managers' actions by improving their ESG activities (Becker et al., 2022; Gajewski & Tran, 2024; Martinez-Meyers et al, 2024) and

reducing GHG emissions (Dai et al., 2023), our study further documents that funds exhibit improvements across the ESG pillar scores following the announcement of a sustainability disclosure regulation. Leveraging the reclassification wave triggered by the introduction of SFDR Level 2, our study examines whether reclassified funds align their new labels with ESG scores and exposure to controversial industries, which are previously unexplored in the literature. Based on that, we find evidence of the regulation's ability to reduce greenwashing risk, contributing to the body of research on the mechanisms through which disclosure regulations have impacts on fund behaviours (Dai et al., 2023; Spaans et al, 2024; Gajewski & Tran, 2024; Martinez-Meyers et al, 2024).

Furthermore, while previous studies typically group Article 8 and 9 funds together as ESG funds and compare them against Article 6 (Becker et al., 2022; Emiris et al., 2023; Dai et al., 2023), contrast PRI and non-PRI funds (Kim & Yoon, 2020; Gibson Brandon et al., 2022; Bauckloh et al., 2023), or focus exclusively on Article 9 funds (Scheitza & Busch, 2024; Lambillon & Chesney, 2023), our study extends the existing literature by explicitly differentiating between Article 8 and Article 9 funds instead of treating them identically. Under the SFDR, Article 8 and Article 9 funds have varying levels of commitment to sustainability, referred to as different shades of ‘green’. Given their distinct investment scopes and disclosure requirements, we examine the regulatory impacts on these two categories separately. Moreover, while existing research uses single-time-point data for article classifications (Becker et al., 2022; Emiris et al., 2023; Dai et al., 2023), this study employs monthly observations. The use of time-series data accounts for fund reclassifications, tracks how funds respond to regulatory changes over time, and identifies immediate effects of the regulation that might be missed with single-time-point data.

In terms of regulatory implications, in the context of the current implementation of SFDR Level 2 and the European Commission's consultations regarding the regulation (European Commission, 2024), our study provides evidence on the regulation's effectiveness. This helps understand its immediate impact on the fund industry and assesses whether it successfully advances the goals of the EU Sustainable Finance Action Plan. The findings also contribute to the conversation around greenwashing, offering policymakers insights into the potential of SFDR Level 2 to mitigate greenwashing and providing investors with essential information to shape investment strategies for each fund category. In the current landscape, where many

asset managers overstate their ESG engagement without fully adhering to it, implementing rigorous disclosure regulations serves multiple purposes. It improves transparency, enhances ESG outcomes in the financial sector, mitigates litigation risks associated with greenwashing, and helps prevent potential financial losses. As a pioneering regulation in sustainability disclosure, the effectiveness of SFDR in the EU can serve as a reference for other jurisdictions developing similar legislation.

The remainder of the chapter is organised as follows. Section 2 provides an overview of the study's background. Section 3 examines relevant literature and formulates hypotheses. Section 4 describes the data and methodologies. Section 5 presents the findings, and section 6 provides conclusion.

2. Institutional background

The Level 1 of SFDR, which came into effect in March 2021, establishes mandatory disclosure requirements for investment funds regarding how they incorporate sustainability risks and factors into their investment processes. The regulation is applied for financial market participants with over 500 employees. A key aspect of this initial phase is the introduction of the three classifications of financial products according to their sustainability commitments, including Article 6 (referred to as 'brown products' because these funds do not have sustainability features), Article 8 (referred to as 'light green products'), and Article 9 (referred to as 'dark green products')[1] (ESMA, 2023), along with disclosure requirements for each classification. SFDR aims to integrate sustainability into financial investments through Article 8 products, which promotes environmental or social characteristics, and Article 9 products, which have a sustainable investment objective. Despite its transformative potential, Level 1 has been criticised for unclear definitions and ambiguous guidance, leading to different approaches by asset managers in product classification (Quirici, 2023; Morningstar, 2022a). Funds within the same category can vary significantly (Scheitza & Busch, 2024), while funds in different categories do not clearly distinguish sustainability attributes (Cremasco & Boni, 2022). Also, due to the lack of strict regulation, after the introduction of the three fund categories under Level 1, most funds classify themselves as Article 8 or Article 9 without

[1] ESMA notes that the usage of such terms as 'dark' or 'light green' products and related categorisations is not endorsed by regulators and supervisory authorities. See https://www.esma.europa.eu/sites/default/files/2023-06/ESMA30-1668416927-2498_Progress_Report_ESMA_response_to_COM_RfI_on_greenwashing_risks.pdf

making substantial changes to their investment holdings or strategies to validate their classifications (Webb, 2022) and even invest in unsustainable assets and sectors[2].

The EC's Delegated Regulation (EU) 2022/1288, marking the introduction of Level 2 of the SFDR, was officially announced on April 6, 2022, and became effective on January 1, 2023 (see Figure 1). Compared to Level 1, Level 2 includes several advancements that enhance funds' transparency in disclosure and improve the quality of sustainability information provided to stakeholders. One of the key advancements is the disclosure templates for pre-contractual and periodic disclosures for products under Article 8 and Article 9, with detailed guidance on the required information. This is beneficial because, while Level 1 introduces fund classifications, it does not provide specific instructions for funds to meet their classification definitions in their disclosures. Another significant aspect of Level 2 is the confirmation that Article 9 funds should only invest in 'sustainable investments', unless they are required to invest in other assets due to sectorial regulatory mandates. This stipulation is not explicitly stated in Level 1, but it is emphasised in the EC's Q&A in June 2021 (ESMA, 2021) and included in the pre-contractual disclosure template for funds under Article 9. Additionally, while Level 1 requires funds to disclose the principal adverse impacts (PAI) of investment decisions on sustainability factors, it does not specify the qualitative or quantitative terms for PAI disclosure. Level 2 addresses this by introducing a list of adverse sustainability indicators, along with relevant metrics to measure them and requires funds to explain any increases or decreases in these metrics compared to the previous year. This quantitative disclosure requirement assists investors in comparing the sustainability impacts of fund investments and encourages asset managers to recognise and mitigate these impacts of their products. Finally, Level 2 also mandates that funds disclose whether their investments align with the EU Taxonomy Regulation, preventing exaggerated or misleading claims about the sustainability of their investments. The transition from SFDR Level 1 to Level 2 represents a significant step towards enhanced transparency and comparability in sustainability disclosures among EU funds.

[2] As of December 2021, 39% of products applying Art.8 and 33% of products applying Art.9 have over 5% exposure to fossil fuel companies. Around 22% of products applying Art.9 have some exposure to companies deriving more than 5% revenue from thermal coal, compared with 36% of products applying Art.8. See https://www.eurosif.org/wp-content/uploads/2022/06/Eurosif-Report-June-22-SFDR-Policy-Recommendations.pdf

The introduction of SFDR Level 2 has caused asset managers to thoroughly re-evaluate the classifications of their products, triggering a significant wave of fund reclassification, as many funds are unable to meet the disclosure requirements for their existing labels. Notably, before SFDR Level 2 took effect in January 2023, there were numerous reclassifications from Article 9 to Article 8 as asset managers determined that their products did not meet the definition because they "were not designed to include only sustainable investments" (Morningstar, 2023, p.13). Notable examples include funds from large asset managers such as Robeco (Morningstar, 2022c), NN, PIMCO (Morningstar, 2022b), and BNP Paribas (Morningstar, 2023). This reclassification is part of a broader wave beginning in the second quarter of 2022, marking the announcement date of April 6, 2022. From that point until the end of 2022, Morningstar reported 1,156 upgrades and 368 downgrades, with most upgrades occurring from Article 6 to Article 8, and most downgrades occurring from Article 9 to Article 8 (Morningstar, 2022b, 2022c; Morningstar, 2023). Meanwhile, during the year following the effective date of SFDR Level 1 (March 2021), approximately 1,800 fund upgrades were recorded with no downgrades (Morningstar, 2022a), indicating that funds only attempted to follow the growing sustainability trend, identifying themselves as 'green' to draw investment. The reclassification wave after Level 2 announcement reveals that the stringent RTS have caused asset managers to rigorously assess their sustainability commitment level, moving beyond merely adopting green labels to attract capital. Ultimately, SFDR is a disclosure regime rather than a labelling system. The second phase of SFDR, therefore, plays a pivotal role in mitigating greenwashing among institutional investors. Details of the reclassification statistics are presented in Appendix A.

3. Literature review and hypothesis development

This section reviews existing literature on the impact of regulatory frameworks and labelling systems on sustainability performance within financial markets, establishing the foundation for the hypotheses presented in this study.

Greenwashing has been widely documented in the context of voluntary sustainability-related disclosures and initiatives aimed at promoting sustainable investment among asset managers. This prevalence is not surprising, as voluntary disclosure regimes typically encourage transparency rather than impose rigorous standards or provide detailed guidance on sustainability reporting. The adoption of sustainability practices is frequently accompanied by

the assignment or self-designation of ESG labels by funds, which serve as a public declaration of their commitment to sustainable investment. Several studies have shown that investment funds often adopt these ESG-related labels primarily to attract investments without making substantive changes to their investment strategies or improving their sustainability performance (Kaustia & Yu, 2021; Abouarab et al., 2025). Funds with ESG names are more likely to invest in firms that violate labour and environmental laws, pay high fines for these infractions, emit high carbon per unit of revenue (Raghunandan & Rajgopal, 2022), have low sustainability ratings, or show weak support for ESG proposals (Dumitrescu et al., 2022). In addition to self-declared ESG labels, asset managers can earn ESG labels by signing ESG initiatives. These labels are also criticised for being more of a marketing tool than a transparency tool. For example, funds signing up for the PRI are claimed to use the PRI label to attract investments without making meaningful progress in ESG practices or demonstrating improvements in ESG scores (Kim & Yoon, 2020; Dumitrescu et al., 2022; Gibson Brandon et al., 2022). Funds managed by asset managers affiliated with climate initiatives such as Climate Action 100+, Net Zero Asset Managers, and the Investor Group on Climate Change have higher portfolio carbon intensities than funds managed without such affiliations (McLean et al., 2022). The gap between the proclaimed sustainability efforts and actual practices can be attributed to the financial motivation of investors when seeking responsible investment and ESG information (Amel-Zadeh & Serafeim, 2018; McLean et al., 2022).

With the increasing adoption of sustainability-related disclosure regulations for the financial services sector across regions and countries, scholarly attention has shifted toward evaluating the impact of these regulatory frameworks. While much of the existing literature has focused on assessing whether such regulations lead to improvements in the ESG performance of investment funds (Becker et al., 2022; Ding, 2023;Dai et al., 2023; Gajewski & Tran, 2024), fewer studies have explicitly addressed their effectiveness in mitigating greenwashing. Although the evidence suggests that mandated disclosure has real effects on enhancing ESG outcomes, it remains unclear whether these improvements reflect genuine sustainability efforts or are merely responses to regulatory compliance pressures. Nonetheless, it is reasonable to expect that mandatory disclosure regimes may help deter greenwashing, particularly given the heightened litigation risks asset managers face when failing to uphold their publicly stated ESG commitments. In the context of non-financial firms, prior research

has highlighted the critical role of litigation risk in ensuring alignment between disclosure and actual corporate behaviour (Skinner, 1995; Badawi & Partnoy, 2022; Christensen et al., 2020;Fiechter et al., 2022; Huang et al., 2023)—a mechanism that may similarly operate within the asset management industry.

Recognised as the most comprehensive sustainability disclosure regulation for institutional investors to date, the SFDR has created new opportunities for research into its broader implications and effects. Research has shown that post-implementation of SFDR Level 1, affected funds have exhibited significantly improved ESG scores (Becker et al., 2022), a decrease in greenwashing (Ding, 2023), and a reduction across Scope 1, 2, and 3 emissions within investment portfolios (Dai et al., 2023). Article 173-VI of the French Energy Transition and Green Growth Act, which requires institutional investors to disclose portfolio carbon footprint, effectively reduces the carbon footprints following the law's enactment (Gajewski & Tran, 2024). Although the effects of sustainability disclosure on financial and non-financial firms can differ in several aspects such as costs and benefits of disclosure, behaviour change channels, and enforcement (Dai et al., 2023), the literature suggests that mandatory sustainability disclosure positively influences financial firm behaviour. These improvements are attributed to the shifts in funds' investment strategies, such as divesting from high-emission firms and allocating to those with lower emissions (Dai et al., 2023), rebalancing towards more climate-conscious firms (Gajewski & Tran, 2024), and investing in firms with strong sustainability commitments and ESG ratings (Lambillon & Chesney, 2023).

Unlike SFDR Level 1, there has been limited study on Level 2 due to its recent implementation. Some may argue that Level 2 is essentially an enhanced version of Level 1, requiring additional disclosures rather than introducing a new regulation designed to encourage asset managers to market themselves with their labels. Therefore, it might seem unlikely that funds would improve their sustainability performance solely due to the introduction of Level 2. However, literature indicates that increased transparency of existing information can lead to real performance changes. For instance, Christensen et al. (2017) find that SEC-registered mining firms reduce workforce injuries after being required to include safety records in their financial reports, despite the records being previously available—though less accessible—on the Mine Safety and Health Administration's website. Similarly, Downar et al. (2021)examine the Companies Act 2006 Regulations 2013, which mandates UK listed firms to report overall GHG

emission levels in their annual reports, even though direct emissions per installation are already publicly accessible via the EU Emissions Trading System. Firms under this mandate significantly reduce emissions after providing more transparent and accessible reports. These studies suggest that increased disclosure, not just new information, can also improve real performance. Additionally, one key enhancement of Level 2 compared to Level 1 is the quantitative disclosure requirements, such as the measurements of PAI indicators. These measurements compel managers to review and manage these indicators more carefully, in line with the well-known management accounting adage that "what gets measured, gets managed" (Drucker, 2012, cited in Downar et al., 2021).

The unclear guidelines of SFDR Level 1 cause asset managers to make their own decisions on these issues, resulting in inconsistencies among financial products. Funds classified under the same category can be very different (Scheitza & Busch, 2024), while funds in different categories do not clearly distinguish sustainability attributes (Cremasco & Boni, 2022). This raises doubts about the accuracy of SFDR classifications and increases the risk of greenwashing (Bodellini, 2023). However, the effectiveness of SFDR Level 1 remains a topic of mixed opinions when a study by Dai et al. (2023) claims that funds categorised under Articles 8 and 9 have reduced portfolio carbon emissions compared to those under Article 6 following SFDR enforcement.

By introducing strict disclosure requirements for specific fund categories, SFDR Level 2 aims that funds adopt appropriate labels reflecting their true sustainability commitments. As classification is a critical focus of SFDR Level 2 and is of significant interest to investors, in this study, we examine the impact of SFDR Level 2 on each fund category individually, different from prior studies that either examine the combined effects of Article 8 and 9 compared to Article 6 (Becker et al., 2022; Emiris et al., 2023;Dai et al., 2023) or contrast PRI and non-PRI funds (Kim & Yoon, 2020;Gibson Brandon et al., 2022; Bauckloh et al., 2023). Given that Article 8 and Article 9 are defined by distinct sustainability commitments, investigating their regulatory impacts is essential. We expect that Article 9 funds, which represent the highest standard of ESG commitment, demonstrate greater ESG scores compared to those in the other categories. The hypothesis is stated as follows:

Hypothesis 1: Following the mandatory ESG disclosure regulation, funds with greener labels exhibit significantly higher ESG performance compared to funds with less green labels.

The above argument supports reclassification wave triggered by the announcement of SFDR Level 2. The stringent RTS prompt funds to reclassify themselves into categories that more accurately reflect their ESG commitments. Therefore, it is expected that the new classifications will correspond more closely with actual ESG performance, implying that funds moving to a higher classification will improve their ESG scores relative to those that do not reclassify. Nishi et al. (2024) report that Article 9 funds downgrading to Article 8 after SFDR Level 2 show an increase in their ESG risk ratings, indicating they are less green—a change that accurately reflects their new labels. However, their study analyses data from three months before, one month after, and three months after each fund's downgrade within Article 9. In contrast, our study extends across all categories, examining changes for up to 21 months following the regulation's announcement. The hypothesis is as follows.

Hypothesis 2: Following the mandatory ESG disclosure regulation, funds that upgrade their labels show significant increase in ESG performance compared to funds that retain their labels.

4. Research design

4.1. Sample selection

The sample construction begins with the population of EU open-ended funds and exchange-traded funds available in Morningstar Direct. We exclude from the sample non-equity funds, funds without data on article classifications, and those not following SFDR. Following Dai et al. (2023), we subsequently remove funds with inception date after the announcement date of SFDR Level 2, i.e. April 6, 2022, to ensure reclassification only involves funds existing before the introduction of the regulation.

For each fund, Morningstar provides a list of share classes associated with that fund. Each share class under a given fund shares the same fund ID and is assigned identical portfolio sustainability scores and assets under management. To prevent duplicate observations, we consolidate all share classes within the same fund into a single record. For example, Ecofi Optim Variance includes two share classes—Ecofi Optim Variance C and Ecofi Optim Variance E—both identified by the fund ID FS00009F24. These share classes are thus treated as a single fund in our analysis.

This study first adopts a difference-in-differences approach to examine the average improvements in ESG performance of EU funds following the SFDR Level 2, which is the premise underlying our main hypothesis on the effect on each fund category. We utilise mutual funds based in the UK as a control group for benchmarking. The sampling process results in 85,863 observations of EU mutual funds and 26,060 observations of UK mutual funds spanning from December 2021 to December 2023. Summary statistics of the EU and UK funds in the sample are presented in Table 1. For the main research question concerning greenwashing mitigation, we examine each fund category, using reclassified funds as the treated group and non-reclassified funds as the control group. The analyses cover the period from December 2021 to December 2023, with the announcement date of SFDR Level 2 being April 2022. This creates a pre-event period of 04 months and a post-event period of 21 months. The decision not extending the pre-event period further back than December 2021 stems from data limitations and the potential confounding effects of SFDR Level 1, implemented in March 2021, which could obscure the specific impacts of SFDR Level 2.

4.2. The effects of the SFDR Level 2 on sustainability scores

4.2.1. Average effect

We begin the empirical analyses by investigating the average effect of the SFDR Level 2 announcement on affected EU firms, which is the premise underlying our hypothesis on the effects on each category separately. We use a difference-in-differences design to regress the mutual funds' ESG performance on the three main predictor variables—*treated, post_SFDR, and treated* $\times$ *post_SFDR*, as depicted by Equation (1):

$$ESG_{i,t} = \beta_0 + \beta_1 treated_{i,t} + \beta_2 post\_SFDR_t + \beta_3 treated_{i,t} \times post\_SFDR_t + \sum \beta_k control_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t} \quad (1)$$

The dependent variable, $ESG_{i,t}$, is a comprehensive score capturing overall portfolio sustainability score, environmental score, social score, and governance score of fund i in month t. The indicator variable $treated_{i,t}$ differentiates between EU funds and UK funds, which equals 1 if the fund is domiciled in the EU, and 0 otherwise. $post\_SFDR_t$ distinguishes the period before and after April 2022—the announcement date of SFDR Level 2, which equals 1 for the months after April 2022, and 0 otherwise. The interaction $treated_{i,t} \times$

$post\_SFDR_t$ indicates observations for EU funds in the period after the announcement of SFDR Level 2. $control_{i,t}$ is a vector of control variables. We control for fund age ($age_{i,t}$), total net asset ($log\_fund\_size_{i,t}$), return ($return_{i,t}$), and net flows ($net\ flows_{i,t}$). Fund fixed effects (α_i) and time fixed effects (δ_t) are employed to control for any time-invariant effects. Appendix B provides variable descriptions for all variables used.

In addition, we expand Equation (1) to estimate monthly treatment effects of SFDR Level 2 on the affected funds to assess whether the effects occur prior to or subsequent to the regulation announcement. Equation (2) represents our model.

$$ESG_{i,t} = \beta_0 + \beta_1 treated_{i,t} + \beta_2 month_t + \sum \beta_3 treated_{i,t} \times month_t + \sum \beta_k control_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t} \quad (2)$$

Where $month_t$ ranges from December 2021 to December 2023, with the announcement date, April 2022, as baseline; $treated_{i,t} \times month_t$ reflects the monthly treatment effects.

4.2.2. Effects on each article category

This section examines the regulatory impact on each fund category separately, as stated in Hypothesis 1. We expand Equation (1) by dividing the treated funds into their respective article classifications while continuing to use UK funds as the control group. In Equation (3), as outlined below, the control group serves as the baseline for comparison with the other categories, therefore omitted from the model.

$$ESG_{i,t} = \beta_0 + \beta_1 article6_{i,t} \times post\_SFDR_t + \beta_2 article8_{i,t} \times post\_SFDR_t + \beta_3 article9_{i,t} \times post\_SFDR_t + \sum \beta_k control_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t} \quad (3)$$

The indicator variables $article6_{i,t}, article8_{i,t}, and\ article9_{i,t}$ define fund classification in month t. Specifically, $article6_{i,t}$ equals 1 if fund i is classified under Article 6 of the SFDR in month t, and 0 otherwise. $article8_{i,t}$ equals 1 if fund i is classified under Article 8 of the SFDR in month t, and 0 otherwise. $article9_{i,t}$ equals 1 if fund i is classified under Article 9 of the SFDR in month t, and 0 otherwise The interaction $article_{i,t} \times post\_SFDR_t$ indicates observations for the funds in the period after the announcement of SFDR Level 2.

4.2.3. Comparison of sustainability scores between fund categories

In this set of analysis, we apply ANOVA for cross-sectional data to examine differences in sustainability scores among the three EU fund classifications. The analysis first compares the ESG scores of these classifications up to April 2022, and subsequently compares these scores in the period following April 2022. This analysis is to complement the examination in section 4.2.2 by investigating the variation in sustainability scores across these article categories before and after the regulation announcement.

4.2.4. Variation in sustainability scores between reclassified and non-reclassified funds

This analysis investigates how ESG scores have changed between funds that reclassify and those that do not, as stated in Hypothesis 3. Notably, a significant reclassification movement took place from Q2 of 2022 to Q1 of 2023 following the regulation announcement. We first split the sample into three subsamples.

- Funds upgrading from Article 6 to Article 8 (410 funds), upgrading from Article 6 to Article 9 (13 funds), and those remaining Article 6 (2,107 funds).

- Funds upgrading from Article 8 to Article 9 (52 funds), downgrading from Article 8 to Article 6 (16 funds), and those remaining Article 8 (3,430 funds).

- Funds downgrading from Article 9 to Article 8 (256 funds) and those remaining Article 9 (336 funds). We excluded funds downgrading from Article 9 to Article 6 due to their limited number.

The following model explores whether funds that moved from Article 6 to Article 8 or Article 9 experience an increase or decrease in their ESG scores compared to those that remained as Article 6 during the reclassification period. The analysis focuses on the sub-sample of funds that have Article 6 label prior to the SFRD Level 2 announcement.

$$ESG_{i,t} = \beta_0 + \beta_1 article6\_to\_8 \times post\_label\_change_t + \beta_2 article6\_to\_9 \times post\_label\_change_t + \sum \beta_k control_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t} \quad (4)$$

Where $article6\_to\_8_i$ and $article6\_to\_9_i$ indicate whether fund i, originally classified under Article 6, upgrades to Article 8 or Article 9, respectively, during the reclassification period.

Similarly, Equation (5) examines whether funds that reclassify from Article 8 to either Article 6 or Article 9 increase or decrease their ESG scores compared to funds that retain their Article

8 label. Equation (6) examines whether funds downgrading from Article 9 to Article 8 experience changes in their ESG scores relative to those that maintain their Article 9 label. Given the limited number of funds downgrading from Article 9 to Article 6, Equation (6) focuses solely on the sub-sample of Article 9 funds that either move to Article 8 or do not choose reclassification.

$$ESG_{i,t} = \beta_1 article8\_to\_6 \times post\_label\_change_t + \beta_2 article8\_to\_9 \times post\_label\_change_t + \sum \beta_k control_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t} \quad (5)$$

$$ESG_{i,t} = \beta_1 article9\_to\_8_i \times post\_label\_change_t + \sum \beta_k control_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t} \quad (6)$$

Where $article8\_to\_6_i$ and $article8\_to\_9_i$ indicate whether fund i, originally classified under Article 8, move to Article 6 or Article 9, respectively. $article9\_to\_8_i$ shows if fund i, originally classified under Article 9, shift to Article 8 during the reclassification period.

5. Findings

5.1. The effects of the SFDR Level 2 on ESG scores

5.1.1. Average effects

We initially conduct a univariate analysis to investigate the average impact of SFDR Level 2 on the ESG performance of EU-based funds relative to UK-based funds. The results presented in Table 2 indicate that following the Level 2 announcement, EU funds exhibit significant increases in all ESG metrics compared to the control group, e.g., 0.0605 points in the overall sustainability score, 0.0617 points in the environmental score, 0.0686 points in the social score, and 0.0515 points in the governance score.

We subsequently conduct a cross-sectional analysis to examine Equation (1) with the inclusion of control variables. The findings in Table 3 indicate a significant increase in the ESG scores of EU funds across all metrics compared to their UK counterparts when accounting for both time and fund fixed effects. Specifically, the overall sustainability score increases by 0.0613 points, the environmental score by 0.0614 points, the social score by 0.0679 points, and the governance score by 0.0545 points relative to UK funds. These findings imply that, in general, EU-domiciled funds have improved their ESG scores following the issuance of the SFDR Level 2 compared to unaffected funds. Our findings align with those of Becker et al. (2022), who report improvements in overall sustainability scores for EU funds following SFDR

Level 1 introduction, and further extend to demonstrate enhancements across all three ESG pillars. The findings are thus consistent with existing literature that reporting entities actually alter their behaviours according to what they disclose, and that an additional requirement on already available disclosure can further improve the sustainability performance of entities previously compliant with disclosure requirements (Christensen et al., 2017; Downar et al., 2021).

This finding may be explained firstly by the potential litigation risks funds face if they fail to follow through on their disclosure. Incremental disclosures heighten awareness of sustainability records, leading stakeholders to place greater emphasis on the sustainability aspects of funds (Christensen et al., 2017). SFDR Level 2 advances beyond the general disclosure framework of Level 1 by providing specific guidelines on what sustainability risks and PAI need to be disclosed and how they should be reported, including the requirement for quantitative disclosures. This makes it more challenging for asset managers to obscure or avoid the sustainability impacts of their products. Additionally, the requirements for consistent presentation (such as mandated templates) and standardised measurements enhance comparability between funds and across different years for the same fund. Such comparability can influence investor decisions, as the cost of investing in a fund with higher adverse impacts on sustainability factors may increase. These factors incentivise asset managers to be more mindful of their performance when adhering to enhanced disclosure requirements.

Monthly treatment effects of SFDR Level 2

Figure 2 presents the monthly effect of SFDR Level 2 around its announcement date. All the graphs show that prior to the event date, the coefficients of $treated_{i,t} \times month_t$ exhibit both positive and negative fluctuations, yet none are statistically significant, suggesting no evidence that the treatment influences the ESG scores during this period. However, from May 2022 onwards, these coefficients are consistently positive and indicating an upward trend thereafter. For the overall sustainability score and the governance score, the significant effects start immediately after the announcement date. For the environmental score, the effect becomes continuously significant from August 2022, while for the social score, the significant effect starts from November 2022. These outcomes align with the initial analysis

and offer additional insights into the timing of these impacts. The observed monthly effects are expected because ESG scores require time to improve and align with the January 2023 deadline when SFDR Level 2 is officially implemented.

5.1.2. Effects on each article category

Table 4 presents the findings on how SFDR Level 2 impacts the ESG scores for each of the article classification, using UK-based funds as a control group. Specifically, Article 8 funds show significant improvements across all ESG metrics relative to UK-based funds, with an increase of 0.0804 points in overall sustainability scores, and increases of 0.0882, 0.0936, and 0.0602 points in the environmental, social, and governance scores, respectively. In contrast, Article 9 funds exhibit a significant increase only in social score, while Article 6 funds do not display any significant improvements in the three ESG pillars. This suggests that 'light green' funds are the most influenced by SFDR Level 2 among the three groups.

The findings may be attributed to the regulatory specifications on article classification provided by SFDR. Article 9 funds, expected to be exclusively based on 'sustainable investment', typically follow a solution-oriented approach with a thematic focus on specific sectors or impact areas (Walther et al., 2023). This thematic concentration might result in improvements in targeted ESG pillars, but not necessarily across all pillars, causing the lack of significant increase on average ESG scores. In contrast, Article 8 funds do not have sustainable investing as their core objective and often employ more traditional ESG strategies, such as general integration and "best-in-class" approaches (Walther et al., 2023). These funds benefit from a broader investment latitude, allowing them to invest in firms not fully aligned with societal ESG values. For instance, coal producers excluded from socially responsible investment funds (i.e., Article 9 funds) might be included in Article 8 funds if they have sound governance and social practices. A study by the OECD and MSCI in 2017 highlights that the top 20% of firms in the tobacco sector – a sin sector – performed above the MSCI World average (Boffo & R. Patalano, 2020). While these tobacco firms would not be in an Article 9 fund's portfolio, they could be included in an Article 8 fund, giving Article 8 funds an advantage in improving their ESG scores. A noticeable issue is that a fund's sustainability score is often determined relative to other funds in its peer group. For example, a renewable energy fund could have a low or below-average sustainability score relative to other renewable energy funds, while a traditional energy fund might score above average or high relative to

other traditional energy funds. Consequently, the renewable fund in this example could have a lower score than the traditional energy fund (Boffo & R. Patalano, 2020). This flexibility allows Article 8 funds more opportunities to improve their ESG performance under the clarified definitions and requirements of Level 2. Additionally, Morningstar reports that many large funds previously classified as Article 9 had to downgrade to Article 8 because they could not meet the new definitions, while in fact they are pioneers in sustainable investment with high ESG scores. This further explains why Article 8 funds are improving their ESG performance more than other fund categories. Meanwhile, Article 6 funds, with no inherent ESG focus, show no significant ESG score improvements, which is to be expected.

5.1.3. Comparison of ESG performance between article categories

In this section, we use ANOVA to compare the ESG scores of the three fund categories before and after the introduction of Level 2. The results in Table 5 indicate that before the regulation announcement, on average, Article 6 funds have significantly lower ESG scores compared to Article 8 across most pillars. Article 9 funds show lower ESG scores across all metrics compared to Article 8, with a significant difference observed only in the environmental score, which is 0.4914 points lower. Additionally, Article 9 funds exhibit higher environmental scores and governance scores than Article 6 funds.

The comparison following the release of SFDR Level 2 are presented in Table 6. The data reveals that, on average, Article 6 funds continue to exhibit significantly lower ESG scores than Article 8 across all metrics. However, the disparities are less pronounced than those observed before the regulation. Noticeably, during this post-regulation period, most ESG metrics for Article 9 funds are significantly larger to those of Article 8, apart from the environmental score, which remains significantly lower, but the gap has been decreased to 0.2612 points. These findings support the critique that the definitions of article classifications from SFDR Level 1 are ambiguous, resulting in comparable sustainability performance between ‘light green’ and ‘dark green’ funds. However, Level 2 has effectively refined fund classifications, ensuring that ‘dark green’ funds demonstrate enhanced ESG performance relative to their ‘light green’ counterparts. Figure 3 visually corroborates the results obtained from the ANOVA analysis.

In summary, SFDR Level 2 appears to affect ESG scores of all fund categories, particularly highlighting the disparities between Article 8 and Article 9 funds. While there is no significant difference between these two fund groups before the regulation, the 'dark green' funds show significantly better performance than the 'light green' funds across most of the ESG metrics post-regulation. These findings suggest that the stringent requirements of SFDR Level 2 effectively ensures funds are correctly classified, addressing the potential for misclassification encountered under Level 1 (Bodellini, 2023; Quirici, 2023; Scheitza & Busch, 2024) and responds to significant concerns about greenwashing in previous studies (Kim & Yoon, 2020; Raghunandan & Rajgopal, 2022; Gibson Brandon et al., 2022).

5.1.4. Variation in ESG performance between reclassified and non-reclassified funds

Tables 7, 8, and 9 display the changes in ESG scores for Article 6, Article 8, and Article 9 funds, respectively, comparing those that changed their labels to those that retained their original labels. The results indicate that Article 6 funds upgrading to Article 8 and Article 9 see significant increase in most of the metrics relative to Article 6 funds that remain unchanged. Specifically, 'brown' funds that upgrade to 'light green' funds see an increase of 0.0594 points in the overall sustainability score, along with increases of 0.0718 points in the environmental score, 0.1006 points in the social score compared to funds that retain their 'brown' label. In contrast, 'brown' funds upgrading to 'dark green' funds do not exhibit significant improvements in their ESG scores, likely due to the small number of funds making this shift. Funds moving from Article 8 to Article 9 significantly increase 0.1684 points in environmental scores relative to Article 8 funds that do not reclassify. In contrast, funds that downgrade from Article 8 to Article 6 show negative, yet non-significant changes across all the ESG scores. Within the Article 9 category, funds that downgrade to Article 8 significantly increase their overall and environmental scores compared to those maintaining Article 9 label.

These findings imply that transitioning from 'brown' to 'green' labels is associated with significant improvements in sustainability performance. This suggests that these funds have changed their article classification because they believe their sustainability commitments better align with the new labels than with their previous ones, and that the reclassification is accompanied by genuine improvements in sustainability practices. However, this improvement is not observed in funds transitioning between 'dark green' and 'light green' labels. This may be attributed to the inherent similarities in sustainability practices between

these article categories upon reclassification. In fact, many large funds downgrading from Article 9 to Article 8 already maintain robust sustainability practices; their downgrade is often due to not meeting the criteria for 'sustainable investment,' (see Appendix A) hence the change has little impact on their ESG scores. Furthermore, the reclassification occurs in the preparatory phase for the implementation of SFDR Level 2, resulting in a lack of pronounced improvements at this stage. Nevertheless, these findings supplement previous analyses to reinforce the efficacy of SFDR Level 2 in addressing greenwashing risk, as evidenced by the improved ESG scores of funds transitioning from 'brown' to 'green' labels, indicating that these funds have indeed taken steps towards a more sustainable portfolio that aligns with their new labels.

We employ alternative proxies for ESG performance—specifically, the funds' exposure to controversial activities—and incorporate them into Equations (4), (5), and (6). The exposures analysed include controversial weapons, tobacco, severe controversies, thermal coal, and nuclear energy. Exposure is measured by the percentage of product involvement in each industry (see Appendix B). Using the difference-in-differences analysis, we find that, similar to improvements in ESG scores, the most noticeable reduction in exposure to controversial activities occurs among funds upgrading from Article 6 to Article 8 (see Table 10). Other fund groups—such as Article 8 funds upgrading to 9 or downgrading to 6, and Article 9 funds downgrading to 8—do not show significant improvements. This may be because their label changes are more likely driven by compliance with label definitions rather than actual shifts in sustainability strategies (see Table 11 and Table 12).

The significant reduction in controversial exposure among 'brown' funds upgrading to 'greener' labels indicates that those asset managers are actively aligning their portfolios with sustainability criteria. This finding suggests that, following reclassification under SFDR Level 2, the risk of greenwashing is reduced, as funds appear to adjust their investments to match the labels they claim.

5.2. Sensitivity and additional analyses

To verify the robustness of our findings that affected funds improve ESG scores following the introduction of SFDR, we apply PSM to pair each EU fund with a UK fund and perform the difference-in-differences analysis again. The matching parameters include all control variables—fund age, fund size, return, and net flow. Following Fiechter et al. (2022) and

Downar et al. (2021), we base our matching on the averaged pre-regulation values of these variables. Specifically, we calculate the average values over the five months from December 2021 to April 2022 for each variable. Funds with missing data for any of these variables in at least one month during this period are excluded from the sample. Consequently, the matching sample is smaller than the original, comprising 6,215 EU funds and 1,026 UK funds[3]. We first use one-to-one matching without replacement, which results in 1,062 pairs of treated-control funds. After incorporating post-event values for the variables in the sample and removing missing values, the sample includes 17,984 EU observations and 24,744 UK observations. Next, we apply matching with replacement, allowing one control fund to be matched with multiple treated funds, resulting in 6,215 pairs of treated-control funds. Following the addition of post-event variable values and the removal of missing data, the sample expands to 115,448 EU observations and 20,283 UK observations. Table 13 and 14 present the analysis results based on the matched samples, which align with the main findings that EU funds, on average, improve most of their ESG scores, except from Social scores, compared to UK funds following the introduction of SFDR Level 2. Furthermore, Table 15 shows that within the non-replacement PSM sample, Article 8 funds significantly improve their ESG scores compared to UK funds. In Table 16, within the replacement PSM sample, both Article 8 and Article 9 funds demonstrate significant ESG score improvements compared to UK funds. These results are consistent with the main findings, highlighting that 'light green' investors are the most affected by the regulation.

We acknowledge that during the sample period, France implemented Article 29 of the French Energy and Climate Law 2019, requiring institutional investors to publish annual reports detailing biodiversity and climate-related risks. These reports must align with SFDR

[3] There is an issue with the classification data (i.e., Article 6, 8, or 9) for EU funds in the pre-regulation period (December 2021 to March 2022). In the original sample, several funds are missing classification data for this period because Morningstar did not receive updated data from the funds for these months. However, all funds complying with SFDR Level 1 had their classifications in place since its implementation in March 2021.
In the original analyses, we address these missing values by removing the observations from the sample, as matching is not used. However, for the matching sample, removing these observations would lead to the exclusion of entire funds, resulting in fewer treated funds than control funds (since control funds do not require classification data). To address this issue, we make an assumption to impute the missing classification data for the pre-regulation period. Specifically, we assumed that a fund's classification during this period is consistent with its classification as of April 2022. For instance, if a fund lacks classification data from December 2021 to March 2022 but is classified as Article 6 in April 2022, we assumed it is also classified as Article 6 during the missing months.

requirements and include a list of financial products categorised under Article 8 and Article 9 of the SFDR, along with the corresponding asset under management (AUM) meeting these definitions. While French-domiciled funds are included in our main analyses, we find that the results remain consistent when these funds are excluded from the sample. Table 17 exhibits the analysis findings without French-domiciled funds in the sample.

We conducted some additional analyses to examine the characteristics of reclassified funds regarding fund age and fund size. The untabulated findings show that, on average, non-reclassified funds are significantly older than reclassified funds by 18.7 months. In particular, funds upgrading from Article 6 and 8 to Article 9 are significantly younger than non-reclassified Article 6 and 8 funds, with ages of 40 months and 33 months, respectively. Funds downgrading from Article 8 to Article 6 are significantly older than non-reclassified Article 8 funds, with an age of 34 months.

Regarding fund size, the untabulated results show that non-reclassified funds are significantly larger than reclassified funds, with a size difference of 21,800,000 million euros. Within Article 6 and 8 categories, reclassified funds are smaller in size than non-reclassified funds. However, Article 9 funds downgrading to Article 8 are significantly larger than non-reclassified Article 9 funds, with an average size of 172 million euro. This finding aligns with Morningstar reports, which highlight that several large funds—such as those from Blackrock, Robeco, and AXA IM—were downgraded from Article 9 to Article 8. Although these funds are proactive in sustainability, they were initially not designed to include only sustainable investments as required by SFDR's criteria for Article 9, which ultimately led to their reclassification.

The above findings suggest that younger funds are more likely to upgrade from 'brown' to 'green' due to their greater adaptability toward change. In contrast, older and larger funds, typically well-established in the market with a stable investor base, may have less pressure to adjust their labels to attract new investors. Additionally, these funds often have established investment strategies that already incorporate ESG policies, making them less flexible to adopt significant changes. Such adjustments would require operational overhauls and efforts to convince existing investors of the transition, thus might involve costs. Larger and older funds, which may be more risk-averse, could prefer to maintain their current classification to avoid potential risks and additional costs.

6. Conclusion

This study investigates the impact of increased disclosure requirements on sustainability performance and greenwashing mitigation among investment funds, utilising the introduction of SFDR Level 2 as an exogenous intervention affecting sustainability disclosure for funds domiciled in the EU. Building on the initial phase of SFDR, Level 2 enhances the general framework by imposing rigorous requirements on the disclosure of sustainability risks and PAI related to investment processes. It also clarifies the definitions of fund classifications and specifies the corresponding disclosure requirements for each classification. The introduction of Level 2 has triggered a wave of reclassifications as funds reassess their labels upon the updated definitions and disclosure standards.

Our results show that SFDR Level 2 effectively improves the ESG scores of EU funds on average compared to unaffected funds, with a particularly strong impact on 'light green' funds. The reclassifications triggered by SFDR Level 2 have successfully sorted funds into more precise categories, ensuring that greener labels correspond to higher ESG scores. Funds that transitioned from a 'brown' label to a 'green' label exhibit significant improvements in ESG scores compared to those that remained 'brown'. In addition to better ESG scores, funds upgrading to greener labels demonstrate reduced exposure to controversial industries, indicating consistency between their claimed labels and actual investment behaviours. Furthermore, the study reveals that younger and smaller funds are more likely to upgrade their labels, emphasising their flexibility and adaptability to new disclosure requirements and the market's shift toward sustainability.

This study contributes to the growing literature on the impacts of disclosure requirements in the financial sector within the ESG domain. It suggests that an increase in disclosure requirements for already available information can further enhance actual sustainability performance and help reporting funds align with appropriate sustainability labels, thereby reducing greenwashing risks. These findings underscore the crucial role of disclosure regulations in enhancing ESG performance and reducing greenwashing risk. This provides valuable insights for policymakers during the consultation and development of future sustainability regulations. As the most developed non-financial disclosure regulation for institutional investors, the achievement of SFDR serves as a strong reference for other countries and regions seeking to establish or refine their own sustainability regulations.

Our findings are subject to several limitations. First, there is a potential risk of violating the parallel-trends assumption. Additional sensitivity tests, such as a placebo test, could help address this limitation and strengthen the robustness of the findings. Second, due to data limitations, the pre-announcement period is considerably shorter than the post-announcement period, potentially skewing the analysis. Moreover, missing data on fund classifications prior to the introduction of Level 2 requires us to make assumptions to fill gaps for the PSM analyses. This limitation also prevents us from identifying the exact time points when funds switched classifications, restricting the scope for more detailed and insightful analyses. Future research could explore how funds adjust their investment portfolios to align with their new sustainability labels under SFDR, providing a deeper understanding of this moderation process.

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APPENDIX A

Additional background on reclassification wave following the announcement of SFDR Level 2

Since the first level of SFDR came into effect on March 10, 2021, funds domiciled in the EU began categorising themselves under Articles 6, 8, and 9. In the period following this date throughout 2021, Morningstar reported approximately 1,800 fund upgrades either from Article 6 to Article 8 or 9, or from Article 8 to 9, with no downgrades recorded for that year (Morningstar, 2022a). However, the announcement of the level 2 of SFDR, with the RTS, on April 6, 2022, has caused asset managers to critically reassess their fund labels to ensure compliance with the SFDR criteria for each article. As a result, downgrades have begun to occur and increase.

The wave of reclassification began in the second quarter of 2022, marking the announcement date of April 6, 2022, and continues up to present. In quarter 2 (Q2) of 2022, Morningstar documented 713 funds changing their SFDR classification, including 696 upgrades and a mere 16 downgrades (Morningstar, 2022b). The third quarter saw 352 upgrades along with 41 downgrades. However, the number of downgrades surged as the implementation date of the SFDR RTS, January 1, 2023, approached. Quarter 4 of 2022 reported 311 downgrades and 108 upgrades, as asset managers were acting on to prepare their pre-contractual documentation for the upcoming January deadline (Morningstar, 2023). During this period, numerous large funds, including DWS, BlackRock, UBS Asset Management, Amundi, and BNP Paribas Asset Management, chose to reclassify their Article 9 products as Article 8. After the effective date of SFDR Level 2, the pace of downgrades began to decrease, while the number of upgrades picked up throughout 2023. The latest data of Morningstar from quarter 4 of 2023 shows 231 upgrades and 25 downgrades (Morningstar, 2024).

Most label upgrades occurred from Article 6 to Article 8. There were 1,052 funds making this transition from April 2022 to the end of that year, and another 895 in 2023. Examples include the Flossbach von Storch Multiple Opportunities and Aberdeen Asia Pacific Sustainable Equity Fund, which, upon upgrading to Article 8, started to exclude firms associated with weapons, tobacco, gambling, oil and gas, and coal, as well as those in significant breach of the United Nations Global Compact principles (Morningstar, 2022c). Similarly, BlackRock elevated several funds from Article 6 to Article 8 by adopting strategies aimed at reducing carbon emissions,

investing in green bonds, and supporting companies with lower carbon footprints or commitments to decarbonisation (Morningstar, 2022c).

Although not as prevalent as other trends, there were several funds upgrading from Article 6 or Article 8 to Article 9 throughout 2022 and 2023. For those moving from Article 6 to Article 9, this represented a significant shift, as transitioning from 'non-green' to 'dark green' funds means completely overhauling their investments and objectives. An example is BNP Paribas Sustainable Asian Cities Bond, which now only invests in firms generating at least 20% of their revenue from products and services addressing environmental or social issues (Morningstar, 2022b). For funds upgrading from Article 8 to Article 9, this often marks the final stage of a lengthy process to align portfolios with the Sustainable Development Goals, with examples including Allianz Global Water, ABN EdenTree European Sustainable Equities, and Aviva Natural Capital Transition Global Equity Fund (Morningstar, 2022c).

The most popular downgrade trend observed was funds moving from Article 9 to Article 8, with the peak of this activity occurring in the fourth quarter of 2022 when 307 Article 9 funds declassified to Article 9 (Morningstar, 2023). This shift is the consequence of the European Securities and Markets Authority's (ESMA) clarification on the European Commission's Q&A in June 2021 (ESMA, 2021). This clarification emphasises that funds labelling as Article 9 may only invest in sustainability investments, which is regulated in Article 2 No. 17 of the Disclosure Regulation, excluding cash and assets used for hedging. Such '100% sustainable investments' requirement for Article 9 products creates a benchmark that prompts many Article 9 funds to reclassify as Article 8 ahead of the SFDR Level 2 implementation in January 2023. To explain for this action, NN Investment stated that the requirement was not yet available when they initially classified their funds as Article 9, necessitating a reassessment of their fund classifications to ensure compliance with SFDR RTS disclosures (Morningstar, 2022b). Other asset managers, such as AXA IM and Robeco, decided to take a proactive approach ahead of the implementation of SFDR Level II by declassifying their products and improving them later (Morningstar, 2022c). After the enforcement of SFDR Level 2, while this downgrading trend continues, the rate has slowed. The year of 2023 recorded only 40 Article 9 funds moving to Article 8.

Figure 4 presents the breakdown of SFDR fund classifications (including both equity and non-equity funds) by percentage, derived from the Morningstar SFDR Article 8 and Article 9 Funds Quarterly Review.

APPENDIX B

Definition of variables

Variable	Description
Portfolio Sustainability Score	Following Albuquerque et al. (2020), Portfolio Sustainability Score is calculated using the average of Portfolio Environmental, Social, and Governance Score, which collectively represent the overall sustainability performance across the three pillars. The values range from 0 to 100.
Portfolio Environmental Score	Portfolio Environmental Score is calculated based on Portfolio Environmental Risk Score, which are displayed as values between 0 and 100, where lower scores are better. Environmental Risk Scores of funds are collected from Morningstar, then Portfolio Environmental Score is computed by subtracting the Portfolio Environmental Risk Score from 100. Thus, Portfolio Environmental Score also ranges from 0 to 100, with higher scores indicating better Environmental performance.
Portfolio Social Score	Portfolio Social Score is calculated based on Portfolio Social Risk Score, which are displayed as values between 0 and 100, where lower scores are better. Social Risk Scores of funds are collected from Morningstar, then Portfolio Social Score is computed by subtracting the Portfolio Social Risk Score from 100. Thus, Portfolio Environmental Score also ranges from 0 to 100, with higher scores indicating better Social performance.
Portfolio Governance Score	Portfolio Governance Score is calculated based on Portfolio Governance Risk Score, which are displayed as values between 0 and 100, where lower scores are better. Governance Risk Scores of funds are collected from Morningstar, then Portfolio Governance Score is computed by subtracting the Portfolio Governance Risk Score from 100. Thus, Portfolio Governance Score also ranges from 0 to 100, with higher scores indicating better Governance performance.

SFDR Product Type (Article)	An indication of the article of SFDR European regulation applying to the product as reported in the European ESG template.
Fund age (in months)	Within each fund, the age of each share class is determined by the number of months between the SFDR Level 2 announcement date and the share class's inception date. The fund age is the oldest share class age within each fund, following Hartzmark & Sussman (2019).
Fund size (in million Euro)	Fund size is measured by its total net assets under management (Ammann et al., 2019; Hartzmark & Sussman, 2019). The logarithm of fund size is used in the examined models.
Return (in %)	Return for each fund is determined by calculating a weighted average of its share classes' returns. The weight assigned to each share class is based on its proportion of the fund's total assets. First, the percentage of net assets for each share class relative to the fund's total assets is computed. These percentages are then used as weights. Next, the return of each share class is multiplied by its corresponding weight. The final step is summing all these weighted returns to determine the total return of the fund.
Net flows (in % of total net assets)	Net flows are calculated as the net growth in fund assets beyond reinvested returns (Ammann et al., 2019; Sirri & Tufano, 1998), using the following formula: $$Net\ flows_{it} = \frac{TNA_{it} - TNA_{i,t-1}(1 + R_{i,t})}{TNA_{i,t-1}}$$ With TNA_{it} being the total net assets of fund i at the end of month t, and $R_{i,t}$ being the return of fund i during month t
Controversial weapons	Percent of product involvement in controversial weapons
Tobacco	Percent of product involvement in tobacco
Severe controversies	Percent of AUM with severe controversies
Thermal coal	Percent of product involvement in thermal coal
Nuclear	Percent of product involvement in nuclear energy

Table 1. Summary statistics of variables

	EU funds (N = 85,863)					UK funds (N = 26,060)				
	Mean	Median	Standard deviation	Min	Max	Mean	Median	Standard deviation	Min	Max
Portfolio Sustainability score	93.7144	93.5566	1.3080	90.6300	98.3933	93.5720	93.3800	1.0959	91.3233	97.2333
Portfolio Environmental score	95.6993	95.8200	1.6865	88.4400	99.1900	95.5085	95.6400	1.4539	89.8200	98.6600
Portfolio Social score	92.0114	91.7000	1.7939	88.3200	97.7900	91.7753	91.4500	1.5078	89.0100	96.9900
Portfolio Governance score	93.4471	93.2900	1.3896	90.5400	98.3800	93.4456	93.3200	1.1773	91.0700	97.4100
Age (in months)	154.2668	118.2600	122.9667	4.9333	478.7333	197.5250	154.2500	161.0820	4.8333	655.6667
Log (fund size)	8.2082	8.2450	0.7482	6.2995	9.7899	8.3885	8.4167	0.6943	6.4847	9.9276
Return (%)	0.1729	0.0585	5.2099	-11.8765	13.4091	-0.3765	-0.4001	4.8491	-11.8143	11.6608
Net flows (in % of total net assets)	-0.1580	-0.04590	5.1662	-13.2606	11.8902	0.3859	0.4043	4.8174	-11.5430	11.8194

Table 2. Univariate analysis

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Treated x post_SFDR	0.0605***	0.0617**	0.0686**	0.0515**
	(0.0209)	(0.0264)	(0.0293)	(0.0000)
Fund fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	111,148	111,148	111,148	111,148
Adjusted R^2	0.9719	0.9665	0.9694	0.9752

This table reports the results from univariate analysis with the dependent variables Portfolio Sustainability Score, Portfolio Environmental Score, Portfolio Social Score, and Portfolio Governance Score. The explanatory variable is the interaction *treated x post_SFDR*. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3. Effects of SFDR Level 2 on Portfolio ESG scores

Dependent variable	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Treated x post_SFDR	0.0613***	0.0614**	0.0545**	0.0545**
	(0.0210)	(0.0265)	(0.0220)	(0.0220)
Age	0.0028	0.0049	-0.0007	-0.0007
	(0.0025)	(0.0032)	(0.0025)	(0.0025)
Log_fund_size	0.0047	-0.0141	0.0138	0.0138
	(0.0226)	(0.0309)	(0.0221)	(0.0221)
Return	-0.0045	-0.0044	-0.0034	-0.0034
	(0.0028)	(0.0033)	(0.0025)	(0.0025)
Net_flows	-0.0034	-0.0037	-0.0013	-0.0013
	(0.0024)	(0.0029)	(0.0024)	(0.0024)
Fund fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	111,148	111,148	111,148	111,148
Adjusted R^2	0.9719	0.9665	0.9753	0.9753

This table reports the results from estimating Equation (1), which examines the improvements in overall sustainability scores of funds affected by the SFDR Level 2 in comparison to unaffected funds. By including fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. All variables are defined in Appendix B. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Effects of SFDR Level 2 on individual fund category

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Article6 x post_SFDR	0.0322	0.0170	0.0245	0.0530**
	(0.0233)	(0.0311)	(0.0363)	(0.0243)
Article8 x post_SFDR	0.0804***	0.0882***	0.0936***	0.0602**
	(0.0221)	(0.0287)	(0.0308)	(0.0236)
Article9 x post_SFDR	0.0473*	0.0505	0.0603*	0.0309
	(0.0241)	(0.0339)	(0.0328)	(0.0251)
Age	0.0026	0.0047	0.0043	-0.0008
	(0.0025)	(0.0032)	(0.0045)	(0.0025)
Log_fund_size	0.0037	-0.0153	0.0076	0.0132
	(0.0225)	(0.0308)	(0.0312)	(0.0221)
Return	-0.0045	-0.0044	-0.0048	-0.0033
	(0.0028)	(0.0033)	(0.0040)	(0.0025)
Net_flows	-0.0034	-0.0038	-0.0045	-0.0013
	(0.0024)	(0.0029)	(0.0035)	(0.0024)
Fund fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	111,148	111,148	111,148	111,148
Adjusted R^2	0.9719	0.9666	0.9694	0.9753

This table reports the results from estimating Equation (3), which examines the improvements in ESG scores of funds across each of article category under SFDR in comparison to control funds, using fund fixed effects and time fixed effects. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. All variables are defined in the appendix. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Comparison of ESG scores among fund categories before SFDR Level 2 announcement

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Article 6 vs Article 8	-0.6166***	-1.0315***	-0.2517	-0.5460***
	(0.1148)	(0.1203)	(0.1651)	(0.1230)
Article 9 vs Article 8	-0.2514	-0.4914***	-0.2331	-0.0308
	(0.1671)	(0.1752)	(0.2403)	(0.1791)
Article 9 vs Article 6	0.3652	0.5401***	0.0185	0.5152***
	(0.1782)	(0.1867)	(0.2562)	(0.1909)
Observations	992	992	992	992
Adjusted R^2	0.0264	0.0678	0.0007	0.0184

This table presents the ANOVA results that compare ESG scores among Article 6, Article 8, and Article 9 funds in the period prior to the announcement of SFDR Level 2. All variables are defined in the appendix. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Comparison of ESG scores among fund categories after SFDR Level 2 announcement

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Article 6 vs Article 8	-0.3824***	-0.6425***	-0.3124***	-0.1795***
	(0.0091)	(0.0116)	(0.0125)	(0.0097)
Article 9 vs Article 8	0.2250***	-0.2612***	0.4358***	0.4947***
	(0.0160)	(0.0204)	(0.0220)	(0.0170)
Article 9 vs Article 6	0.6074***	0.3814***	0.7482***	0.6742***
	(0.0167)	(0.0213)	(0.0229)	(0.0178)
Observations	96,778	96,778	96,778	96,778
Adjusted R^2	0.0233	0.0308	0.0130	0.0150

This table presents the ANOVA results that compare ESG scores among Article 6, Article 8, and Article 9 funds in the period after to the announcement of SFDR Level 2. All variables are defined in Appendix B. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7. Portfolio ESG scores of reclassified Article 6 funds post-reclassification

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Article6_to_8 x post_label_change	0.0594***	0.0718**	0.1006***	-0.0004
	(0.0195)	(0.0318)	(0.0292)	(0.0213)
Article6_to_9 x post_label_change	0.0674	0.1419	0.0666	0.0003
	(0.0653)	(0.0887)	(0.1619)	(0.0854)
Age	0.0013	0.0062	0.0011	-0.0008
	(0.0042)	(0.0059)	(0.0067)	(0.0035)
Log_fund_size	0.0133	-0.0919*	0.0676	0.0527
	(0.0417)	(0.0502)	(0.0597)	(0.0408)
Return	-0.0101	-0.0094	-0.0139	-0.0049
	(0.0062)	(0.0092)	(0.0099)	(0.0072)
Net_flows	-0.0084	-0.0076	-0.0136	-0.0024
	(0.0059)	(0.0091)	(0.0094)	(0.0071)
Fund fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	59,718	59,718	59,718	59,718
Adjusted R^2	0.9649	0.9600	0.9622	0.9683

This table presents the results from estimating Equation (4), which analyses the changes in ESG scores between Article 6 funds that undergo reclassification and those that remain their Article 6 label following the announcement of SFDR Level 2. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. All variables are defined in Appendix B. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 84. Portfolio ESG scores of reclassified Article 8 funds post-reclassification

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Article8_to_6 x post_label_change	-0.1482	-0.0699	-0.2272	-0.2307
	(0.1693)	(0.1216)	(0.2390)	(0.2135)
Article8_to_9 x post_label_change	-0.0190	0.1684**	-0.1317	-0.0918
	(0.0668)	(0.0686)	(0.0794)	(0.0891)
Age	0.0009	-0.0027	0.0084*	-0.0026
	(0.0025)	(0.0033)	(0.0044)	(0.0031)
Log_fund_size	0.0513	0.0338	0.0567	0.0496
	(0.0307)	(0.0410)	(0.0440)	(0.0294)
Return	-0.0093**	-0.0132**	-0.0079	-0.0069*
	(0.0039)	(0.0057)	(0.0057)	(0.0038)
Net_flows	-0.0059*	-0.0102**	-0.0051	-0.0024
	(0.0032)	(0.0048)	(0.0049)	(0.0034)
Fund fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	82,188	82,188	82,188	82,188
Adjusted R^2	0.9687	0.9483	0.9662	0.9728

This table presents the results from estimating Equation (5), which analyses the changes in ESG scores between Article 8 funds that undergo reclassification and those that remain their Article 8 label following the announcement of SFDR Level 2. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. All variables are defined in Appendix B. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 9. Portfolio ESG scores of reclassified Article 9 funds post-reclassification

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Article9_to_8 x post_label_change	-0.0351*	-0.0543*	-0.0433	-0.0033
	(0.0182)	(0.0283)	(0.0273)	(0.0214)
Age	0.0010	-0.0111	0.0037	0.0101
	(0.0071)	(0.0090)	(0.0111)	(0.0070)
Log_fund_size	0.0159	-0.0204	-0.0087	0.0830*
	(0.0429)	(0.0547)	(0.0576)	(0.0419)
Return	-0.0077	-0.0056	-0.0079	-0.0106*
	(0.0070)	(0.0074)	(0.0097)	(0.0058)
Net_flows	-0.0042	-0.0013	-0.0045	-0.0069
	(0.0066)	(0.0073)	(0.0091)	(0.0052)
Fund fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	13,680	13,680	13,680	13,680
Adjusted R^2	0.9403	0.9505	0.9487	0.9647

This table presents the results from estimating Equation (6), which analyses the changes in ESG scores between Article 9 funds that downgrade to Article 8 and those that remain their Article 9 label following the announcement of SFDR Level 2. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. All variables are defined in Appendix B. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 10. Effects of SFDR Level 2 on controversial exposure of reclassified Article 6 funds

Dependent variables	(1) Controversial weapons	(2) Tobacco	(3) Severe controversies	(4) Thermal coal	(5) Nuclear
Article6_to_8 x	-0.1113**	-0.0848**	-0.0465	-0.2163***	-0.0638
post_label_change	(0.0523)	(0.0408)	(0.0318)	(0.0404)	(0.0620)
Article6_to_9 x	-0.3139**	-0.0576	-0.1272	-0.1268	-0.1594
post_label_change	(0.1202)	(0.0975)	(0.0784)	(0.1065)	(0.1130)
Age	-0.0020	-0.0035	-0.0132	-0.0039	-0.0122
	(0.0126)	(0.0055)	(0.0137)	(0.0115)	(0.0086)
Log_fund_size	0.0696	-0.2072***	0.1463*	0.0712	-0.0489
	(0.0795)	(0.0704)	(0.0827)	(0.0746)	(0.0879)
Return	0.0010	0.0243**	-0.0236*	-0.0018	-0.0042
	(0.0202)	(0.0115)	(0.0137)	(0.0106)	(0.0123)
Net_flows	0.0029	0.0229*	-0.0213	-0.0059	-0.0070
	(0.0203)	(0.0106)	(0.0138)	(0.0096)	(0.0116)
Fund fixed effect	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	57,528	57,528	57,528	57,528	58,539
Adjusted R^2	0.8843	0.8407	0.8172	0.8349	0.8993

This table presents the changes in controversial exposure between Article 6 funds that upgrade to Article 8 and 9 and those that remain their Article 6 label following the announcement of SFDR Level 2. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. All variables are defined in Appendix B. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 11. Effects of SFDR Level 2 on controversial exposure of reclassified Article 8 funds

Dependent variables	(1) Controversial weapons	(2) Tobacco	(3) Severe controversies	(4) Thermal coal	(5) Nuclear
Article8_to_6 x	0.5708	0.1205	-0.0789	0.1750	-0.3894
post_label_change	(0.5318)	(0.0921)	(0.2420)	(0.1626)	(0.2300)
Article8_to_9 x	-0.0263	-0.0346	-0.0335	0.0781	-0.0688
post_label_change	(0.0481)	(0.0681)	(0.0593)	(0.0605)	(0.2691)
Age	-0.0017	-0.0028	0.0050	-0.0115	-0.0025
	(0.0029)	(0.0026)	(0.0063)	(0.0071)	(0.0076)
Log_fund_size	-0.0973**	-0.0598*	0.0226	-0.0544	-0.0732
	(0.0431)	(0.0295)	(0.0377)	(0.0429)	(0.0780)
Return	0.0088	-0.0075	-0.0012	-0.0075	-0.0202
	(0.0055)	(0.0054)	(0.0037)	(0.0143)	(0.0208)
Net_flows	0.0097*	-0.0084*	-0.0016	-0.0105	-0.0226
	(0.0055)	(0.0044)	(0.0038)	(0.0148)	(0.0210)
Fund fixed effect	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	80,064	80,064	80,064	80,064	80,064
Adjusted R^2	0.8899	0.6771	0.7184	0.8105	0.8855

This table presents the changes in controversial exposure between Article 8 funds that upgrade to Article 9 or downgrade to Article 6 and those that remain their Article 8 label following the announcement of SFDR Level 2. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. All variables are defined in Appendix B. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 12. Effects of SFDR Level 2 on controversial exposure of reclassified Article 9 funds

Dependent variables	(1) Controversial weapons	(2) Tobacco	(3) Severe controversies	(4) Thermal coal	(5) Nuclear
Article9_to_8 x	0.0042	-0.0489*	0.0046	0.0514*	0.0688
post_label_change	(0.0275)	(0.0264)	(0.0143)	(0.0289)	(0.0614)
Age	-0.0199	0.0075***	-0.0098	-0.0073	0.0416
	(0.0119)	(0.0025)	(0.0096)	(0.0118)	(0.0283)
Log_fund_size	0.0258	-0.0146	-0.0016	0.0092	-0.0756
	(0.0418)	(0.0497)	(0.0167)	(0.0274)	(0.0819)
Return	-0.0003	0.0015	-0.0009	-0.0009	-0.0058
	(0.0054)	(0.0048)	(0.0019)	(0.0028)	(0.0088)
Net_flows	0.0009	0.0023	-0.0014	-0.0011	-0.0031
	(0.0055)	(0.0033)	(0.0017)	(0.0020)	(0.0079)
Fund fixed effect	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	12,915	12,915	12,915	12,915	12,915
Adjusted R^2	0.8024	0.2847	0.6604	0.8568	0.8864

This table presents the changes in controversial exposure between Article 9 funds that downgrade to Article 8 and those that remain their Article 9 label following the announcement of SFDR Level 2. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. All variables are defined in Appendix B. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 13. Effects of SFDR Level 2 on Portfolio ESG scores (Non-replacement PSM sample)

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Treated x post_SFDR	0.0435**	0.0526*	0.0323	0.0413**
	(0.0173)	(0.0296)	(0.0229)	(0.0166)
Age	0.0004	0.0014	0.0014	-0.0019
	(0.0036)	(0.0042)	(0.0061)	(0.0033)
Log_fund_size	0.0060	-0.0721	0.0667	0.0188
	(0.0441)	(0.0537)	(0.0625)	(0.0471)
Return	-0.0095	-0.0129	-0.0107	-0.0050
	(0.0076)	(0.0089)	(0.0110)	(0.0077)
Net_flows	-0.0074	-0.0114	-0.0087	-0.0022
	(0.0075)	(0.0091)	(0.0112)	(0.0076)
Fund fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	42,716	42,716	42,716	42,716
Adjusted R^2	0.9645	0.9582	0.9607	0.9687

This table reports the results from estimating Equation (1), which examines the improvements in ESG scores of funds affected by the SFDR Level 2 in comparison to unaffected funds, using non-replacement PSM sample. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. We perform our matching based on averaged pre-directive values of our matching variables without replacement. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 14. Effects of SFDR Level 2 on Portfolio ESG scores (Replacement PSM sample)

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Treated x post_SFDR	0.0593***	0.0850***	0.0321	0.0528***
	(0.0153)	(0.0291)	(0.0190)	(0.0134)
Age	0.0034	0.0038	0.0097**	-0.0028
	(0.0022)	(0.0030)	(0.0037)	(0.0023)
Log_fund_size	0.0333	-0.0056	0.0567*	0.0425*
	(0.0223)	(0.0283)	(0.0329)	(0.0229)
Return	-0.0073***	-0.0044	-0.0099**	-0.0066**
	(0.0024)	(0.0028)	(0.0041)	(0.0025)
Net_flows	-0.0055**	-0.0030	-0.0087**	-0.0040
	(0.0021)	(0.0027)	(0.0036)	(0.0024)
Fund fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	135,177	135,177	135,177	135,177
Adjusted R^2	0.9690	0.9622	0.9665	0.9727

This table reports the results from estimating Equation (1), which examines the improvements in ESG scores of funds affected by the SFDR Level 2 in comparison to unaffected funds, using replacement PSM sample. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. We perform our matching based on averaged pre-directive values of our matching variables without replacement. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 15. Effects of SFDR Level 2 on individual fund category (Non-replacement PSM sample)

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Article6 x post_SFDR	0.0333	0.0329	0.0074	0.0443**
	(0.0206)	(0.0339)	(0.0293)	(0.0201)
Article8 x post_SFDR	0.0491**	0.0612*	0.0506	0.0394*
	(0.0204)	(0.0332)	(0.0311)	(0.0208)
Article9 x post_SFDR	0.0794	0.1632*	0.0422	0.0346
	(0.0516)	(0.0804)	(0.0574)	(0.0591)
Age	0.0004	0.0014	0.0014	-0.0019
	(0.0036)	(0.0042)	(0.0061)	(0.0033)
Log_fund_size	0.0057	-0.0730	0.0665	0.0189
	(0.0441)	(0.0538)	(0.0626)	(0.0471)
Return	-0.0095	-0.0128	-0.0108	-0.0050
	(0.0076)	(0.0090)	(0.0109)	(0.0077)
Net_flows	-0.0073	-0.0112	-0.0087	-0.0022
	(0.0075)	(0.0091)	(0.0111)	(0.0076)
Fund fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	42,716	42,716	42,716	42,716
Adjusted R^2	0.9645	0.9582	0.9607	0.9687

This table reports the results from estimating Equation (3), which examines the improvements in ESG scores of funds across each of article category under SFDR in comparison to control funds, using non-replacement PSM sample. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. All variables are defined in the appendix. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 16. Effects of SFDR Level 2 on individual fund category (Replacement PSM sample)

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Article6 x post_SFDR	0.0370**	0.0386	0.0165	0.0432***
	(0.0155)	(0.0282)	(0.0216)	(0.0145)
Article8 x post_SFDR	0.0698***	0.1040***	0.0414**	0.0581***
	(0.0160)	(0.0306)	(0.0195)	(0.0140)
Article9 x post_SFDR	0.0678***	0.1277***	0.0217	0.0498***
	(0.0208)	(0.0392)	(0.0244)	(0.0173)
Age	0.0034	0.0038	0.0097**	-0.0028
	(0.0021)	(0.0029)	(0.0037)	(0.0023)
Log_fund_size	0.0324	-0.0076	0.0561	0.0421*
	(0.0222)	(0.0282)	(0.0330)	(0.0229)
Return	-0.0073***	-0.0044	-0.0099**	-0.0067**
	(0.0024)	(0.0028)	(0.0041)	(0.0025)
Net_flows	-0.0055**	-0.0029	-0.0087**	-0.0040
	(0.0021)	(0.0027)	(0.0036)	(0.0024)
Fund fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	135,177	135,177	135,177	135,177
Adjusted R^2	0.9690	0.9622	0.9665	0.9727

This table reports the results from estimating Equation (3), which examines the improvements in ESG scores of funds across each of article category under SFDR in comparison to control funds, using replacement PSM sample. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. All variables are defined in the appendix. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 17. Effects of SFDR Level 2 on Portfolio ESG scores (excluding French-domiciled funds)

Dependent variables	(1) Portfolio Sustainability Score	(2) Portfolio Environmental Score	(3) Portfolio Social Score	(4) Portfolio Governance Score
Treated x post_SFDR	0.0632***	0.0613**	0.0732**	0.0550**
	(0.0215)	(0.0272)	(0.0300)	(0.0223)
Age	0.0030	0.0049	0.0048	-0.0006
	(0.0026)	(0.0033)	(0.0046)	(0.0025)
Log_fund_size	0.0078	-0.0146	0.0126	0.0211
	(0.0236)	(0.0325)	(0.0326)	(0.0230)
Return	-0.0058**	-0.0054	-0.0065*	-0.0042
	(0.0027)	(0.0035)	(0.0038)	(0.0027)
Net_flows	-0.0045*	-0.0047	-0.0061*	-0.0021
	(0.0025)	(0.0034)	(0.0034)	(0.0026)
Fund fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Observations	103,758	103,758	103,758	103,758
Adjusted R^2	0.970	0.966	0.968	0.974

This table reports the results from estimating Equation (1), which examines the improvements in ESG scores of funds affected by the SFDR Level 2 in comparison to unaffected funds, excluding French-domiciled funds from the sample. By including both fund and time fixed effects, the analysis controls for unobserved time-invariant characteristics of funds and common time trends that might influence ESG scores. We perform our matching based on averaged pre-directive values of our matching variables without replacement. All continuous variables are winsorised at the 1% and 99% levels. Standard errors double clustered at the fund level and time level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure 1. SFDR key dates

Figure 2. Coefficient plots of monthly effects of SFDR Level 2 on ESG scores

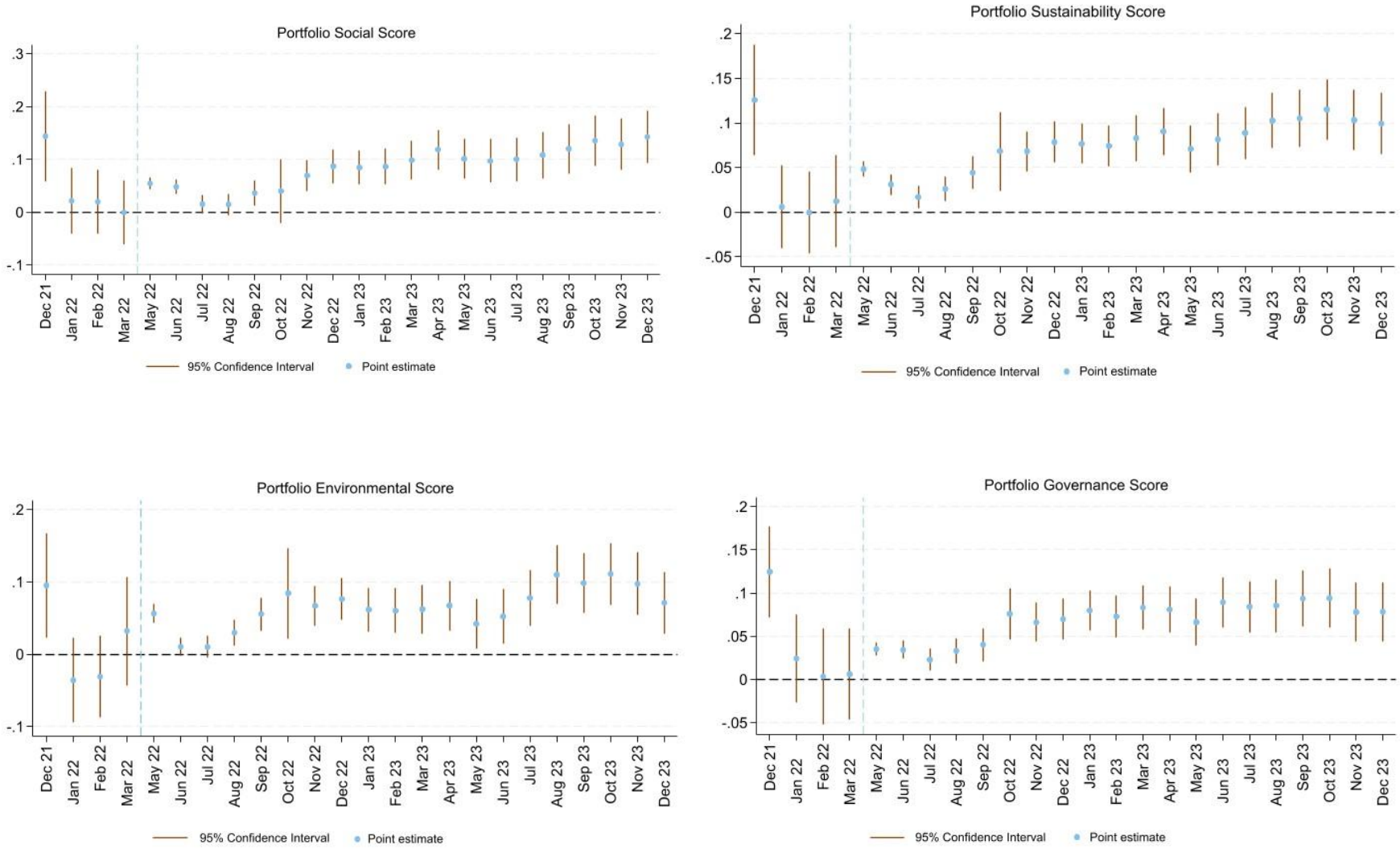

Figure 3. Portfolio ESG scores across three fund categories

Figure 4. SFDR fund type breakdown (by number of funds)