Sustainable Finance Disclosure Regulation: voluntary signaling or mandatory disclosure?

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Abstract

We study the consequences of mandatory sustainable finance disclosure regulation (SFDR) for the money flows and investment behavior of mutual funds. Under SFDR, any EU-regulated mutual fund is required to publicly classify itself as either Article 8 (promoting ESG characteristics), Article 9 (having ESG/sustainability goals as objective 9), or Article 6 ('Other' funds). Applying difference-differences analysis, we find that, EU funds classified as either Article 8 or 9 experience on average a 0.96 percentage point higher annualized flow post SFDR relative to Article 6 funds. This difference in flow is significant after both the SFDR introduction date and implementation date and holds regardless of whether funds received a high or low Morningstar Sustainability Rating pre-SFDR. Following SFDR, retail (but not institutional) funds with Article 8 or 9 classification demonstrate stronger portfolio decarbonization and higher portfolio-level ESG scores compared to Article 6 funds. In aggregate, EU-regulated funds significantly improve the ESG profile of their investments relative to U.S. mutual funds, holding for both retail and institutional funds. Taken together, the results suggest that sustainable finance disclosure regulation enables mutual funds to attract capital by signaling commitments to sustainable investments, and it induces funds to change their behavior.

1 Introduction

The demand for "green" assets has been increasing rapidly since the Paris Agreement in 2015. The United Nations estimated that in 2020 sustainable investment funds encompassed approximately $1.7 trillion in assets under management (AUM), making up 3 percent of assets of all global open-ended funds' assets. Investors have increasingly shown shifts in their preferences towards sustainable products, instigating this surge in the supply of green assets. The increasing prominence of sustainability-conscious investors has consequently also led to a demand for improved transparency of the non-financial performance of not only firms but also of other financial market participants such as mutual funds or banks. Despite a surge in company and fund commitments toward incorporating climate risks, financial stakeholders are required to make decisions based on the disclosures that companies and firms voluntarily put forward, either by considering the disclosure directly or by using sustainability indicators from external rating agencies such as MSCI or Morningstar.

Aiming to lower information asymmetries in the financial market concerning the sustainability considerations of financial products, the Sustainable Finance Disclosure Regulation (SFDR) was enforced in European Union member states in March 2021. The SFDR is a sustainability information disclosure regulation requiring financial market participants to be transparent about their sustainability efforts: fund managers need to publicly disclose whether their funds are grey, light green, or dark green (Article 6, 8, and 9, respectively), based on their sustainability commitments and objectives. Next to labeling, the mandate enables fund managers to self-select themselves into a disclosure dose (here 'degree' of non-financial disclosure as well as sustainability). Unlike voluntary disclosure, a mandatory disclosure regulation such as the SFDR will obligate (fund) managers to credibly convey their sustainability efforts to the market. Several papers have indicated concerns that voluntary disclosure may bring about an increased risk of window dressing. Chen et al. (2021) show that investor reliance on intermediary information providers fuels fund managers' incentives to misclassify their holdings, and Aghamolla and Smith (2023); Jin et al. (2022) find additional evidence that managers tend to issue more complicated disclosure upon observing negative news. A working paper by Parise and Rubin (2023) suggests that mandatory portfolio disclosure does not stop from taking part in 'ESG manipulation'.

In this paper, we study the behavior of both investors and mutual funds concerning the announcement and implementation of the SFDR. The disclosure regulation allows fund managers to publicly commit themselves to consider sustainability in their portfolios. This form of public commitment may be interpreted by the market as a signal of their initial or future level of sustainability. Different from signals that have a voluntary origin, the SFDR requires all funds sold on the European market to also provide transparency about their signal. We seek to find out whether investors respond to these commitments, and as a consequence, we evaluate to what extent these signals are credible–do Article 8 or 9 mutual funds also improve their sustainability performance?

We show that the Article labels have the following two effects. First, the labels aim to bring a common sustainability metric to the European fund universe, making it easier to compare funds. Without a regulated label, investors make decisions based on voluntarily disclosed information and or sustainability labels provided by external rating agencies. Second, it enables European fund managers to signal their funds' sustainability objectives to the market. The voluntary disclosure literature often uses signaling theory (Spence, 1973) to explain how managers show their commitment to considering ESG issues: nondisclosure imposes an adverse signal, and managers should only

disclose when the benefits of doing so exceed the costs (i.e., direct, proprietary, and political costs). In the context of funds, literature shows that fund managers may decide to sign up to the United Nations Principles for Responsible Investment (PRI) to publicly signal their funds' commitment to sustainability to the market (Kim and Yoon, 2023; Humphrey and Li, 2021; Liang et al., 2022) by disclosing their responsible investment activity. In return, these funds also see additional investor flows.

To examine whether investors respond to the funds' signaling, we focus on a sample of European mutual funds from the Morningstar global equity funds database and exploit the announcement and implementation dates of the SFDR in a quasi-natural experimental setting. On November 27th, 2019 the European Commission announced their request for more transparency in the financial market concerning sustainability, setting the 10th of March 2021 as the date when the SFDR was to be officially implemented. For our sample of funds, we identify each fund's Article label using the Morningstar SFDR Article variable. To determine changes in fund ESG behavior we use data on their carbon intensity, Morningstar Globe Score, and MSCI Impact Measure.

Conform the literature, we find evidence that investors respond to the SFDR Article labels. We conduct a fund flow analysis that aims to pick up to what degree investors move their investment flows toward Article 8 or Article 9 funds. Although statistically significant at the 5 percent level, investor flows merely increase by 0.08 percentage points. While the effect may be considered economically small, we find some evidence that the SFDR encourages investors to shift their investments toward more sustainable products–therefore fulfilling the goal of the European Union. Especially notable is the modest magnitude of this effect compared to other studies such as Gibbon et al. (2023); Hartzmark and Sussman (2019) that look at investor behavior through changes in flows. A possible explanation for our findings may, similar to the findings of Hartzmark and Sussman (2019), be that investors are mostly interested in moving their investments toward funds with the highest sustainability indicators–in the context of the SFDR, investors are expected to target Article 9 or dark-green funds. Lastly, we check for heterogeneous effects concerning pre-SFDR sustainability levels in a triple difference (DDD) model and find no evidence of heterogeneous flow effects for Article 8(/9) funds that, pre-SFDR, have a low Morningstar Globe Score compared to those with a high score. In a horse race we try to disentangle the different sustainability signals. Our results indicate that while investors do not seem to care much about the Article 8 (i.e., light-green) label compared to other sustainability labels (e.g., high MS glove ratings, MSCI impact score, or MS Low Carbon Designation), an Article 9 signal does better in attracting average investor flows than other fund-level sustainability indicators. This is especially true for our sample of retail funds.

Next, we test the hypothesis that funds with an Article 8 or 9 label adjust their portfolios towards more sustainable companies to bring credibility to their signal. While the SFDR allows fund managers to (strategically) choose what Article label they publicly associate their funds with, the most important component of the SFDR is the mandatory disclosure of non-financial ESG information. In the context of SFDR where non-financial information disclosure is mandated, funds that signal themselves as light or dark green importantly also need to be transparent regarding the actual greenness of their assets: "The aim is to ensure [...] that the SFDR plays its part in tackling greenwashing" (European Commission, 2023). To the extent to which the SFDR's Article labels alone *should* be used or interpreted as a signal, we expect Article 8 and 9 funds to improve their sustainability to a larger degree than funds that take on an Article 6 label. Using a difference-in-difference estimation we find that these funds both improve their Morningstar Globe ESG scores

as well as reduce their carbon intensity levels more than Article 6 funds. This effect is robust when estimating inverse probability weighted estimators Abadie (2005), and when we control for the months when COVID-19 disrupted the market.

We recognize that there may be two mechanisms at play: one where the SFDR enforces the mandatory disclosure of sustainability information, and one where the regulation allows for funds to signal their sustainability commitment. We therefore distinguish two groups: retail funds that cater to less sophisticated investors, and institutional funds that cater to a sophisticated clientele of institutional investors. We expect the former to respond to sustainability signals, while we expect the latter to exclusively respond to the disclosed information.

As retail investors are more limited in their resources and are subject to more search frictions than institutional investors, they are more likely to rely on close-at-hand public signals such as ESG scores (Brown et al., 2008; Calvet et al., 2007; Rzeźnik et al., 2022; Brown et al., 2023; Moss et al., 2023). Even though the SFDR Articles were initially not meant to be used as a labeling regime (European Insurance and Occupational Pensions Authority, 2023), the differentiation in the regulation's requirements for each label may make retail investors use them as such. To test whether retail investors drive the flow effect, we test a triple difference model controlling for the level of sophistication of the funds' investor base. As expected we find that retail investors respond to the newly imposed sustainability signals in the market, while institutional investors do not. This brings about two potential explanations: (i) institutional investors may already be aware of information that the SFDR obliges fund managers to disclose, and may additionally recognize ex-ante how funds will self-select into the Article labels (e.g., Brown et al., 2008), or (ii) institutional investors do not believe the Article label to be a credible signal; they for example instead choose to consider the fund's underlying investments' sustainability characteristics.

By splitting our sample between retail and institutional investors we try to get a better glimpse of the mechanisms of the voluntary and the mandatory component of the SFDR. In line with signaling theory, our sample of European retail funds shows that post-SFDR Article 8 (and 9) funds reduce their carbon intensity more extensively than Article 6 funds, by 8.364 to 8.579 metric tons. Similar effects are found for the Morningstar Globe Score. However, in our sample of institutional funds, we do not find this. Instead, we find that institutional Article 8 and 9 as well as institutional Article 6 funds lower their carbon intensity post-SFDR.

To bring additional insights into the mechanism at play, we expand our analysis by creating a new control group made existing out of a sample of US-domiciled equity mutual funds. With the treatment group being set to *all* funds eligible for sale in the EU, we want to see whether the SFDR incentivizes European funds, regardless of their Article label, to adjust their portfolio towards more sustainable investments than non-affected US funds. Here we again split the sample for retail and institutional funds. Interestingly, we see that both European institutional as well as European retail funds reduced their carbon intensity after the introduction of the SFDR. Compared to US-domiciled institutional funds, European institutional funds reduced their carbon intensity strongly, by 14.169 metric tons after the SFDR announcement. The size of the difference-in-difference coefficient in an economic sense is similar but larger than for the retail funds sample. This suggests that the SFDR, as intended, successfully urges funds to improve greenness. This finding imposes the question of why institutional Article 8(/9) funds do not see improvements of higher quantity in their carbon intensity or ESG scores compared to institutional Article 6 funds. We offer the following potential mechanisms.

Firstly, institutional funds, irrespective of having an Article 6 or Article 8(/9) label, may shift their portfolios toward more sustainable investments to address any reputational concerns that come from the disclosure mandate. Both Cao et al. (2019); Tomar (2023) describe how peer effects of CSR policies may take form as a strategic response after ESG information is disclosed. Second, institutional funds, irrespective of having selected into an Article 6 or Article 8(/9) label may try to meet their investors' sustainability demands (e.g., Edmans et al., 2022; Ilhan et al., 2021). Dyck et al. (2019) reports that the demand for responsible investments is largely driven by institutional investors. Moreover, similar to the funds they invest in, European institutional investors also need to abide by the regulations of the SFDR; the sustainability concerns of institutional funds directly affect the required disclosure of their institutional investors. Third, following a similar reasoning as for the second mechanism, institutional funds may be more apprehensive to signal to be sustainable (i.e., take on an Article 8, or 9 label). The literature finds that institutional investors are better monitors than retail investors (Hartzell and Starks, 2003; He et al., 2019). As a result, these investors may to a larger extent consider the sustainability associations of their underlying investments.

This research also relates to work on investor preferences regarding sustainability (Riedl and Smeets, 2017; Hartzmark and Sussman, 2019; Ceccarelli et al., 2024; Gibson Brandon et al., 2022); we note that investors respond to sustainability signals in the market. In this paper, we indeed see evidence that retail investors respond to a new sustainability signal in the market. Our results show a small net inflow towards Article 8 funds. More interesting are our horse race findings where we see that retail investors in the SFDR time frame significantly respond to funds that signal with an Article 9 (or dark-green) label. Institutional investors on the other hand respond to the 'dark-green' signal to a lesser extent, seeing a convergence of the top-sustainability performance indicators after the SFDR implementation date.

Additionally, we contribute to the literature on how mutual funds cater to the demand for sustainable assets. Literature on voluntary disclosure finds that, in equilibrium, the firms who disclose more sustain a higher level of benefits from disclosing than the level of costs they need to endure (e.g., Beyer and Dye, 2012; Matsumura et al., 2022; Goldstein et al., 2022; Ilhan et al., 2021; Banerjee et al., 2023) Similarly, funds may opt to signal their sustainability commitments by becoming a signatory of the United Nations Principles for Responsible Investment (PRI). Theoretically, agents should only choose to signal when they find themselves to be (one of) the most sustainable" among their competitors. However, several papers show how funds may partake in window-dressing activities to attract additional investor flows (e.g., Agarwal et al., 2014; Chen et al., 2021). In their research on sustainability commitments, Kim and Yoon (2023) found no significant difference in the sustainability level between funds that signed up for the UN's PRI and those that did not, both before and after signing up. Other studies that find evidence of ESG window-dressing are Liang et al. (2022); Raghunandan and Rajgopal (2022); Gibson Brandon et al. (2022); Michaely et al. (2021). In our research, we describe how the SFDR allows for signaling but simultaneously enforces heightened levels of transparency through the information disclosure mandate. We, accordingly, find no evidence of window-dressing.

This paper sheds light on how mandatory disclosure brings credibility to mutual funds' sustainability signals that the regulation allows for; put differently, we examine how mandatory disclosure induces mutual funds to change their behavior. In her study on corporate green bonds, Flammer et al. (2021) describes how firms that issue green bonds subsequently improve their environmental performance, showing that green bonds are a credible signal of their commitment to sustainability.

Our findings focus on mutual funds instead of firms, finding that a mandatory disclosure regulation that targets financial market participants can induce fund managers to lower their carbon intensity and raise their ESG scores.

Studies that examine the behavioral effects of non-financial disclosure mandates have primarily targeted firms: Grewal et al. (2019); Downar et al. (2021); Jouvenot and Krueger (2019); Huang and Lu (2022) find evidence that mandatory disclosures targeting firms have proven effective in stimulating behavior change. Additional information and/ or improved transparency in the market drive changes in the behavior of stakeholders and consequently that of firms, moving through mechanisms such as the cost of capital, peer bench-marking, and reduced agency costs (Christensen et al., 2021). Different from voluntary disclosure, mandatory disclosure levels out the playing field, removing information asymmetries and improving comparability (Dyer et al., 2017). By shifting its focus from firms to financial market participants, the SFDR is breaking new ground in the context of non-financial disclosure. The disclosure mandate for funds brings about a standardized sustainability metric (i.e., Article 6, 8, or 9), lowers information asymmetries by requiring disclosure of funds' ESG incorporation and/ or objectives, and forces all European funds to comply.

More general examples of lowered information asymmetries are explained in works by for example, Chatterji and Toffel (2010) who discuss how firms respond in rectifying manners to being publicly rated on their corporate environment, and Jin and Leslie (2003) who find evidence that restaurants improve their hygiene standards after mandatory disclosure. Instead, our research provides insight into the fund-level effects of mandated sustainability information disclosure.

Furthermore, work on mandatory disclosure addressing funds has focused on the SEC's quarterly holding reporting mandate (Agarwal et al., 2014, 2015; Parise and Rubin, 2023). Parise and Rubin (2023) show that even when funds are required to report their holdings, in between these disclosure dates, funds try to chase returns by rebalancing their portfolios towards less sustainable, but higher risk-adjusted return firms. Our work specifically considers the newly implemented non-financial disclosure regulation implemented by the EU, bringing additional fund-level transparency regarding ESG. Gupta and Starmans (2023) describe how mandatory disclosure can either take on a 'lax' or a 'stringent' format. In their work, they describe how before 2023, the SFDR's requirements may be considered less stringent, allowing for some green-washing within the greenness of funds (light-green vs dark-green). In this paper, we consider fund-level data until December 2022. Interestingly, even in this 'lax' regulatory environment, we find economically and statistically significant reductions in fund carbon intensity for SFDR-compliant, and Article 8(/9) funds.

Lastly, disclosure literature touches upon the sophistication level of economic agents receiving information. Retail investors tend to respond to ESG signals (such as ESG scores) but do react to material ESG disclosures (Rzeźnik et al., 2022; Moss et al., 2023). A similar effect is visible in the context of consumers: Leonelli et al. (2024) find that consumers rarely consult disclosed firm ESG reports, but those who are more financially sophisticated respond more strongly to ESG information. Analogously we find evidence that indeed retail investors positively respond to funds' sustainability labels. Institutional investors, on the other hand, tend to use more sophisticated performance benchmarks (Barber et al., 2016) and are better monitors (Hartzell and Starks, 2003; He et al., 2019). Accordingly, we see that institutional investors do not respond to the SFDR Article labels. We additionally, find no differences between the sustainability outcomes for institutional funds with an Article 8(/9) or Article 6 label. Nevertheless, we observe that compared to *US-domiciled* institutional funds, *SFDR-compliant* institutional funds strongly improve their

sustainability outcomes.

2 Background: SFDR

As part of the European Union (EU) 2018 Sustainable Growth Action Plan, on November 27th, 2019 the EU introduced its Sustainable Finance Disclosure Regulation (SFDR) (MSCI, 2021). As of March 10th, 2021, this regulation aims to promote sustainable investment by requiring asset management companies to report on their investments' environmental, social, and governmental (ESG) risks. Additionally, financial market participants are ought to disclose information regarding the consideration of their investments' (adverse) sustainability impacts (The European Union, 2019). Based on their sustainability objectives, asset managers need to classify their EU-based funds as Article 6, 8, or 9. Specifically, funds that are promoted to consider ESG objectives are classified as either Article 8 or 9 products, with Article 9 differentiating from Article 8 by only considering funds that have a sustainable investment objective alongside generating a financial return (Robeco, 2022; Bioy et al., 2022). By aligning with Article 8 or 9, funds must disclose more information on their sustainability measures and objectives, than if they were to merely comply with Article 6. Sustainable investment objectives may for example be measured by fund-level sustainable development goals (SDG) scores. Of all assets sold in the EU, in 2021, 42.4 percent were classified as an Article 8 or 9 fund (Bioy et al., 2022). With the SFDR, the EU aims to lower information asymmetries between affected mutual funds and investors–the policy aims to promote transparency, discourage greenwashing, and promote responsible and sustainable investment.

After the implementation of the SFDR on 10 March 2021, as of 2022 funds are also required to disclose a Principal Adverse Impact (PAI) statement on both the entity level and the product level on their website and in pre-contractual financial product documentation, respectively. This statement provides market information on the negative effects on sustainability that are considered in the investment decisions of the fund on two levels. Most importantly, Article 9 funds have to comply with the 'do no significant harm (DNSH) principle of their sustainable objective, while this holds for the proportion of sustainable investments of Article 8 funds. The DNSH principle is directly linked to the EU Taxonomy Minimum Safeguards.

The announcement and implementation dates of the SFDR serve as a shock to both investors and mutual fund managers. The announcement of the SFDR forced affected fund managers to assign themselves to an Article label and provide the required disclosure on their funds' ESG measures and objectives. The regulation brings new ESG information into the market through the fund regulation, lowering information asymmetries between the market and the funds. Additionally, the practicalities of the regulation enable fund managers to use the Article assignments to signal their sustainability commitments to investors.

3 Data

To test our research questions about whether investors and mutual funds respond to the signaling and disclosure effects of the SFDR, we focus on two samples of global equity mutual funds from Morningstar Direct. Specifically, we first consider all equity mutual funds eligible for sale in the European Union and use the Morningstar SFDR flag to assign them to an Article 6, 8, or 9 label.

Morningstar collects fund Article labels of the funds from their prospectuses. For the second part of our analysis on mutual fund behavior, we gather a set of US-domiciled equity mutual funds to form a control group for all European funds that are treated under the SFDR.

From Morningstar Direct we gather a survivorship-bias-free sample of all open-end mutual equity funds that covers the period from December 2017 to December 2022. Next to this, we use Datastream and FactSet to gather complementary data. From this global sample, we keep all funds for which we have an ISIN or Ticker identifier and we keep the funds that are domiciled (or marketed) in the US and member states of the European Union. Additionally, we keep funds that are not domiciled in the European Union but are eligible for sale in EU member states. To determine the latter we match our sample with the Region of Sale indicator of Datastream which provides a detailed list of all countries in which the fund is available for sale[1]. Lastly, we filter our sample on Morningstar Category, removing for example sector-specific funds[2].

Similar to other works (e.g., Hartzmark and Sussman, 2019; Gantchev et al., 2023; Ceccarelli et al., 2024) we aggregate the data from Morningstar Direct that is on a share class level to the fund level for our analyses. All our monetary variables are denoted in USD. Fund size (TNA in USD) is computed as the sum across all share classes. Following the literature we limit our end-month fund-level TNA data points to those with a TNA above one million dollars. Returns and expense ratios are calculated by taking the mean across share classes. For the Morningstar Star Ratings, we use those of the fund's largest share class, and fund age is calculated using the inception date of the oldest share class. To estimate fund flows we follow Sirri and Tufano (1998) by dividing the monthly flow in USD by the lagged TNA. Next to this, similar to Hartzmark and Sussman (2019) and Ceccarelli et al. (2024) we estimate a normalized flow variable by splitting funds into deciles based on their TNA after which we assign each fund to percentiles based on their flows within each size decile.

To assess how SFDR affects mutual funds' ESG performance, we collect fund-level metrics that measure the ESG performance of funds' underlying holdings. We collect from Morningstar, respectively, the Globe Rating, their fund-level carbon intensity measure, and the Morningstar Low Carbon Designation, and from Factset the MSCI ESG Fund Impact Measure. Morningstar assigns an asset-weighted aggregate of firm-level ESG risk ratings to funds if at least 67 percent of the fund's holdings have such a firm-level ESG rating[3]. The fund-level Globe Score ranges from 1 to 5 and is estimated monthly by Morningstar, respectively to the fund's category. Next to this, Morningstar provides information on a fund's carbon intensity. This measure is the asset-weighted fund's portfolio's total emissions scope 1, 2 (metric tons of CO2) divided by the revenue (Mil USD). For funds, it measures their carbon efficiency measured in metric tons of CO2. Finally, we gather data on MSCI's Impact Measure from their ESG Fund Metrics. Different from Article 8 funds, Article 9 funds also need to comply with the SFDR's DNSH principle. In practice, this means that Article 9 funds aim to invest in companies with a positive impact on society or the

[1]Morningstar's region of sale indicator is less detailed, only providing whether the share class' region of sale is 'All Offshore', 'Pure Offshore', 'European Cross-Border', 'Nordic Cross-Border', 'Asian Cross-Border', or 'Global Cross-Border'.

[2]The remaining Morningstar Categories are similar to that of Ceccarelli et al. (2024). The thirteen categories in our sample are Europe emerging markets equity, Europe equity large cap, Europe equity mid/small cap, global equity large cap, global equity mid/small cap, long/short equity, UK equity large cap, UK equity mid/small cap, US equity large cap blend, US equity large cap growth, US equity large cap value, US equity mid cap, and US equity small cap.

[3]The firm-level ESG risk rating data is developed and maintained by Sustainalytics

environment. To account for differences between ESG alignment (Article 8) and environmental and/ or social investment objectives (Article 9), we match our fund sample with MSCI's impact measure. Specifically, this measure accounts for the funds' exposure to firms that purposely address environmental/ social challenges.

Most important for our analysis is the SFDR Article flag that Morningstar provides. Morningstar for all SFDR-targeted funds, collects fund information on the SFDR using the funds' prospectuses and annual reports. They provide 'Article 8 & 9 flags' indicating whether the fund is 'No product acc. to Art. 8/9', an 'Article 8 SFDR Product', 'Article 9 SFDR Product', or 'Product is not in SFDR scope'. This variable does not vary over time and remains constant over time. We are also interested in distinguishing any differences in fund behavior for institutional or retail funds. As we are interested in fund-level sustainability indicators, we define a fund as institutional when more than fifty percent of TNA comes from its institutional share classes.

Table 1, panel A shows the summary statistics of the European funds, while panel B shows the summary statistics of the sample in which we also include the US-based funds. Our total sample contains 8,309 European funds and 2,908 US-domiciled funds, of which we identify 2,770 institutional and 7,361 retail funds. The SFDR Articles are self-assigned and reported by European-domiciled and- marketed funds in their prospectuses. In our European fund sample, we identify 5,986 funds that are flagged with either an Article 8 or 9 label by Morningstar and 1,664 that are indicated as 'No product acc. to Art. 8/9', which we assume are Article 6 funds. If we assume that Morningstar correctly flags all Article 8 and 9 funds, we may assume funds with a missing label to be Article 6, raising our sample of Article 6 funds to 2,323[4]. Panel C shows the summary statistics splitting our sample between funds with an Article 8 or 9 label, and funds with an Article 6 label.

[4]Morningstar's SFDR guide mentions the following about their fund-level SFDR information: "Morningstar will collect and disseminate EU ESG Fund Type information, i.e., Article 8 & 9 flags, as well as key data points from updated SFDR compliant ESG prospectuses" (Morningstar, 2021, p. 7), indicating that they do not focus on flagging Article 6 funds.

Table 1: Summary statistics

Table 1 presents the summary statistics for the variables for our sample of mutual funds over our total sample of 61 end-of-months (December 2017 to December 2022). Panel A covers all mutual funds that are domiciled or marketed in member states of the European Union. At the same time, Panel B also includes the mutual funds that are domiciled in the United States. Panel C splits the European sample into our treatment group, funds with an Article 8 or Article 9 label, and our control group, Article 6 funds. *Article 8/9 Dummy* is an indicator equal to 1 for funds flagged with an Article 8 or Article 9 label. *Flows* is the monthly growth of assets, net of reinvested returns (divided by 100). *Normalized flows* is computed following Hartzmark & Sussman (2019) and Ceccarelli et al. (2023). *TNA* is the natural logarithm of total net assets in USD. *Age* is the number of years since the inception of the oldest share class. *Star Rating* denotes the Morningstar performance rating, scaled 1-5. *Expense ratio* is the percentage of the total investment shareholders pay for the mutual fund's operating expenses. *Returns* is the monthly net return, in percentages. *Institutional Dummy* is an indicator equal to 1 when the fund is an institutional fund (when the largest share class is an institutional share class). *Carbon intensity* (in metric tons per million USD) is the asset-weighted fund's portfolio's total emissions scope 1, 2 (metric tons of CO2) divided by the revenue (Mil USD). *Low Carbon Designation* is an indicator equal to 1 when the fund has obtained the label from Morningstar. *MSCI Impact Score* measures funds' exposure to firms that purposely address environmental or social challenges. *Globe rating* denotes the Morningstar sustainability rating, scaled 1-5. *Carbon risk* is the fund's Morningstar portfolio carbon risk score. All our continuous variables are winsorized at the 1st and 99th percentiles.

Panel A: Fund-level variables, European fund sample

Variable	*N*	*Mean*	*Std. Dev.*	*Min*	*Max*
Article 8/9 Dummy	466,650	0.782	0.413	0	1
Flows (/100)	351,432	0.0008	0.019	-0.0313	0.0378
Normalized flows	351,432	50.085	28.868	0.148	100
TNA (log)	364,544	18.549	1.496	16.429	21.431
Age (levels)	447,560	11.461	9.624	0	122.995
Star Rating	287,696	3.113	1.095	1	5
Expense ratio	105,548	1.387	0.684	0.1	4.34
Returns	394,148	0.304	4.546	-7.307	7.023
Institutional dummy	446,093	0.165	0.371	0	1
Carbon intensity	276,216	156.962	80.969	51.6	308.68
Low Carbon Designation	320,738	0.231	0.422	0	1
MSCI impact score	246,974	6.865	4.686	0	66.27
Globe rating	276,431	3.171	1.101	1	5
Carbon risk	240,480	8.599	3.461	0.71	42.3

Panel B: Fund-level variables, European and US fund sample

Variable	*N*	*Mean*	*Std. Dev.*	*Min*	*Max*
Flows (/100)	507,027	-0.0001	0.019	-0.0313	0.0378
Normalized flows	507,285	50.059	28.867	0.106	100
TNA (log)	523,060	18.902	1.621	16.429	21.431
Age	608,859	13.074	11.053	0.000	122.995
Star Rating	432,442	3.154	1.082	1	5
Expense ratio	269,922	1.159	0.566	0.01	3.3
Returns	555,326	0.381	4.535	-7.307	7.023
Institutional dummy	617,991	0.273	0.446	0	1
Carbon intensity	403,625	158.885	84.036	49.56	313.96
Low Carbon Designation	424,319	0.382	0.486	0	1
MSCI impact score	394,600	6.288	4.233	0	66.27
Globe rating	414,349	3.112	1.096	1	5
Carbon risk	355,269	8.677	3.441	0.71	42.3

Panel C: Fund-level variables, split Article 8/9 and Article 6 sample

	Treatment: Article 8/9		Control: Article 6	
Variable	*N*	*Mean*	*N*	*Mean*
Flows (/100)	265,119	0.0011	86,313	-0.0003
Normalized flows	265,119	50.637	86,313	48.390
TNA (log)	274,395	18.703	90,149	18.083
Age	318,647	11.698	128,913	10.877
Star Rating	218,165	3.189	69,531	2.873
Expense ratio	83,429	1.369	22,119	1.452
Returns	295,273	0.321	98,875	0.252
Institutional dummy	331,230	0.182	114,863	0.117
Carbon intensity	213,230	151.803	62,986	174.425
Low Carbon Designation	218,483	0.416	69,000	0.286
MSCI impact score	191,257	7.217	55,717	5.643
Globe rating	211,788	3.256	64,643	2.894
Carbon risk	185,808	8.391	54,672	9.310

4 Results

4.1 Investor behavior

With the SFDR the EU aims to bring in a common sustainability metric, European-domiciled and marketed funds were required to self-assign into one of the three Article labels. In brief, with the SFDR the EU tries to prevent greenwashing and therefore assist in an efficient allocation of capital toward green assets. In this section, we are interested in determining whether investors respond to the SFDR Article labels; specifically, we examine whether Article 8 and Article 9 funds attract additional flows compared to Article 6 funds after the SFDR was announced.

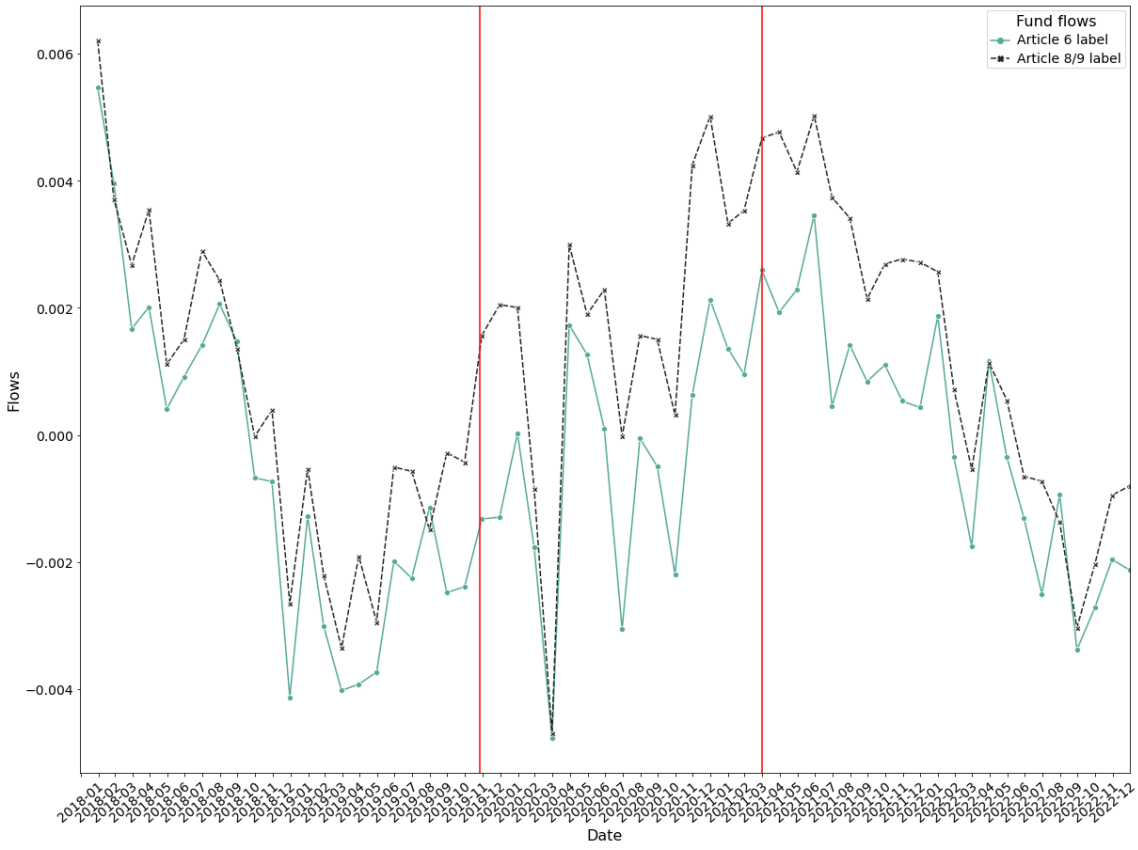
Hartzmark and Sussman (2019) and Ceccarelli et al. (2024) both document that mutual fund flows indeed respond to the introduction of new common sustainability metrics such as the Morningstar Globe Rating and the Morningstar Low Carbon Designation. On a similar note, literature has also noted that investors respond to mutual fund signaling (e.g., Kim and Yoon, 2023; Liang et al., 2022; Cooper et al., 2005). Work by Gantchev et al. (2023) on the other hand, suggests that the increase in flows may be short-lived because mutual funds flows over time become unresponsive

to the Globe Scores. We utilize the SFDR as a quasi-natural shock to investors, bringing new sustainability information to the market. This information takes shape as a sustainability metric (here, the Article label), and as disclosed sustainability information on the funds' portfolio.

In Figure 1 we plot the average, equal-weighted net fund flows from December 2017 to December 2022 of our sample of funds that are domiciled or marketed in EU member states. In the plot, we distinguish between flows toward Article 8 and 9 funds, and Article 6 funds. In the figure, we see that flows toward Article 8(/9) are higher than to Article 6 funds. At the moment the SFDR is announced we see that flows of the two groups start to diverge strongly. Also at the moment of the implementation of the SFDR in March 2021, we see that there is a wide gap between the two lines. It therefore seems that the SFDR urges flows to funds that take on an Article 8 or 9 label. Following the implementation of the SFDR, the flows of the two groups seem to converge.

Figure 1: Net flows plotted over time: SFDR-compliant funds

The graph shows the equally weighted, average monthly net flows of funds domiciled or marketed in EU member states with an Article 8(/9) label (dashed line), and with an Article 6 label (solid line). The two vertical date staps (dashed vertical lines) indicate, first, the announcement of the SFDR, and second, the implementation of the SFDR.



We estimate the following difference-in-difference model, using the announcement of the SFDR in November 2019 to indicate our treatment timing:

$$Flows_{i,t} = \beta_0 + \beta_1 Treat_i \times Post_t + \gamma^{'} \mathbf{X}_{i,t-1} + \eta_i + \zeta_{c,t} + \epsilon_{i,t} \quad (1)$$

where $Flows_{i,t}$ indicates the end of the month net flows of the fund. $Treat_i$ captures whether the fund has an Article 8 or 9 label, taking value 1 if the fund has an Article 8 or an Article 9 label, 0 otherwise (i.e., Article 6)[5]. $Post_t$ is a dummy variable that equals 1 for observations after the announcement date of the SFDR on November 27th 2019[6]. $\mathbf{X}_{i,t-1}$ is a vector of fund-level, time-varying lagged control variables: *Returns*, the natural logarithm of *TNA*, and the natural logarithm of *Age*. As for fixed effects, we employ fund fixed effects η_i, and year-month $\times$ category fixed effects $\zeta_{c,t}$. We additionally double-cluster the standard errors along year-months and fund categories.

Table 2 presents our results of the estimations of Equation (1). In columns 1 and 2 we see that the $Treat_i \times Post_t$ interaction is positive and statistically significant. After the announcement of the SFDR, funds that took on an Article 8 or 9 label received on average 0.08 percentage points higher net flows compared to Article 6 funds. Annually, this flow effect accounts for an increase of 0.96 percentage points in the total assets of the fund. The coefficient and significance do not change when we omit Article 9 funds from our sample, indicating that investors also respond to a ' light-green' signal. In columns 3 and 4 we re-estimate Equation (1) for our normalized flow measure. The coefficients of the $Treat_i \times Post_t$ interaction remain statistically significant[7].

What can be noted in Table 2 is the low economic significance of the estimated coefficients on net flows. Previous literature that also considers the flow effects on sustainability and ESG signals report flows ranging from 0.36 percentage points (Ceccarelli et al., 2024) to 2.04 percentage points (Gibbon et al., 2023). Work by Hartzmark and Sussman (2019); Gantchev et al. (2023); Hartzmark and Shue (2023) have shown that investors tend to mainly respond to the 'highest' ESG scores or 'dark-green' signals. Therefore, we run a horse race on the various sustainability signals available in the market.

In Figure 2 we calculate the monthly average net flows to funds with an Article 8 or an Article 9 label and compare these to funds that (a) are in the lowest decile of monthly fund carbon intensity, (b) are in the top decile of monthly fund MSCI Impact exposure, (c) have been assigned a Morningstar Low Carbon Designation, (d) have received a Morningstar Globe score of 5, and (e) are in the lowest decile of monthly fund carbon risk. The figure shows that funds with an Article 9 label seem to receive more net flows than Article 8 funds and funds that are high sustainability performers based on five other metrics. This is as expected especially true after the SFDR was announced and implemented; on average post-SFDR investors respond to a greater extent to funds that signal to be 'dark-green' compared to funds that are ranked to be at the top of other high sustainability indicators. At the end of 2022, we see that the fund flows for the different top sustainability metrics converge.

To test which high-sustainability indicator drives investor flows, similar to Ben-David et al.

[5]While the SFDR only requires funds to take on an Article label after the regulation's implementation in March 2021, funds may already decide to do so priorly, after the SFDR timeline was announced in November 2019 to meet the requirements of the regulation that was enforced in March 2021. Morningstar does not provide us with an elaborate dynamic SFDR indicator, forcing us to make use of their static Article 8/ Article 9 flag. As a result, we cannot identify the funds that receive treatment (take on an Article 8 or Article 9 label) first from the funds that are not-yet-treated. To account for the anticipation effect, we, therefore, determine our $Post_t$ indicator using the date when the SFDR was announced.

[6]Our total time series consists of 61 months. The SFDR announcement happens in month 24, making month 23 the last month before treatment. Month 24 to month 61 encompasses the post-treatment period. The SFDR gets implemented in month 40, on March 10th, 2021.

[7]As robustness, we omit the year 2020 from our sample in which the COVID-19 pandemic reached its peak. Our estimates remain significant economically as well as statistically (results are available as per request)

Table 2: Regression Results for Flows, Relative

This table presents the difference-in-difference regressions of monthly fund net flows (columns 1 and 2), and normalized flows (columns 3 and 4) following the methodology of Hartzmark and Sussman (2019), on the interaction of dummy variables Treat (Article 8 and/ or Article 9 funds) and Post (all months following the SFDR announcement on November 27th 2019). The even columns (2 and 4) omit the Article 9 funds from our sample. The regressions control for lagged fund characteristics and year-month × category and fund fixed effects. Robust standard errors are clustered at both the fund and year-month level and shown in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

	Flows		Normalized Flows	
	(1)	(2)	(3)	(4)
Post x Treat	0.0008**	0.0008**	0.866*	0.919*
	(0.0003)	(0.0004)	(0.471)	(0.507)
Constant	0.0531***	0.053***	106.218***	106.487***
	(0.0062)	(0.006)	(7.965)	(8.157)
Controls	YES	YES	YES	YES
Category x Year-Month FE	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES
Observations	349,842	330,688	349,842	330,688
R-squared	0.234	0.234	0.229	0.229
Treatment group	Article 8/9	Article 8	Article 8/9	Article 8

(2022), we perform horse races between funds with an Article 8 or 9 label, and funds that are the top sustainability performers according to five other sustainability indicators. We estimate panel regressions of monthly fund flows on pairs of top-sustainability-performing fund indicators. Table 3 reports the differences in the coefficients of the two regressions per pair, and in tandem, shows the corresponding t-statistics. In columns 3 and 4, and 5 and 6, we also split our sample into two time periods, all months after the announcement of the SFDR, and all months after the implementation of the SFDR, respectively. In line with Figure 2, columns 1, 3, and 5 of Table 3 show that an Article 9 signal seems the most important driver of investor flows, compared to other fund high-sustainability indicators. This is also true when we only consider the months after the SFDR announcement as well as after the SFDR implementation.

As expected, investors seem more keen on moving their investments toward 'dark-green' investments, offering an explanation as to why our estimates from Table 2 of Equation (1) are relatively modest. Article 8 funds receive additional flows after the SFDR was announced, but other indicators of high sustainability may remain more important indicators.

Figure 2: Average monthly flows to high sustainability funds

This figure shows the average monthly flows to funds that are top performers according to several sustainability measures. *Article 8* indicates whether the fund signals with an Article 8 label, *Article 9* indicates whether the fund signals with an Article 9 label, *Article 8/9* indicates whether the fund signals with an Article 8 or 9 label, *Carbon intensity* indicates the funds that are in the lowest decile of that months' funds' carbon intensity outcomes, *MSCI Impact* indicates the funds that are in the highest decile of that months' funds' MSCI Impact exposure outcomes, *Low Carbon Designation* indicates whether the fund that quarter has been assigned a Morningstar Low Carbon Designation label, *ESG Globe Score* indicates the funds that have a 5-Globe rating on the Morningstar Globe Score, and *Carbon risk* indicates the funds that are in the lowest decile of that months' funds' carbon risk outcomes. The solid vertical lines indicate the dates of the SFDR announcement (left) and SFDR implementation (right).

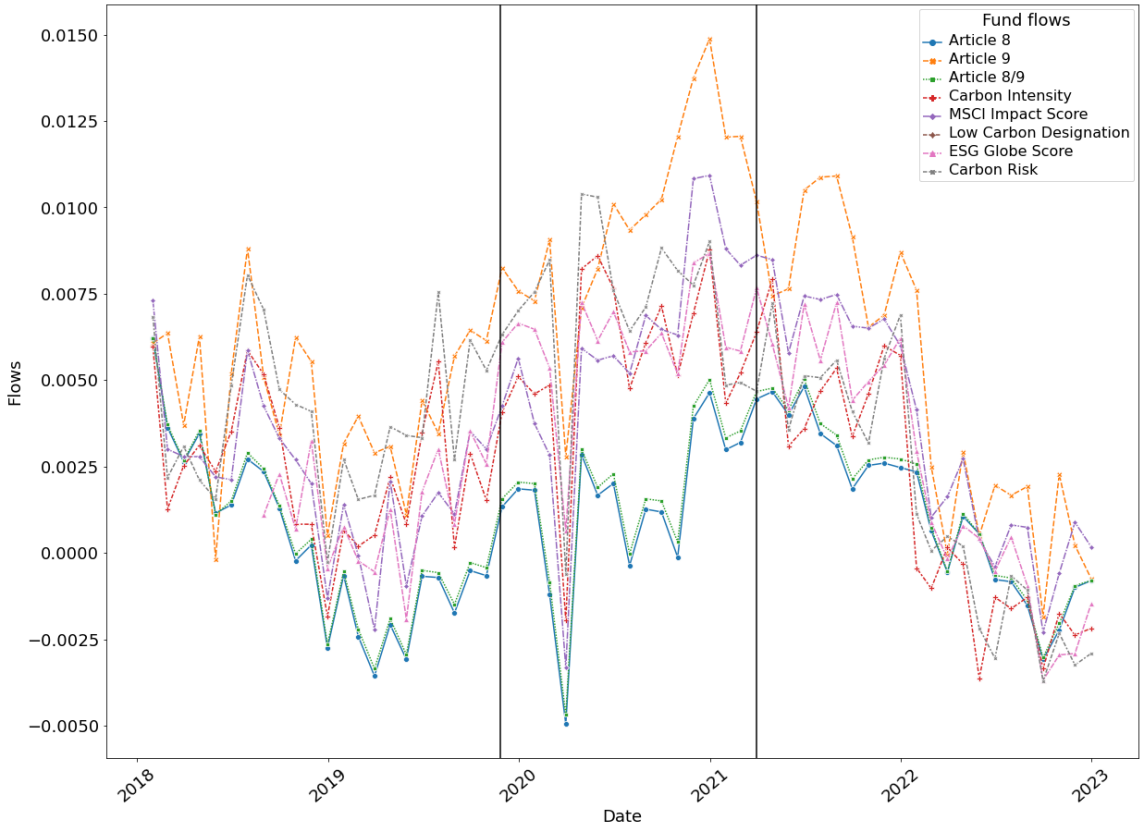


Table 3: Horse Races on Fund Sustainability Measures

This table presents the horse races carried out between various top sustainability-performance indicators and SFDR Article signals. *Article 8* indicates whether the fund signals with an Article 8 label, *Article 9* indicates whether the fund signals with an Article 9 label, *Article 8/9* indicates whether the fund signals with an Article 8 or 9 label, *Carbon intensity* indicates the funds that are in the lowest decile of that months' funds' carbon intensity outcomes, *MSCI Impact* indicates the funds that are in the highest decile of that months' funds' MSCI Impact exposure outcomes, *MS LCD* indicates whether the fund that quarter has been assigned a Morningstar Low Carbon Designation label, *MS Globe* indicates the funds that have a 5-Globe rating on the Morningstar Globe Score, and *Carbon risk* indicates the funds that are in the lowest decile of that months' funds' carbon risk outcomes. Per 'pair' of sustainability indicators (e.g., *Article 9* and *MS Globe*), we run two panel regressions on flows using two different dummy indicators: Flows on *Article 9* and Flows on *MS Globe*. We then estimate the standard error of the difference between the two coefficients; concurrently we estimate the t-statistics. Columns 1, 3, and 5 report the differences between the coefficients of the pairs of regressions, the corresponding t-statistics are reported in parentheses. In columns 3 and 4, and 5 and 6, we also split our sample into two time periods, all months after the announcement of the SFDR, and all months after the implementation of the SFDR, respectively. The regressions control for year-month fixed effects. Robust standard errors are clustered at both the fund and year-month levels. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

	Full Sample		Post SFDR Announc.		Post SFDR Implem.	
	Difference	t-stat	Difference	t-stat	Difference	t-stat
	(1)	(2)	(3)	(4)	(5)	(6)
Article 8 vs. MS Globe	-0.0021***	(-15.723)	-0.0021***	(-13.227)	-0.0007***	(-3.585)
Article 8 vs. MS LCD	-0.0005***	(-4.664)	-0.0002*	(-1.887)	0.0007***	(4.973)
Article 8 vs. Carbon intensity	-0.0015***	(-9.803)	-0.0012***	(-6.810)	0.0004	(1.636)
Article 8 vs. MSCI Impact	-0.0026***	(-16.968)	-0.0029***	(-15.916)	-0.0021***	(-9.093)
Article 8 vs. Carbon Risk	-0.0024***	(-15.275)	-0.0019***	(-9.734)	0.0003	(1.198)
Article 9 vs. Article 8	0.0047***	(21.662)	0.0049***	(19.041)	0.0031***	(10.139)
Article 9 vs. MS Globe	0.0025***	(10.618)	0.0028***	(9.999)	0.0024***	(7.358)
Article 9 vs. MS LCD	0.0042***	(19.355)	0.0047***	(18.209)	0.0039***	(12.732)
Article 9 vs. Carbon intensity	0.0032***	(13.343)	0.0037***	(12.741)	0.0035***	(10.135)
Article 9 vs. MSCI Impact	0.0021***	(8.477)	0.0020***	(6.789)	0.0011***	(3.131)
Article 9 vs. Carbon Risk	0.0023***	(9.236)	0.0030***	(10.339)	0.0034***	(9.682)

4.1.1 Differences between institutional and retail investors

While the SFDR aims to lower information asymmetries between mutual funds and investors, the degree to which investors respond to new sustainability signals in the market may depend on how (un)informed the investors are before the disclosure mandate.

Mandatory disclosure mandate reduces information asymmetries by releasing new information to investors (Goldstein and Yang, 2017). We expect these information asymmetries to be larger for less sophisticated investors such as retail investors; they may have a harder time getting access to material ESG and or sustainability information or may face difficulty disentangling said information. Rzeźnik et al. (2022); Ammann et al. (2019) find evidence that retail investors are sensitive to ESG ratings. More sophisticated investors, such as institutional investors, have higher monitoring

resources, and may not reap benefits from the sudden increase in transparency. We, therefore, expect institutional investors not to respond to the Article 8(/9) signal–they are more likely to have already been aware of the sustainability characteristics of the funds' underlying portfolios.

In Table 4 we show the estimates of a triple-difference model in which we interact our difference-in-difference estimator of Equation (1) with a dummy indicator that equals 1 when the fund is classified as an institutional fund, $Instit_i$:

$$\begin{aligned} Flows_{i,t} = \beta_0 + \beta_1 Treat_i \times Post_t \times Instit_i + \beta_2 Treat_i \\ \times Post_t + \beta_3 Post_t \times Instit_i + \gamma^{'} \mathbf{X}_{i,t-1} + \eta_i + \zeta_{c,t} + \epsilon_{i,t} \end{aligned} \tag{2}$$

where $Flows_{i,t}$ indicates the end of the month net flows of the fund. $Treat_i$ captures whether the fund has an Article 8 or 9 label, taking value 1 if the fund has an Article 8 or an Article 9 label, 0 otherwise (i.e., Article 6). $Post_t$ is a dummy variable that equals 1 for observations after the announcement date of the SFDR on November 27th 2019. $\mathbf{X}_{i,t-1}$ is a vector of fund-level, time-varying lagged control variables: *Returns*, the natural logarithm of *TNA*, and the natural logarithm of *Age*. We employ fund fixed effects η_i, and year-month $\times$ category fixed effects $\zeta_{c,t}$. We again double-cluster the standard errors along year-months and fund categories.

Table 4 reports the coefficients for our triple interaction $Treat_i \times Post_t \times Instit_i$ and shows the monthly net flows to Article 8(/9) institutional funds concerning the net flows toward Article 8(/9) retail funds. The coefficient is negative and significant at the 5 percent level, indicating that the announcement of the SFDR brings about heterogeneous effects depending on whether the fund's investor base consists of retail or institutional investors. In sum, compared to Article 8(/9) retail funds, Article 8(/9) institutional funds on average receive lower net flows after the SFDR announcement. Our results remain robust after we omit Article 9 funds from our sample. In Appendix A.3 we additionally split our sample into retail and institutional funds and note that retail funds with an Article 8(/9) label enjoy additional net inflows, while the difference-in-difference estimator for the institutional fund sample is insignificant.

Institutional investors may already be aware of the newly disclosed information and/ or may disregard the published Article labels of European funds. More specifically, the Article labels do not aim to and should not function as the *source* of the newly disclosed information; instead, they function as a signal about the underlying sustainability information (European Insurance and Occupational Pensions Authority, 2023). For these reasons, unsurprisingly, unlike retail investors, institutional investors do not seem to respond to an Article 8 or Article 9 signal.

Table 4: Regression results of triple difference model

This table presents the triple difference regressions of monthly fund net flows on the interaction of dummy variables Treat (Article 8 and/ or Article 9 funds) and Post (all months following the SFDR announcement on November 27th 2019). We differentiate by institutional and retail funds with the Intit dummy, equaling 1 for institutional funds, and 0 for retail funds. Column 2 omits the Article 9 funds from our sample. The regressions control for lagged fund characteristics and year-month × category and fund fixed effects. Robust standard errors are clustered at both the fund and year-month level and shown in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

	Flows	
	(1)	(2)
Treat x Post x Instit	-0.0019**	-0.0022**
	(0.0008)	(0.0009)
Constant	0.0530***	0.0530***
	(0.0063)	(0.0064)
Controls	YES	YES
Category x Year-Month FE	YES	YES
Fund FE	YES	YES
Observations	349,661	330,507
R-squared	0.234	0.234
Treatment group	Article 8/9	Article 8

Lastly, to better picture to what extent retail and institutional investors respond differently to sustainability signals in the market, we run the same horse races as presented in Table 3, now slit for our samples of retail and institutional funds. In Figure 3 we plot the monthly average net fund flows. Retail funds in panel A show a similar pattern to that shown in Figure 2[8]; retail investors respond more eagerly to funds that signal with an Article 9 label than to funds that are top performers of other sustainability indicators[9].

For institutional funds, we also see that flows are more strongly predicted by funds that signal with an Article 9 label than those with an Article 8 label; this seems to be the case in the months before the implementation of the SFDR[10]. However, more interesting is that compared to other top sustainability performance indicators[11], the Article 9 label becomes less of a predictor for fund flows after the implementation of the SFDR[12]. Visually, Figure 3b shows that the trend of average net flows to institutional Article 9 funds deviates *less* from the time trends of net flows to funds that are top performers of the five other sustainability indicators than for a sample of retail funds[13].

[8] In appendix A.4, similar to Table 3, we present the results of the horse races for our split sample

[9] Panels A, B, and C of Appendix A.4 also find that retail investors reward these Article 9 funds after the announcement and implementation of the SFDR.

[10] See Appendix A.4, Panel A, row six with Article 9 vs. Article 8 pair, the difference of the coefficients between the two regressions is 0.0042, which is significant at the 1 percent level.

[11] i.e., high MS globe score, MS low carbon designation, low carbon intensity, low carbon risk, high MSCI Impact exposure

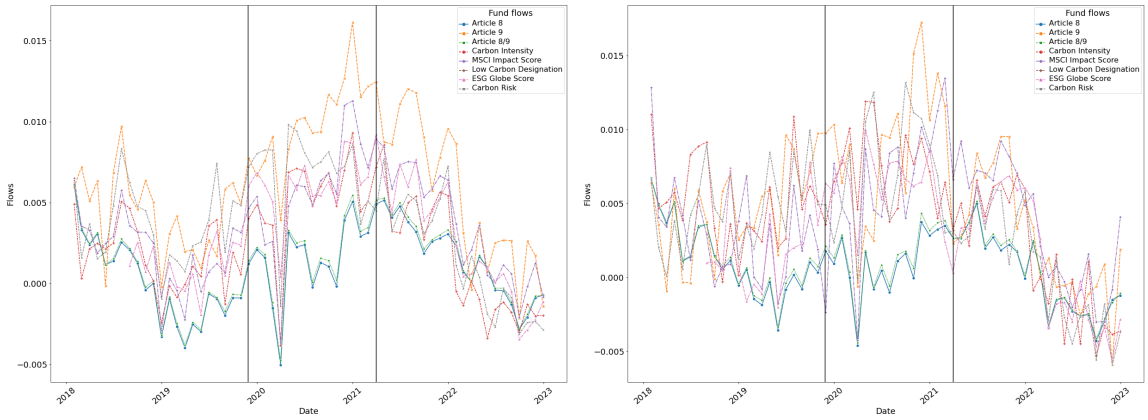
[12] See columns 3 and 4 of Panel C in Appendix A.4.

[13] Appendix A.4 shows that the differences of the coefficients of the regression pairs between Article 9 and other top-sustainability indicators are lower for institutional funds than for retail funds.

Additionally, we see that Article 9 signals create less of a predictive power of flows for our sample of institutional funds compared to funds that are the top performers in terms of carbon intensity and exposure to impact firms[14]. This may indicate that institutional investors pay more attention to the sustainability outcomes of funds' underlying portfolio, instead of going off on scores or ratings.

Figure 3: Average monthly flows to high sustainability funds

This figure shows the average monthly flows to funds that are top performers according to several sustainability measures. Definitions are the same as for Figure 2, but here we split the sample in retail funds (a) and institutional funds (b). *Article 8* indicates whether the fund signals with an Article 8 label, *Article 9* indicates whether the fund signals with an Article 9 label, *Article 8/9* indicates whether the fund signals with an Article 8 or 9 label, *Carbon intensity* indicates the funds that are in the lowest decile of that months' funds' carbon intensity outcomes, *MSCI Impact* indicates the funds that are in the highest decile of that months' funds' MSCI Impact exposure outcomes, *Low Carbon Designation* indicates whether the fund that quarter has been assigned a Morningstar Low Carbon Designation label, *ESG Globe Score* indicates the funds that have a 5-Globe rating on the Morningstar Globe Score, and *Carbon risk* indicates the funds that are in the lowest decile of that months' funds' carbon risk outcomes. The solid vertical lines indicate the dates of the SFDR announcement (left) and SFDR implementation (right).



(a) Retail funds

(b) Institutional funds

4.1.2 Heterogeneous effects

Before the SFDR, investors with social preferences were confined to using voluntarily disclosed sustainability information or sustainability scores from external vendors like Morningstar or MSCI. By enforcing the disclosure of sustainability information, the SFDR aims to reduce the information asymmetry among financial market participants and investors. Therefore, if the Article labels prove to be a reliable sustainability signal[15], then we can assume that funds that showed high sustainability performance before SFDR (such as those with a high Globe Score) would not benefit as much from additional investor flows as compared to funds that showed low sustainability before SFDR.

[14] See Appendix A.4, Panels A and B.

[15] As suggested in firm-level mandatory disclosure literature (e.g., Downar et al., 2021; Cao et al., 2019), a sudden boost of transparency may incentivize firms to change their behavior. See section 4.2 for our analyses of mutual fund behavior.

Furthermore, funds that had a low Morningstar Globe Rating or had not received a Morningstar Low Carbon Designation can use the mandatory Article labels to signal their *future* sustainability performance. For the former group, an Article 8 or 9 label would not provide investors with new information, while for the latter group, it would be informative.

In Table 5 we present a triple difference model where we interact our difference-in-difference estimator of Equation (1) with either a dummy variable 'high globe', or 'LCD'. The 'high globe' variable is equal to 1 for funds that in October 2019 (so in $t = -1$) had a Morningstar Globe Score of either 4 or 5, 'LCD' equates to 1 for funds that in October 2019 were assigned a Morningstar 'Low Carbon Designation'. The Morningstar Globe Score, similar to other ESG scores, does not only consist of environmental performance indicators. Therefore, we proxy for environmental performance by using the Morningstar Low Carbon Designation. Thus, we replace $Treat_i \times Post_t$ from Equation (1) with $Treat_i \times Post_t \times HighGlobe_i$ and $Treat_i \times Post_t \times LCD_i$.

Columns 1 to 3 show no evidence of heterogeneous effects between Article 8(/9) funds that ex-ante had a high globe score and Article 8(/9) funds that had a low globe score. This is the case for our full, retail, and institutional samples. The triple difference estimator $Treat_i \times Post_t \times HighGlobe_i$ is statistically insignificant. Differentiating between funds that pre-SFDR had a Low Carbon Designation, columns 2 to 4 also show an insignificant coefficient of our triple interaction. In summary, investors respond to the Article signals homogeneously; funds that signal with a green Article on average receive net inflows in a similar magnitude, despite their pre-SFDR sustainability indicators. This finding may indicate that retail investors reckon the Article classifications of funds credible, with Article 8(/9) funds receiving additional net inflows irrespective of their pre-disclosure sustainability indicators.

Table 5: Heterogeneity in mutual fund flows

This table presents the difference-in-difference regressions of monthly fund net flows on the interaction of dummy variables Treat (Article 8 and/ or Article 9 funds) and Post (all months following the SFDR announcement on November 27th 2019), differentiating by Globe Score (columns 1 to 3) and Morningstar Low Carbon Designation (columns 4 to 6). *HighGlobe* is a dummy variable equaling 1 for funds that in October 2019 received a Morningstar Globe Score of 4 or 5, 0 otherwise. For the regressions displayed in columns 1 and 3, we limit the sample to only include funds with either a high Globe score (i.e., 4 or 5) or a low Globe score (i.e., 1 or 2). *LCD* is equal to 1 if the fund in October 2019 possessed over a Morningstar Low Carbon Designation, 0 otherwise. Columns 1 and 4 report the estimates for our full sample. Columns 2 and 5 show the estimates for retail funds. Columns 3 and 6 show the estimates for our sample of institutional funds. The regressions control for lagged fund characteristics and year-month × category and fund fixed effects. Robust standard errors are clustered at both the fund and year-month level and shown in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

	Flows			Flows		
	(1)	(2)	(3)	(4)	(5)	(6)
Post x Treat x HighGlobe	-0.0011	-0.0005	-0.0011			
	(0.0008)	(0.0008)	(0.0024)			
Post x Treat x LCD				-0.0011	-0.0008	-0.0033
				(0.0008)	(0.0008)	(0.0023)
Constant	0.0531***	0.0557***	0.0444	0.0494***	0.0507***	0.0456***
	(0.0076)	(0.0083)	(0.0100)	(0.0065)	(0.0072)	(0.0078)
Controls	YES	YES	YES	YES	YES	YES
Category x Year-Month FE	YES	YES	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES	YES	YES
Observations	278,440	129,968	28,731	278,440	226,047	52,279
R-squared	0.209	0.230	0.193	0.209	0.224	0.175
Sample	Full	Retail	Institutional	Full	Retail	Institutional

4.2 Mutual fund behavior

In this section, we investigate whether the SFDR led to any changes in the behavior of mutual funds. We measure fund behavior through fund-level sustainability outcomes: carbon intensity, Morningstar Globe Score, and MSCI impact. Specifically, we are interested in two mechanisms at play: (i) whether funds that choose to label themselves with Article 8 or Article 9 provide a credible sustainability signal to the market, and (ii) whether the reduction in information asymmetries between investors and mutual funds urges the affected funds to incorporate additional sustainability standards (i.e., effects that are driven through the disclosure mandate).

4.2.1 The signaling effect

We begin our analysis by estimating the effect of the announcement of the SFDR on fund sustainability outcomes. To do so, we estimate a difference-in-difference model that utilizes the announcement date of the SFDR as a quasi-natural shock:

$$Y_{i,t} = \beta_0 + \beta_1 Treat_i \times Post_t + \gamma^{'} \mathbf{X}_{i,t-1} + \eta_i + \zeta_{c,t} + \epsilon_{i,t} \tag{3}$$

where Y_i, t is the fund's i outcome variable at time t taking form as *Carbon intensity*, *Globe Score*, or *MSCI Impact Score*. $Treat_i$ captures whether the fund has an Article 8 or 9 label, taking value 1 if the fund has an Article 8 or an Article 9 label, 0 otherwise (i.e., Article 6). This variable is static and does not change throughout. $Post_t$ is a dummy variable that equals 1 for observations after the announcement date of the SFDR on November 27th 2019. $\mathbf{X}_{i,t-1}$ is a vector of fund-level, time-varying lagged control variables: *Returns*, the natural logarithm of *TNA*, the natural logarithm of *Age*, and *Flows*. As for fixed effects, we employ fund fixed effects η_i, and year-month $\times$ category fixed effects $\zeta_{c,t}$. We additionally double-cluster the standard errors along year-months and fund categories.

We expect funds that take on an Article 8 or Article 9 label after the SFDR announcement to improve their sustainability outcomes; we expect that our estimated difference-in-difference coefficient is (i) negative when $Y_{i,t}$ is carbon intensity, and positive when $Y_{i,t}$ is (ii) Globe Score or (iii) MSCI Impact Score. Table 6 indicates the regression estimates of Equation (3).

Column 1 shows that the interaction effect between $Treat_i$ and $Post_t$ on fund carbon intensity is negative and statistically significant. This implies that funds that take on an Article 8 or 9 label significantly lower their carbon intensity compared to funds with an Article 6 label after the SFDR was announced. Economically speaking, after the SFDR, Article 8 and Article 9 funds reduce their carbon intensity by 8.579 metric tons per million USD. On a similar note, in column 3, we note that after the announcement of the SFDR Article 8 and Article 9 funds, compared to Article 6 funds, increased their Globe Score by 0.118 points. This is significant at the 1 percent level. In column 3, we additionally note that Article 8 and Article 9 funds, compared to Article 6 funds, slightly increase their exposure in MSCI 'impact' firms by 0.243 percentage points after the SFDR is announced. This effect, however, is economically modest–Table 1 finds that our sample of European-domiciled and marketed funds have an average MSCI Impact Exposure of 6.865 percent, with a standard deviation of 4.686.

To ensure that our results are not driven by funds that signal with a 'dark-green' label (i.e., Article 9), in columns 2, 4, and 6, we omit these funds from our sample. While the effect sizes are slightly lowered, they remain statistically significant. Interestingly, the coefficient for the MSCI Impact Score only remains significant at the 10 percent level, indeed suggesting that Article 9 funds aim to invest in companies with a positive impact on society or the environment. As robustness, we omit the year 2020 from our sample in which the COVID-19 pandemic reached its peak. Our estimates remain significant economically as well as statistically (results are available as per request).

4.2.2 Event study

More interesting would be the dynamic effects of the SFDR. In an event study, we can see more clearly how SFDR affects mutual funds behavior over time. This is especially relevant knowing that we do not precisely know *when* each fund took on their SFDR Article. While all funds are expected to disclose theirs in their prospectus after the official implementation of the SFDR in March 2021, Article 8 and Article 9 funds may already start improving their sustainability outcomes before this, but *after* the announcement of the SFDR. We estimate the following dynamic regression equation:

Table 6: Mutual Fund Behavior

This table presents the difference-in-difference regressions of fund sustainability outcomes, carbon intensity (in columns 1 and 2), globe scores (in columns 3 and 4), and MSCI impact scores (in columns 5 and 6), on the interaction of dummy variables Treat (Article 8 and/ or Article 9 funds) and Post (all months following the SFDR announcement on November 27th 2019). The even columns (2, 4, and 6) omit the Article 9 funds from our sample. The regressions control for lagged fund characteristics and for year-month × category and fund fixed effects. Robust standard errors, clustered at both the fund and year-month level, are shown in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

	Carbon Intensity		Globe Score		MSCI Impact	
	(1)	(2)	(3)	(4)	(5)	(6)
Post × Treat	-8.579***	-8.364***	0.118***	0.116***	0.243**	0.202*
	(2.059)	(2.141)	(0.034)	(0.034)	(0.108)	(0.108)
Constant	84.957***	80.724***	2.775***	2.638***	9.739***	9.422***
	(16.444)	(17.112)	(0.347)	(0.365)	(0.984)	(0.949)
Controls	YES	YES	YES	YES	YES	YES
Category × Year-Month FE	YES	YES	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES	YES	YES
Observations	243,615	230,825	244,979	236,862	217,929	210,596
R-squared	0.773	0.772	0.722	0.718	0.836	0.828
Treatment group	Article 8/9	Article 8	Article 8/9	Article 8	Article 8/9	Article 8

$$Y_{i,t} = \sum_{t=-23; t\neq -1}^{37} \beta_t \times Treat_i + \gamma' \mathbf{X}_{i,t-1} + \eta_i + \zeta_{c,t} + \epsilon_{i,t} \tag{4}$$

where $Y_{i,t}$ is the fund's i outcome variable at time t taking form as *Carbon intensity*, *Globe Score*, or *MSCI Impact Score*. $Treat_i$ captures whether the fund has an Article 8 or 9 label, taking value 1 if the fund has an Article 8 or an Article 9 label, 0 otherwise (i.e., Article 6). Event time t indexes the number of months relative to the announcement of the SFDR in November 2019, here $t = 0$. We use October 2019, or month 23, as our reference month $t = -1$. Similar to Equation (2) we also include a vector of lagged control variables on the fund level $\mathbf{X}_{i,t-1}$: *Returns*, the natural logarithm of *TNA*, the natural logarithm of *Age*, and *Flows*. Again, we employ fund fixed effects η_i, and year-month × category fixed effects $\zeta_{c,t}$. Further, we additionally double-cluster the standard errors along year-months and fund categories.

In Figures 4, 5, and 6 we plot the β_t coefficients from Equation (4) with 95 percent confidence intervals. The dependent variables respectively are fund carbon intensity, Globe Score, and MSCI Impact Score. The panels (a) of these three figures show the event study plots using an OLS specification, while panels (b) show the plots when we apply inverse probability weights (IPW) to match our treatment and control groups (Abadie, 2005). In this latter specification, we estimate inverse propensity weights based on propensity scores based on pre-SFDR covariates: monthly net flows, monthly returns, logged age, logged TNA, and Morningstar category. In Appendix A.5 we also report the *aggregate* weighted ATT estimates, as expected the effect sizes are smaller than in our OLS specification as reported in Table 6, but the coefficients remain statistically significant when our dependent variable takes shape as carbon intensity, and Globe Score.

In Figure 4 panel (a) we plot the OLS estimates of β_t of Equation (4) on fund carbon intensity.

In panel (b) we apply an inverse probability weighting matching scheme based on our pre-treatment control variables (i.e., log TNA, log age, returns, flows, and Morningstar Category)[16]. The inverse probability weighted event study in Figure 4, panel (b) shows no pre-trends leading up to the date of the announcement of the SFDR. The estimated effect grows from 0 to -15 metric tons per million USD in months 0 to 40. The ATT becomes largest after the implementation of the SFDR at $t \leq 20$.

Next, we shift our focus to the ESG scores of funds, as measured by the Morningstar Globe Scores. For this event study, we fixate on the implementation date of the SFDR in March 2021 instead of the SFDR announcement date. We employ the following reasoning. First, one month before the announcement of the SFDR, in October 2019, Morningstar adopted the new Sustainalytics ESG Risk Ratings methodology for their fund-level Globe Score. As a result, we see an artificial jump in funds' ESG scores around this time (see also Rzeźnik et al., 2022). This contaminates our event study analysis [17]. We therefore only use the Morningstar Globe Score data from October 2019 onwards. We adjust Equation (4) to

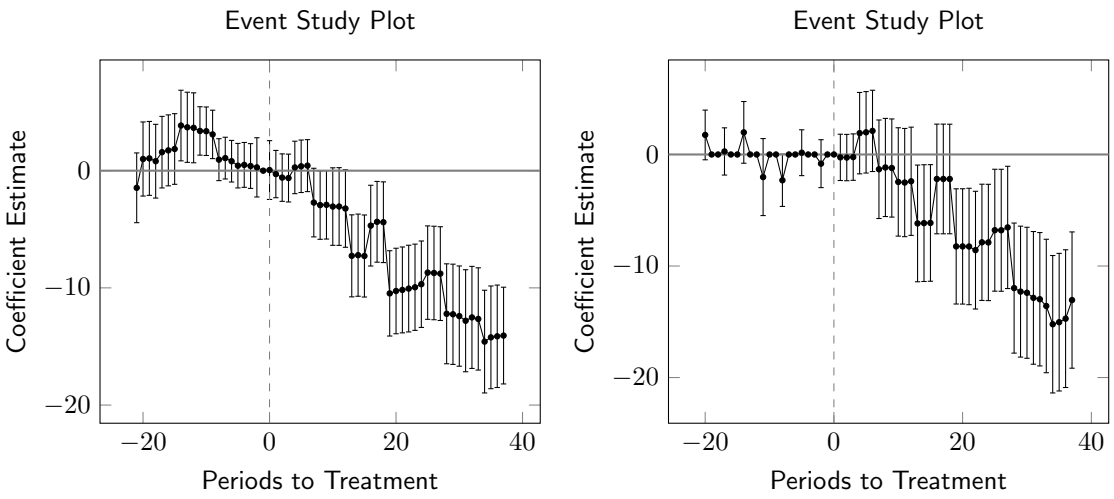
$$Y_{i,t} = \sum_{t=-16; t\neq -1}^{21} \beta_t \times Treat_i + \gamma^{'} \mathbf{X}_{i,t-1} + \eta_i + \zeta_{c,t} + \epsilon_{i,t} \tag{5}$$

where we have February 2021 as a reference date. Figure 5 panels (a) and (b) plot the $beta_t$ coefficients of Equation (5). If the SFDR urges mutual funds to follow through on their SFDR-insinuated sustainability signal, compared to Article 6 funds, Article 8(/9) funds are expected to improve their ESG scores. Both panels (a) and (b) show that after the SFDR was put into force, Article 8 and 9 funds indeed, compared to the control group, improved their Morningstar Globe Score by 0.05 to 0.15 points. Appendix A.1 reports the event study plots for the full data sample, with the reference point, $t = -1$, kept on October 2019.

Lastly, we plot the β_t coefficients of Equation (4) on the MSCI Impact Score. As panels (a) and (b) of Figure 6 suggest, the parallel trends are noisy which prevents us from interpreting the effect. We want to note that Article 8 funds do not need to be fully aligned with the SFDR's DNSH principle; Article 8 funds do not need to have a social or environmental commitment. Instead, the MSCI Impact metric may be a suitable measure for Article 9 funds. Columns 5 and 6 of Table 6 signal to such an interpretation.

[16] Different from our unmatched specification, we employ year-month and category fixed effects separately. We do so as we match based on Morningstar Category. Additionally, the CSDID package of Callaway and Sant'Anna (2021) specification which we use to estimate our IPW estimators, does not let us use year-month × category fixed effects.

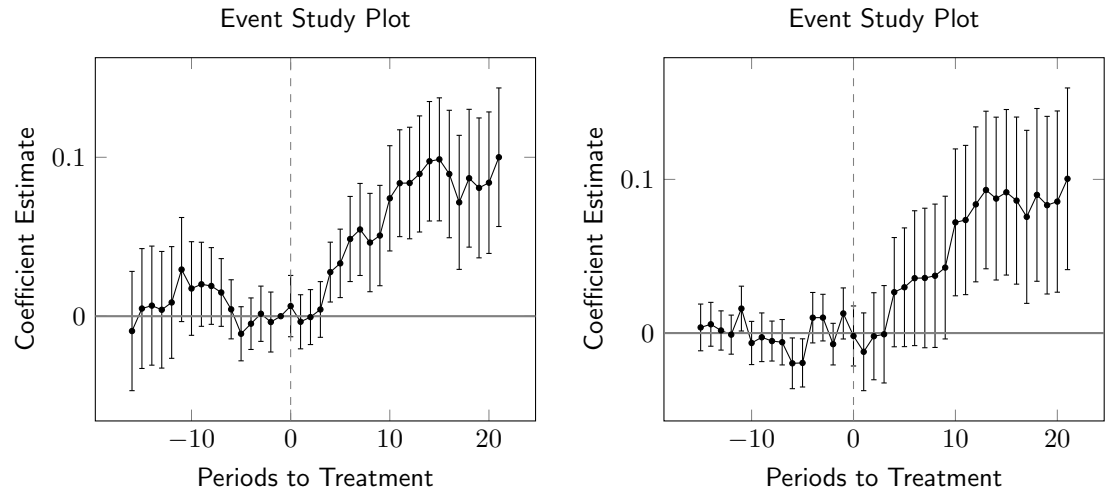
[17] Next to this, we do not expect the fund's globe scores to immediately change after the announcement of the SFDR. The announcement of the SFDR enables fund managers to prepare their compliance with the regulation which was implemented almost sixteen months later. Even within this period of anticipation, the disclosure mandate sparked uncertainty; the final regulation rules were published by the EU in December 2020. Leon Saunders Calvert, head of sustainability finance at data provider Refinitiv, even reported that "There is no real clarity, yet, as to what a mandatory disclosure looks like at a global level or even, quite frankly, at a country level" (Financial Times, 2020).



(a) OLS, not weighted

(b) Inverse Probability Weighted

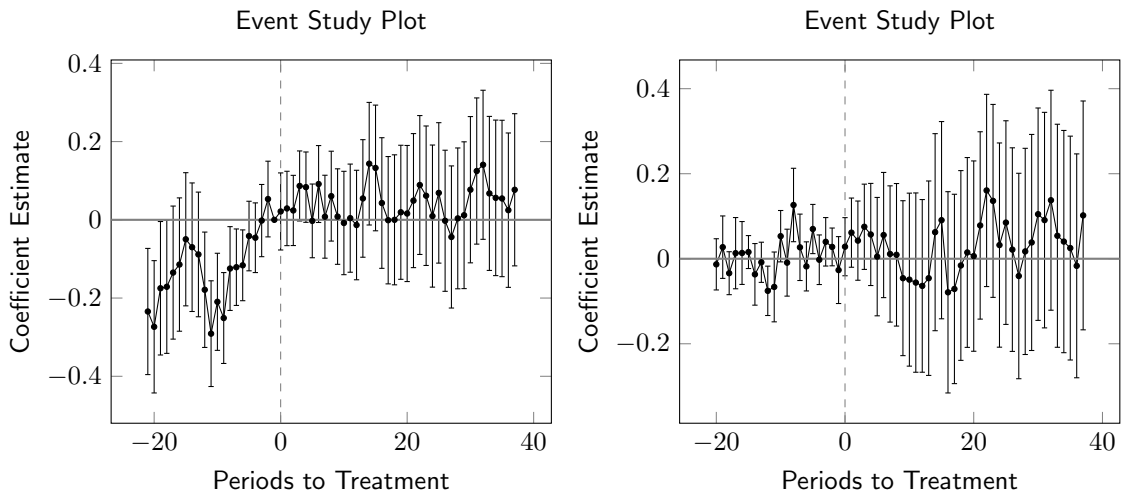
Figure 4: Event study plots on carbon intensity



(a) OLS, not weighted

(b) Inverse Probability Weighted

Figure 5: Event study plots on MS Globe Score



(a) OLS, not weighted

(b) Inverse Probability Weighted

Figure 6: Event study plot on MSCI Impact exposure

4.2.3 Heterogeneous effects

To further understand what drives funds to improve their sustainability outcomes, we are interested in seeing whether there is evidence of heterogeneity in mutual fund behavior. Especially, we might expect Article 8 and Article 9 mutual funds that before November 2019 showed signs of not being sustainable, to improve their sustainability outcomes to a greater degree.

In Table 7 we present a triple difference model where we interact our difference-in-difference estimator of Equation (3) with either a dummy variable 'high globe', or 'LCD'. Similar to section 4.1.2, we replace $Treat_i \times Post_t$ from equation (3) with $Treat_i \times Post_t \times HighGlobe_i$ and $Treat_i \times Post_t \times LCD_i$. The 'high globe' variable is equal to 1 for funds that in October 2019 (so in $t = -1$) had a Morningstar Globe Score of either 4 or 5, 'LCD' equates to 1 for funds that in October 2019 were assigned a Morningstar 'Low Carbon Designation'.

Columns 1 and 3 show no evidence of heterogeneous effects between Article 8(/9) funds that ex-ante had a high globe score and Article 8(/9) funds that had a low globe score. The triple difference estimators $Treat_i \times Post_t \times HighGlobe_i$ on both Carbon Intensity and Globe Score as our dependent variable are statistically insignificant. On a similar note, columns 2 and 4 also do not show evidence for heterogeneous effects between Article 8(/9) funds that before the SFDR announcement had a Low Carbon Designation label and those Article 8(/9) funds that did not. In summary, funds that decide to take on a sustainability signal through an Article 8 or Article 9 label do not improve their portfolio's carbon intensity or ESG scores differently depending on their pre-SFDR sustainability levels (estimated by a dummy indicator for Low Carbon Designation or a Globe Score of 4 or 5). Funds that signal their sustainability considerations with Article 8 or 9 improve their sustainability outcomes accordingly and homogeneously.

Table 7: Heterogeneity in mutual fund behavior

This table presents the triple difference regressions of fund-level sustainability outcomes, carbon intensity (in columns 1 and 2), and fund Morningstar Globe Score (in columns 3 and 4) on the interaction of dummy variables Treat (Article 8 and/ or Article 9 funds) and Post (all months following the SFDR announcement on November 27th 2019), differentiating by Globe Score (columns 1 and 3) and Morningstar Low Carbon Designation (columns 2 and 4). *HighGlobe* is a dummy variable equaling 1 for funds that in October 2019 received a Morningstar Globe Score of 4 or 5, 0 otherwise. For the regressions displayed in columns 1 and 3, we limit the sample to only include funds that either had a high Globe score (i.e., 4 or 5) or a low Globe score (i.e., 1 or 2). *LCD* is equal to 1 if the fund in October 2019 possessed over a Morningstar Low Carbon Designation, 0 otherwise. The regressions control for lagged fund characteristics and year-month $\times$ category and fund fixed effects. Robust standard errors, clustered at both the fund and year-month level, are shown in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

	Carbon Intensity		Globe Score	
	(1)	(2)	(3)	(4)
Post x Treat x HighGlobe	7.325		-0.072	
	(5.119)		(0.083)	
Post x Treat x LCD		6.856		-0.025
		(4.612)		(0.082)
Constant	94.999***	101.416***	2.409***	2.794***
	(21.969)	(17.492)	(0.409)	(0.346)
Controls	YES	YES	YES	YES
Category x Year-Month FE	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES
Observations	132,474	219,632	136,590	222,761
R-squared	0.771	0.767	0.756	0.704

4.2.4 Signaling and increased transparency

Next, we are interested in examining whether the funds' investor base matters to the extent they align their funds' sustainability commitments to their selected SFDR Article labels. The SFDR as a mandatory disclosure regulation allows for signaling as well as requires funds to be transparent about their sustainability practices. The improvements in sustainability behavior of Article 8 and 9 funds that we register in sections 4.2.1 and 4.2.2 may be driven through signaling mechanisms (Flammer et al., 2021), or disclosure effects (e.g., increased investor pressure, and reputational concerns from peer bench-marking).

We aim to disentangle these two sets of mechanisms. In section 4.1 we found that institutional investors do not seem to respond to the Article 8 or Article 9 labels. In line with current research, retail investors appear to direct some of their flows toward Article 8(/9) funds, driven by the sustainability signal that an Article 8 or Article 9 label provides (in line with the findings of Hartzmark and Sussman, 2019; Moss et al., 2023; Rzeźnik et al., 2022). On a similar note, we expect in a sample of retail funds, Article 8(/9) and Article 6 funds to behave by their signal, with the latter group having little incentive to lower their carbon intensity/ improve their ESG score.

Institutional funds, on the other hand, have a more sophisticated clientele who also tend to be better monitors (Hartzell and Starks, 2003; He et al., 2019). If the SFDR leads to better sustainability information, we expect funds managers to align their funds' sustainability commitments with those of their investor preferences (e.g., Christensen et al., 2021). Therefore, we expect Article 8(/9) institutional funds to act according to their signal since their investors profit from the increased transparency in the market.

However, funds that assign themselves an Article 6 label may be impelled to also make improvements to their sustainability outcomes. First of all, different from retail investors, the investors of institutional European funds also need to comply with the mandatory disclosure regulation, the sustainability outcomes of SFDR-abiding institutional funds directly affect the SFDR disclosures of institutional investors. Secondly, mandatory disclosure may bring heightened reputational concerns. Cao et al. (2019); Tomar (2023) report benchmarking against peer firms' CSR practices. Institutional funds may face similar practices concerning their portfolio's underlying sustainability outcomes. Thirdly, monitoring by institutional investors may prevent funds from taking on an Article 9 or even Article 8 label (Hartzell and Starks, 2003; He et al., 2019).

To explore the differences in the behavior of institutional and retail funds concerning their sustainability outcomes, we split up our sample of European funds into retail and institutional funds. Here we again define institutional funds as those whose largest share class is an institutional share class. We estimate Equation (3) separately for these two kinds of funds.

Table 8 presents the results. In columns 1 and 3 we find that retail funds show similar outcomes to our estimate of Equation (3) on our full sample of European funds (see Table 6). Retail funds with an Article 8(/9) label lower their carbon intensity by 8.576 metric tons compared to Article 6 funds after the SFDR was announced. Similarly, on average, they also increase their ESG scores by 0.129 points. Both results are statistically significant. For our sample of institutional funds, we do not note any significant differences in the sustainability outcomes of Article 8 (/9) or Article 6 funds. While economically speaking the coefficients of the interaction term $Post_t \times Treat_i$ in columns 2 and 4 take on the same sign as those of the retail sample (columns 1 and 3 respectively), they are not statistically significant.

Although we cannot test *why* institutional Article 8(/9) do improve their sustainability outcomes to a larger degree than institutional Article 6 funds, we can test whether institutional funds are affected by the SFDR at all. We do so by expanding our sample to include both European-domiciled and marketed funds as well as US-domiciled funds. The latter group is not affected by the SFDR and is not required to disclose information regarding their commitment to sustainability. Our treatment group consists of all funds that are domiciled or marketed in European member states[18]. Table 9 shows the estimates for Equation (3) where $Y_{i,t}$ is the fund's i outcome variable at time t, taking form as carbon intensity, or Globe Score. $Treat_i$ captures whether the fund is treated by the SFDR, taking value 1 if the fund is domiciled or marketed in an EU member state, and 0 if the fund is US-domiciled. $Post_t$ is a dummy variable that equals 1 for observations after the announcement date of the SFDR on November 27th 2019. We again control for lagged fund characteristics, fund fixed effects, and category $\times$ year-month fixed effects[19].

[18]For this analysis we omit funds from our treatment group that are in Morningstar's UK equity large cap or UK equity mid/small cap categories as none of our US funds (control group) are assigned to those categories.

[19]Appendix A.2 shows the event study plots of β_t of Equation (4) for the specification of Table 9. Different from Figures 4, 5, and 6, our treatment group consists of European-domiciled and marketing funds, and our control group of US-domiciled funds. $Treat_i$ indicates whether a fund is domiciled or marketed in an EU member state. In panels

Columns 1 and 3 of Table 9 show that funds treated by the SFDR report both a lower carbon intensity as well as a higher ESG score than our control group (here US-domiciled funds). Specifically, after the SFDR was announced, European funds reduced their carbon intensity by 10.735 metric tons and increased their Globe Score on average by 0.262 points, compared to US-domiciled funds. These results are statistically significant at the 1 percent level[20].

Similar to Table 6, we again split our sample into retail and institutional funds. Interestingly, columns 3 and 6 show that European institutional funds significantly reduce their carbon intensity and increase their ESG scores compared to US institutional funds. This supports the expectation that mandatory disclosure results in, what the disclosure literature calls, 'real effects' (e.g., Christensen et al., 2021; Mésonnier and Nguyen, 2020). After the announcement of the SFDR, European institutional funds, compared to their US control group, reduced their carbon intensity by 14.169 metric tons. Additionally, they significantly increase their Globe Scores. Columns 2 and 5 report economically and statistically comparable results for our sample of retail funds. Noticeable is that the (absolute values of the) coefficients from Equation (2) on our sample of institutional funds (columns 3 and 6) are larger in magnitude than those on our sample of retail funds (columns 2 and 5). This suggests that European institutional funds saw a large reduction in information asymmetries between them, their peers, and their investors.

Following our findings in Table 8 and Table 9, we find evidence that the improvement in sustainability outcomes for European retail funds seems to have been the result of a credible signaling strategy of Article 8 and Article 9 funds. On the other hand, we do not see the same pattern for our sample of European institutional funds; the mandatory disclosure instead of the signaling mechanism stimulates institutional Article 6 funds to improve their sustainability outcomes.

(a), we use an unweighted OLS estimation, while in panels (b) we estimate IPW estimators following Abadie (2005). Our parallel trends assumption holds for our specification of carbon intensity, despite some anomalies around $t < -8$. In our specification of Equation (4) on MS Globe Score, in panel (a), we see a sudden jump in our estimates due to the implementation of Sustainalytics' risk measure, this is also visible in our specification in Appendix A.1. Similar to Figure 6, our difference-in-difference estimates on MSCI Impact Exposure are noisy.

[20] In Appendix A.6. we report the inverse probability weighted ATT estimates. The effect sizes are smaller than our unweighted DiD estimates presented in Table 9, but remain significant.

Table 8: Mutual Fund Behavior Split for Retail and Institutional Funds

This table presents the difference-in-difference regressions of fund sustainability outcomes, carbon intensity (in columns 1 and 2), globe scores (in columns 3 and 4), on the interaction of dummy variables Treat (Article 8 and Article 9 funds) and Post (all months following the SFDR announcement on November 27th, 2019). Columns 1 and 3 show the estimates for retail funds. Columns 2 and 4 show the estimates for our sample of institutional funds. The regressions control for lagged fund characteristics and year-month × category and fund fixed effects. Robust standard errors are clustered at both the fund and year-month level and shown in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

	Carbon Intensity		ESG Score	
	(1)	(2)	(3)	(4)
Post x Treat	-8.576***	-7.101	0.129***	0.061
	(2.219)	(5.387)	(0.036)	(0.079)
Constant	103.649***	36.611	2.421***	3.697***
	(18.947)	(31.014)	(0.401)	(0.47)
Controls	YES	YES	YES	YES
Category x Year-Month FE	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES
R-squared	0.771	0.784	0.727	0.716
Observations	196,133	47,375	201,958	47,600
Sample	Retail	Institutional	Retail	Institutional

Table 9: Mutual fund behavior: European and US funds

This table presents the difference-in-difference regressions of fund sustainability outcomes, carbon intensity (in columns 1, 2, and 3), globe scores (in columns 4, 5, and 6), on the interaction of dummy variables Treat and Post. Treat takes value 1 for all European domiciled and marketed funds, and 0 for all US-domiciled funds. Post (all months following the SFDR announcement on November 27th, 2019). Columns 1 and 3 show the results for our full sample. Columns 2 and 4 show the estimates for retail funds. Columns 4 and 6 show the estimates for our sample of institutional funds. The regressions control for lagged fund characteristics and year-month × category and fund fixed effects. Robust standard errors are clustered at both the fund and year-month levels and shown in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

	Carbon Intensity			ESG Score		
	(1)	(2)	(3)	(4)	(5)	(6)
Post x Treat	-10.735***	-9.206***	-14.169***	0.262***	0.262***	0.336***
	(1.886)	(2.193)	(2.905)	(0.037)	(0.046)	(0.057)
Constant	102.614***	122.015***	69.733***	2.285***	1.905***	2.852***
	(24.314)	(18.434)	(23.265)	(0.336)	(0.409)	(0.409)
Controls	YES	YES	YES	YES	YES	YES
Category x Year-Month FE	YES	YES	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES	YES	YES
R-squared	0.789	0.786	0.799	0.701	0.715	0.696
Observations	364,897	252,751	112,039	384,372	262,954	112,327
Sample	Full	Retail	Institutional	Full	Retail	Institutional

5 Conclusion

Even though in recent years the demand for green assets has grown significantly, a lack of transparency regarding the actual greenness of assets brings uncertainty to investors (Akerlof, 1978). These information asymmetries concerning sustainability bring about concerns about 'greenwashing' in the capital market, affecting the information set of all investors and additionally preventing an efficient allocation of capital by investors with social preferences toward green assets (Parise and Rubin, 2023; Bingler et al., 2023). With the announcement and following the implementation of the Sustainable Financial Disclosure Regulation, the EU introduced the first non-financial mandatory disclosure regulation targeting financial market participants.

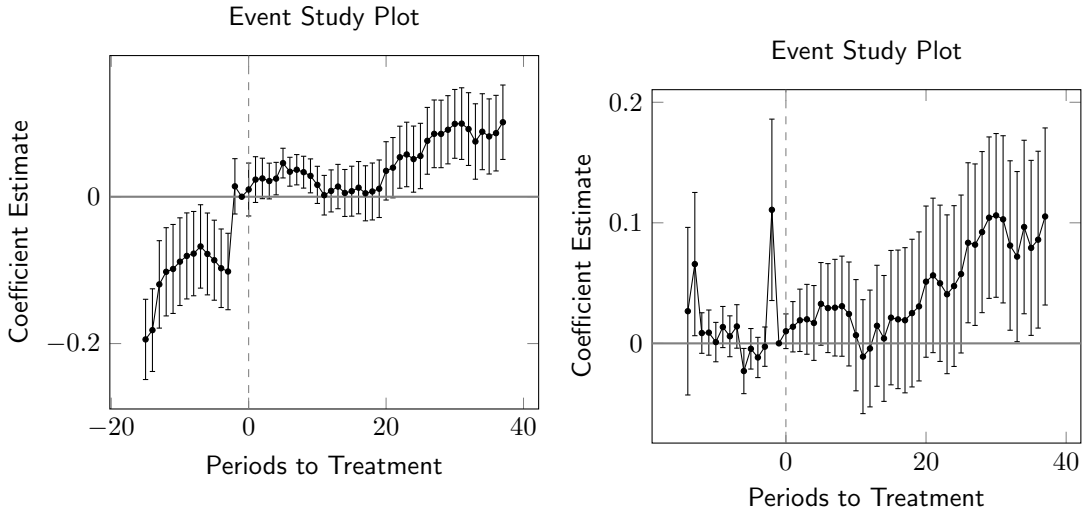
In this paper, we point out that (i) the SFDR similarly to voluntary disclosure enables funds to signal their sustainability commitments to the market, while (ii) like mandatory disclosure, requires these funds to be transparent about the sustainability outcomes of their underlying portfolio.

In a difference-in-difference setting, we show that investors indeed respond to the Article signals, but that this effect is driven by retail investors. These investors seem to think of the Article labels as a credible signal. Institutional investors on the other are do not seem to be affected and do not change their investments from or toward Article 8(/9) funds after the announcement of the SFDR.

In the second part of the paper, we are interested in (i) whether funds that choose to label themselves with Article 8 or Article 9 provide a credible sustainability signal to the market, and (ii) whether the reduction in information asymmetries between investors and mutual funds urges the affected funds to incorporate additional sustainability standards (i.e., effects that are driven through the disclosure mandate). In a difference-in-difference analysis and corresponding event study, we see that mutual funds that take on an Article 8(/9) label after the SFDR announcement improve their sustainability outcomes compared to Article 6 funds. Specifically, we note that retail funds behave in accordance with their signal, while for institutional funds we do not find that Article 8(/9) funds behave differently from Article 6 funds. We disregard the hypothesis that these institutional funds partake in 'window-dressing', instead we find evidence that mandatory disclosure induces European institutional funds to significantly improve their sustainability outcomes compared to untreated, US-domiciled institutional funds.

Appendix

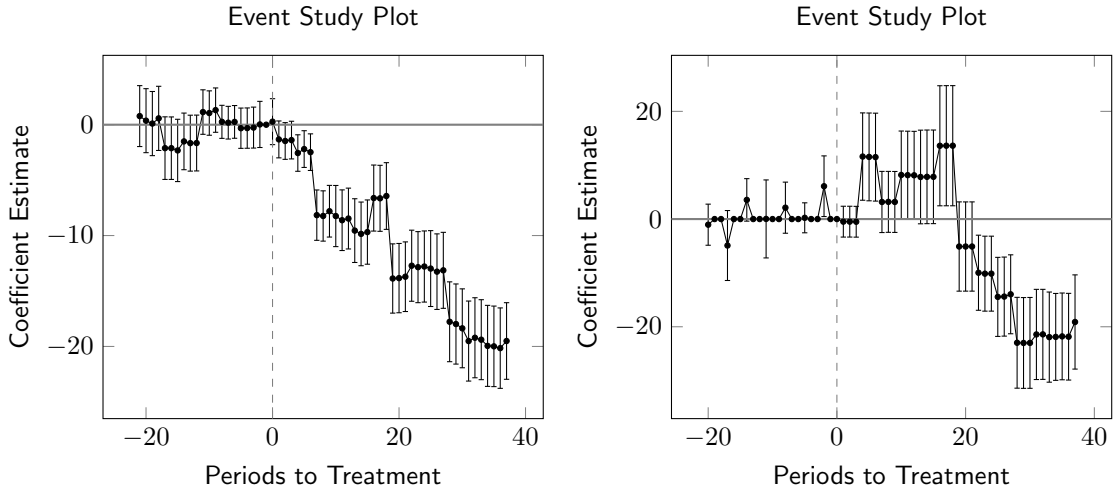
A.1 Full sample event study plot on Globe Score



(a) OLS, not weighted **(b)** Inverse Probability Weighted

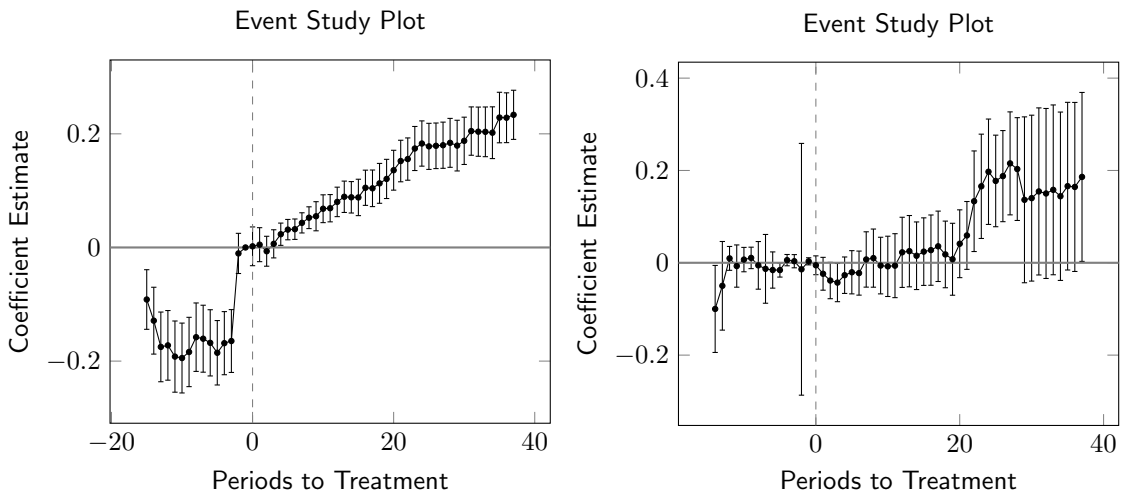
Event study plot on MS Globe Score: full European-domiciled/ marketing data sample, October 2019 is reference point $t = -1$

A.2 Event study plots European and US funds



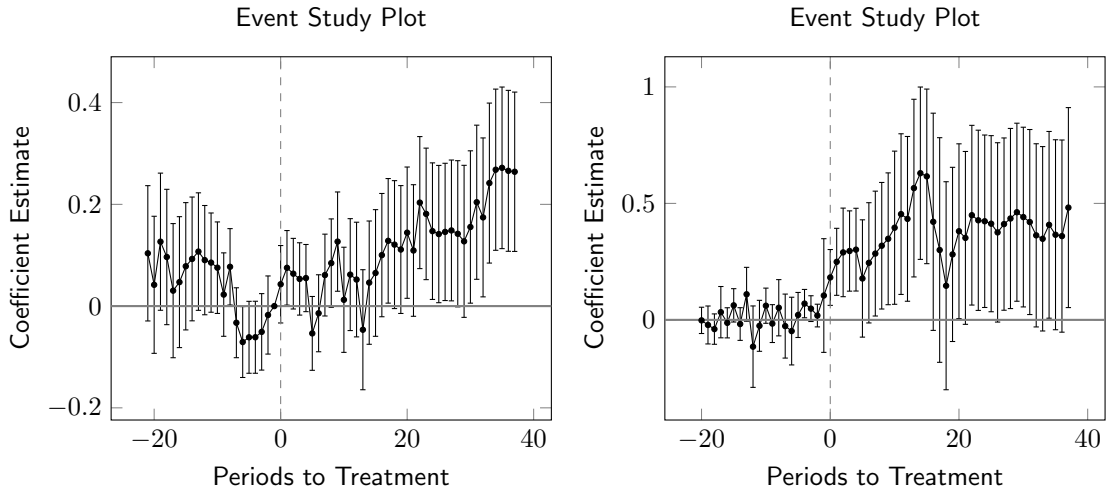
(a) OLS, not weighted **(b)** Inverse Probability Weighted

Event study plot on carbon intensity: full European-domiciled/ marketing and US-domiciled data sample, October 2019 is reference point $t = -1$



(a) OLS, not weighted **(b)** Inverse Probability Weighted

Event study plot on MS Globe Score: full European-domiciled/ marketing and US-domiciled data sample, October 2019 is reference point $t = -1$



(a) OLS, not weighted **(b)** Inverse Probability Weighted

Event study plot on MSCI Impact exposure: full European-domiciled/ marketing and US-domiciled data sample, October 2019 is reference point $t = -1$

A.3 Flow analysis: split for institutional and retail funds

This table presents the difference-in-difference regressions of monthly net fund flows, on the interaction of dummy variables Treat (Article 8 and Article 9 funds) and Post (all months following the SFDR announcement on November 27th, 2019). Columns 1 shows the estimates for institutional funds. Columns 2 shows the estimates for our sample of retail funds. The regressions control for lagged fund characteristics and year-month $\times$ category and fund fixed effects. Robust standard errors are clustered at both the fund and year-month level and shown in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

	Flows	
	(1)	(2)
Post x Treat	-0.0008	0.0011***
	(0.0008)	(0.0003)
Constant	0.0492***	0.0545***
	(0.0073)	(0.0068)
Controls	YES	YES
Category x Year-Month FE	YES	YES
Fund FE	YES	YES
Observations	62,354	287,247
R-squared	0.191	0.248
Treatment group	Institutional	Retail

A.4 Horse race: split for institutional and retail funds

This table presents the horse races carried out between various top sustainability-performance indicators and SFDR Article signals, split for retail and institutional funds. *Article 8* indicates whether the fund signals with an Article 8 label, *Article 9* indicates whether the fund signals with an Article 9 label, *Article 8/9* indicates whether the fund signals with an Article 8 or 9 label, *Carbon intensity* indicates the funds that are in the lowest decile of that months' funds' carbon intensity outcomes, *MSCI Impact* indicates the funds that are in the highest decile of that months' funds' MSCI Impact exposure outcomes, *MS LCD* indicates whether the fund that quarter has been assigned a Morningstar Low Carbon Designation label, *MS Globe* indicates the funds that have a 5-Globe rating on the Morningstar Globe Score, and *Carbon risk* indicates the funds that are in the lowest decile of that months' funds' carbon risk outcomes. Columns 1 and 3 report the differences between the coefficients of the pairs of regressions, the corresponding t-statistics are reported in parentheses. In panels B, and panel C, we also split our sample into two time periods, all months after the announcement of the SFDR, and all months after the implementation of the SFDR, respectively. The regressions control for year-month fixed effects. Robust standard errors are clustered at both the fund and year-month levels. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

Panel A: Full sample

	Retail		Institutional	
	Difference	t-stat	Difference	t-stat
Article 8 vs. MS Globe	-0.0022***	(-14.438)	-0.0022***	(-6.313)
Article 8 vs. MS LCD	-0.0004***	(-3.690)	-0.0008***	(-3.056)
Article 8 vs. Carbon intensity	-0.0010***	(-6.169)	-0.0032***	(-8.497)
Article 8 vs. MSCI Impact	-0.0024***	(-14.128)	-0.0034***	(-8.893)
Article 8 vs. Carbon Risk	-0.0022***	(-12.854)	-0.0028***	(-7.098)
Article 9 vs. Article 8	0.0048***	(20.076)	0.0042***	(8.349)
Article 9 vs. MS Globe	0.0026***	(10.139)	0.0019***	(3.567)
Article 9 vs. MS LCD	0.0044***	(18.270)	0.0033***	(6.732)
Article 9 vs. Carbon intensity	0.0038***	(14.257)	0.0010*	(1.826)
Article 9 vs. MSCI Impact	0.0024***	(8.933)	0.0008	(1.454)
Article 9 vs. Carbon Risk	0.0026***	(9.618)	0.0014**	(2.528)

Panel B: Post SFDR announcement

	Retail		Institutional	
	Difference	t-stat	Difference	t-stat
Article 8 vs. MS Globe	-0.0020***	(-11.454)	-0.0027***	(-6.603)
Article 8 vs. MS LCD	-0.0001	(-0.859)	-0.0008**	(-2.399)
Article 8 vs. Carbon intensity	-0.0007***	(-3.727)	-0.0032***	(-7.019)
Article 8 vs. MSCI Impact	-0.0025***	(-12.474)	-0.0044***	(-9.605)
Article 8 vs. Carbon Risk	-0.0016***	(-7.626)	-0.0027***	(-5.815)
Article 9 vs. Article 8	0.0050***	(17.475)	0.0048***	(7.900)
Article 9 vs. MS Globe	0.0030***	(9.709)	0.0020***	(3.184)
Article 9 vs. MS LCD	0.0049***	(17.115)	0.0040***	(6.723)
Article 9 vs. Carbon intensity	0.0042***	(13.317)	0.0016**	(2.401)
Article 9 vs. MSCI Impact	0.0024***	(7.615)	0.0004	(0.613)
Article 9 vs. Carbon Risk	0.0034***	(10.469)	0.0020***	(3.009)

Panel C: Post SFDR implementation

	Retail		Institutional	
	Difference	t-stat	Difference	t-stat
Article 8 vs. MS Globe	-0.0006***	(-2.762)	-0.0012**	(-2.363)
Article 8 vs. MS LCD	0.0009***	(5.235)	0.0003	(0.795)
Article 8 vs. Carbon intensity	0.0008***	(3.118)	-0.0011*	(-1.954)
Article 8 vs. MSCI Impact	-0.0017***	(-6.746)	-0.0036***	(-6.367)
Article 8 vs. Carbon Risk	0.0005**	(2.105)	-0.0004	(-0.759)
Article 9 vs. Article 8	0.0033***	(9.796)	0.0025***	(3.251)
Article 9 vs. MS Globe	0.0027***	(7.523)	0.0013	(1.599)
Article 9 vs. MS LCD	0.0042***	(12.437)	0.0028***	(3.783)
Article 9 vs. Carbon intensity	0.0041***	(10.737)	0.0014*	(1.646)
Article 9 vs. MSCI Impact	0.0017***	(4.327)	-0.0011	(-1.378)
Article 9 vs. Carbon Risk	0.0039***	(9.966)	0.0020**	(2.388)

A.5 Mutual fund behavior: Article 8/9 funds vs. Article 6, IPW estimators

This table presents the Average treatment effects (ATT) when applying inverse probability weight to our difference-in-difference model described in Equation (3), following the methodology of Abadie (2005). Treat equals 1 for Article 8 and Article 9 funds, and Post indicates all months following the SFDR announcement on November 27th 2019. We estimate probability weights based on pre-treatment (all dates before the announcement of the SFDR) lagged fund level covariates: monthly net flows, monthly returns, logged age, logged TNA, and Morningstar category. The regressions control for for lagged fund characteristics and year-month, fund, and category fixed effects. Robust standard errors are clustered at the fund level and shown in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

	Carbon Intensity	Globe Score	MSCI Impact
Post x Treat	-6.163***	0.046**	0.031
	(1.981)	(0.023)	(0.083)
Controls	YES	YES	YES
Year-Month FE	YES	YES	YES
Fund FE	YES	YES	YES
Category FE	YES	YES	YES

A.6 Mutual fund behavior: EU-domiciled/marketed vs. US-domiciled, IPW estimators

This table presents the Average treatment effects (ATT) when applying inverse probability weight to our difference-in-difference model described in Equation (3), following the methodology of Abadie (2005). Treat equals 1 for funds domiciled or marketed in EU member states, and Post indicates all months following the SFDR announcement on November 27th 2019. We estimate probability weights based on pre-treatment (all dates before the announcement of the SFDR) lagged fund level covariates: monthly net flows, monthly returns, logged age, logged TNA, and Morningstar category. The regressions control for lagged fund characteristics and year-month, fund, and category fixed effects. Robust standard errors are clustered at the fund level and shown in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

	Carbon Intensity	Globe Score	MSCI Impact
Post x Treat	-4.609*	0.073**	0.375**
	(2.710)	(0.036)	(0.135)
Controls	YES	YES	YES
Year-Month FE	YES	YES	YES
Fund FE	YES	YES	YES
Category FE	YES	YES	YES

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